FEDERAL RESERVE BANK OF KANSAS CITY

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According to many analysts, uncertainty about future inflation rises as inflation rises. As a result, these analysts argue that the Federal Reserve could reduce inflation uncertainty by reducing inflation. Other analysts argue that high inflation creates no more uncertainty than low inflation, as long as inflation remains stable. As a result, these analysts argue that high inflation does not necessarily interfere with decisionmaking or reduce economic well-being.

Golob reviews the results of previous research and presents new empirical evidence finding that inflation uncertainty rises with inflation.

The Rise of U.S. Exports to East Asia and Latin America 67

By Timothy J. Schmidt

Exports have become an increasingly important source of revenue for both national and regional firms in the United States. U.S. exports are rising rapidly, especially from the Midwest. As a result, national and district firms must be ever more attentive to changes in U.S. export markets. One such change is the rapid growth of U.S. export markets in the developing nations of East Asia and Latin America.

Schmidt analyzes current trends in the geographic distribution of U.S. exports and identifies the primary growth markets for U.S. exports in the years ahead. He suggests the developing nations in East Asia and Latin America will soon rival today's industrialized nations as the most important U.S. trading partners. This finding presents U.S. firms with a significant challenge. To take advantage of these growing markets, U.S. firms must establish new distribution networks, learn foreign regulations and customs, and train sales personnel in these developing geographic regions. Because such tasks require commitments of time and investment, firms must be able to forecast where the future demand for U.S. exports will be concentrated.

The Natural Rate and Inflationary Pressures

By Stuart E. Weiner

The natural rate of unemployment has become an important topic recently as the Federal Reserve has raised short-term interest rates in an attempt to keep the economy from overheating. The inflation outlook for the latter part of this year and next depends critically on how close the economy is to reaching capacity constraints. The natural rate of unemployment measures capacity constraints in labor markets.

BACKGROUND

The natural rate of unemployment is a key concept in monetary economics. It represents the lowest possible unemployment rate that is consistent with stable inflation. When the demand for workers is so strong that the actual unemployment rate falls below the natural rate, wage and price pressures intensify and inflation starts to rise.

The natural rate of unemployment cannot be observed but must be estimated. Chart 1 presents estimates of the natural rate for the years 1961 through 1994. To produce this series, a statistical technique was used that links inflation movements to unemployment movements. Also shown in the chart is the actual unemployment rate.

In looking at the chart, three features stand out. First, the actual unemployment rate has rarely equaled the natural unemployment rate. Second, the natural rate has remained at a relatively high level throughout the period. And third, after rising in the 1970s, the natural rate has drifted down a bit in the 1980s and 1990s.

The divergence of the actual and natural rates of unemployment is a reflection of the business cycle. In the chart, periods when the actual unemployment rate exceeds the natural unemployment rate are periods of recession or the early stages of recovery. Periods when the actual rate is below the natural rate are periods of a booming economy.

The relatively high level of the natural rate reflects imperfections in labor markets, imperfections that exist regardless of the overall state of the economy. Individuals unemployed at the natural rate may be unemployed for a variety of reasons. They may have the wrong skills, live in the wrong areas, or have little incentive to accept the jobs they are offered. Or, in an environment of expanding employer mandates, they may simply be too expensive for employers to hire. Whatever its many sources,

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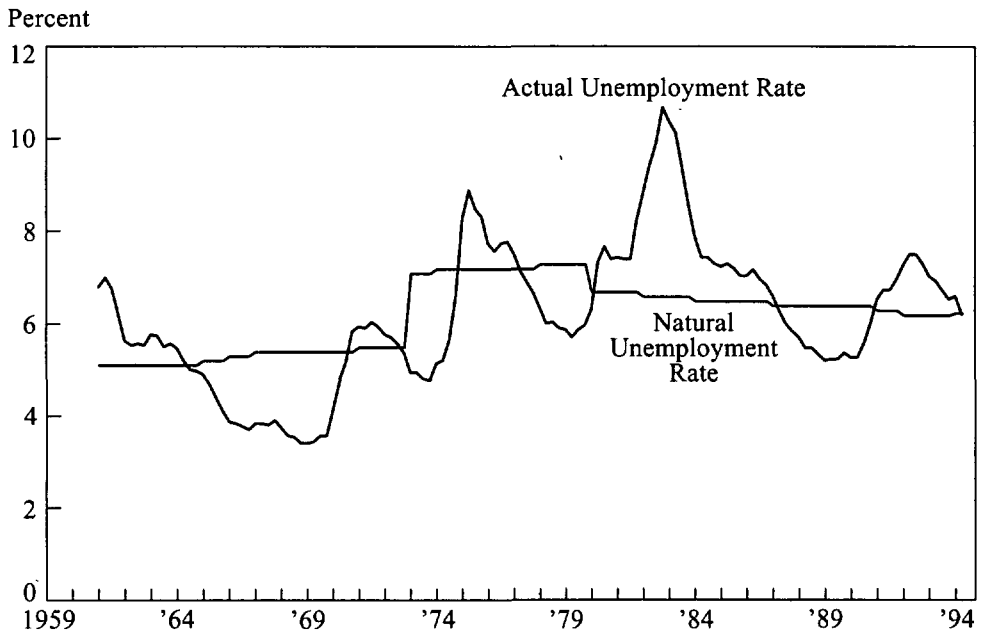
This article is an updated version of remarks made before the Board of Directors of the Federal Reserve Bank of Kansas City on April 7, 1994. Underlying research results are reported in the author's "New Estimates of the Natural Rate of Unemployment," which appeared in the Fourth Quarter 1993 issue of ECONOMIC REVIEW

Chart 1

Unemployment



Sources: Actual unemployment rate: U.S. Department of Labor. Natural unemployment rate: Stuart E. Weiner, "New Estimates of the Natural Rate of Unemployment," Federal Reserve Bank of Kansas City *Economic Review,* 1993: Q4.

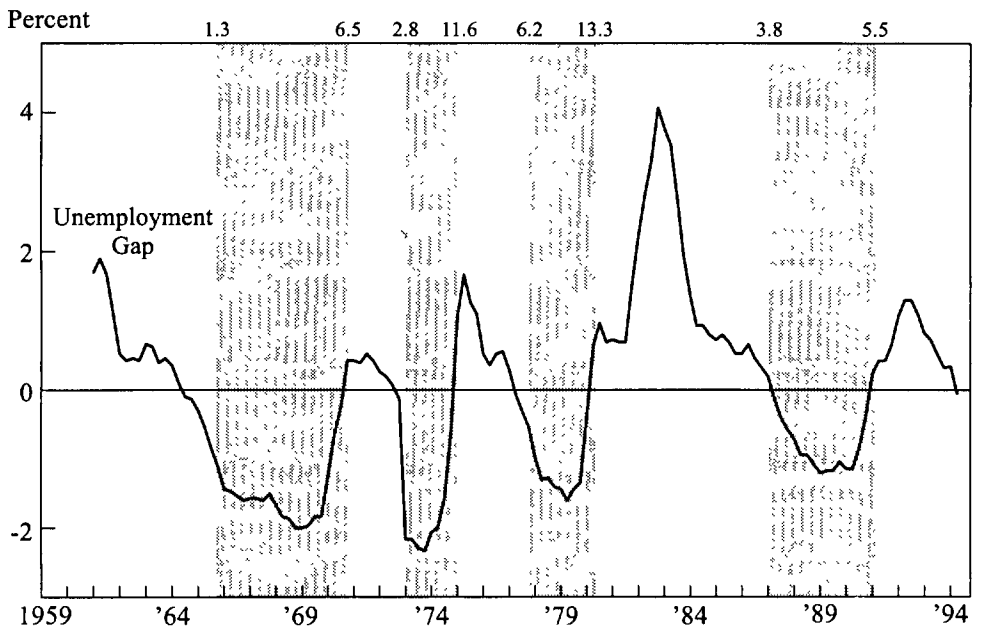
unemployment at the natural rate is independent of cyclical factors and hence falls outside the domain of monetary policy.

The third feature that stands out in the chart, the change in the natural rate over time, reflects both demographic and structural forces. The natural rate rose in the 1970s in part because of the growing share of women and youths in the labor force. Because women and youths typically have higher unemployment rates than men, the overall unemployment rate consistent with stable inflation rose. Also contributing to the rise in the natural rate in the 1970s were the two oil shocks and the productivity decline, all of which increased the cost of labor to employers.

Since 1980, the natural rate has drifted down a bit on favorable demographic trends, the principal one being the sharp decline in the share of youths in the labor force. At the same time, however, structural forces have kept the natural rate high. These include the shift from manufacturing jobs to service jobs, the growing gap between high-tech job requirements and low-tech worker skills, and the downsizing and restructuring of firms throughout the economy. Thus, according to the estimates reported in the chart, the natural rate of unemployment is currently 6 1/4 percent. With the actual unemployment rate averaging 6.2 percent in the second quarter, this means that labor markets currently are operating at full capacity.

Chart 2

Unemployment and Inflation



Notes: Shaded areas represent periods of rising inflation as measured by the consumer price index less food and energy; beginning and ending inflation rates are noted along the top edge. The unemployment gap is calculated by subtracting the natural rate of unemployment from the actual unemployment rate.

Sources: Actual unemployment rate and inflation: U.S. Department of Labor. Natural unemployment rate: Stuart E. Weiner, "New Estimates of the Natural Rate of Unemployment," Federal Reserve Bank of Kansas City *Economic Review,* 1993: Q4.

IMPLICATIONS

Historically, the gap between the actual unemployment rate and the natural unemployment rate has been a reliable indicator of future increases in inflation. This can be seen in Chart 2. The shaded areas represent periods of sustained rises in inflation, with beginning and ending inflation rates noted along the top edge. The "unemployment gap" is calculated from Chart 1 and equals the actual unemployment rate minus the natural unemployment rate. Thus, when the gap moves below the zero line, the actual unemployment rate is below the natural rate, and when the gap moves above the zero line, the actual unemployment rate is above the natural rate.

As shown by the shaded areas, the U.S. economy has experienced four periods of sustained increases in inflation over the past 35 years. In all four cases, the increases were accompanied by the actual unemployment rate going below the natural unemployment rate. And at no time has there been a false signal; that is, at no time has the actual unemployment rate gone below the natural rate without the economy ultimately experiencing a rise in inflation.

The most recent inflationary episode began in 1987. In early 1987, the unemployment rate moved below the natural rate and stayed below the natural rate for four years. As a result, inflation began to edge upwards, from 3.8 percent to 5.5 percent, and it was not until early 1991 that it leveled off. A concern this year has been that the economy is facing a similar situation today. Or, to put it in terms of the chart, a concern has been that it might be necessary to draw in a fifth shaded area before too long.

In thinking about the policy implications of unemployment rate movements this year, several points need to be made.

The first involves the lead time between a move below the natural rate and the eventual increase in inflation. As can be seen in the chart, in three of the four inflationary episodes, the actual unemployment rate went below the natural rate in advance of the increase in inflation. Only in the most recent episode were the movements concurrent. Thus, there certainly is a precedent for the situation today, where the unemployment rate is at the natural rate but a general increase in inflationary pressures is not yet showing through. That is why relying on current inflation as an indicator of future inflation is dangerous, and why the Federal Reserve has taken timely policy action. Because of the inertia in the inflation process and the lags in the effect of policy, the Federal Reserve has needed to stay ahead of the curve if a rise in inflation is to be avoided.

A second point concerns the prospects for the natural rate itself. One could be less concerned about the inflation outlook if one believed the natural rate would be declining from its currently estimated 6 1/4 percent level. But there is little reason to think it is going to fall. On the demographics side, the share of young workers is expected to stabilize and the share of minority workers is expected to rise. Both will keep the natural rate at a high level. Nor will structural forces be beneficial. Such factors as continued firm downsizing and continued skill mismatch will prevent the natural rate from declining. And in some instances structural forces will interact with demographic forces to exacerbate labor market problems. The U.S. Department of Labor, for example, has noted that while the fastest growing occupations in coming years will be those occupations that historically have required relatively higher levels of education, the composition of the labor force will be shifting toward groups that typically have attained lower levels of education.

Given the inherent difficulty of estimating the natural rate, it is possible that the natural rate is somewhat lower than 6 1/4 percent, and it is safer to think in terms of a range of estimates. However, a third point to make is that, even if the natural rate is as low as 6 percent, prior to the firming of policy earlier this year some private forecasters were looking for the actual unemployment rate to slip below this level by yearend. So a concern over potential inflationary pressures is not inextricably tied to any one specific estimate of the natural rate.

Finally, it should be emphasized that one need not be satisfied with an unemployment rate as high as 6 1/4 percent. On the contrary, unemployment this high represents a waste of resources, with substantial economic, social, and human costs. Rather, what the natural rate framework implies is that it is at this point that monetary policy can do no more. To further reduce unemployment, policymakers should be looking at potential labor market policies, such as improvements in education and job training programs and reductions in the cost of employer mandates.

The Federal Reserve has done about all it can to guide the economy to full employment. The challenge now is to ensure that inflation remains under control.

ENDNOTES

[1] A complicating factor this year has been the revisions to the Current Population Survey. With the January employment report, the U.S. Department of Labor started basing its unemployment rate calculations on a new questionnaire and new collection techniques. It was estimated that the new methodology would raise the measured unemployment rate by about one-half percentage point, and most analysts raised their estimates of the natural rate by an equal amount. To date, however, the differences between the new and old surveys have been less pronounced, and it now appears that a 0.5 adjustment factor may be too high. In this article, no adjustment factor is applied. Hence, the natural rate estimates used in this article are identical to those reported by the author in "New Estimates of the Natural Rate of Unemployment," Federal Reserve Bank of Kansas City, *Economic Review*, 1993:Q4.

Nominal GDP Targeting Rules: Can They Stabilize the Economy?

By Todd E. Clark

As the monetary aggregates have become less reliable guides for monetary policy, considerable interest has developed in identifying some other fundamental guide for policy. Many analysts argue that the best guide might be nominal gross domestic product (GDP). Some of these analysts also argue the Federal Reserve should target nominal GDP using one of several possible rules. Such a rule would specify how the Federal Reserve should adjust policy to affect a short-term interest rate in response to deviations of nominal GDP from target.

This article examines the performance of nominal GDP targeting rules using statistical simulations of the economy. The first section reviews the argument that policymakers should target nominal GDP using a rule. The second section describes some alternative targeting rules. The third section shows how these rules would perform based on simulation analysis of models of the U.S. economy. The article concludes that policymakers cannot be certain that a simple nominal GDP targeting rule would improve economic performance.

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THE ARGUMENT FOR A NOMINAL GDP TARGETING RULE

Since the mid-1970s, the Federal Reserve has established target ranges for the monetary aggregates and has monitored growth in the aggregates relative to the targets. But in recent years, financial market innovation and deregulation have made the aggregates much less reliable policy guides. Many believe the reduced reliability of the aggregates has created a need for some other fundamental guide for policy. Some analysts also argue that nominal GDP should replace the monetary aggregates as a guide for monetary policy and that following a simple rule for targeting nominal GDP would help stabilize the economy.

The need for an alternative target variable

Targets for variables like the monetary aggregates or nominal GDP, it is maintained, might help policymakers balance the policy goals of sustainable economic growth and price stability. With a good target variable, holding the variable on target should help stabilize real GDP in the short term and also yield inflation consistent with the long-term objective of price stability.[1]

For a number of years, the Federal Reserve

relied on targets for the monetary aggregates. The targets helped stabilize real GDP in the short term. For example, sluggish money growth was seen to signal a slowdown in real GDP growth. As a result, easing monetary policy when money growth fell below target helped moderate declines in real GDP growth. The targets for the monetary aggregates were also expected to help policymakers achieve long-term inflation objectives. Throughout most of the 1980s, for example, the Federal Reserve gradually lowered the money growth targets to guide its efforts to gradually reduce inflation.

In recent years, however, the monetary aggregates have become unreliable guides. For example, given the historical relationship between M2 growth and economic activity, the sluggish behavior of M2 in 1992 and 1993 would have been consistent with an economy in recession (Board of Governors of the Federal Reserve System). Instead, the economy grew an average of 3.3 percent per year as measured by real GDP. To many analysts, such false signals create a need for some other fundamental guide for policy.

The potential benefits of nominal GDP targeting

Nominal GDP may be a useful guide for policy because it is closely related to real GDP growth and inflation. By definition, nominal GDP equals the product of real GDP and the price level. Similarly, the growth of nominal GDP equals the sum of real GDP growth and inflation.

Over short periods, changes in nominal GDP growth give rise to similar changes in real GDP growth with little or no impact on inflation.[2] For example, nominal GDP growth slowed from 8.7 percent in the first quarter of 1990 to 2.8 percent in the first quarter of 1991. Mirroring the drop in nominal GDP growth, real GDP slowed from a 3.4 percent rate of growth to a 2.1 percent rate of decline. Inflation fell only slightly, from 5.1 percent to 4.8 percent.[3]

Over long periods, in contrast, changes in nominal GDP growth are closely linked to inflation with no impact on real GDP. Because in the long run real GDP grows at a fairly constant trend, long-run inflation will tend to equal nominal GDP growth minus the trend growth of real GDP. For example, if real GDP grows at a trend rate of 2 1/2 percent, the Federal Reserve could achieve a long-run inflation goal of 1 percent by maintaining nominal GDP growth at 3 1/2 percent.

In addition to its link to policy goals, nominal GDP has two other features that would, in principle, make it a good guide for policy.[4] First, under nominal GDP targeting, monetary policy would adjust to offset disturbances to aggregate demand. In the short run, an adverse aggregate demand disturbance, such as a drop in exports stemming from a recession in the economy of an important foreign trading partner, tends to slow real GDP growth and, accordingly, nominal GDP growth. In response to the reduction of nominal GDP growth below the targeted rate, policymakers would ease monetary policy to return nominal GDP growth to target. This policy change would stimulate aggregate demand, returning both demand and real GDP growth to predisturbance levels.

A second attractive feature of nominal GDP targeting is that it would help policymakers balance the goals of stable growth and inflation in responding to aggregate supply disturbances. In the short run, an adverse supply disturbance, such as a jump in oil prices, produces two undesirable consequences—falling real GDP growth and rising inflation. These consequences pose a dilemma. Changing monetary policy to stabilize one variable creates additional volatility in the other variable. For example, easing policy to stimulate an economy slowed by a spike in oil prices would limit the decline in real GDP growth but would exacerbate inflation. Conversely, tightening policy to stabilize inflation would exacerbate the decline in real GDP.

Nominal GDP targeting would help policymakers resolve the dilemma by placing equal emphasis on stability of both real GDP growth and

inflation. Monetary policy would be adjusted to equalize the output and inflation effects of an aggregate supply disturbance. For example, an oil price hike that caused real GDP growth to fall by 1 percent and inflation to rise by 0.5 percent would reduce nominal GDP growth by 0.5 percent. Under nominal GDP targeting, monetary policy would respond by stimulating the economy enough to raise nominal GDP growth by 0.5 percent, thus returning nominal GDP growth to its targeted rate. As a result of this policy response, real GDP growth would fall and inflation would rise by the same amount, say 0.75 percent.[5] Thus, nominal GDP targeting would balance the consequences of the supply disturbance.

The potential benefits of a rule

In implementing nominal GDP targeting, policymakers might adopt any of a variety of targeting procedures. Target ranges for nominal GDP growth might be used in the same way that target ranges for the monetary aggregates have been used in the past. Under such a procedure, policymakers would monitor the actual rate of nominal GDP growth relative to target. They would then use this information, along with other indicators, to make discretionary adjustments to policy. Alternatively, policymakers might adopt more formal procedures for targeting nominal GDP. For example, policymakers could use a simple rule, rather than discretion, in adjusting policy.[6]

Rule-based and discretion-based monetary policy differ fundamentally in that a rule dictates systematic monetary policy action, while discretion does not. A rule would specify when and by how much the Federal Reserve would adjust policy in response to deviations from target of a variable like nominal GDP. A rule ensures systematic action: under a rule, policymakers would adjust policy the same way this year in response to a deviation from target as they would two years from now. In contrast, discretion-based policy permits policymakers to make policy adjustments on a case-by-case basis.

Some analysts argue rule-based policy is superior because it will produce lower inflation than discretionary policy. Suppose, for example, policymakers announce a target for nominal GDP growth of 3.5 percent under the assumption that such a rate is consistent with a long-term inflation objective of 1 percent and an expected long-term real GDP growth rate of 2.5 percent. The systematic policy adjustments dictated by a nominal GDP targeting rule would be expected to yield nominal GDP growth of 3.5 percent over long periods. As long as real GDP grows at the expected trend rate of 2.5 percent, inflation would remain at 1 percent.

In contrast, the nonsystematic policy adjustments permitted by discretionary policy could result in an average nominal GDP growth rate that exceeds the target rate. Consequently, discretionary policy might yield higher inflation than desired. Discretionary policy may suffer an inflationary bias because it gives policymakers the option to depart occasionally from announced targets.[7] For example, policymakers may decide to boost nominal GDP growth above target when an aggregate supply disturbance reduces growth or causes a recession. Such discretionary shifts to easier policy might not only push nominal GDP growth above target but, if maintained, might also result in higher inflation.

SOME SIMPLE NOMINAL GDP TARGETING PROCEDURES

Advocates of rules for targeting nominal GDP have proposed a number of specific rules. Typically, these rules call for adjusting a short-term interest rate, such as the federal funds rate, to keep nominal GDP on target.[8] While policymakers have no direct control over nominal GDP, they do have great influence over short-term interest rates. Through open market operations, for example, policymakers can increase the degree of pressure on reserve positions, thereby causing the federal funds rate to rise.

The proposed rules for targeting nominal GDP differ, in part, as to when policymakers would react

to deviations of nominal GDP from target. One rule dictates that monetary policy would change when actual nominal GDP is *observed* to deviate from target. Another rule dictates that policy would change when *projected future* nominal GDP deviates from target. This section examines these two rules for targeting nominal GDP—a lagged adjustment rule and a forecast adjustment rule.[9]

Lagged adjustment. Under the lagged adjustment rule, policymakers would adjust a short-term interest rate, such as the federal funds rate, after observing a deviation of nominal GDP growth from target. Policymakers would raise the funds rate if nominal GDP growth last quarter exceeded the targeted growth rate. Conversely, policymakers would lower the funds rate if nominal GDP growth last quarter was below the targeted rate. The rule stipulates that policymakers adjust the current interest rate systematically by x percent whenever last quarter's nominal GDP growth rate (annualized) deviated from target by one percentage point.[10]

Advocates of this rule have set the adjustment parameter x at a variety of values. Most recently, Judd and Motley (1993) suggested a value of 0.20. At this level, whenever nominal GDP growth (annualized) exceeds target by one percentage point, policymakers would raise the short-term interest rate by 0.20 percent, or 20 basis points. In a previous study, Judd and Motley (1992) advocated a lower adjustment rate x of 0.125. At this level, for every one-percentage-point gap between actual and target GDP growth (annualized), policymakers would adjust the interest rate by 0.125 percent, or 12.5 basis points.[11]

Because the lagged adjustment rule calls for adjusting an interest rate only after nominal GDP deviates from target, it may result in unnecessarily protracted deviations of nominal GDP from target. These deviations would occur because the rule ignores delays in the effects on nominal GDP of changes in monetary policy.[12] From the time policymakers adjust a short-term interest rate, two to three quarters may pass before nominal GDP responds. Many firms, for example, commit well in advance to plans for spending on plants and equipment. While a change in the interest rate might quickly affect plans for future spending, a number of months could pass before any change in plans affects actual spending.

Forecast adjustment. An alternative rule which accounts for the delays in the effects of monetary policy may better stabilize nominal GDP growth at the targeted rate. Under this alternative forecast adjustment rule, policymakers look forward, recognizing that an adjustment in current monetary policy probably will not affect nominal GDP until two to three quarters in the future. Using forecasts of future nominal GDP growth, this alternative rule adjusts current monetary policy to try to offset expected future deviations of nominal GDP from target.

Under the forecast adjustment rule, policymakers would adjust a current short-term interest rate until forecasted future growth in nominal GDP equals the targeted rate. If, at the current interest rate level, forecasts indicate nominal growth next year will exceed the targeted rate, policymakers would raise the short-term interest rate. The increase in the interest rate would be expected to slow future growth in nominal GDP and, as a result, reduce forecasted nominal GDP growth. Policymakers would raise the interest rate enough that, based on the higher rate, the forecast for future growth of nominal GDP equals the targeted rate.[13] Conversely, if forecasts indicate nominal GDP growth next year will be below target, policymakers would reduce the short-term interest rate enough to raise forecasts to target.

Advocates of the rule have proposed a variety of forecast procedures. Some suggest the Federal Reserve use its own forecasts for nominal GDP growth in setting policy. These forecasts might be the consensus of Federal Open Market Committee members or the view of the staff of the Board of Governors.[14] In this version of the forecast adjustment rule, policymakers would rely on their own projection for the next year in adjusting a current interest rate to keep projected nominal GDP growth on target. In contrast, Hall and Mankiw (1993) suggest the Federal Reserve use a consensus prediction of

private forecasters, such as the Blue Chip consensus, in setting policy.[15] In this version of the rule, policymakers would adjust a current interest rate until the consensus private forecast for next year equals the targeted nominal GDP growth rate.

Both rules have merits. In principle, the forecast rule would prove superior to the lagged adjustment rule at stabilizing nominal GDP growth. The forecast rule adjusts policy now to prevent predicted future deviations of nominal GDP from target. For example, suppose current forecasts indicate U.S. exports will decline next year and, as a result, the projected growth of next year's nominal GDP is below the targeted rate. The forecast adjustment rule dictates that policymakers reduce a short-term interest rate now, by enough to spur next year's nominal GDP growth rate to exactly offset the predicted effect of the fall in exports. In contrast, the lagged adjustment rule would adjust monetary policy only after nominal GDP actually deviates from target. Given this delayed reaction of policy and the lagged effects of policy changes, several quarters may pass before monetary policy succeeds at spurring nominal GDP back toward target.

In practice, however, forecasters make errors in predicting future movements in nominal GDP. If forecast errors are large and frequent, the lagged adjustment rule may better stabilize nominal GDP. A simple example illustrates how, in practice, the lagged adjustment rule might prove superior. Suppose forecasts call for next year's nominal GDP growth rate to fall 1 percent below target due to a sharp deterioration in exports. Under the forecast rule, policymakers would reduce the current interest rate to spur next year's nominal GDP growth rate enough to offset this disturbance. If, however, forecasters proved to be wrong and the projected deterioration in exports failed to occur, the change in monetary policy would push nominal GDP growth above the targeted rate. Due to the forecast error, the forecast adjustment rule would create a deviation of nominal GDP from target.

Because analysts disagree about the magnitude of forecast errors, they disagree about which rule would better stabilize nominal GDP. Some analysts argue forecasts are sufficiently accurate that the forecast rule would better stabilize nominal GDP. Hall and Mankiw (1993), for example, show forecasts have "substantial" predictive power for actual nominal GDP growth and conclude the forecast rule "makes sense." Others argue forecast errors are so large that the lagged adjustment rule would better stabilize nominal GDP. Meltzer (1987), for example, shows forecast errors are large enough to prevent forecasters from distinguishing between recession and boom. He concludes "policies based on forecasts are unlikely to stabilize the economy" and suggests a lagged adjustment rule.

SIMULATION EVIDENCE

While there is reason to believe simple nominal GDP targeting rules might be good policy-setting procedures, policymakers have no experience with such rules. As a result, direct evidence on their performance is not available. Instead, statistical simulations can provide indirect evidence on how well the proposed rules for targeting nominal GDP might perform.

The statistical simulations presented here measure the performance of the economy under each of the two policy rules.[16] As detailed in the appendix, the simulations use the policy rules to create counterfactual data on real GDP growth and inflation. The data are counterfactual because they are generated from a model in which monetary policy is guided by one of the nominal GDP targeting rules.

The performance of each rule is gauged by comparing volatility in counterfactual, rule-guided data to volatility in historical data.[17] If, for example, real GDP growth and inflation volatility prove to be lower in the counterfactual data than in historical data, the simulations will provide indirect evidence that the rules would be good policies.

This section presents simulations of the forecast adjustment and lagged adjustment rules for

targeting nominal GDP. The simulations yield two important findings. First, some of the simulation results contradict the results of earlier studies. Second, some of the simulation results differ sharply from most analysts' and policymakers' prior expectations about successful policies. These findings suggest simulation analysis cannot definitively determine whether the simple nominal GDP targeting rules will improve economic performance.

The models

To ensure that the simulation results do not depend on the specific model of the economy used in the analysis, simulations are conducted with two different models. The first model, detailed in the appendix, imposes little structure on the economy and may be viewed as an atheoretical model. It relates current values of real GDP growth, inflation, M2 growth, and a short-term nominal interest rate to previous values. This model is similar to atheoretical models used in other studies (such as Judd and Motley 1992, 1993). It differs from some atheoretical models in two minor respects. The atheoretical model used here features the level of the interest rate rather than the change in the interest rate.[18] And, the model imposes no restrictions on the relationships between the current values of each variable in the model and previous values, whereas some other studies impose restrictions by eliminating particular variables from certain equations of the model.

The second model, also detailed in the appendix, assumes a textbook aggregate supply/aggregate demand structure to the economy.[19] The aggregate supply equation, a Phillips curve, relates inflation to expected inflation and the gap between actual and potential real GDP. The aggregate demand equation relates real GDP growth to a short-term real interest rate. This structural model is also similar to models used in other studies. It differs slightly from some other models, however, in that monetary policy affects aggregate demand directly rather than indirectly.[20] In the structural model used in this article, policy adjustments to the interest rate affect real GDP growth directly. In other studies (Judd and Motley 1992, 1993), policy adjustments to the interest rate affect real GDP growth indirectly through their influence on money growth.

Evidence on the forecast adjustment rule

Statistical simulations are first used to evaluate the forecast adjustment rule. As detailed in the appendix, the forecast rule examined in these simulations relies on forecasts of nominal GDP from an equation that relates nominal GDP growth to lagged values of nominal GDP growth and a short-term interest rate. The specification of the equation is derived from historical estimates of the relationship between nominal GDP growth and lagged values of nominal GDP growth and the interest rate.

Simulations using the forecast adjustment rule indicate the rule will significantly stabilize both real GDP growth and inflation (Table 1). The atheoretical model simulations show that using the forecast adjustment rule to keep nominal GDP growth on target can be expected to reduce volatility in both real GDP growth and inflation by about 8.5 percent relative to historical levels. Simulations of the structural model indicate the forecast adjustment rule will yield smaller but still sizable benefits. According to these simulations, both real GDP growth and inflation variability will fall about 5 percent. Thus, at least on the surface, the forecast adjustment rule appears to hold promise for the conduct of monetary policy.

Evidence on the lagged adjustment rule

As was the case with the forecast adjustment rule, statistical simulations of both the atheoretical and structural models are used to evaluate the lagged adjustment rule. Following the recent work of Judd and Motley (1993), the version of the lagged adjustment rule first examined in these simulations sets the adjustment parameter x at 0.20. At this level,

Table 1

Economic Performance Under the Forecast Adjustment Rule

Percentage Reduction in Volatility

	Atheoretical model
Real GDP growth	8.6
Inflation	8.4
	Structural model
Real GDP growth	4.9
Inflation	5.5

Note: Positive entries indicate reductions in volatility relative to historical volatility.

policymakers adjust a short-term interest rate 20 basis points for every one-percentage-point gap between actual and targeted nominal GDP growth.

Simulations with this version of the lagged adjustment rule suggest the rule will fail to stabilize the economy (Table 2, column 1). The policy rule will raise the volatility of both real GDP growth and inflation substantially above historical levels. The atheoretical model simulations indicate that, under the rule, real GDP growth volatility will soar 13.7 percent above the historical level. And, inflation variability will rise 3.2 percent. The structural model simulations indicate comparably adverse consequences of lagged adjustment. The volatility of real GDP growth will rise 6.4 percent above the historical level, and the volatility of inflation will rise 13.9 percent.

While the lagged adjustment rule fails when the adjustment parameter x is set at 0.20, the rule may well succeed at stabilizing the economy when x takes on different values. The rule may, for example, succeed when the adjustment parameter x equals the value of 0.125 first advocated by Judd and Motley (1992). At this level, policymakers change a short-term interest rate 12.5 basis points for every one-percentage-point difference between actual and targeted nominal GDP growth.

Simulations using this version of the lagged adjustment rule indicate the rule might succeed at stabilizing the economy (Table 2, column 2). The atheoretical model simulations indicate this version of the rule will reduce volatility in real GDP growth by 2.9 percent and volatility in inflation by 5.5 percent. In contrast, simulations under the structural model indicate this specification of the lagged adjustment rule will perform slightly worse than historical policy. According to the structural model simulations, the rule will raise real GDP variability by 0.6 percent and inflation variability by 4.0 percent. Together, the favorable atheoretical model results and the unfavorable structural model results suggest at least the possibility that this version of the rule might stabilize the economy.

These simulations show clearly that the lagged adjustment rule performs better when the adjustment parameter x is set at the lower value of 0.125

Table 2

Economic Performance Under the Lagged Adjustment Rule

Percentage Reduction in Volatility

	Adjustment percent $x = .20$	Adjustment percent $x = .125$	Adjustment percent $x = 0$ (constant rate)
	Atheoretical model		
Real GDP growth	-13.7	2.9	12.1
Inflation	-3.2	5.5	12.0
	Structural model		
Real GDP growth	-6.4	-.6	4.5
Inflation	-13.9	-4.0	13.3

Note: Positive entries indicate reductions in volatility relative to historical volatility. Conversely, negative entries indicate increases in volatility.

rather than 0.20. According to the atheoretical model simulations, for example, the volatility of real GDP growth falls 2.9 percent from the historical level when the adjustment parameter is set at 0.125, but rises 13.7 percent when the parameter is set at 0.20.

The improvement in the performance of the lagged adjustment rule associated with the reduction of the adjustment parameter suggests the rule may perform even better if the adjustment rate is reduced further. Additional simulations confirm this speculation. Simulations using versions of the lagged adjustment rule that set the adjustment parameter x at a number of different values indicate the rule best stabilizes the economy when x is reduced all the way to zero. At this level, policymakers do not adjust the interest rate at all when nominal GDP growth deviates from target. They instead maintain a constant interest rate.

Under the constant interest rate policy, the volatility of real GDP growth and inflation is greatly reduced (Table 2, column 3).[21] The atheoretical model simulations indicate the constant-rate policy will reduce variability in both real GDP growth and inflation by about 12 percent relative to historical policy. The structural model simulations show the constant-rate policy will reduce real GDP growth volatility by 4.5 percent and inflation variability by about 13 percent. These reductions in volatility are even greater than those achieved under the forecast adjustment rule.

Lessons from the simulation evidence

On the surface, the simulation results suggest a simple rule for targeting nominal GDP might perform well, stabilizing both real GDP growth and

inflation. For example, evidence suggests the forecast adjustment rule would reduce volatility of real GDP growth and inflation and that, with a sufficiently low adjustment parameter, the lagged adjustment rule would also reduce volatility. Considered carefully, however, the simulation results are not convincing. Some of the simulation results differ sharply from those of previous studies. Moreover, other simulation results run strongly contrary to most analysts' and policymakers' expectations. These findings suggest simulation analysis does not provide convincing evidence for a nominal GDP targeting rule.

Differences from previous studies. The forecast adjustment rule results contradict those of Hall and Mankiw (1993). This article finds the forecast adjustment rule succeeds at reducing volatility in real GDP growth and inflation. In contrast, Hall and Mankiw (1993) concluded the forecast adjustment rule fails.[22] In their analysis the rule produces more volatility than historical policy has produced, especially in real GDP growth.[23]

In addition, the results for the version of the lagged adjustment rule that sets the adjustment parameter x at 0.20 differ from the results of Judd and Motley (1993). This article finds that when the parameter x equals 0.20, the lagged adjustment rule fails. The rule raises real GDP growth and inflation volatility significantly above historical levels. In contrast, Judd and Motley (1993) concluded the policy succeeds. In their analysis the rule reduces inflation volatility, while leaving real GDP growth volatility near the historical level. Since the models used by Judd and Motley differ only slightly from those used in this article, these differences in results suggest conclusions about rules drawn from simulation evidence are very sensitive to slight differences in models.[24]

A difference from expectations. The result that the constant-rate policy best stabilizes the economy is at sharp odds with most analysts' and policymakers' expectations. Most believe stabilizing real GDP growth and inflation would require significant volatility in the interest rate (for example, Hall and Mankiw). Accordingly, most would expect the constant interest rate version of the lagged adjustment rule to fail at stabilizing the economy.

The expected failure of the constant-rate policy rule is supported by economic theory.[25] Theory suggests pegging an interest rate will reduce policymakers' control of inflation and tend to lead to excessive inflation. When monetary policy pegs an interest rate, it must accommodate every increase in the demand for money. An increase in money demand will tend to push up the interest rate, so monetary policy must increase the supply of money to keep the interest rate at the pegged level. Because increases in the supply of money lead to increases in the price level, there is nothing to tie down the price level (Friedman; Blanchard and Fischer). Interest rate pegging therefore reduces policymakers' control of inflation.

CONCLUSIONS

Some analysts argue monetary policy should follow a simple nominal GDP targeting rule. They point to the general benefits of targets and to the specific advantages of nominal GDP targets and rules for policy. A number of alternative nominal GDP targeting rules have been proposed. These rules include adjusting an interest rate so that forecasted nominal GDP growth always equals the targeted rate, and adjusting a current interest rate in response to last quarter's gap between actual and targeted nominal GDP growth.

Simulations of models of the economy with nominal GDP targeting rules yield two troubling findings. First, some pieces of the simulation evidence contradict the results of earlier studies which used slightly different models. Second, some pieces of the simulation evidence differ sharply with most analysts' and policymakers' prior expectations about successful policies. These findings show that, based on simulation analysis, policymakers cannot be certain a simple nominal GDP targeting rule will improve economic performance.

APPENDIX

This appendix details the specifications of the atheoretical and structural models, the specification of the forecast adjustment rule, and the simulation procedure.

The atheoretical model

The atheoretical model takes the form of a vector autoregression (VAR), augmented to include an error correction term. The VAR variables consist of real GDP growth, inflation as measured by the growth rate of the GDP implicit price deflator, M2 growth, and the 3-month T-bill rate. The error correction term equals the log level of M2 velocity. Four lags of each variable are included in the VAR. The residuals of each VAR equation represent the model shocks.

While this model imposes few restrictions on the data, it lacks a theoretical structure. None of the model's equations or disturbance terms can be directly interpreted as aggregate supply or aggregate demand forms. The only structure imposed on the model is the assumption that the interest rate equation of the VAR represents historical policy (following Feldstein and Stock). Monetary policy may be viewed as setting the interest rate according to a rule given by the deterministic component of the equation, with discretionary changes in policy given by the residual.

The structural model

The structural model takes a textbook aggregate supply/aggregate demand form, with equations for aggregate demand, aggregate supply, and historical monetary policy.[26] The aggregate demand function relates current real GDP growth to lagged values of growth, lagged values of the real short-term interest rate, and a demand disturbance:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \alpha_3 (i_{t-2} - \pi^e_{t-2}) + \alpha_4 (i_{t-4} - \pi^e_{t-4}) + \alpha_5 (i_{t-8} - \pi^e_{t-8}) + \varepsilon^d_t,$$

where ΔY denotes real GDP growth, i represents the 3-month T-bill rate, π^e denotes the expected rate of inflation, and ε^d is a demand shock. Expected inflation equals the inflation rate predicted by a relationship between actual inflation and lagged values of inflation and the interest rate:

$$\pi^e_t = \delta_0 + \sum_{j=1}^{4} \delta_j i_{t-j} + \sum_{j=1}^{4} \delta_{j+4} \pi_{t-j}.$$

The aggregate supply function relates actual inflation to expected inflation, the gap between the levels of actual and potential real GDP, and a supply disturbance:

$$\pi_t = \pi^e_t + .02 (Y_t - YP_t) + \varepsilon^s_t,$$

where Y and YP indicate the levels of, respectively, actual and potential real GDP, and ε^s is a supply shock. Potential output is measured as the smooth trend in actual real GDP.[27] The Phillips curve slope is set at 0.02 to be consistent

with previous studies (such as Judd and Motley 1992, 1993).

The historical policy equation relates the current interest rate to lagged values of the interest rate, real GDP growth, inflation, and a discretionary disturbance:

$$i_t = \beta_0 + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \sum_{j=1}^{4} \beta_{j+2} i_{t-j} + \sum_{j=1}^{3} \beta_{j+6} \pi_{t-j} + \varepsilon_t^{pol},$$

where ε^{pol} is a discretionary change in monetary policy. Monetary policy may be viewed as setting the interest rate according to a rule given by the deterministic component of the equation, with discretionary changes in policy given by the residual ε^{pol}.

The model parameters

The parameters of the atheoretical and structural models are estimated using quarterly data from 1959 to 1988. Ending the sample period in 1988 is a matter of convenience: 1959-88 parameter estimates produce more stable simulations than 1959-93 estimates. The instability induced by extending the sample period may be associated with the recent upward trend in M2 velocity.

Specification of the forecast adjustment rule

The forecast rule is based upon a simple regression relationship between the interest rate and nominal GDP growth, fit with 1959-88 data:

$$\Delta X_t = \varphi_0 + \varphi_1 \Delta X_{t-1} + \varphi_2 \Delta X_{t-2} + \varphi_3 i_{t-2} + \varphi_4 i_{t-3} + \varphi_5 i_{t-4} + \varepsilon_t,$$

where ΔX denotes nominal GDP growth and ε represents the error in forecasting current nominal GDP growth from previous values of nominal GDP growth and the interest rate. According to this relationship, movements in the current interest rate do not affect growth until two quarters in the future. So the forecast rule adjusts the current interest rate to keep nominal growth two quarters hence on target.

The adjustment rule simplifies to a relationship between the current interest rate and lagged values of the interest rate and nominal GDP growth. The rule specification assumes the Federal Reserve has only lagged information on growth and inflation when it must decide to adjust the current interest rate. The parameters of the rule are derived by using the estimated nominal GDP growth equation to compute the forecasted growth rate two periods in the future as a function of the current interest rate and the lagged interest rates and growth rates, setting that forecast equal to the target growth rate, and then solving for the current interest rate.

Simulation procedure

The basic simulation procedure consists of two steps, the second of which is performed twice. The first step is to generate random shocks for 1989-98 from the same statistical distribution as the actual shocks observed for the selected model.[28] The second step is to pass

the simulated shocks through the selected model to create artificial data on real GDP growth, inflation, and the interest rate for 1989-98. Following Feldstein and Stock (1993), on one pass of this step the historical policy equation is used as the policy rule to construct artificial historical data. On the other pass one of the policy rules is imposed in lieu of the historical policy equation, to construct the counterfactual data which would be observed if the rule were imposed.[29]

The ten years of artificial data are then used to compare the volatility of the economy under the policy rule to volatility under historical policy. To gauge the average effects of the policy change, this comparison is made for each of 1,000 simulated 1989-98 data sets (again, following Feldstein and Stock). Tables 1 and 2 report the median (over the 1,000 data sets) percentage changes—from historical policy to the rule—in the standard deviations of growth and inflation.

ENDNOTES

[1] Because of difficulties in measuring the aggregate price level, price stability does not necessarily correspond to a 0 percent rate of inflation in measures of the aggregate price level (Kahn). Price stability is achieved when inflation is sufficiently low and stable that it is not a factor in the decisions made by households and firms.

[2] Tobin, an early advocate of nominal GDP targeting, pointed out the short-run relationship between nominal GDP growth and real GDP growth in 1980.

[3] In this example, nominal GDP growth differs slightly from the sum of real GDP growth and inflation because of rounding error in the data.

[4] This simple discussion abstracts from concerns which some analysts raise in detailed analyses. While under one mathematical model of the economy nominal GDP would be a better target than the monetary aggregates, under another reasonable model the aggregates would be superior (Bean; West).

[5] A simple model of aggregate supply and aggregate demand shows that the precise amount by which real GDP falls and inflation rises depends on the slope of the aggregate supply curve.

[6] In response to supporters of discretionary policy, some advocates of rules stress that the procedures they propose and study need not be used as strict rules. These rule proponents point out that the policy decisions dictated by a rule might simply be used as a baseline path around which discretionary policy decisions could be oriented (Judd and Motley 1992, 1993; McCallum 1993; Taylor). Under this strategy a rule would probably affect policy decisions, but permit discretionary policy changes.

[7] More formally, the inflationary bias in discretionary policy stems from a problem known as time inconsistency (Kydland and Prescott; Barro and Gordon). The simple discussion here abstracts from the important role that expectations of future events, such as policy adjustments, play in the problem of time inconsistency.

[8] Some analysts argue for rules that adjust another instrument of monetary policy, the monetary base, to keep nominal GDP on target (McCallum 1987, 1988). Interest rate-based rules offer the advantage that they involve little change from the Fed's current policy-setting practices. Currently, when policymakers wish to change the stance of monetary policy, they typically do so by adjusting short-term nominal interest rates.

[9] Hall and Mankiw (1993) suggest a closely related type of rule, under which policymakers would adjust the interest rate in response to not only the gap between actual and targeted nominal GDP growth but also to the gap between actual and

potential real GDP levels. Such a hybrid procedure offers the advantage that if nominal GDP growth exceeds target but the real GDP level falls below potential, policymakers would adjust policy less aggressively than they would under the simpler growth rules. When simulated using the models and procedures of this article, hybrid rules fail, raising volatility in both real GDP growth and inflation above historical levels. This finding conflicts with the results of Hall and Mankiw (1993).

[10] This rule takes the mathematical form

$$\Delta i_t = x\,(\Delta GDP_{t-1} - \Delta GDP^*)\,,$$

where Δi_t indicates the change in the interest rate, ΔGDP_{t-1} denotes last period's nominal GDP growth rate (annualized), and ΔGDP^* equals the target growth rate.

[11] For a one-percentage-point gap between actual and targeted GDP growth on a *quarterly* basis, which corresponds to a four-percentage-point gap on an *annual* basis, policymakers adjust the interest rate 50 basis points. Since Judd and Motley (1992) specified the policy rule in terms of GDP growth on a quarterly basis, they set the adjustment rate to 0.50. Since this article (following Judd and Motley 1993) specifies the rule in terms of GDP growth on an annual basis, it sets the corresponding adjustment parameter x at 0.125.

[12] Delays in the reporting of nominal GDP may result in additional, but much smaller, disadvantages to the lagged adjustment rule. The U.S. Commerce Department typically provides a preliminary estimate of a quarter's nominal GDP three to four weeks after the end of the quarter. Under the lagged adjustment rule, this reporting delay would add roughly another month to the two to three quarters which would pass before a change in monetary policy would be made in response to a deviation of nominal GDP from target. Moreover, because the preliminary estimate of nominal GDP is typically revised later, measurement error may create unnecessary volatility in the economy. If, for example, nominal GDP growth proves to be at the target rate but the preliminary estimate was above target, changing monetary policy in response to the preliminary estimate would create unnecessary volatility. In simulation analysis, however, the additional volatility created by data revisions appears to be small (Judd and Motley 1993).

[13] This rule has no simple mathematical form. Based upon the model used to forecast nominal GDP growth, the rule relates the current interest rate to values of a variety of variables, such as past interest rates and past inflation, which are used to forecast future nominal GDP growth. The appendix explains the precise form of the forecast adjustment rule used in this article.

[14] The Federal Reserve presents projections for nominal GDP growth in its semiannual report to Congress on the Full Employment and Balanced Growth Act of 1978. Projections made by the Federal Open Market Committee for 1993 and 1994, for example, are published in *1993 Monetary Policy Objectives: Midyear Review.*

[15] Hall and Mankiw (1993) prefer this specification of the forecast rule because it eliminates the possibility of policymakers' discretion affecting monetary policy and therefore eliminates the possibility of an inflationary bias in policy. If the rule were to use Federal Reserve forecasts, policy actions might be affected by the judgments of policymakers naturally embedded in the forecast. Policymakers' discretion might enter, for example, in predicting the effects of a change in monetary policy during a time of unprecedented financial innovation. The forecasting model projects the effects of the policy change from existing economic theory and historical economic fluctuations; the forecasters, who in this case would be policymakers, would adjust the model projection based on their judgment of the effects of the ongoing innovation.

[16] For each of the rules, the target nominal GDP growth rate equals the historical average growth rate. This article abstracts from the possibility that a rule would improve upon historical policy by preventing the Federal Reserve from systematically exceeding a targeted rate of growth. This analysis simply presumes the historical average nominal GDP growth rate to represent the historical target rate. To the extent that historical policy actually overshot its underlying target, this analysis will understate any benefits associated with a policy rule which ensures average growth near the target.

[17] Following Feldstein and Stock (1993), historical volatility is measured from estimates of how the economy would respond to the artificial disturbances if policymakers adjusted the interest rate as they appear to have adjusted it historically. As detailed in the appendix, historical policy is represented by the estimated historical relationship between the interest rate and other variables such as inflation. This historical policy for adjusting the interest rate is combined with a model of the economy and used to generate artificial data on real GDP growth, inflation, and the interest rate. These generated data measure how the economy would respond to the same artificial disturbances affecting the rule-guided economy if policy were directed as it has been historically. Volatility under the policy rules is compared to volatility in these counterfactual, historical policy-guided data.

[18] The levels specification reflects the presumption that, over the 1959-88 period, the short-term nominal interest rate is stationary, consistent with the stationarity of velocity reported, for example, by Hallman, Porter, and Small (1991).

[19] As in Mankiw (1992), for example, the model features an aggregate supply function which is positively sloped in the short run and vertical in the long run and an aggregate demand function which is importantly affected by monetary policy.

[20] In a textbook IS/LM model of aggregate demand, the aggregate demand function specified in this article's structural model corresponds to the IS curve. This specification assumes that monetary policy allows the money supply to adjust in keeping the interest rate at a desired level. Other studies (such as Judd and Motley 1992, 1993) specify an aggregate demand function which corresponds to a combination of the IS and LM curves, with the restriction that changes in expected inflation have no impact on aggregate demand.

[21] The policy rule simulations set the interest rate constant at the average level produced by the historical policy simulations.

[22] These statements apply to their "conservative assumptions" results, in which the shocks to aggregate demand are the same as those observed historically despite the change in policy-setting procedures. The rule performs much better under their alternative, highly optimistic assumption that the forecast adjustment rule eliminates all shocks to aggregate demand and deviations of nominal GDP growth from target.

[23] The tables of results reported by Hall and Mankiw (1993) show that the rule significantly raises inflation volatility above the historical level when, as in this analysis, volatility is measured by the standard deviation of inflation (the variability of inflation about the historical mean rate of inflation). In their discussion of the results, however, Hall and Mankiw concluded that the rule reduces inflation volatility below the historical level. That statement is only true when the historical volatility of inflation is measured by the root-mean-squared deviation of inflation, which is the variation of inflation about zero. The comparison made by Hall and Mankiw gives an unfair advantage to the rule, which they designed to achieve average inflation of zero, unless it is assumed that policymakers' historical inflation goal was very different from the historical average inflation rate.

[24] Simulations of a structural model patterned after that of Judd and Motley (1992, 1993) yield results qualitatively similar to theirs. The lagged adjustment rule significantly reduces inflation volatility with little effect on real GDP growth volatility. Using their structural model, when the adjustment parameter x is set at 0.20, the lagged adjustment rule reduces inflation volatility by about 7 percent while raising real GDP growth volatility about 1.5 percent. When x is set at 0.125, the rule reduces inflation volatility by about 4 percent while having no effect on real GDP growth volatility.

[25] While pegging an interest rate is widely viewed as an inferior policy, under some circumstances pegging an interest rate can be a superior policy. In an economy that has stable money demand but is subject to disturbances in the textbook "IS" curve, pegging an interest rate stabilizes the economy (Poole).

[26] The precise form of the aggregate demand function was derived by eliminating statistically insignificant variables in a more general regression of real GDP growth on lags of growth and lags of the real interest rate. The inflation expectations equation was derived by eliminating statistically insignificant lags in various regressions of inflation on lagged values of inflation and other variables such as growth, the interest rate, and the output gap. The policy equation specification was obtained by eliminating statistically insignificant lags in different regressions of the interest rate on lagged values of the interest rate and other variables.

[27] The trend is estimated with the Hodrick and Prescott (1980) filter.

[28] Overall results differ very little when the models are instead simulated over 1960-98, using a variety of initial conditions. The artificial shocks are drawn from a normal distribution with the variance-covariance matrix equal to that of the historical estimates of the model shocks.

[29] On the pass used to construct historical data, simulated interest rate equation shocks are included in the model. These shocks represent artificial discretionary policy changes like those observed historically (as measured by the residual in the estimated historical policy equation). Consequently, the precise specification of historical policy is not crucial to the results. Estimating a model which includes an interest rate equation from historical data and then using it to create artificial data from randomly generated disturbances having the same distribution as the estimated model disturbances will yield artificial data with the same volatility as the actual, historical data. This applies regardless of the precise form of the historical interest rate equation.

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Does Inflation Uncertainty Increase with Inflation?

By John E. Golob

One of the most important costs of inflation is the uncertainty it creates about future inflation. This uncertainty clouds the decisionmaking of consumers and businesses and reduces economic well-being. Without this uncertainty, consumers and businesses could better plan for the future.

According to many analysts, uncertainty about future inflation rises as inflation rises. As a result, these analysts argue that the Federal Reserve could reduce inflation uncertainty by reducing inflation. Other analysts argue that high inflation creates no more uncertainty than low inflation, as long as inflation remains stable. As a result, these analysts argue that high inflation does not necessarily interfere with decisionmaking or reduce economic well-being.

While most previous studies have found a positive relationship between inflation and inflation uncertainty, a few key studies have not. Previous studies may be flawed, however, because they ignore a general downtrend in inflation uncertainty that has occurred over time. Reasons for the downtrend —which is independent of the level of inflation— are not well understood. Nevertheless, accounting for the downtrend is important in determining the true relationship between inflation and inflation uncertainty.

This article accounts for the downtrend in inflation uncertainty and finds unambiguous evidence that inflation uncertainty rises with inflation. The first section identifies the consequences of uncertainty about inflation and discusses some likely causes of the positive relationship between inflation and inflation uncertainty. The second section reviews the results and inconsistencies in previous research. The third section presents empirical evidence resolving these inconsistencies and pointing to a robust positive relationship between inflation and inflation uncertainty.

HOW DOES INFLATION UNCERTAINTY INTERACT WITH THE ECONOMY?

Whenever expected inflation is a factor in an economic decision, uncertainty about inflation is also likely to be a factor. For example, uncertainty about future inflation can affect both business investment decisions and consumer saving decisions. This uncertainty has adverse economic consequences that potentially rise with inflation.[1]

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Consequences of inflation uncertainty

Uncertainty about inflation has two types of economic effects. First, inflation uncertainty causes businesses and consumers to make economic decisions that differ from the ones they would make otherwise. Analysts refer to these effects as *ex ante*, because the decisions anticipate future inflation. The second category of effects takes place after the decisions have been made, or *ex post*. These effects occur when inflation differs from what had been expected.

Ex ante effects. Uncertainty about inflation can affect the economy ex ante through three channels. First, inflation uncertainty affects financial markets by raising long-term interest rates. Second, inflation uncertainty leads to uncertainty about other variables that are important in economic decisions. Finally, inflation uncertainty encourages businesses to spend resources avoiding the associated risks.

The first channel through which inflation uncertainty affects the economy is by increasing long-term interest rates. An important determinant of long-term rates is the return required by investors. If inflation is uncertain, the return on nominal long-term debt will be riskier. As a result, investors will require higher expected returns, which imply higher long-term interest rates. Higher rates, in turn, imply that businesses will invest less in plant and equipment, and consumers will invest less in housing and other durable goods.

Some economists believe inflation uncertainty has been an important factor in explaining high long-term interest rates in the 1980s and 1990s. Before the high inflation of the 1970s, the spread between short-term and long-term rates was usually much lower than in recent years. Concern about another episode of high inflation is one possible reason the term premium remains high today.

The second channel through which inflation uncertainty affects the economy is by causing uncertainty about interest rates and other economic variables. When the payments in a contract are not indexed to inflation, inflation uncertainty causes the real value of future payments to be uncertain. For example, inflation uncertainty can cause employers and employees to be uncertain about future wages, and landlords and tenants to be uncertain about future rents. To the extent that taxes are not indexed to inflation, inflation uncertainty also implies uncertain tax rates. For example, capital gains taxes are not indexed, so inflation uncertainty implies that entrepreneurs will be uncertain about the tax rates on their capital gains. Also, the value of depreciation deductions will be uncertain, affecting the way profits are calculated and taxed. This spread of uncertainty to other economic variables interferes with the ability of consumers and businesses to make informed decisions.

Uncertainty about interest rates and other economic variables can reduce economic activity. When businesses are uncertain about interest rates, wages, tax rates, and profits, they may choose to delay hiring, production, and investment decisions until some of the uncertainty is resolved. Investment is most vulnerable because investment is so costly to reverse.

Uncertainty about interest rates also encourages businesses and consumers to finance investment with long-term fixed-rate debt to avoid the risk of increases in short-term interest rates. But since fixed long-term rates are typically higher than short-term rates, using long-term debt increases financing costs and thereby reduces investment. The purchase of a home mortgage provides an example of this effect. A consumer who is uncertain about future inflation will be uncertain about future interest rates as well. To eliminate the risk of future increases in interest rates, the consumer may choose a fixed-rate over a variable-rate mortgage. But this choice could lead the consumer to take out a smaller mortgage than otherwise because interest rates are typically higher in the first years of fixed-rate mortgages. So inflation uncertainty could limit the size of the mortgage and therefore the size of the home that the consumer purchases.

In the third channel through which inflation uncertainty affects the economy, businesses spend resources avoiding the risks of future inflation. For

example, when inflation uncertainty is high businesses may spend more resources improving their forecast of inflation. In addition, some businesses may try to hedge against unexpected inflation using specialized financial instruments, known as derivatives. But both forecasting and hedging activities imply that resources are diverted from other more productive business purposes. And while these strategies reduce the risk of unexpected inflation, they do not eliminate risk.[2] Furthermore, forecasting and hedging are not practical for most small businesses and consumers.

Ex post effects. The other effects of inflation uncertainty—the ex post effects—occur when inflation differs from what had been expected. Unexpected inflation leads to a transfer of wealth whenever the payments in a contract are specified in nominal dollars. When inflation is higher than forecast, the real value of nominal payments is lower than expected. A fixed-rate mortgage provides one example where unexpected inflation implies a transfer of wealth from the lender to the borrower. If inflation is unexpectedly high, the real value of the mortgage payments to the lender is less than had been expected. Similar effects occur in wage and rent contracts. When wages and rents are fixed in nominal dollars, employees and landlords are hurt by an unexpected increase in inflation.

Because a wealth transfer implies that someone wins while someone else loses, it is difficult to measure aggregate ex post effects. But if the unexpected inflation is large enough, the effect can be felt throughout the economy. The crisis in the savings and loan industry provides a striking example of an inflation-induced wealth transfer. In this industry, S&Ls used short-term deposits to make long-term loans. When inflation rose unexpectedly in the late 1970s, the real value of the payments on fixed-rate mortgages declined. Meanwhile, as short-term nominal interest rates rose with inflation, S&Ls were forced to pay higher rates to their depositors. By paying higher rates on deposits than they were receiving on loans, many S&Ls went bankrupt. Thus, the unexpected inflation of the 1970s led to a massive transfer of wealth out of the S&L industry. If the inflation of the 1970s had been less of a surprise, the taxpayer bailout of the industry might have been avoided.

Why inflation uncertainty might increase with inflation

While the costs of inflation uncertainty are relatively easy to identify, explaining why inflation uncertainty increases with inflation is more difficult. The most appealing explanation involves the response of monetary policy to inflation.[3] When inflation is low, monetary policymakers try to keep it low. To the extent they are successful, inflation remains low and stable. When inflation is high, however, monetary policymakers are more likely to adopt disinflationary policies. These policies, by lowering the inflation rate, increase inflation variability. Moreover, the policies create inflation uncertainty because the timing and short-run impact of policy on inflation are uncertain.

The timing of disinflationary policy actions is uncertain, in part, because of short-run tradeoffs among the goals of monetary policy. Although the long-run goal of monetary policy is to make progress toward eliminating inflation, the Federal Reserve also tries in the short run to moderate the depth of economic downturns. When inflation is high at the same time the economy is in a slump, it is not obvious which goal should take immediate priority. Thus, uncertainty arises about the timing of policy actions to reduce inflation.

The impact of monetary policy on inflation is also uncertain (Holland 1993b). In particular, the effects of policy take time to work their way through the banking system, to the real economy, and eventually to inflation. Moreover, the speed with which monetary policy actions are transmitted to inflation varies widely over time. Thus, the complexity of predicting how much and how quickly prices will respond to monetary policy creates inflation uncertainty, even if the stance of monetary policy were known with certainty.[4]

PREVIOUS RESEARCH

Research on inflation uncertainty goes back over 20 years. In the first study on the issue, Okun found that countries with high inflation also had more variable inflation. He interpreted the greater variability as an indication of greater uncertainty. Since Okun's initial work, over 20 empirical papers have been published on inflation uncertainty. The greatest flurry of activity occurred in the early 1980s, after a decade of unusually high inflation in the industrialized countries.

The vast majority of the research—17 of the 21 papers since Okun's study—has concluded that high inflation leads to more inflation uncertainty. However, four papers have been unable to find this relationship. In addition to these four papers, some research on exchange rate regimes is relevant. When inflation uncertainty is examined across exchange rate regimes, the evidence suggests uncertainty does not rise with inflation. Thus, although substantial evidence suggests that inflation leads to more inflation uncertainty, the evidence is not unanimous.

In recent research, two different strategies have been used to estimate inflation uncertainty.[5] The first strategy uses surveys and the second uses forecasting models. Since different estimates of uncertainty can lead to different empirical results, this section discusses both research strategies. Researchers using survey estimates of uncertainty consistently find a positive relationship between inflation and inflation uncertainty. Researchers using forecasting models do not find this relationship as consistently because different models yield different results.

The survey strategy

The first strategy for estimating uncertainty about inflation uses surveys of economists and consumers. Analysts estimate inflation uncertainty from the surveys using two different approaches. One approach estimates uncertainty by asking respondents to provide a range of values over which inflation might fall.[6] For example, one respondent might expect inflation of 3 to 4 percent, while another one might expect inflation of 2 to 5 percent. Because the second respondent identified a wider range of possible outcomes, this respondent is presumed to be more uncertain about future inflation.

The second approach to estimating inflation uncertainty from surveys is based on the variability, or dispersion, of inflation expectations across survey participants. Unlike the first approach where uncertainty can be estimated for an individual, the variability estimate of uncertainty requires several survey participants. When survey participants have similar expectations of future inflation, uncertainty is presumed to be low. But if they disagree about the inflation outlook, uncertainty is presumed to be high. For example, if 90 percent of participants' median inflation forecasts are between 3 and 4 percent, uncertainty is lower than if only 60 percent of the forecasts are in this range.

When inflation uncertainty is estimated from surveys, researchers consistently find that uncertainty is high during periods of high inflation. Eight papers reach this conclusion using data from four surveys.[7]

The forecasting model strategy

The second strategy for estimating inflation uncertainty uses economic forecasting models. In this approach researchers use an econometric model of inflation to forecast future inflation. Large forecast errors from the model imply high uncertainty, while small forecast errors imply low uncertainty.

Results from the forecasting model strategy are less consistent than those from the survey strategy. While most researchers find large forecast errors during periods of high inflation, some do not. One reason for this inconsistency is a lack of consensus about the best way to forecast inflation. Forecasts are typically based on previous values of a variety of economic variables, such as wage inflation, money growth, unemployment, import price

changes, and overall inflation. But there are many ways of building a model of inflation from these variables, and the relative performance of different models depends on the time period being considered. For example, growth in the M1 money supply has often been used in inflation forecasting models. But changes in the behavior of M1 in the early 1980s caused the performance of these models to deteriorate. Since economists have different opinions about how to forecast inflation, they have different interpretations of the forecasting model evidence on inflation uncertainty.

Two branches of research using forecasting models fail to find the positive relationship between inflation and inflation uncertainty. In the first branch, researchers use a highly restrictive model structure to investigate the link between inflation and uncertainty. In the second branch, inflation uncertainty is examined across exchange rate regimes.

Restricted-uncertainty models. Of the four papers in the literature that do not find more uncertainty when inflation is high, three use "restricted-uncertainty" models.[8] These models were originally developed to analyze financial data, where volatility often changes over time. Since inflation volatility also appears to change over time, researchers have adapted these models for analyzing inflation. The restricted-uncertainty models typically constrain uncertainty to change slowly over time.

Although researchers have found restricted-uncertainty models useful for financial data, the assumptions may be inappropriate for inflation uncertainty. Specifically, any rapid change in inflation uncertainty would be inconsistent with the constraints typically imposed in these models. For example, after Iraq's invasion of Kuwait in 1990, oil prices increased rapidly and uncertainty about their impact on overall inflation was high. However, the quick resolution of the resulting war in the Gulf led to a rapid decline in both oil prices and uncertainty about inflation. Such a rapid decline in uncertainty would be inconsistent with the assumptions in a typical restricted-uncertainty model. To the extent that the assumptions in these models are inappropriate, the results from the models are also suspect.

Inflation uncertainty across exchange rate regimes. If the only evidence against a relationship between inflation and inflation uncertainty came from restricted-uncertainty models, analysts might discount this limited contrary evidence. But research on exchange rate regimes also suggests that inflation uncertainty does not increase with inflation. The United States has been in two distinct regimes since the end of World War II. Exchange rates were fixed during the Bretton Woods period, which ended in 1973. Since the collapse of the Bretton Woods system, U.S. exchange rates have been allowed to float.

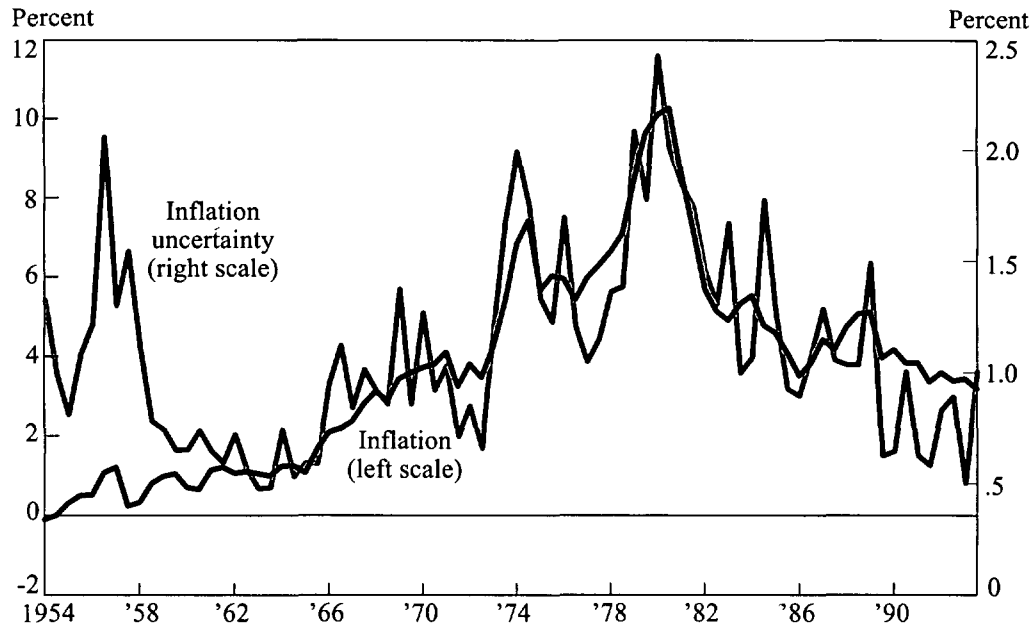
By examining inflation uncertainty across exchange rate regimes, researchers have indirectly provided evidence on the link between inflation and inflation uncertainty. This indirect evidence exists because the average level of inflation is higher in the floating-rate regime. If inflation uncertainty increases with inflation, uncertainty should also be higher in the floating-rate regime.

Inflation uncertainty has been examined across exchange rate regimes by Meltzer (1985, 1986, 1988) and Meltzer and Robinson.[9] The forecasting models use quarterly data for the GDP deflator and annual data for the producer price index. In all of these papers, inflation uncertainty was about the same or slightly higher during the fixed-rate regime as during the post-1973 floating-rate regime. Yet inflation was only about half as high during the fixed-rate regime as during the floating-rate regime. This finding suggests that inflation uncertainty may not increase with inflation.

In summary, researchers who estimate inflation uncertainty from survey data consistently find that inflation uncertainty rises with inflation. But results from forecasting models are not as conclusive. Results from restricted-uncertainty models are mixed, and results from exchange rate research suggest no relationship at all. To reconcile the disagreement, the next section takes another look at the evidence.

Chart 1

Inflation and Inflation Uncertainty



Note: Inflation is the average of the Livingston Survey 12-month inflation forecasts. Inflation uncertainty is the dispersion of the Livingston Survey 12-month inflation forecasts.
Source: Livingston Survey, Federal Reserve Bank of Philadelphia.

EMPIRICAL EVIDENCE

This section presents empirical evidence of an unambiguously positive relationship between inflation uncertainty and inflation. The analysis also reveals that, independent of the level of inflation, inflation uncertainty has been trending down over time. This downtrend explains the apparent inconsistencies in both the restricted-uncertainty models and the research on exchange rate regimes.

The empirical analysis in this paper is based on the 1954-93 period. The 1954 starting date is typical of research on inflation uncertainty.[10] Although earlier data are available, it is desirable to avoid the influences of World War II, the Korean War, a price control period in the early 1950s, and occasional episodes of deflation that could complicate the analysis. To ensure robustness and overcome the criticisms of the individual measurement techniques, the analysis uses evidence from a survey and from forecasting models.

Survey evidence

Uncertainty in CPI inflation is estimated using the Livingston survey, the only survey conducted continuously since 1954.[11] In the Livingston survey, approximately 50 economists are surveyed twice a year, in June and December.[12] Inflation uncertainty is estimated as the standard deviation of the participants' inflation expectations. The standard devia-

Table 1

Regression Results Using the Livingston Survey, 1954-93

Dependent variable	Constant	Time trend	Lagged uncertainty	Expected inflation
Inflation uncertainty (6-month horizon)	.443** (.096)	-.011** (.003)	.432** (.098)	.137** (.025)
Inflation uncertainty (12-month horizon)	.479** (.133)	-.011** (.004)	.395** (.146)	.110** (.027)

Note: Inflation uncertainty is estimated as the standard deviation of inflation forecasts from the Livingston Survey. Standard errors are in parentheses.

** Indicates significance at 0.01.

tion is a measure of the variability, or dispersion, of their inflation expectations.

A chart of the 12-month Livingston forecasts reveals a positive relationship between inflation and inflation uncertainty (Chart 1).[13] Both of these variables were highest in 1980, when inflation was over 10 percent and the standard deviation of inflation expectations was over 2 percent.[14]

In addition to the positive relationship between inflation and inflation uncertainty, Chart 1 also reveals a modest downtrend in uncertainty. In particular, the estimates of inflation uncertainty are generally above estimates of inflation in the early years and generally below inflation in the later years.[15]

A formal statistical analysis of the relationship between the level of CPI inflation and the dispersion measure of CPI uncertainty confirms the results suggested by Chart 1. Table 1 shows the results when uncertainty is regressed on expected inflation, time, and last period's uncertainty. For both six-month and 12-month Livingston forecasts, the coefficient on inflation is positive. This result implies that higher inflation is associated with more inflation uncertainty. The negative coefficient on the time trend implies that uncertainty has been declining over time.[16] This decline in inflation uncertainty over time is independent of the relationship between inflation uncertainty and the level of inflation.[17]

The main result in Table 1 confirms what other researchers have found in survey data—that inflation uncertainty increases with inflation. The downtrend, however, is a feature of the data that was not observed in previous research. Given the results in the literature, finding a positive relationship between inflation and uncertainty is not surprising. A more interesting question is whether the downtrend in uncertainty can resolve any of the inconsistent evidence from forecasting models.

Forecasting model evidence

Inflation uncertainty is estimated in forecasting models for two versions of the CPI and for the GDP deflator. The two versions of the CPI are the total CPI and the core CPI. The total CPI reflects the prices paid by a typical urban consumer, whereas

Table 2

Regression Results from Forecasting Models for Consumer Price Indexes

(Models based on 1957-93 quarterly data)

Dependent variable	Constant	Time trend	Lagged inflation
Uncertainty in core CPI inflation	.092 (.053)	-.0012* (.0006)	.28** (.035)
Uncertainty in total CPI inflation	.266** (.057)	-.0002 (.0006)	.127** (.033)

Note: Uncertainty is estimated from forecast errors. Standard errors are in parentheses.

* Indicates significance at 0.05.

** Indicates significance at 0.01.

the core CPI excludes food and energy prices. This latter index may give a more accurate representation of inflation because the total CPI is distorted by short-term volatility in its food and energy components. The analysis uses both of these indexes to see if the downtrend in uncertainty can be attributed to a decline in the volatility of food and energy prices.[18]

Uncertainty in the CPI. The forecasting model used to estimate uncertainty in total CPI and core CPI inflation is similar to a model evaluated by Stockton and Glassman. The model uses quarterly data on inflation and assumes that next quarter's inflation depends on inflation in each of the past four quarters.[19] Stockton and Glassman have shown that the performance of this simple model is comparable to the performance of more complicated models.

For uncertainty in core CPI inflation, results from the forecasting model approach are similar to results from the survey approach (Table 2). Uncertainty increases as inflation rises, but uncertainty declines over time.[20] More precisely, for a 1 percent increase in inflation, the regression indicates that uncertainty (as measured by the forecast error) increases by 0.28 percentage points.

The forecasting model results for the total CPI differ slightly from those for core CPI (Table 2). While uncertainty still rises as total CPI inflation rises, the coefficient on the time trend is no longer significant. The insignificant coefficient implies that unlike core CPI, uncertainty is not trending down in total CPI. This result likely occurs because the volatility of food and energy prices is the dominant component of uncertainty in total CPI. Food and energy volatility has not declined over time, and this high volatility obscures the declining uncertainty in the core component of total CPI.[21]

Uncertainty in the GDP Deflator. Two different forecasting models are used to estimate uncertainty in the GDP deflator. Ball and Cecchetti devised the first model, which forecasts inflation using past values of inflation and past forecast errors. Bollerslev devised the second model, which estimates uncertainty for the GDP deflator using a restricted-uncertainty model.[22] Inflation still depends on past inflation, but the model restricts how

Table 3

Regression Results from Forecasting Models for the GDP Deflator

(Models based on 1954-93 quarterly data)

Dependent variable	Constant	Time trend	Lagged inflation
Ball and Cecchetti Model			
Inflation uncertainty	.325*	-.0062*	.094*
	(.044)	(.0014)	(.039)
Bollerslev Restricted-Uncertainty Model			
Inflation uncertainty	.219**	-.0008*	.920*
	(.038)	(.0003)	(.415)
Inflation uncertainty	.135**		.75
	(.026)		(.42)

Note: For both the Ball-Cecchetti and Bollerslev models inflation uncertainty is estimated from forecast errors, but the Bollerslev model imposes restrictions on how uncertainty varies over time. Standard errors are in parentheses.

* Indicates significance at 0.05.
**Indicates significance at 0.01.

fast uncertainty can change over time.

Results from both GDP forecasting models are similar to results from the analysis of core CPI uncertainty. In the first model in Table 3, estimated uncertainty is larger when inflation is higher, but uncertainty declines over time. Similar results are obtained with the restricted-uncertainty model.[23] Table 3 also shows the results of a second regression with the restricted-uncertainty model. When time is removed from the regression, the coefficient on past inflation is no longer significant. This result illustrates how excluding time from the analysis can change the interpretation of the results.[24]

Reconciling the evidence

The downtrend in uncertainty may explain why a positive relationship between inflation and inflation uncertainty is not found in some previous research. The failure of previous researchers to recognize the downtrend may have biased their results. While higher inflation in the second half of the sample tends to raise uncertainty, the downtrend works in the other direction. Thus, the failure of previous studies to detect a relationship between inflation and uncertainty arises because the two effects on uncertainty tend to counteract each other.

The downtrend also explains the results from research on exchange rate regimes. Recall that although inflation was almost twice as high in the floating-rate as in the fixed-rate regime, there was no corresponding increase in inflation uncertainty. In this case, the combined effects of inflation and time neutralized each other, so there was little change in uncertainty across the two regimes.

Recognizing that inflation uncertainty has trended down over time substantially increases the weight of evidence that uncertainty increases with inflation. While some studies from the literature seem to be inconsistent with this result, the vast majority of these studies were based on either restricted-uncertainty models or exchange rate regime research. When these analyses are reexamined in the light of this article's evidence of a downtrend in inflation uncertainty, the conclusion that high inflation is associated with high uncertainty is even more compelling.

SUMMARY

Most research on inflation uncertainty finds high uncertainty during periods of high inflation. But this conclusion is not universal, and contrary evidence is found both in restricted-uncertainty models and in exchange rate research. This article reaffirms the positive relationship between inflation and inflation uncertainty, and offers an explanation for the inconsistent results in previous research.

The article provides evidence of a downtrend in inflation uncertainty, and shows how this downtrend can conceal the positive relationship between inflation and inflation uncertainty. Both survey and forecasting model estimates of uncertainty confirm the downtrend. When inflation uncertainty research is reexamined in the light of this downtrend, the conclusion that uncertainty increases with inflation is unambiguous.

The results in this article have a clear implication for monetary policy. To minimize the disruptions to economic decisionmaking caused by inflation uncertainty, the Federal Reserve should continue to work toward price stability.

ENDNOTES

[1] Several researchers find that inflation uncertainty has negative effects on economic activity. Holland (1993a) and Golob give summary discussions of this research.

[2] A few companies have encountered problems using complicated hedging strategies with derivatives. In an ironic twist, the strategies have inadvertently led to greater rather than less risk. The strategies are vulnerable to two problems. First, the strategies are so complicated that even alleged experts find it difficult to anticipate all possible contingencies. Second, strategies can require frequent trading when markets are moving, which requires that markets exist for each financial instrument used in a strategy. Unfortunately, when long-term interest rates moved rapidly in early 1994, even dealers were unable to establish prices of some exotic derivatives, so these markets essentially shut down. This led to a failure of the hedging strategies that depended on the closed markets.

[3] This explanation is similar to a formal economic model developed by Ball. In Ball's model policymakers have different attitudes toward inflation, some will disinflate while others will not. Since the public is uncertain about who will control policy in the future, the public is uncertain about whether high inflation will be reduced.

[4] Uncertainty about the impact of monetary policy is likely to contribute more to inflation uncertainty, at least in the short run, than uncertainty about monetary policy itself. Most evidence suggests monetary policy takes six months to a year to have an impact on inflation. Consequently, a change in monetary policy today will have only a limited impact on forecasts for inflation over the next six months to a year. The near-term outlook for inflation will, however, continue to be clouded by uncertainty about the impact of past monetary policy actions.

[5] Early researchers assumed that inflation variability was a good measure of uncertainty, but limitations of this approach were quickly recognized (Foster). A basic weakness is that some variations in inflation can be predicted, so variability does not always represent uncertainty. Because of this weakness, the variability approach has not been used much over the last decade.

[6] Only the Survey of Professional Forecasters measures the uncertainty of individual respondents. Respondents are asked to assign specific probabilities to different ranges for inflation. For example, a respondent could assign a probability of one-half to the range from 2 to 3 percent and a probability of one-half to the range from 3 to 4 percent.

This survey was first conducted by the American Statistical Association and the National Bureau of Economic Research, and is sometimes referred to as the ASA-NBER survey. It is currently conducted by the Federal Reserve Bank of Philadelphia.

[7] Most of this research is based on U.S. data, but Australian researchers find a similar result using the Morgan Poll.

[8] The technical description of these models is "conditional heteroskedasticity," which is often designated by the acronyms ARCH (autoregressive conditional heteroskedasticity) and GARCH (generalized ARCH).

[9] Inflation uncertainty in the United States since World War II is only one aspect of the research on uncertainty across exchange rate regimes. The research also considers uncertainty in other economic variables, other countries, and time periods back to the 1800s. The general conclusion from this research is that economic uncertainty in the United States was much higher at the turn of the century when the United States was on the gold standard. Uncertainty was higher in inflation, nominal GDP, real GDP, and money. Results for other countries are similar, although not as consistent across different economic variables as in the United States.

[10] Several researchers have noted that inflation was significantly more volatile before 1954 (Cosimano and Jansen). Most of the results in this article are robust to changing the starting and ending dates of the analysis.

[11] The survey is named after the late Joseph Livingston, who started the survey in 1946 when he was a columnist with the *Philadelphia Enquirer*. The survey is currently conducted and published by the Federal Reserve Bank of Philadelphia.

The Survey of Professional Forecasters includes estimates of both the GDP deflator and the CPI, but this survey did not begin until 1968. The University of Michigan Survey did not begin asking for estimates of CPI inflation until 1966. Previously, participants had only been asked whether prices were going up or down.

[12] When the surveys are collected in June and December, official data are only available through April and October, respectively. This has led Carlson to conclude that the forecasts actually cover the subsequent 8-month and 14-month periods. Many analyses of the Livingston data recognize the Carlson adjustment.

[13] Inflation is the average of inflation expectations across survey participants. The results of the analysis are the same when the ex post measured inflation rate is substituted for the expected rate from the survey. Using the survey estimate of inflation avoids the controversy about the time horizon of the Livingston survey that is discussed in note 12.

[14] Chart 1 also reveals that inflation uncertainty is more variable than expected inflation. For example, although expected inflation was approximately 6 percent in 1976 and 1977, uncertainty declined from 1.7 to 1.1 percent over these two years.

[15] Uncertainty was particularly high in the early part of the sample. But an econometric analysis reveals that the downtrend exists even when the 1954-60 period is excluded.

[16] The regressions were corrected for serial correlation in the residuals using a maximum likelihood approach (Hall, TSP User's Guide). Other specifications for the regression were also explored. But coefficients were not significant for lagged expected inflation or for higher order lags on uncertainty. To allow for a possible unit root in inflation, a regression was also conducted on differenced data. In this regression, inflation uncertainty increased with inflation and a negative constant suggested a downtrend over time. But the constant coefficient was not statistically significant.

[17] While there is evidence of a downtrend in inflation uncertainty, the reasons for this decline are not immediately apparent. Lower uncertainty could reflect structural changes in the economy or more knowledgeable forecasters. An example of structural change in the economy would be a change in how consumers spend their income. For example, compared with 40 years ago, more of the typical budget is spent on health services and less is spent on durable goods. If the price of health services is less variable than the price of durable goods, the increased weight of health services might make overall inflation less variable and more predictable. Better forecasting is another reason that uncertainty may have declined. That is, forecasters may be using advances in computer and communication technology to develop better models of the economy. However, with the limited evidence shown above, it is not yet possible to diagnose definitively the true cause of the downtrend in inflation uncertainty.

[18] Since data on the core CPI are available only from 1957, this analysis starts three years later than the other work in this article.

[19] In the Stockton and Glassman model, inflation depends on four lagged values. Standard model selection criteria (see Wei) indicate that this is a good model. For the core CPI, a model with three lagged values is better.

[20] Past inflation is taken as the average over the last six months to smooth out the short-term fluctuations in quarterly

data. This approach will be used in regressions of uncertainty on past inflation for all of the forecasting models.

[21] The regressions in Table 2 provide evidence that uncertainty is higher in total CPI than core CPI. The constant term is almost three times higher for total CPI than for core CPI.

[22] In Bollerslev's model, inflation depends on inflation over the previous four quarters. The conditional heteroskedasticity (uncertainty) is assumed to follow a GARCH(1,1) process.

[23] The dependent variable in Table 3 is the conditional variance from the restricted-uncertainty model. Since this number is very small in a model that forecasts quarterly percentage changes in the GDP deflator, all the coefficients in Table 3 are shown as 10,000 times the actual values. The regressions were corrected for serial correlation in the errors using a maximum likelihood technique. This regression is not as robust as the other results in this article. Results from other models were robust to changing the starting and ending dates, and to eliminating the 1973-81 period when oil price shocks were important. In contrast, results with the restricted-uncertainty model are more sensitive to such adjustments.

[24] Researchers have proposed alternative explanations for the inconsistent results in inflation uncertainty research. Brunner and Hess suggest that asymmetry is an important issue in the failure of GARCH models to find a relationship between inflation and inflation uncertainty. Ball and Cecchetti suggest that inflation uncertainty should be separated into short-term and long-term components and that the level of inflation is more closely related to long-term uncertainty than to short-term uncertainty.

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People on the Move: Trends and Prospects in District Migration Flows

By Glenn H. Miller, Jr.

Since the early 1970s, the states of the Tenth Federal Reserve District have experienced wide swings in economic activity and interstate migration. The swings in migration not only reflect the region's economic performance but also have important consequences for future economic activity.

This article discusses recent trends and prospects for migration into and out of the district. The first section reviews trends in net migration flows and shows how they correspond with swings in district economic performance. The second section examines the composition of migrant flows, indicates that a significant brain drain occurred from much of the district in the late 1980s, and considers the migration outlook for the district.

SWINGS IN MIGRATION FLOWS AND ECONOMIC PERFORMANCE

The Tenth District has had three major swings in migration flows over the past two decades. In each case, the population shift was closely correlated with a big swing in the district economy. This correspondence between swings in migration and the economy is not new. The migration of people from place to place has long been closely related to regional economic growth and development. Migration is a response to changing economic activity across regions. Individuals who move are motivated by changing conditions in their region of origin and by greater economic opportunity in potential destination regions. Thus the ebb and flow of economic opportunity in the Tenth District compared with that in the rest of the nation has provided much of the push and pull to district migration.

Migration has many impacts. It affects the migrants themselves, who generally move to find better economic opportunity. If they find opportunity, they are likely to settle down as residents; if not, they may well move again.[1] On a more aggregate level, migration affects the regions of origin and destination. Receiving regions are likely to enjoy strengthened economic activity as the demand for goods and services, including housing, increases. Multiplier effects further enhance the economic benefits of migration inflows.[2] By contrast, regions with migration outflows are likely to suffer weakened economic activity and shrunken tax bases.

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Migration flows

From the mid-1970s to the early 1990s, the Tenth District has experienced three significant shifts in net migration.[3] From 1975-76 to 1982-83, the region experienced net inmigration from the rest of the nation (See charts in Appendix). At the peak in 1981-82, almost 93,000 more people moved into the district than moved out. After a sharp slowdown in net inmigration in 1982-83, net outflows began in 1983-84 and lasted through 1989-90. Net outmigration reached a maximum of about 87,000 in 1987-88. Net outmigration then slowed, and net inmigration to the district resumed in 1990-91 and continued in 1991-92, the last year for which data are available. (The data used here are from the Internal Revenue Service, so the estimated annual migration flows refer to the 12-month period from April of one year to April of the next year. Annual data for each state and the district, including gross inmigration and outmigration, are shown in Appendix Table 1).[4]

The net migration experiences of some district states ran counter to that of the region as a whole. Missouri, for example, had net outmigration in the early 1980s but net inmigration during the last half of the decade. Nebraska had a net outflow in every year from 1975-76 to 1991-92 except one; Kansas had a net outflow in every year but two. Among the other four states, Wyoming turned from net inflow to net outflow in 1982-83, much sooner than the rest. New Mexico, however, did not make the switch until 1987-88.

Migration effectiveness. Migration always brings some population redistribution between places unless gross flows of inmigrants and outmigrants exactly cancel out, leaving pure population swapping. Population redistribution due to net migration is usually more important to a region's economy than population swapping.[5]

A concept called migration effectiveness is used here to focus attention on population redistribution.[6] Specifically, migration effectiveness is a region's net migration (gross inmigration minus gross outmigration) as a percent of its total migration (gross inmigration plus gross outmigration). Effectiveness captures two key attributes of migration. First, the measure's absolute size shows the power of the migration system in redistributing population. A high value shows large net redistribution of population relative to total migration, hence high migration effectiveness. A low value shows population swapping but little redistribution of population as the gross flows tend to cancel out one another.[7] Second, the effectiveness measure shows the direction of migration. The measure is positive when there is net inmigration and negative when there is net outmigration.[8]

Table 1 shows migration effectiveness for the district and district states from 1975-76 to 1991-92.[9] The effectiveness measure confirms the region's three major swings in migration flows and shows their power in redistributing population. For the district as a whole, effectiveness rose to a peak of 9.3 in 1981-82. That is, of all the people who were coming into and going out of the region, 9.3 percent came into the district. As migration effectiveness measures go, that was a sizable influx. Similarly, district migration effectiveness swung to a sizable peak outflow in 1987-88. The region's effectiveness again turned positive in 1990-91 and swung further toward net inflows the following year.

The district's energy and mountain states contributed heavily to the early peak in effective inmigration and the later peak in effective outmigration. Oklahoma and Wyoming, for example, shifted from being highly effective receivers of net inmigration in 1981-82 to being highly effective providers of net outmigration in 1987-88. Colorado and New Mexico had less severe outflows in the mid-1980s but became the district's most powerful migration magnets by the early 1990s.

Among other district states, Missouri was a contrarian in its migration flows. Missouri moved from being an effective provider of net outmigration in the early 1980s to being a modest receiver of net inmigration in the mid-1980s, the same time that most other district states were losing population. Although Kansas and Nebraska had sizable

Table 1

Migration Effectiveness for Tenth District States, Selected Years, 1975-92

	1975-76	1976-77	1978-79	1980-81	1981-82	1982-83	1983-84	1984-85
Colorado	5.7	8.9	10.8	12.7	16.6	7.5	4.5	1.9
Kansas	1.3	-1.9	-4.8	-2.3	-6.3	-5.4	-6.0	-6.8
Missouri	-2.2	.7	-2.0	-6.7	-11.5	-.9	.6	-1.4
Nebraska	-3.6	-5.6	-11.0	-7.4	-10.6	-10.2	-8.4	-13.6
New Mexico	8.4	6.9	7.3	4.1	5.8	8.5	4.3	3.6
Oklahoma	9.3	9.7	8.3	14.7	30.2	10.4	-4.5	-12.3
Wyoming	13.6	15.3	15.9	13.7	9.4	-10.7	-15.4	-13.6
Tenth District	5.0	8.1	4.7	6.1	9.3	3.2	-1.9	-5.6

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Colorado	-.2	-3.0	-9.8	-7.4	-.8	8.0	14.9
Kansas	-7.0	-4.4	-1.9	-4.3	-4.5	-4.6	1.8
Missouri	1.0	3.8	1.2	.7	2.0	-.6	.1
Nebraska	-17.3	-14.9	-10.2	-5.9	-3.1	-.8	.1
New Mexico	2.1	.7	-4.3	-2.7	-1.1	3.3	7.1
Oklahoma	-14.0	-23.3	-20.0	-11.1	-6.2	-.6	3.2
Wyoming	-14.9	-36.0	-23.2	-15.7	-10.0	-.1	3.8
Tenth District	-6.6	-9.6	-10.3	-7.1	-2.8	1.7	7.0

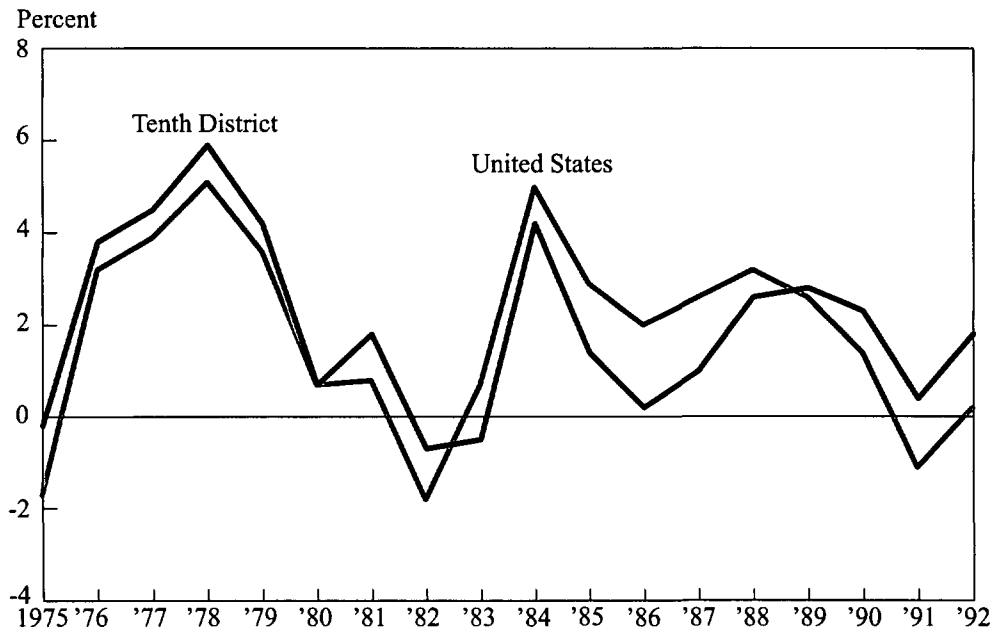
Source: Computed at the Federal Reserve Bank of Kansas City from IRS data.

outflows in the mid-1980s, their migration effectiveness has receded since then.

The connection between migration and the economy

The swings in district migration occurred against a backdrop of sharp swings in economic growth across the region, due largely to a boom and bust cycle in its important energy sector. While both the district and national economies fluctuated considerably from the mid-1970s to the early 1990s, their relative growth performance diverged in the middle of the period. The divergences in economic growth between the district and the nation are a major factor

Chart 1
Employment Growth
United States and Tenth District



Source: U.S. Department of Labor.

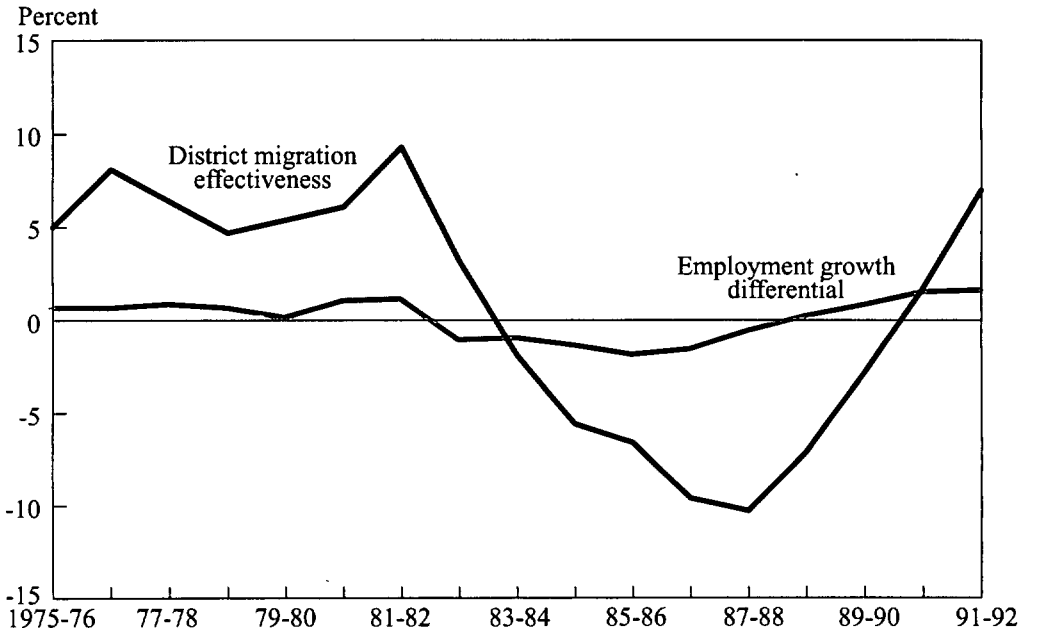
in explaining why so many people were coming and going in the district during this period.

Employment growth fluctuated considerably from 1975 to 1992 in both the Tenth District and the nation (Chart 1).[10] The district economy outpaced the national economy in the late 1970s and early 1980s, but the tables turned in 1983 when the national economy began to outpace the district. Growth was faster in the nation than in the district until the nation began to slip into the 1990-91 recession. The divergences in economic performance between the district and the nation were due less to national business cycle fluctuations than to a cycle of boom and bust in the district's energy industry.

The energy industry in the Tenth District and elsewhere in the United States responded briskly to large swings in oil prices in the 1970s and 1980s. Growth in district mining employment averaged nearly 10 percent per year from 1972 to 1981, when the number of jobs in the sector reached its peak. Then as oil prices slipped somewhat in the early 1980s and plummeted in 1986, district mining employment fell by almost 11 percent per year from 1981 to 1991.

Migration effectiveness lends itself well to studying the relation between migration and economic

Chart 2
Tenth District Migration Effectiveness and Employment Growth Differential Between United States and Tenth District



Source: U.S. Department of Labor and Internal Revenue Service.

performance because it encompasses two important features of migration—its population redistributive power and its directionality. The high levels of migration effectiveness for the district both in the 1970s and the 1980s, and the significant reversal of direction of net migration flows, indicate the substantial redistribution of population into and out of the district. They also reflect the substantial changes in economic activity and structure that took place and the related shifts in economic opportunity for both residents and migrants.

Regional differentials in economic opportunity and their timing are important factors influencing migration. An analysis of district economic performance and migration from 1975-76 to 1991-92 bears this out. Chart 2 shows the district's migration effectiveness and the differential between national employment growth and district employment growth. Inspection shows that in years when district employment growth was above the nation's, the district tended to register effective inmigration. Conversely, when district employment growth was below the nation's, the district tended to post solidly effective outmigration.[11] Therefore, differences in economic opportunity between the district and the rest of the nation appear to have been closely

associated with the migration patterns of district states throughout the 1975-92 period.

Averages of district economic performance obscure some significant differences between district states. The greatest differences were between the district's mountain and energy states (Wyoming, Colorado, New Mexico, and Oklahoma) and the remaining states (Kansas, Missouri, and Nebraska). Events in the four mountain and energy states accounted for most of the overall swings in the district's average economic performance over the whole period. For example, the slowdown in district economic activity from the late 1970s to the late 1980s was substantially greater in the mountain and energy states than in the other states. Moreover, the mountain and energy states tended not to participate in the national economic downturns of 1980 and 1982 but experienced their own declines later in the decade. The other district states did take part in the national recessions of the early 1980s, however, and then generally maintained their growth through the decade. These state-by-state differences in economic performance were generally reflected in the migration patterns of the individual states.

WHO MOVED TO AND FROM THE DISTRICT?

The district's major swings in migration flows are important by themselves, but even more important may be the question of who was moving. Migration research has shown that migrant numbers often conceal much that is important about migration (Greenwood). Even with little or no population redistribution (that is, when migration effectiveness is zero or low), migration can still influence a region's economy by altering the composition of its population. Put another way, the characteristics of people moving out may be very different from those moving in.

An examination of migration data for the district reveals a troublesome trend. In the second half of the 1980s many states in the district suffered a "brain drain"—a net outflow of highly educated workers, those with college or more advanced degrees. Educational attainment is a crucial migration characteristic because human resources are one of the most important assets to a region's long-run economic growth. Moreover, states spend a sizable part of their resources in making higher education available to their residents and the return on this investment from a state's viewpoint depends on where its young people choose to live. Migration research shows that more educated and skilled members of the labor force are more likely to migrate because they typically have information about and participate in labor markets that extend well beyond regional boundaries (Greenwood and others; Gabriel and others). Thus, district states face a considerable challenge should current migration trends continue.

A brain drain from the district

An analysis of district migration flows from 1985 to 1990 reveals a marked brain drain from most district states. Six of seven district states suffered brain drains in degrees ranging from substantial to moderate (Table 2).[12] This, of course, was a period when the district economy was performing poorly relative to the nation, and one in which most district states experienced substantial net outmigration.

Nebraska and Missouri experienced substantial brain drains, but within different contexts. Nebraska had a large overall net outmigration, spread across all age groups and all education levels. Of the state's net outmigrants from 1985 to 1990, 54 percent were college graduates or advanced degree holders. Making matters worse, Nebraska's brain drain was more evident among persons younger than 45 than among those age 45 and older. Missouri, on the other hand, had net inmigration overall throughout the period but suffered a substantial net outmigration of college graduates and advanced degree holders. Thus, Missouri was gaining migrants with high school diplomas or even less

Table 2

Net Migration in Tenth District States by Educational Attainment, 1985-90

(25 years and over)

Migrants	Colorado	Kansas	Missouri	Nebraska	New Mexico	Oklahoma	Wyoming
Total	(51,255)	(24,176)	17,165	(24,055)	2,288	(83,277)	(37,528)
HS grad or less	(22,319)	(9,761)	21,653	(4,079)	(2,463)	(22,632)	(16,732)
Some college	(13,765)	(8,355)	7,708	(6,970)	(215)	(26,220)	(12,165)
Bachelors degree	(11,914)	(3,998)	(6,126)	(7,597)	1,525	(23,610)	(5,574)
Advanced degree	(3,257)	(2,062)	(6,070)	(5,409)	3,441	(10,815)	(3,057)

Note: Educational attainment in 1990.

Source: U.S. Bureau of the Census.

schooling while losing highly educated people. This pattern held true across all age groups.

Four other district states experienced brain drains, though to a lesser extent than Nebraska and Missouri. Oklahoma's brain drain was the largest of the four relative to overall net outmigration. Oklahoma also had the largest absolute number of net outmigrants with bachelor's degrees and advanced degrees of any district state. As a share of total net outmigration, net outflow of college graduates and holders of advanced degrees was smallest in Colorado, Kansas, and Wyoming. It was still significant, however, ranging from 23 percent for Wyoming to 30 percent for Colorado.

Though six states suffered brain drains, one district state benefited from a "brain gain." New Mexico had a net inflow of highly educated persons during the 1985-90 period. The net inmigration of college graduates and advanced degree holders into the state more than offset a net outflow of the less educated, leaving New Mexico with a small net inmigration overall. The state recorded net inmigration of advanced degree holders in all age groups.

Migration prospects for district states

Looking ahead, a critical question for most district states is whether their brain drains will continue. The answer will depend on two factors. The first is net migration. Are the district's large aggregate net outflows of the late 1980s likely to be continued or reversed in the 1990s? The second is whether the brain drain from most district states is systemic or just tied to the overall ebb and flow of net migration.

Two pieces of information provide insight on the prospects for net migration in the district in the 1990s—estimates of net migration to date and projections of net migration for the decade. Both indicate that for most district states net migration in the 1990s is more favorable than in the 1980s. Estimates by the U.S. Bureau of the Census of actual net interstate migration for district states from 1990 to 1993 show all of them except Missouri moving from outmigration to inmigration (or to lessened outmigration) (Table 3).[13]

Similarly, Census Bureau projections also

Table 3

Net Migration, District States

State	Actual		Estimated	Projected	
	1975-80	1985-90	1990-93	1990-95	1995-2000
Colorado	128,685	(77,998)	141,777	207,000	168,000
Kansas	(12,657)	(23,450)	(10,351)	13,000	16,000
Missouri	(23,377)	28,057	15,621	8,000	27,000
Nebraska	(28,473)	(39,950)	(6,152)	15,000	13,000
New Mexico	30,080	(11,457)	33,037	55,000	48,000
Oklahoma	116,818	(127,760)	(3,178)	—	26,000
Wyoming	47,358	(56,693)	3,348	14,000	14,000

Source: U.S. Bureau of the Census.

show significant changes in net migration patterns across the district in the early 1990s compared with the late 1980s (Table 3).[14] Most district states are projected to have net inmigration from 1990 to 1995. Only Missouri is projected to have a smaller net inflow than in the late 1980s. Oklahoma is projected to have zero net migration, but that compares favorably with sizable net outmigration in the late 1980s. Net inmigration is projected for all district states in the second half of this decade.

The projections for district states are not fully consistent with the estimates of actual net migration for 1990-93. The estimates of net migration in the early 1990s seem generally consistent with the projections for the mountain states of Colorado, New Mexico, and Wyoming, and for Missouri. But the return to net inmigration projected for Kansas, Nebraska, and Oklahoma does not show up in the 1990-93 estimates, which indicate continued net outmigration from these three states in the early 1990s.[15]

Neither the estimates of net migration in the early 1990s nor the projections of interstate migration for the 1990s contain any information about the composition of the migrant flows involved. Hence they reveal nothing directly about the prospects for continued brain drains from district states. It is possible, however, to consider the potential influence of a changed aggregate migration environment on the brain drain situation by examining their relationship in the late 1970s. The district recorded strong net inmigration overall in that period, although there were significant differences between the states.

The situation may be most favorable for Colorado and New Mexico. Both states are experiencing strong net inmigration flows in the early 1990s, a trend that is likely to continue. An examination of their experience in the late 1970s shows a favorable relationship between aggregate migration and the flow of highly educated people. Nearly 40 percent of Colorado's large net inmigration in the late 1970s were highly educated persons (Table 4). Substantial net inmigration in the 1990s might again be associated with net inflows of the highly educated. And New Mexico, with amenities and a high tech

Table 4

Net Migration of the Highly Educated

Age 25 and Over in Census Year, by Educational Attainment

	1975-80			1985-90		
	Number of migrants		Percent	Number of migrants		Percent
	Total	Highly educated	Highly Educated	Total	Highly educated	Highly Educated
Colorado	62,588	24,479	39.1	(51,255)	(15,171)	(29.6)
Kansas	(18,124)	(8,077)	(44.6)	(24,176)	(6,060)	(25.1)
Missouri	(12,412)	(12,208)	(98.4)	17,165	(12,196)	(71.1)
Nebraska	(20,080)	(8,458)	(42.1)	(24,055)	(13,006)	(54.1)
New Mexico	23,684	7,204	30.4	2,288	4,966	217.0
Oklahoma	55,784	4,147	7.4	(83,277)	(34,425)	(41.3)
Wyoming	21,454	4,498	21.0	(37,528)	(8,631)	(23.0)

Note: Highly educated denotes bachelors or advanced degree.
Source: U.S. Department of Commerce.

industrial structure similar to Colorado's, may be expected to see net inmigration of highly educated persons in the 1990s as it did in both the late 1970s and 1980s.

Other district states may have less reason to expect significant improvement in their ability to retain or attract highly educated persons, barring unforeseen, notable changes in their relative economic performance or industrial structure. Kansas and Nebraska had substantial net outflows of highly educated people in the late 1970s and the late 1980s, both periods of overall net outmigration. About the same number of college graduates and advanced degree holders left Missouri in the 1980s (a period of overall net inmigration) as in the 1970s (a period of net outmigration). And while Oklahoma and Wyoming experienced massive overall net inmigration in the late 1970s, highly educated migrants made up only a small share of the total. Oklahoma's case is the more extreme. Less than 10 percent of that state's net inmigrants in the late 1970s were college graduates or advanced degree holders, but just over 40 percent of Oklahoma's net outmigrants in the late 1980s had that amount of schooling. The potential for continued brain drains in the 1990s is a worrisome prospect for these four states.

SUMMARY AND CONCLUSIONS

Interstate migration of people has been an important feature of the recent economic history of Tenth District states. From the mid-1970s to the early 1990s, district states experienced substantial swings in net migration and its effectiveness in redistributing population. A flood of net inmigrants into the district in the 1970s and early 1980s was followed by a surge of net outmigrants through the

late 1980s. These flows reflected district economic performance stronger than the nation's in the earlier period, followed by district performance weaker than the nation's in the later period. Much, but not all, of the difference in relative performances was due to boom and bust in the energy sector, with its related linkages to the rest of the economy. With the dampening of the energy cycle and a return to relatively favorable economic performance in the region, moderate net migration into the district resumed in the early 1990s.

The ebb and flow of economic opportunity in the district compared with that in the rest of the nation have provided much of the push and pull to migration. But aggregate flows of migrants—even net flows that provide population redistribution between regions—are not the whole story. The composition of migrant streams may be as, if not more, important. The net inflow or outflow of migrants with particular attributes, such as high levels of educational attainment, can have their own effects apart from the impact of overall numbers. For example, the 1985-90 period was marked by Nebraska's substantial brain drain and New Mexico's brain gain—as well as by Missouri's net outmigration of highly educated persons coincident with a net inmigration of those with less schooling.

Projections of net migration for the 1990s, as well as estimates of actual migration for 1990-93, are more positive for Colorado and New Mexico than for the other district states. However, these estimates and projections of aggregate migration reveal nothing about the composition of expected future migrant flows, including movements of highly educated people. But given the growing importance of human capital for economic development, the ability to retain and attract highly educated people is especially important to the long-run economic health of district states. Some states in the region probably face an uphill climb in this regard.

APPENDIX

Table A1

Gross and Net Migration, Tenth District States, 1975-92

	1975-76	1976-77	1978-79	1980-81	1981-82	1982-83	1983-84	1984-85
Colorado								
Gross in	144,309	156,955	170,874	167,475	178,628	149,661	149,352	140,775
Gross out	128,651	131,254	137,620	129,683	127,881	128,754	136,514	135,491
Net in	15,658	25,701	33,254	37,792	50,747	20,907	12,838	5,284
Kansas								
Gross in	89,651	88,480	86,913	87,447	83,418	77,895	83,330	78,176
Gross out	87,299	91,971	95,628	91,474	94,675	86,739	93,947	89,665
Net in	2,352	(3,491)	(8,715)	(4,027)	(11,257)	(8,844)	(10,617)	(11,489)
Missouri								
Gross in	124,178	133,355	133,835	118,459	115,441	117,936	126,061	118,614
Gross out	129,874	131,379	139,193	135,515	145,362	120,016	124,505	121,865
Net in	(5,696)	1,976	(5,358)	(17,056)	(29,921)	(2,080)	1,556	(3,251)
Nebraska								
Gross in	48,570	51,457	46,211	43,775	41,784	39,293	42,647	39,712
Gross out	52,150	57,509	57,665	50,804	51,703	48,217	50,511	52,245
Net in	(3,580)	(6,052)	(11,454)	(7,030)	(9,919)	(8,924)	(7,864)	(12,533)
New Mexico								
Gross in	67,276	69,136	71,223	71,453	75,339	70,877	70,131	65,816
Gross out	56,820	60,220	61,547	65,860	67,070	59,809	64,380	61,232
Net in	10,456	8,916	9,676	5,593	8,269	11,068	5,751	4,584
Oklahoma								
Gross in	108,605	112,991	115,951	126,404	167,438	127,929	106,,093	87,847
Gross out	90,095	93,093	98,272	94,011	89,796	103,833	115,992	112,535
Net in	18,510	19,898	17,679	32,393	77,642	24,096	(9,899)	(24,688)
Wyoming								
Gross in	33,470	36,739	40,282	43,271	42,225	29,502	25,736	25,127
Gross out	25,482	26,988	29,220	32,856	34,992	36,539	35,102	33,019
Net in	7,988	9,751	11,062	10,415	7,233	(7,037)	(9,366)	(7,892)
Tenth District								
Gross in	476,564	501,110	513,203	508,100	545,035	470,988	460,826	422,574
Gross out	430,876	426,419	467,059	450,019	452,241	441,802	478,427	472,559
Net in	45,688	74,691	46,144	58,081	92,794	29,186	(17,601)	(49,985)

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Colorado							
Gross in	138,664	133,864	117,480	120,934	130,645	136,186	149,403
Gross out	139,335	142,218	142,896	140,146	132,755	116,100	110,554
Net in	(671)	(8,354)	(25,416)	(19,212)	(2,110)	20,086	38,849
Kansas							
Gross in	78,065	79,115	76,748	74,525	76,147	73,055	77,217
Gross out	89,753	86,382	79,730	81,265	83,282	80,065	74,530
Net in	(11,688)	(7,267)	(2,982)	(6,740)	(7,135)	(7,010)	2,687
Missouri							
Gross in	121,374	123,557	116,252	115,891	119,197	110,753	110,603
Gross out	118,967	114,413	113,471	114,186	114,453	112,174	110,384
Net in	2,407	9,144	2,781	1,705	4,744	(1,421)	219
Nebraska							
Gross in	37,860	38,578	37,693	40,601	42,749	40,324	40,866
Gross out	53,653	52,068	46,271	45,704	45,446	40,940	40,799
Net in	(15,793)	(13,490)	(8,578)	(5,103)	(2,697)	(616)	67
New Mexico							
Gross in	65,898	64,010	58,024	60,224	63,298	64,996	67,195
Gross out	63,127	63,147	63,261	63,555	64,646	60,823	58,289
Net in	2,771	863	(5,237)	(3,331)	(1,348)	4,173	8,906
Oklahoma							
Gross in	84,163	74,900	71,195	77,510	83,545	84,399	86,873
Gross out	111,509	120,289	106,887	96,911	94,496	85,393	81,487
Net in	(27,346)	(45,389)	(35,692)	(19,401)	(10,951)	(994)	5,386
Wyoming							
Gross in	25,099	18,355	18,907	20,090	21,061	22,125	22,806
Gross out	33,913	38,985	30,310	27,554	25,751	22,181	21,117
Net in	(8,814)	(20,630)	(11,403)	(7,464)	(4,690)	(56)	1,689
Tenth District							
Gross in	419,699	402,485	375,974	389,832	416,064	415,590	438,861
Gross out	478,833	487,608	462,501	449,378	440,251	401,428	381,058
Net in	(59,134)	(85,123)	(86,527)	(59,546)	(24,187)	14,162	57,803

Source: Internal Revenue Service.

Chart A1

Net Migration, Tenth District States, 1975-92

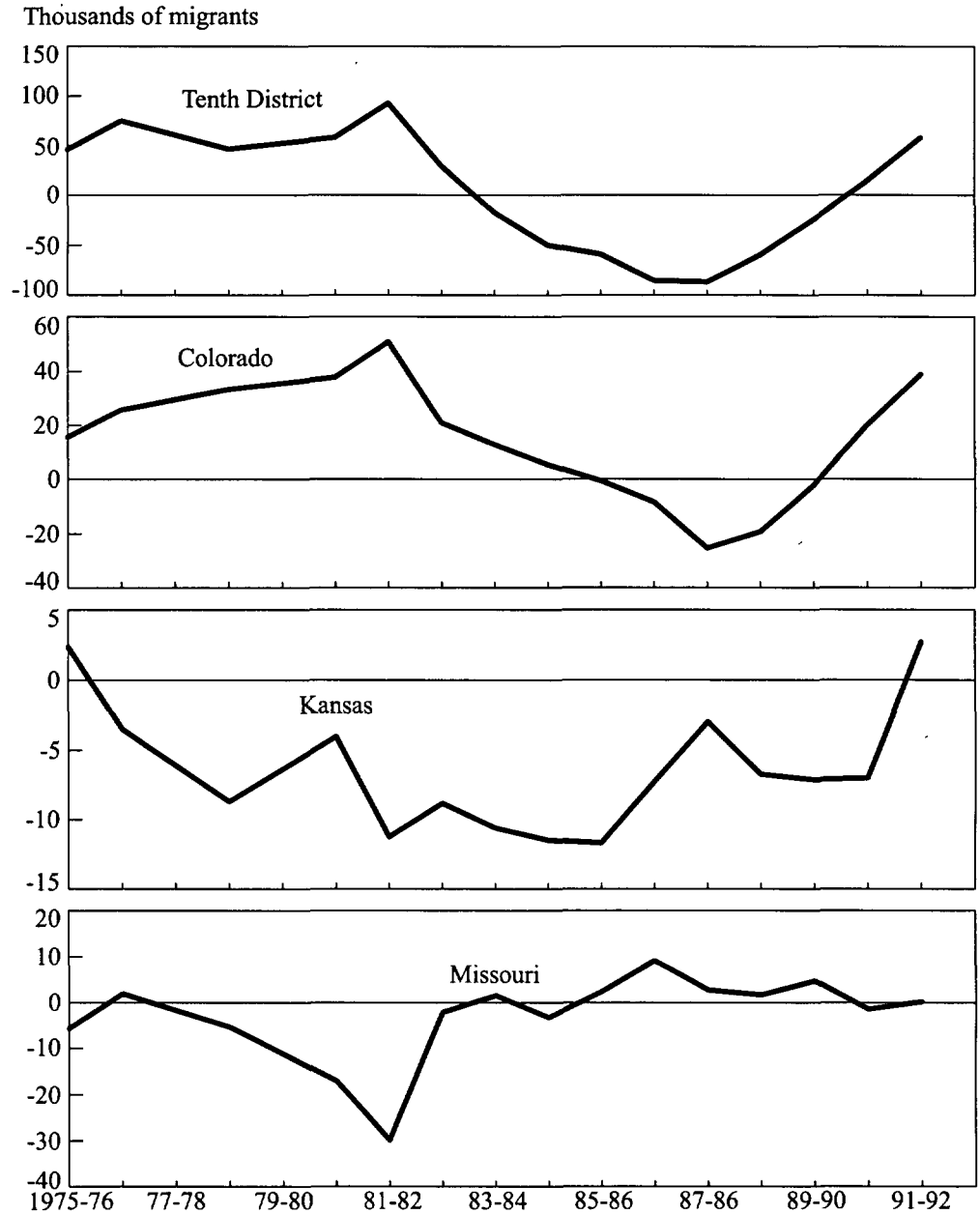
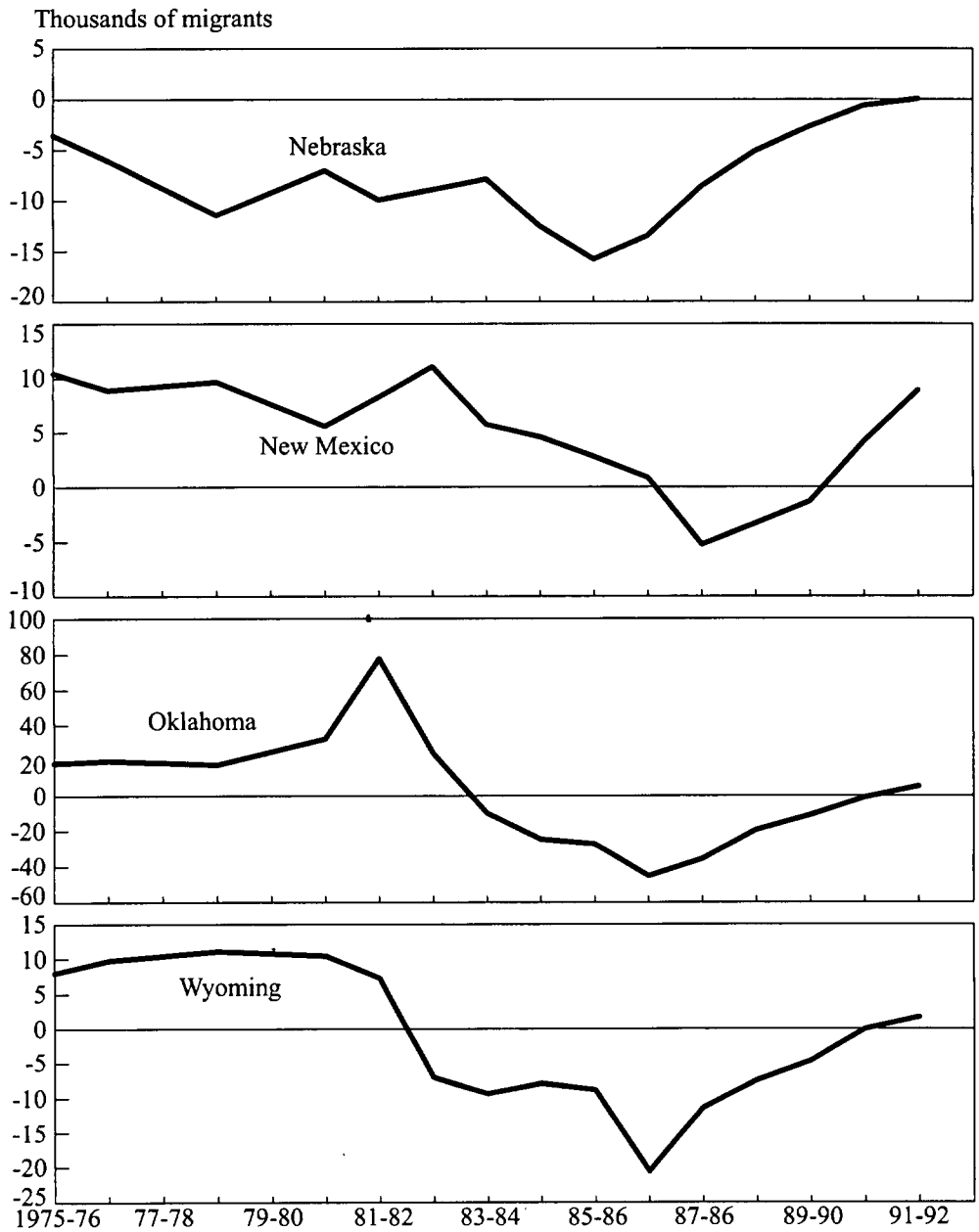


Chart A1, continued

Net Migration, Tenth District States, 1975-92



ENDNOTES

[1] "Areas of rapid growth seem certain to lose some of their gains because young and mobile in-migrants may leave the area for other promising places, or because in-migrants decide to return to their former region of residence. Areas that have been losing migrants, likewise, should receive some of their people back" (Rogerson and Plane 1985, p. 47).

[2] Economic change that stimulates inmigration generally has other effects on the local economy as well. Some of the associated new jobs will be taken by residents who were formerly unemployed or not in the labor force. And, backward and forward linkages from the industry whose growth stimulated the migration will be partly felt in the region.

[3] Internal migration data for the United States are available from several sources. The data used here are the Internal Revenue Service (IRS) annual data, which are derived from individual income tax returns. "Migration is estimated by matching individuals' returns from one year to another by Social Security number and comparing the addresses to identify movers and nonmovers" (Isserman and others, p. 287). The IRS data are valuable because they provide information on gross flows of people from state to state, on an annual basis, and with nearly total coverage of the U.S. population. The data, which include filers plus the number of exemptions claimed (except exemptions for age and blindness in order to avoid double-counting), cover more than 90 percent of the U.S. population though coverage varies from state to state. Disadvantages of the IRS data include the lack of detailed information on migrant characteristics, and possible inaccuracies arising from factors such as listed exemptions not changing residences when filers do. Nevertheless, the availability of annual data on place-to-place flows makes the IRS series valuable despite their limitations. Gaps in the series exist for the years 1977-78 and 1979-80, for which the data are not available. For a detailed review and critical assessment of five major federally-produced migration series, see Isserman and others 1982. For other discussions of the IRS data, see Engels and Healy 1981, Gabriel and others 1993, McHugh and Gober 1992, and Rogerson and Plane 1985.

[4] Appendix Table 1 shows for the Tenth District and its states how the area's net migration resulted from much larger inflows and outflows of people. It is not unusual for large numbers of people to flow into and out of a state at the same time that net migration is relatively small. Indeed, a state may have significant net losses of population by outmigration while experiencing substantial inflows of people at the same time (Engels and Healy, p. 1347). The district's total gross migration ranged from 800,000 to 1 million persons per year from the mid-1970s to the early 1990s. Thus a substantial amount of "population swapping" underlies the net migration flows recorded by all district states during the period. Use of the IRS data also allows the identification of the states of origin and destination of migrants who flowed into and out of district states, both for gross flows and for net flows. Thus interstate migration paths can be identified and their stability over time can be observed. For details on district states, see Miller 1994.

[5] Even with little or no population redistribution in the aggregate, however, migration can change the composition of populations in both origin and destination regions due to flows of particular subgroups. The migration of subgroups with different characteristics may have different consequences, at places of both origin and destination.

[6] This measure is often labeled "migration efficiency"; for example, in Plane 1984, and McHugh and Gober. "Migration effectiveness" is used here to avoid any confusion with the concept of economic efficiency. Migration effectiveness is intended to be interpreted only in demographic terms and should not be interpreted as an indicator of economic efficiency.

[7] For further discussion see McHugh and Gober, and Plane 1984. Users of the migration effectiveness measure as an analytical tool should be fully aware of the important caveat noted by McHugh and Gober: "... migration may alter the composition of the population even under the condition of overall low demographic efficiency. This is because directionality in flows among particular subgroups of the population may be masked within aggregate migration data" (p. 429). The migration of subgroups with different characteristics may have different consequences, for both origin and destination regions.

[8] While the net migration rate also shows the contribution to population change and its direction, some demographers prefer migration efficiency over the net migration rate for analysis of changing migration patterns. "Because the net migration rate is typically computed using area j's total population as the denominator, it is influenced by the entire preceding history of population change in area j. In contrast, the efficiency ratio is a function solely of current period movements" (Plane 1984, p. 296).

[9] The measure of migration effectiveness used here, called area-based effectiveness, focuses on a single state or region as the area of analysis. The migration effectiveness for a state is its total net migration (in or out) as a percent of its total inmigration and outmigration. A state's area-based migration effectiveness may range from -100 to +100 percent; a value

of zero means the number of people leaving the state just equals the number moving in. Two other measures of migration effectiveness are also widely used. The first, called system effectiveness, measures the overall demographic effectiveness of the nation's interstate migration system by showing the net interstate redistribution of population per 100 total migrants. The other, called stream effectiveness, measures the amount of net migration between specific pairs of states relative to the size of their underlying gross migration flows (McHugh and Gober, pp. 429-33).

[10] Changes in other indicators, such as gross state product, personal income, and the unemployment rate, were similar to the changes in employment.

[11] An analysis of the correlation between district migration effectiveness and regional economic differentials over the period shows that differentials in economic growth between the district and the nation are strongly related to the district's area-based migration effectiveness. For example, a large differential between national and district income growth in favor of the nation tends to be strongly associated with highly effective outmigration from the district. And a large differential in favor of district income growth tends to be strongly associated with highly effective inmigration to the district. For further discussion and presentation of the values of the correlation coefficients, see Miller 1994.

[12] Because information on migrant characteristics is not available from the IRS annual data, migration data from the 1990 census are used. These data show population flows from 1985 to 1990. As a part of each census, a sample of the population are asked where they lived five years earlier. Their responses provide the material for tabulations for each state of the number of outmigrants identified by state of destination and inmigrants identified by state of origin. Consequently, interstate gross and net migration flows can be constructed for each state for the five-year time span ending with the census date. The data can also be compiled according to several characteristics of the migrants, including age, occupation, and educational attainment.

[13] These estimates are also from the U.S. Bureau of the Census, but are not strictly comparable with the projected data. The estimates are not directly measured, but are developed as residuals in the process of estimating population. Indeed, these estimates are identified in Census Bureau publications as "residual change". The Census Bureau notes, however, that most of the residual change component is domestic (interstate) net migration. For further detail, see U.S. Department of Commerce, Bureau of the Census, *State Population Estimates by Age and Sex: 1980 to 1992*, Current Population Reports, P25-1106, November 1993, p. v.

[14] U.S. Department of Commerce, Bureau of the Census, *Population Projections for States, by Age, Sex, Race, and Hispanic Origin: 1993 to 2020*, Current Population Reports P25-1111, March 1994. The projections shown in Table 3 are from the Census Bureau's "preferred series", which projects migration using a time series model. Alternative projections are also available. For details, see pp. xxix-xxxi.

[15] The continued net outmigration from these three states in the early 1990s is more in line with an alternative set of projections also published by the Census Bureau. The alternative projections are from an economic model that relates migration primarily to employment projections from the Bureau of Economic Analysis. Both projections show movements toward increased inmigration in the early 1990s over the late 1980s for all district states except Missouri, but the preferred series uniformly shows larger movements toward increased inmigration.

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The Tenth District's Expanding Service Sector

By Tim R. Smith

The proliferation of service jobs in the nation has received much attention. While the manufacturing sector has suffered substantial job losses during the current business cycle, job growth in services has been brisk. Because the service sector comprises a diverse collection of service industries, there is considerable confusion about what kinds of jobs the service industries are creating and what factors will affect the outlook for the service sector.

In the Tenth District, service industry jobs have grown even faster than in the nation. As the service sector becomes a bigger share of the work force, its performance will increasingly influence the outlook for the region's economy. The service sector already employs more workers than any other economic sector in the district, yet little is known about the individual industries that make up this sector.

This article explores the dimensions of the district's service sector and considers the outlook for its key industries. The first section defines the service sector and establishes its importance in the region's economy. The second section reviews service industries in the district and compares the service industry profiles of the individual district states. The final section considers how the outlook for the district's key service industries, health care and business services, will be shaped by an aging population, health care reform, and technological change.

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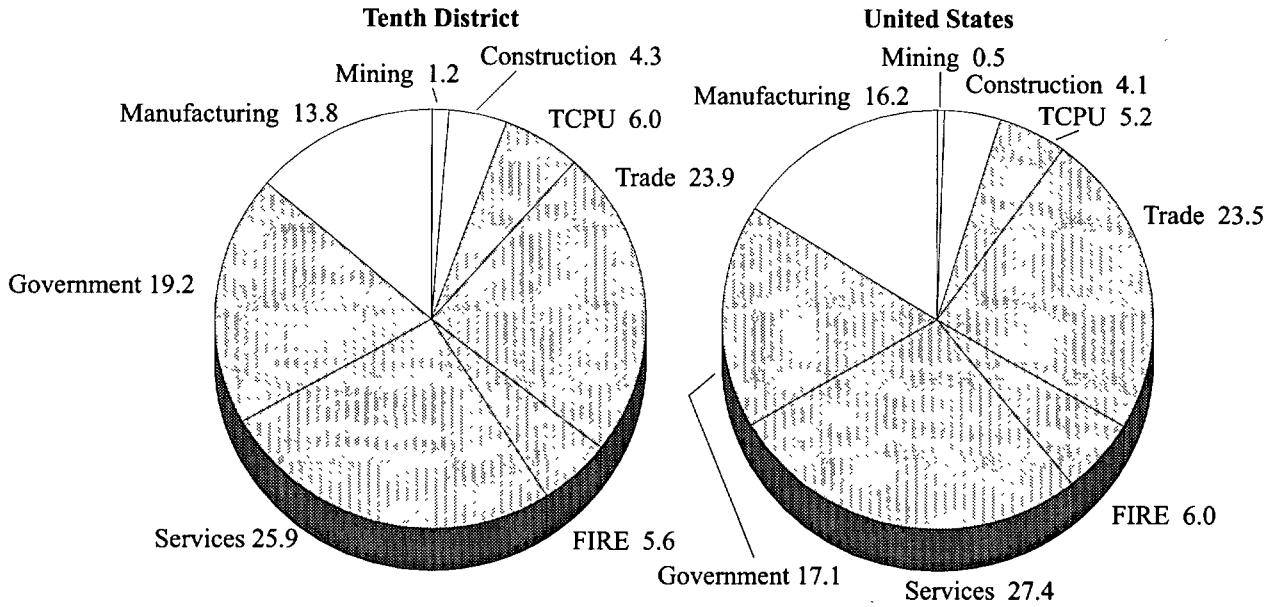
HOW IMPORTANT ARE SERVICES TO THE DISTRICT?

To understand the importance of services to the district economy it is helpful to answer three key questions: What industries make up the service sector, how big is the service sector relative to other parts of the region's economy, and how fast has the service sector been growing?[1]

What is the service sector?

There is a great deal of confusion about what the service sector is, resulting partly from the intangible nature of services. Unlike goods such as food and autos, services are intangible and usually consumed at the time they are produced. Mostly, however, the confusion stems from the fact that other sectors of the economy also provide services. Commercial banks, for instance, provide many financial services. But as an integral part of the finance sector, the Commerce Department includes these services

Chart 1
Employment Shares, 1993
Percent of total nonagricultural employment



Notes: TCPU represents transportation, communications, and public utilities. Trade represents wholesale and retail trade. FIRE represents finance, insurance, and real estate.
Source: U.S. Department of Labor.

in the finance, insurance, and real estate category of the economy. Other sectors of the economy providing services but listed as separate categories include the following: transportation, communications, and public utilities; wholesale and retail trade; and government. The major sectors of the economy are shown in Chart 1 with the shaded area indicating the service-producing sectors.

Throughout this article, the "service sector" will refer to consumer and producer service industries not classified in any of the other service-producing sectors. Bigger than any other service-producing sector, this group of industries is sometimes referred to as "narrow services" or "other services." Table 1 lists all the industries that constitute such consumer and producer services.[2] Consumer services include a broad range of major industries: hotels and other lodging places; personal services; auto repair and parking; motion pictures; amusement and recreation; health care; education; social services; and membership organizations. Producer services include business, legal, and engineering and management services.

A common fear across the nation is that high-paying manufacturing jobs are being supplanted by low-paying service jobs. However, many industries in the service sector pay high wages (Table 2). While hourly earnings in some industries such as personal services, social services, and hotels and other lodging places are well below the average for all nonagricultural jobs, earnings in such other industries as legal services, engineering and man-

Table 1
The Service Sector

Consumer services

Health services
- Offices and clinics of medical doctors
- Offices and clinics of dentists
- Offices of osteopathic physicians
- Offices of other health practitioners
- Nursing and personal care facilities
- Hospitals
- Medical and dental laboratories
- Home health care services
- Health and allied services, NEC

Social services
- Individual and family services
- Job training and related services
- Child day care services
- Residential care
- Social services, NEC

Amusement and recreation services
- Dance studios, schools, and halls
- Producers, orchestras, entertainers
- Bowling centers
- Commercial sports
- Misc. amusement, recreation services

Motion pictures
- Motion picture production and services
- Motion picture distribution and services
- Motion picture theaters
- Video tape rental

Membership organizations
- Business associations
- Professional organizations
- Labor organizations
- Civic and social associations
- Political organizations
- Religious organizations

Hotels and other lodging places
- Hotels and motels
- Rooming and boarding houses
- Camps and recreational vehicle parks
- Membership-basis organization hotels

Personal services
- Laundry, cleaning, and garment services
- Photographic studios, portrait
- Beauty shops
- Barber shops
- Shoe repair and shoeshine parlors
- Funeral service and crematories
- Miscellaneous personal services

Educational services
- Elementary and secondary schools
- Colleges and universities
- Libraries
- Vocational schools
- Schools and educational services, NEC

Auto repair, services, and parking
- Automotive rentals, no drivers
- Automobile parking
- Automotive repair shops
- Automotive services, except repair

Producer services

Business services
- Advertising
- Credit reporting and collection
- Mailing, reproduction, stenographic
- Services to buildings
- Misc. equipment rental and leasing
- Personnel supply services
- Computer and data processing services
- Miscellaneous business services
- Membership organizations, NEC

Engineering and management services
- Engineering and architecture
- Accounting, auditing, and bookkeeping
- Research and testing services
- Management and public relations

Legal services
- Legal services

NEC: Not elsewhere classified

Table 2
1993 Average Hourly Earnings, United States

Industry	Dollars per hour
Total nonagricultural	10.83
Manufacturing	11.74
Mining	14.61
Construction	14.36
Transportation and public utilities	13.63
Wholesale trade	11.73
Retail trade	7.29
Finance, insurance, and real estate	11.35
Services	10.79
Consumer services	
Health services	11.78
Social services	7.86
Amusement and recreational services, including motion pictures	8.43
Membership organizations*	14.95
Hotels and other lodging places	7.57
Personal services**	7.51
Educational services	n.a.
Auto repair, services, and parking	9.33
Producer services	
Business services	10.13
Engineering and management services	15.01
Legal services	15.22

* Professional organizations
** Miscellaneous personal services
Source: U.S. Department of Labor.

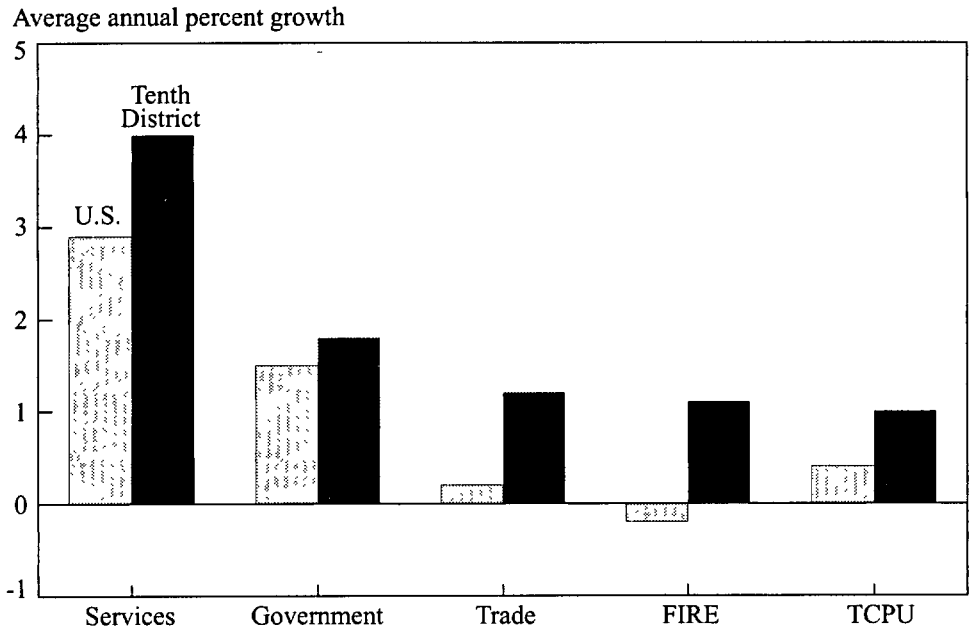
agement services, and membership organizations are far above average. Moreover, hourly earnings in these service industries exceed earnings in manufacturing and even exceed earnings in the high-paying construction and mining sectors.[3]

How big is the service sector?

The service sector employs more workers than any other economic sector in the district. Although accounting for a slightly smaller share of employment in the district than in the nation, the service sector employs about 26 percent of the region's work force (Chart 1). Moreover, the service sector generates the largest share of earnings in the region, accounting for 22.8 percent of total non-farm wages and salaries in 1992, the most recent year for which data are available.[4]

The importance of services varies only moderately across individual district states. Colorado has the highest concentration of service jobs at 28 percent of the state's work force. The shares of employment accounted for by services in Missouri and

Chart 2
Employment Growth in Service-Producing Sectors
1989-93



Note: See note for Chart 1.
Source: U.S. Department of Labor.

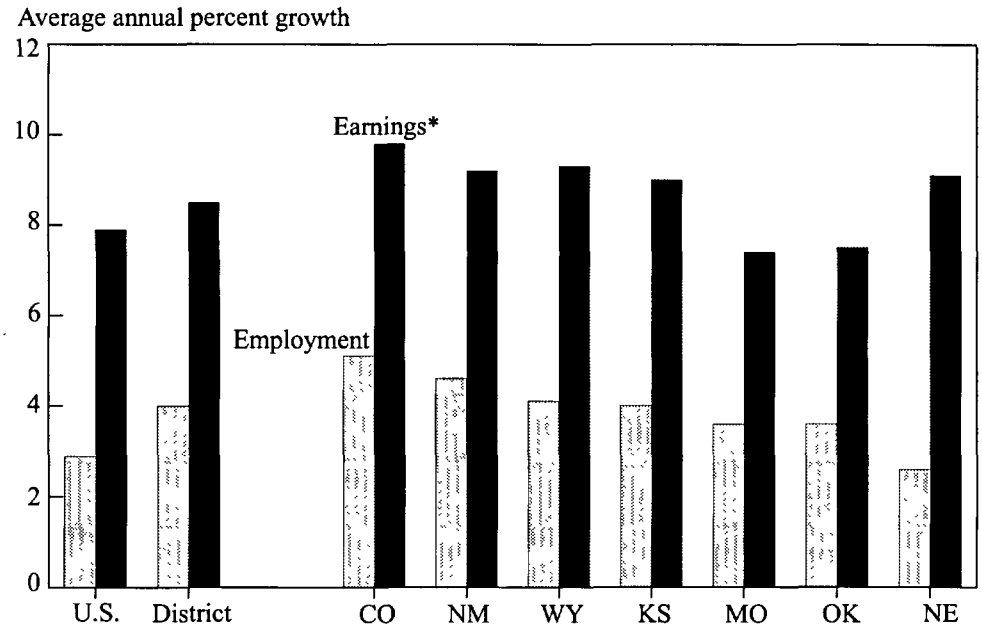
New Mexico are slightly above the district average of 26 percent, while the shares in Kansas, Nebraska, and Oklahoma are slightly below the district average. Wyoming, heavily dependent on its natural resources, has the lowest concentration of service jobs with only 20 percent of its work force employed in service businesses. The share of wage and salary earnings accounted for by services varies somewhat more across states, but the ranking is nearly the same.

How fast is the service sector growing?

Not only is the service sector a major force in the district economy, but it has also been a rapidly growing force during the current business cycle. The period from 1989 to 1993 provides a good time frame for measuring recent growth in the service sector because it captures both the recession and expansion phases of the business cycle. The service sector has been outpacing all of the other service-producing sectors, posting annual job growth of 4 percent from 1989 to 1993 (Chart 2).[5] Moreover, the Tenth District's service sector has been adding jobs at a faster pace than the nation. Growth in wage and salary earnings has also been particularly strong.[6]

Such rapid growth has caused the service sector to gain an increasing share of the region's economic activity. Services' share of total employment grew from 23.8 percent in 1989 to 25.9 percent in 1993. The share of earnings generated by the

Chart 3
Employment and Earnings Growth in Services
1989-93



* Earnings growth for period 1989-92.
Source: U.S. Department of Labor and U.S. Department of Commerce.

service sector grew from 21.0 in 1989 to 22.8 percent in 1993.[7]

Growth in services has been strong in all district states. Both service employment growth and earnings growth have been strongest in the mountain states (Chart 3). In Colorado, service jobs expanded 5.1 percent per year from 1989 to 1993, while earnings expanded almost 10 percent per year. Service employment and income growth in New Mexico, Wyoming, and Kansas followed closely behind. The service sectors in Missouri and Oklahoma recorded income and earnings growth slightly below the district averages, while Nebraska posted strong income growth but below-average employment growth.

A PROFILE OF THE DISTRICT'S SERVICE SECTOR

An important step in forming an outlook for the service sector is to identify which industries are most vital to the region's economy. While it is no secret that the service sector is large and growing overall, its mix of individual industries is not well understood.

The district's key service industries

One way to measure the importance of an industry within the service sector is to look at its share of employment. This measure is especially

Table 3
Service Industry Mix and Growth in the Tenth District

Industry	Employment shares, 1993 (percent of services)		Employment growth (Average annual rate, 1989-93)	
	U.S.	District	U.S.	District
Services	100.0	100.0	2.9	4.0
Consumer services	65.8	64.9*	3.1	3.6*
Health services	29.4	30.0*	4.4	4.1*
Social services	6.9	6.9*	5.9	8.5*
Amusement and recreational services, including motion pictures	5.3	5.6*	3.3	4.0*
Membership organizations	6.5	5.5*	1.7	1.8*
Hotels and other lodging places	5.2	5.4*	-.3	.6*
Personal services	3.7	4.1*	.5	1.5*
Educational services	5.8	3.9*	1.5	1.9*
Auto repair, services, and parking	3.1	3.5*	1.2	2.3*
Producer services	30.5	28.9*	2.9	4.4*
Business services	19.0	18.6*	3.9	5.4*
Engineering and management services	8.4	7.6*	1.4	3.1*
Legal services	3.1	2.6*	1.4	.8*
Other	3.7	6.3*	-.1	6.7*

* Estimates are derived from ES-202 data.
Note: Totals may not add up to 100 due to rounding.

appropriate given the rising concern about the effect of rapid growth of service jobs on the region's economy.

As in the nation, two key industries account for most of the jobs in the district's narrow service sector (Table 3).[8] Health services account for 30 percent of the region's service jobs, ranking highest among service industries. Business services make up the second largest service industry and account for nearly 19 percent of the district's service jobs. The other nine service industries in the sector are much less important, each with employment shares of less than 10 percent.

Health and business services are both broad industry categories encompassing large numbers of diverse activities (Table 1). Health services include medical and dental offices; nursing and personal care facilities; hospitals; home health care services; and several related industries. Business services include advertising; mailing, reproduction, and stenographic services; building maintenance; equipment leasing; personnel supply services; and computer and data processing services (which include

programming, prepackaged software, systems design, data processing, information retrieval, and computer maintenance and repair).

Not only are the health and business services industries big, they are also among the fastest-growing industries of the sector (Table 3). Employment in business services grew 5.4 percent annually from 1989 to 1993, the second-fastest pace among district service industries.[9] And health services, the district's largest service industry, grew at the third-fastest pace of 4.1 percent.

The mix of service industries in district states

The mix of service industries differs little across the individual district states. Table 4 shows the share of employment held by each of the 11 main service industries in each district state. In terms of employment, the health services industry is the largest service industry in all seven district states. The second largest industry in most district states is business services.

In New Mexico, the second largest share of employment is accounted for by engineering and management services. This category is large because it includes research organizations and testing laboratories—service businesses that receive a considerable volume of contracts from the state's Sandia and Los Alamos national laboratories.

In Wyoming, hotels and other lodging places account for a larger share of employment than business services. This category is large because of the state's important tourism industry, which draws on the popularity of Yellowstone and Teton National Parks and mountain skiing.

In Colorado, as in the other mountain states in the region, the share of service jobs in hotels and other lodging places is higher than the district average. Colorado's share of service jobs in engineering and management services is also larger than average, probably due to its concentration of high-technology manufacturing.

THE OUTLOOK FOR THE DISTRICT'S SERVICE SECTOR

Since the profile of the district's service sector closely matches that of the nation, the outlook for the service sector in the district is likely to resemble that of the nation. Moreover, with a similar service sector profile across district states, the outlook is similar from state to state. In all cases, health and business services are likely to be the driving forces behind prospective growth in the service sector.

There is little to suggest that the rapid growth in the district's service sector will diminish. As the nation's economic expansion proceeds, growth in the region and the nation will boost demand for services by both consumers and producers.[10] Moreover, the region's two biggest service industries, health and business services, have solid outlooks.[11]

The outlook for health services

Two factors promise to help keep the health services industry one of the fastest-growing service industries. First, the number of elderly continues to grow. Second, health care reform appears to be on the horizon. As a result, possible extension of health care benefits to a larger share of the population may stimulate growth of health services.

The elderly are a group of intensive consumers of health services whose numbers are increasing for two reasons. First, larger numbers of the population are entering this cohort. Second, those already among the ranks of the elderly are living longer. The share of the population aged 75 years or more has already increased and is expected to continue increasing modestly over the next ten years.[12] Moreover, the share of the population accounted for by this age group is larger in the district than in the nation. These factors should add momentum to the expansion of home care services, the fastest growing component of the health services industry (U.S. Department of Commerce). Also expected to grow are nursing and personal care facilities.

Table 4

Service Industry Mix in the Tenth District

(percent of services)

Industry	U.S.	District	Colorado	Kansas	Missouri	Nebraska	New Mexico	Oklahoma	Wyoming
Services	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Consumer services	65.8	64.9*	59.5*	66.9*	72.1	59.0*	61.7*	59.9*	75.0*
Health services	29.4	30.0*	23.5	37.0*	33.4	31.3	24.8	30.2*	20.4
Social services	6.9	6.9*	5.7	7.4*	6.9	6.2	8.0	7.6*	10.1
Amusement and recreational services, including motion pictures	5.3	5.6*	8.0	5.0*	5.3	3.1	4.0*	5.2*	7.1
Membership organizations	6.5	5.5*	5.2	3.4*	7.8	4.9	7.1	2.3*	8.1*
Hotels and other lodging places	5.2	5.4*	7.1	3.9*	4.7	3.8	7.6	3.3*	18.9
Personal services	3.7	4.1*	3.7	4.8*	4.1	4.2**	3.4	4.0*	4.3
Educational services	5.8	3.9*	3.0	2.4*	6.6	.4	3.9	3.5	.6*
Auto repair, services, and parking	3.1	3.5*	3.2*	3.2*	3.3	5.1	2.9*	3.9*	5.5
Producer services	30.5	28.9*	36.4	29.6*	24.9	32.3	33.9	26.2*	19.4
Business services	19.0	18.6*	23.0	18.4*	16.7	23.5	15.2	16.3*	10.7
Engineering and management services	8.4	7.6*	10.6	8.8*	5.9	6.7	15.8	6.9*	6.1
Legal services	3.1	2.6*	2.9	2.5*	2.4	2.1	2.9	3.0*	2.6
Other	3.7	6.3*	4.1	3.4*	3.0	8.7	4.4	13.9*	5.7

* Estimates are derived from ES-202 data.

** Estimate are derived from ES-202 data and does not include colleges and universities.

Note: Totals may not add up to 100 due to rounding.

Source: U.S. Department of Labor, Kansas Department of Human Resources, and Oklahoma Employment Security Commission.

Health care reform may give another shot in the arm to the region's largest service industry. While it is too early to tell the precise shape of health care reform legislation, benefits are likely to be extended to a larger share of the population. With a bigger base of health care consumers, the size of the health services industry is expected to grow considerably. Mounting pressure to reduce the cost of extending benefits to more people may favor health care delivery systems, such as home care and managed care (health maintenance and preferred provider organizations). Already, employers and private insurers have expanded the use of managed care networks in an effort to contain health care costs.

The outlook for business services

The other force behind an expanding service sector will be rapid growth in business services. This growth will stem from two sources. First, restructuring in the manufacturing sector will continue to cause production activities to be decoupled from related service activities. As a result of this decoupling, or "vertical disintegration," services once provided in house are increasingly purchased from outside vendors. Second, innovations in service provision are giving rise to entirely new services in the marketplace.[13]

The most common explanation offered for continuing rapid growth in business services and other producer services is the "outsourcing" explanation. This explanation holds that as manufacturers restructure to reduce costs, they take advantage of scale economies in business services by purchasing these functions from firms that specialize in service production, instead of providing them in house. For example, a manufacturer may reduce costs by purchasing accounting services from a firm that specializes in accounting, eliminating the need for the manufacturer to maintain its own accounting department.

In addition to slashing costs by exploiting scale economies of specialized service firms, a shift to flexible manufacturing may also stimulate demand for services provided from outside service providers (Coffey and Bailly). Over the past decade, many manufacturers have moved from large "batch" processes to smaller "flexible" processes to satisfy rapidly changing market demands. As a result, service requirements of manufacturers are becoming more complex and costly to supply in house. Thus, many manufacturers are turning to outside service vendors.

The growth in business services from outsourcing will probably lose some of its momentum as the restructuring of the manufacturing sector becomes more complete. As this happens, innovation-based growth in business services promises to sustain solid employment gains in this important producer service industry. A good example of innovation-based growth in business services is the packaged computer software industry. A large and vital service industry has sprouted around development of software to help businesses perform a wide variety of functions, such as word processing and data management.

Ongoing developments in information technology will no doubt continue to fuel development of new ways of conducting business and new types of business services. Additional developments in packaged software, multimedia products, artificial intelligence, and computer-aided design, manufacturing, and engineering are expected to drive growth in business services in the years ahead (Department of Commerce).

SUMMARY AND CONCLUSIONS

The service sector provides more jobs in the Tenth District than any other economic sector. The sector comprises a large and complex collection of industries, and the distribution of these industries is much the same in the nation, the district, and individual district states. Two industries dominate the service sector. Health care and business services account for the lion's share of service jobs and have

been the fastest-growing service industries during the current business cycle.

Continued growth in the regional and national economies is expected to sustain growth in service employment in the short term. In the long term, several developments in the two most important service industries are likely to ensure continued growth. An aging population and extension of health care benefits to a larger share of the population point toward a rapid pace of growth in health services jobs in the years ahead. Additional restructuring of manufacturing firms and innovations in information technology will help boost job growth in business services.

Despite fears of a proliferation of low-paying service jobs, earnings growth in the service sector should remain strong. Jobs in health and business services are among the highest-paying service jobs. Moreover, many of these service jobs pay as much as manufacturing jobs.

Continued growth in its single largest sector bodes well for the district economy. The economic benefits of an expanding service sector will be enhanced by the prospect of selling services to buyers outside the district. Exports of services to customers outside the region are important because they provide a net increase in income to the region and generate additional economic activity within the region when the income is spent. Although most health services are consumed by local residents, the health care industry has some modest potential for exporting services to other regions either by attracting patients from outside the district or by exporting medical technology developed within the district. The prospects for the district economy are particularly enhanced by the favorable outlook for business services. These producer services have great potential to be exported to customers in other regions.

ENDNOTES

[1] The Tenth District comprises Colorado, Kansas, Nebraska, Oklahoma, Wyoming, western Missouri, and northern New Mexico. Because most of the employment and earnings data used in this article are available only at the state level, this article looks at the region comprising the seven district states (often referred to as the district or the region in this article) instead of the slightly smaller region defined by the Tenth District boundaries.

[2] Assignment of industries to consumer services and producer services differs from study to study. For example, some analysts exclude legal services from producer services because a significant number of these services are purchased by consumers.

[3] Some recent studies have even suggested that regions would enhance their growth prospects by emphasizing services instead of manufacturing in their economic development strategies (Smith and Fox, Testa, Schmidt).

[4] By contrast, the manufacturing sector accounted for only 17.1 percent of earnings in 1992.

[5] The employment data used in this article count the number of service jobs and, therefore, are not adjusted for part-time employment. To the extent that recent cost-cutting measures by manufacturing and service companies have increased the number of part-time jobs, the impact of job growth on the region's economy will be diluted even if the growth occurs in high-wage industries.

[6] In addition to strong employment growth, the narrow service sector has had the strongest income growth among the service-producing sectors, with total non-farm wage and salary earnings advancing at an annual rate of 8.5 percent between 1989 and 1992. (The most recent year for which earnings data are available is 1992.)

[7] In the nation, the share of employment accounted for by the service sector increased from 24.9 percent in 1989 to 27.4 percent in 1993. Because the overall district economy was growing faster than the national economy during this period, the increase in the relative size of the district's service sector, in terms of both employment and earnings, was slightly smaller than in the nation.

[8] This section uses three-digit employment data to describe the reliance of district states on various service industries. In some cases, where data were unavailable from the U.S. Department of Labor source, estimates were made using ES-202 establishment data obtained from state reporting agencies. Although uniform data were available for most

states and industries, the profile of the district's service industries presented in this article should be viewed as an approximation based on limited data due to the inclusion of estimates for some states and industries.

9 Although the social services industry—which includes job training and day care—added jobs at a faster pace between 1989 an 1993, this industry accounts for only about 7 percent of total service jobs.

10 Although this article focuses on the recent growth in the service sector during the current business cycle, the expansion of the service sector is not a new phenomenon. The service sector's share of employment more than doubled over the past 30 years. Thus, the service sector dominates the labor force in the 1990s, while manufacturing dominated the labor force in the 1960s. This longer term shift from manufacturing jobs to service jobs has been attributed by some analysts to productivity growth in manufacturing (Beeson and Bryan, Groshen). Just as increased productivity in agriculture led to a shift toward consumption and employment in manufacturing during the early part of this century, an increase in manufacturing productivity has made the population more affluent and shifted consumption and employment toward services.

11 The discussion of the outlook for the district's key service industries is based in part on the U.S. Department of Commerce outlook for these industries (U.S. Department of Commerce).

12 The share of the district's population aged 75 and over increased from 4.8 percent in 1980 to 5.7 percent in 1993 and is projected by the U.S. Department of Commerce to increase to 6.3 percent by the year 2005.

13 Other factors such as transaction costs or increased government regulation may also affect the growth of producer services. See Beyers and Lindahl for a complete discussion of the factors favoring growth in producer services.

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The Rise of U.S. Exports to East Asia And Latin America

By Timothy J. Schmidt

Exports have become an increasingly important source of revenue for both national and regional firms in the United States. U.S. exports are rising rapidly, especially from the Midwest.[1] As a result, national and district firms must be ever more attentive to changes in U.S. export markets. One such change is the rapid growth of U.S. export markets in the developing nations of East Asia and Latin America.

This article analyzes current trends in the geographic distribution of U.S. exports and identifies the primary growth markets for U.S. exports in the years ahead. The analysis suggests the developing nations in East Asia and Latin America will soon rival today's industrialized nations as the most important U.S. trading partners. This finding presents U.S. firms with a significant challenge. To take advantage of these growing markets, U.S. firms must establish new distribution networks, learn foreign regulations and customs, and train sales personnel in these developing geographic regions. Because such tasks require commitments of time and investment, firms must be able to forecast where the future demand for U.S. exports will be concentrated.

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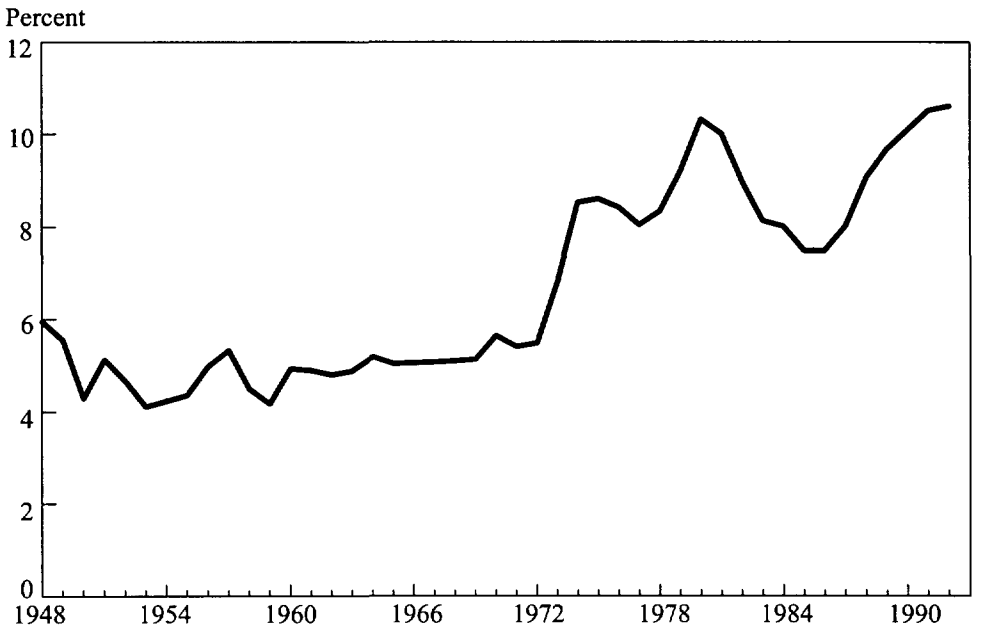
The first section of this article gives an overview of the rapid growth of U.S. exports and their geographic shift toward developing nations. To assess the prospects for U.S. export growth in developed and developing nations, the second section analyzes recent trends and uses a statistical model to predict future U.S. export patterns.

RECENT TRENDS IN U.S. EXPORTS

Two trends in recent U.S. export performance are particularly notable. First, U.S. exports have increased rapidly relative to total U.S. output—a development with important implications for the entire economy. Approximately 130,000 U.S. firms, employing over 10 million domestic workers, export their products (U.S. Bureau of the Census). Second, the geographic distribution of U.S. exports has been shifting dramatically. The industrialized nations of the Organization for Economic Cooperation and Development (OECD) account for about 57 percent of all U.S. exports. However, in recent years the share of U.S. exports to major trading partners in East Asia and Latin America has been rising and now accounts for 26 percent of the total.[2] Thus, economic policymakers can no longer make trade-related decisions without considering their effect on U.S. exports to East Asia and Latin America.[3]

Chart 1
U.S. Exports
Share of GDP



Source: Author's calculations. Data from International Monetary Fund.

The growth in U.S. exports

Exports have not always been vital to the U.S. economy. For more than 20 years after World War II, U.S. exports remained a relatively fixed share of total U.S. output (Chart 1). U.S. export growth was slow to develop after the war because many of the world's industrialized countries, our traditional trading partners, found their economic and trading relationships severely disrupted by the war. The upheaval disrupted income growth in these countries and restrained U.S. exports. However, U.S. export volume began a substantial upward trend in the early 1970s. This trend was interrupted from 1981 to 1987 when the dollar appreciated significantly and the international debt crisis suppressed foreign demand for U.S. goods. More recently, U.S. exports have resumed their rise and are now playing a larger role in the domestic economy.

1973-81. U.S. exports began to swell in 1973 after the breakdown of the Bretton Woods system of fixed exchange rates. Completed in 1944 as the basis for a postwar system of international finance, the Bretton Woods agreement required its signatory countries to fix their exchange rates around a par value. The U.S. dollar was pegged to gold at $35 per ounce. However, during the 1960s and early 1970s, U.S. economic policy became inconsistent

Table 1

GATT Negotiating Rounds

Round	Starting date of round	Number of countries	Value of trade covered (billions of U.S. dollars)
Geneva	1947	23	10
Annecy	1949	33	NA
Torquay	1950	34	NA
Geneva	1956	22	2.5
Dillon	1961	45	4.9
Kennedy	1964	48	40
Tokyo	1973	99	155
Uruguay	1986	117	755

NA: not available.
Source: Bhagwati; General Agreement on Tariffs and Trade.

with the commitment to maintain a fixed exchange rate at the predetermined par value. As a result, the U.S. dollar became significantly overvalued relative to key foreign currencies.[4] The United States and other nations were finally unable to sustain exchange market intervention to maintain the par values of their currencies and in 1973 allowed exchange rates to float. As the U.S. dollar depreciated, the foreign price of U.S. exports fell and the demand for U.S. goods abroad began to accelerate.

Another significant stimulus to U.S. export growth since the early 1970s has been trade liberalization.[5] Trade protection has generally diminished since the 1930s when high tariffs, epitomized by the infamous Smoot-Hawley Act, stifled world trade and output.[6] The movement toward trade liberalization finally gained strong momentum in 1973 with the Tokyo Round of the General Agreement on Tariffs and Trade, or GATT. Although six GATT negotiating rounds preceded it, the Tokyo Round encompassed more than twice the number of countries and almost four times as much trade as the largest prior round (Table 1). More recently, many developing nations have joined the GATT and lowered their barriers against U.S. exports. GATT membership has grown from an original 23 signatory countries in 1947 to more than 100, over two-thirds of which are developing countries (General Agreement on Tariffs and Trade).

1981-87. Two factors temporarily stemmed the rising tide of U.S. exports during the early to mid-1980s. First, the U.S. dollar began to appreciate significantly in 1981 as the United States enacted a restrictive monetary policy and an expansionary fiscal policy.[7] From 1981 to 1985, the dollar rose almost 50 percent, thus making U.S. exports more expensive relative to foreign goods (Hakkio and Whittaker). Second, the international debt crisis culminated in 1982 when Mexico announced a moratorium on its debt payments to commercial

creditors. The debt crisis dramatically reduced income in many developing countries, especially Latin America, thereby paring the demand for U.S. exports.

1987-92. U.S. exports resumed their upward trend in the late 1980s and early 1990s. The dollar depreciated substantially after the major industrialized nations agreed to coordinate their economic policies in the Plaza Agreement of 1985 and the Louvre Accord of 1987. In the Latin American debtor countries, policy reforms stabilized financial conditions and per capita income growth began to recover in 1987 (Edwards 1994). As a result, U.S. exports to Latin America more than doubled from 1987 to 1992.

The geographic shift in U.S. exports

As total U.S. exports have been growing, the geographic distribution of U.S. exports has been shifting dramatically toward certain regions of developing nations. At the vanguard of this shift was East Asia. Rapid income growth and increased trade liberalization have transformed the developing nations of East Asia into a dynamic market for U.S. exports. The successful development of East Asia has influenced other developing countries, most notably in Latin America, to adopt similar policies for economic growth (Schadler). As a result, the developing nations of Latin America have also become important markets for U.S. exports.

The traditional U.S. trading partners are the industrialized countries of the OECD, but the developing countries of East Asia and Latin America are closing the gap. From 1973 to 1992, real U.S. exports to the OECD slightly more than doubled, increasing 4.5 percent annually (Chart 2). During the same period, U.S. exports to East Asia increased four and a half fold, or 8.4 percent annually. Meanwhile, U.S. exports to Latin America rose threefold, or 6.0 percent annually.

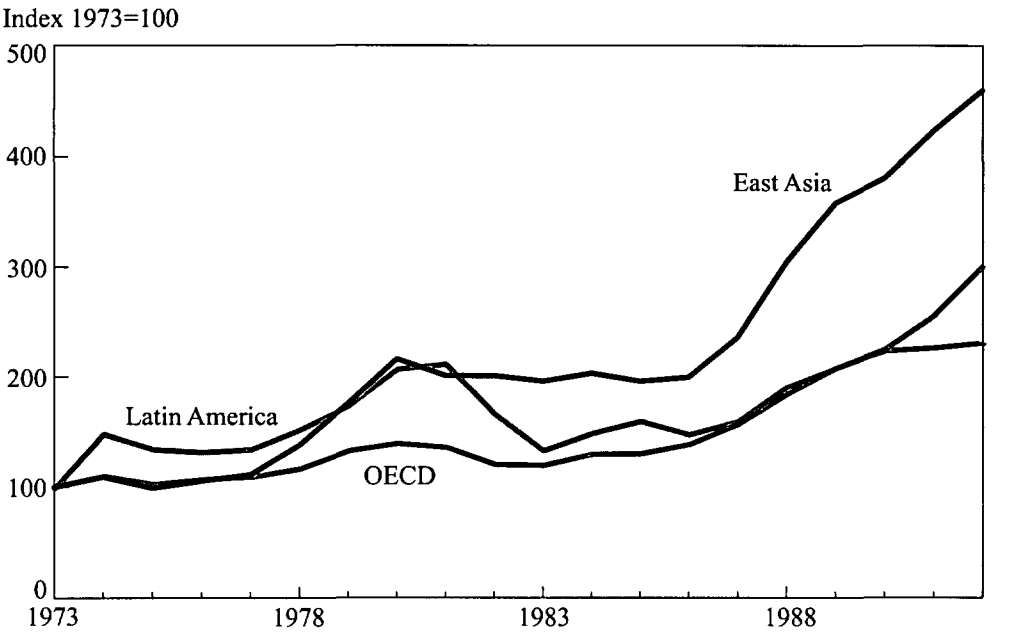
As a result, the share of U.S. exports to East Asia and Latin America has increased relative to the OECD share. In 1992, U.S. exports to East Asia and Latin America accounted for 26.1 percent of total U.S. exports, about half of the OECD's 57.2 percent share. However, the share of U.S. exports to East Asia and Latin America has increased substantially in recent years, while the share to the OECD has actually fallen. From 1973 to 1992, the share of U.S. exports to the OECD shrank 4.6 percentage points, while the share of U.S. exports to East Asia and Latin America swelled 8.1 percentage points. The developing country share would have risen even more if U.S. exports to Latin America and East Asia had not been temporarily depressed by the debt crisis.

In the absence of such external shocks, the demand for U.S. exports is determined by fundamental economic factors. Three factors have been instrumental in expanding the share of U.S. goods exported to developing countries in East Asia and Latin America. First, rapid per capita income growth in these developing nations has made U.S. exports more affordable. Second, strong population growth in East Asia and Latin America has expanded market size by increasing the number of consumers. Third, trade liberalization has enlarged U.S. export markets in East Asia and Latin America by creating or increasing access to previously restricted market segments.

Per capita income growth. A nation can increase its aggregate income in two ways—either by increasing the amount of output per person (productivity growth) or by increasing the number of people (population growth). Both sources of growth are important factors in determining overall market size for U.S. exports. However, real per capita income growth is the basis for long-term improvement in a nation's standard of living. In this context, real per capita income is defined to be real GDP per person.

Real per capita income growth in East Asia has been unprecedented by historical standards. For example, during the industrial revolution of the 19th century, Great Britain and the United States paced the world with annual per capita income growth rates of 1.3 and 1.7 percent, respectively, from 1820 to 1913 (Maddison). At that rate of growth, the

Chart 2
Growth of U.S. Exports to Selected Trading Partners
Constant 1987 dollars



Source: Author's calculations. Data from International Monetary Fund 1994.

United States and Great Britain doubled their levels of GDP per capita in an average of 50 years. In contrast, today's leading developing economies in East Asia commonly register annual real income growth rates of 6 to 7 percent. Such rates allowed South Korea to double its GDP per capita in only 11 years, from 1966 to 1977.

Growth in per capita income has consistently been the most important source of aggregate real income growth in East Asia (Table 2). From 1973 to 1981, real per capita income grew 5.5 percent annually in East Asia, almost three times the comparable rate in the OECD. In recent years, East Asia's real per capita income growth has slowed only marginally and remains more than double the OECD rate. As a result, several developing nations in East Asia have already surpassed some members of the OECD in their level of real per capita GDP.[8] For example, real per capita GDP is now higher in Hong Kong than in 14 OECD countries.

One of the most important elements in promoting long-term per capita income growth is a high rate of domestic investment.[9] A high rate of investment permits an economy to accumulate additional capital and increase its capital-to-labor ratio.[10] The more productive capital that each worker employs, the more output that worker can produce in a given amount of time. Over the last two decades, domestic

Table 2

Real Income, Population, and U.S. Exports, 1973-92

Average annual percent growth

	1973-81			1981-87			1987-92		
	GDP per capita	Population	U.S. exports	GDP per capita	Population	U.S. exports	GDP per capita	Population	U.S. exports
OECD	1.86	.78	3.79	2.26	.59	2.43	2.04	.84	8.04
East Asia	5.45	1.95	9.11	5.01	1.72	2.71	5.19	1.58	14.28
Latin America	3.04	2.61	9.85	-2.11	2.15	-4.67	1.47	1.90	13.56

Note: Growth in GDP per capita for 1991 and 1992 was calculated using growth rates of aggregate real GDP for each country.

Source: Author's calculations. Data from Penn World Tables 5.5 (Summers and Heston); World Bank 1994a; International Monetary Fund 1994.

investment has grown significantly faster in the developing nations of East Asia than in the industrialized nations of the OECD (Table 3). From 1973 to 1981, real gross domestic investment increased 8.9 percent annually in East Asia, seven times the comparable rate in the OECD. Although it slowed to 4.4 percent annually from 1981 to 1987, the growth rate of real domestic investment in East Asia rose again to 10.1 percent annually from 1987 to 1992. This growth was almost four times the annual investment rate in the OECD from 1987 to 1992, and a major factor why East Asia has sustained rapid real per capita income growth.[11]

In Latin America, however, strong real per capita income growth in the 1970s yielded to strains from the debt crisis of the 1980s. From 1973 to 1981, real per capita income grew 3.0 percent annually in Latin America, significantly faster than in the OECD. However, from 1981 to 1987 real per capita income in Latin America actually declined. Real per capita income has only recently begun to recover in Latin America, rising 1.5 percent annually from 1987 to 1992.

Numerous developing countries, including many in East Asia, incurred substantial debt problems in the early 1980s. Latin America was hit particularly hard by the crisis. Its effects lingered in Latin America primarily because appropriate adjustment policies were implemented much later than in East Asia (Sachs). For example, both Korea and Mexico borrowed heavily during the 1970s, primarily to finance public sector spending. However, Korea enacted a tight fiscal policy in 1979 as part of a comprehensive stabilization program. In contrast, Mexico actually increased its public sector expenditures by 14 percent of GDP from 1979 to 1981. As a result, the level of debt exploded and Latin America could not follow East Asia in sustaining its prior growth performance.

The debt crisis reduced U.S. exports to Latin America in two ways. First, the large fiscal deficits led to a crowding-out of private investment and to

Table 3

Real Gross Domestic Investment, 1973-92

Average annual percent growth

	1973-81	1981-87	1987-92
United States	.90	2.84	.02
OECD	1.25	3.08	2.59
East Asia	8.86	4.37	10.13
Latin America	7.31	-4.92	6.13

Source: Author's calculations. Data from World Bank 1994a.

eventual cuts in government investment spending (International Monetary Fund 1987).[12] For example, from 1981 to 1987 real domestic investment in Latin America fell 4.9 percent annually (Table 3). The decline in investment spending was exacerbated by severe capital flight from the debtor countries and a sharp curtailment in lending from foreign creditors.[13] Among major debtor countries, the share of investment financed by external borrowing fell from 23 percent in 1981 to 1 percent in 1984 (International Monetary Fund 1985). As investment declined in these countries, so too did per capita income growth and the demand for U.S. exports. For example, U.S. exports to Latin America fell 4.7 percent annually from 1981 to 1987 (Table 2).

The second way the debt crisis curtailed U.S. exports to Latin America was through the process of current account adjustment. After external lending was sharply reduced by foreign creditors, debtor countries were compelled to increase their foreign exchange earnings to repay their external debts. In other words, exports had to exceed imports in debtor countries. In Latin America, 100 percent of the net trade balance increase between 1980 and 1986 was achieved by reducing imports (Edwards 1989). In effect, Latin America dramatically reduced its consumption of U.S. (and other) exports.

Population growth. The second factor promoting the shift in U.S. exports to East Asia and Latin America has been population growth. Along with increasing per capita income, population growth is an important consideration for U.S. firms seeking to identify regions with expanding markets.

Population growth has been a strong and consistent contributor to economic growth in the developing nations of East Asia and Latin America. From 1973 to 1992, annual population growth was two to three times higher in East Asia than in the OECD. Population growth has been even more important to Latin America's expansion. From 1973 to 1981, population growth accounted for almost half of Latin America's aggregate real income growth (Table 2). In addition, when real per capita income growth turned negative in Latin America during the early 1980s, population growth remained strong and ameliorated the decline in U.S. exports to the region.

Trade liberalization. Access to foreign markets is the third crucial factor in the growth of U.S. exports. Strong foreign income and population growth offer no opportunities for domestic firms

that export unless their goods can be sold in foreign markets at competitive prices. Thus, it is important that developing nations in both Latin America and East Asia have made significant strides toward trade liberalization.

East Asia was at the forefront of developing countries in implementing trade liberalization measures. For example, given their status as entrepôt city-states and lack of natural resources, both Hong Kong and Singapore have depended on free trade for their economic expansion. As a result, Hong Kong and Singapore have long been among the most open countries in the world. After a brief experiment with import-substituting industrialization, Singapore began to liberalize its trade in the late 1960s (Noland).[14] Hong Kong liberalized even earlier, adopting free trade in 1949 along with other laissez-faire policies of its British colonial government (*The Economist* 1989).

Latin American economies, once among the most protected in the world, have more recently emulated the East Asian countries in liberalizing trade. Mexico, already the third-largest market for U.S. exports, offers a vivid illustration of the benefits of lowering trade barriers. As recently as 1985, import licenses protected more than 90 percent of Mexico's domestic production from competing imports (Lustig, Bosworth, and Lawrence). Mexico embarked upon large-scale trade reform in mid-1985 and methodically reduced import licensing to only 19 percent of domestic production by 1990 (Lustig).

Many developing countries in Latin America have also initiated moves to liberalize trade through the GATT. Since 1980, almost half of all new accessions to the GATT have been Latin American nations.[15] In the process, these Latin American nations have agreed to substantial tariff reductions. At the time of their accessions, Mexico, Venezuela, Bolivia, and Costa Rica all committed to tariff ceilings, the highest of which was 55 percent (OECD 1992). These trade liberalization measures contrast starkly with developments in the OECD. Over the last decade, 20 out of 24 OECD member nations have increased their trade barriers (Bergsten and Noland).

In summary, exports have become increasingly important to the U.S. economy. The growth in U.S. exports has been accompanied by a geographic shift toward the developing nations of East Asia and Latin America. Although briefly interrupted by external shocks in the 1980s, three primary factors have precipitated the geographic shift in U.S. exports. Per capita income growth, population growth, and increased trade liberalization have all contributed to faster market expansion in East Asia and Latin America than in the OECD. In fact, these same three factors point toward bright prospects for future U.S. export growth in East Asia and Latin America.

PROSPECTS FOR U.S. EXPORTS TO EAST ASIA AND LATIN AMERICA

The developing nations of East Asia and Latin America will continue to become more important markets for U.S. exports in the years ahead. Spurred by recent investment growth, strong real income growth in these developing nations is likely to continue. Rapid income growth in East Asia and Latin America has important implications for U.S. exports because fast-growing countries tend to import a higher proportion of goods than slow-growing countries (Plosser). In addition, current trends toward increased trade liberalization will allow U.S. exports greater access, while per capita income growth and population growth expand market size in these developing nations.

Per capita income growth

Rapid per capita income growth will remain an important factor in making East Asia and Latin America key U.S. export markets. East Asia's rapid income growth has already made U.S. officials take notice. Commerce Secretary Ronald Brown has said, "These [East Asian] nations are the fastest growing markets for U.S. goods, and if we are to expand the share of world markets claimed by

Table 4

Output and Population Forecasts, 1994-2030

Annual percent change

	Real GDP	Nominal GDP (U.S. dollar terms)	Population 1994-2000	Population 2000-30
United States	2.7	6.0	.95	.79
OECD	2.7	5.9	.51	.23
East Asia	7.6	11.5	1.32	.84
Latin America	3.4	9.6	1.94	1.18

Sources: World Bank 1993, 1994b; World Bank, International Economics Department; Day.

American companies and workers, it will occur in these countries" (*Daily Report for Executives*). In addition, recent policy reforms in Latin America have already begun to restore real income growth and have greatly improved the prospects for future gains.

Current forecasts indicate that East Asia will continue to set the pace for real income growth in the decade ahead (Table 4). During the next ten years, real GDP in the developing nations of East Asia is expected to grow 7.6 percent annually, over two and a half times as fast as in the United States or the OECD.[16] Income growth at these rates makes for a large potential market for U.S. exports. For instance, when converted at purchasing power parity exchange rates, China already has the third largest GDP in the world (International Monetary Fund 1993). This has led some to suggest that China will be an emerging economic superpower in the 21st century (Burt).

Recent policy reforms have also restored the potential for rapid income growth in Latin America.[17] The developing economies in Latin America have made significant progress in restoring macroeconomic stability through deficit and inflation reduction. Chile, Mexico, and Colombia all recorded fiscal surpluses by the late 1980s, while Argentina reduced its deficit from 8 percent of GDP in 1980-82 to 3 percent in 1985-88 (Williamson). With the onset of Economic Solidarity Pact reforms, Mexico's monthly inflation rate was reduced from 10 percent to 1 percent during 1988 (Lustig).

Latin America initiated a second set of policy reforms in privatizing state-owned firms. For example, after nationalizing all but two of Mexico's commercial banks in 1982, the government has completely privatized the banking system (Welch and Gruben). From 1982 to 1992, the number of public firms in Mexico fell from 1,155 to 217 (Banco de Mexico). The process of privatization has reallocated a large amount of capital from inefficient state enterprises to more promising private ventures. As a result, Latin American investment is now better able to spur rapid per capita income growth.

While these reforms have been relatively recent, experience has shown that U.S. exports to a nation can grow rapidly after reforms have been adopted. Reforms were implemented in some of East Asia's

developing nations before U.S. exports took off. For example, prior to its economic reforms begun in 1978, China was a relatively small market for U.S. exports, consuming less than a billion dollars per year. By 1992, however, just 14 years after the first economic reforms, U.S. exports to China increased ninefold to almost $7.5 billion.[18] In an additional parallel to China, foreign capital has been flowing into Latin America in large amounts recently, a sign of investor confidence in the progress of policy reform and the region's growth prospects.[19]

Population growth

Over the next three decades, population growth worldwide is expected to moderate. However, population growth in East Asia and Latin America will continue to outpace the OECD by a wide margin.

Current forecasts suggest that the population in East Asia will expand 1.3 percent annually through the year 2000. This growth is more than two and a half times as fast as in the OECD (Table 4). Although projected to slow thereafter, East Asia's population growth is expected to be more than three and a half times the OECD rate by 2030.

Population growth is also expected to remain robust in Latin America well into the 21st century, thus expanding the potential market for U.S. exports. Current projections indicate that Latin American population will grow about 1.9 percent annually during the 1990s, among the most rapid in the world. At that rate, by the year 2000 about 8.6 percent of the world's population is likely to live directly south of the U.S. border. Although its growth rate is forecast to moderate somewhat after that, Latin America's population is projected to swell from the current 453 million to 765 million by 2030.

Trade liberalization

Trade liberalization improves the prospects for U.S. exports in two ways. First, lower foreign trade barriers directly increase U.S. access to growing markets. Second, trade liberalization indirectly benefits U.S. exports by increasing foreign economic growth and, hence, the potential demand for U.S. exports.

Although several East Asian nations are already among the most open of all developing nations, further progress in trade liberalization is spreading throughout the region. Given their small size and prominent role as trading centers, Hong Kong and Singapore have traditionally been two of the most open markets in the world. In Korea, the average tariff for all industries was cut in half from 36 percent in 1978 to 18 percent in 1988 (Yoo). Korea plans further tariff reductions to 7.9 percent in 1994 (Noland). The relatively high level of remaining trade barriers in East Asia suggests that additional liberalization would provide a substantial boost to U.S. exports. The level of protection in manufacturing industries in several East Asian countries is approximately equivalent to 40 percent tariffs (*The Economist* 1994). Thus, there is substantial room for U.S. exports to expand in the wake of further trade liberalization.

The movement toward free trade is also gaining momentum in Latin America. The North American Free Trade Agreement (NAFTA) just took effect on January 1, 1993. The ensuing gradual phaseout of trade barriers will provide increasingly open markets for U.S. goods. Independent studies have estimated the NAFTA's trade barrier reductions, in conjunction with continued policy reforms in Mexico, will increase U.S. exports by $16.7 billion per year starting in 1995 (Hufbauer and Schott 1992).

The movement to reduce barriers to U.S. exports is spreading throughout other Latin American countries as well. President Clinton recently asked the U.S. Congress for the authority to begin fast-track negotiations to include Chile in the NAFTA. In addition, a recent report by the Institute for International Economics found that Chile and Trinidad and Tobago are in prime position to enter into a free trade agreement with the United States (Hufbauer and Schott 1994). Moreover, U.S. trade negotia-

tions in Latin America are unlikely to end there. The President has said, "We ought to move next on this free trade agreement with Chile and that could be a model for all of South America" (*Telerate* 1994a). It is estimated that a free trade pact encompassing the western hemisphere would raise U.S. exports by an additional $36 billion in 2002 (Dunne). On the basis of these and other factors, U.S. Trade Representative Mickey Kantor has predicted that by the year 2000 the United States will conduct more trade with Latin America than with Europe (*Telerate* 1994b).

In addition, several other developing nations in Latin America are currently applying for GATT membership. These new applications give strong reason to expect additional progress in trade liberalization in the near future. Moreover, Latin American nations have strong incentives to reduce trade barriers, since trade liberalization is likely to add several percentage points to the region's economic growth rate in the 1990s (Malpass). U.S. firms are particularly well positioned to benefit from Latin American trade liberalization because of their geographic proximity to those markets.

Trade liberalization has the added benefit of increasing economic growth and thereby expanding the potential market for U.S. exports. There is increasing evidence, for example, of a direct positive link between East Asia's openness and its rate of economic growth (Trehan). In general, open Asian economies have grown faster than those that were more closed (Helliwell). Specifically, trade liberalization encouraged economic growth in Korea and Thailand by increasing economies of scale and capacity utilization (OECD 1992). In addition, by exposing domestic industries to greater foreign competition, trade liberalization in East Asia may also stimulate productivity and, hence, income growth (*The Economist* 1993). Recent projections suggest that trade liberalization will indeed increase economic growth in East Asia. East Asia stands to gain the most from the liberalization measures in the recent GATT agreement, which will add an estimated $300 billion per year to world income (World Bank 1994b). Other estimates suggest that if current tariff levels were reduced by half, East Asia's income would rise by $100 billion per year (*The Economist* 1994).

In short, the prospects for future U.S. export growth in the developing nations of East Asia and Latin America are very good. A rising tide of trade liberalization is improving the access of U.S. exports to these developing markets at the same time that strong income growth and population growth are expanding the size of those markets. In addition, continued policy reforms in Latin America will free domestic resources from debt service and inefficient state enterprises and create new demand for U.S. capital and consumer goods.

Predicted U.S. export flows

Empirical estimates support the view that the developing nations of East Asia and Latin America will remain the foremost growth markets for U.S. exports in the years ahead. Using income and population growth forecasts, it is possible to predict the flow of U.S. exports to East Asia, Latin America, and the OECD by estimating what international trade theorists call *gravity equations*. Such equations have been used successfully for over 30 years in empirically estimating international trade flows (Aitken; Bergstrand).

The gravity equations estimated for this article use five independent variables: nominal output for the United States and its trading partners, the population of the trading partners, the distance between the United States and its trading partners, and the residuals from the prior year's estimated regression. The U.S. GDP variable represents the potential export supply. Foreign country GDP is included to measure the potential demand for U.S. exports. Foreign population is a proxy to capture the effects of market size.[20] The distance variable represents natural trade resistance factors such as transportation costs.[21] Finally, the residual term from the prior year is included to explain the fact that the United States

Table 5

Gravity Regression Equations

Dependent variable: U.S. exports to region
Sample period: 1981-91

Independent variables					Summary statistics	
U.S. GDP	Foreign GDP	Foreign population	Distance	Lagged residuals	$\bar{R}^2$	Standard error of estimate
			OECD			
1.58	.55	.22	-1.01	.23	.82	.58
(.08)	(.07)	(.09)	(.07)	(.03)		
			East Asia and Latin America			
.69	1.30	-.54	-.13	.12	.84	.39
(.03)	(.03)	(.02)	(.03)	(.02)		

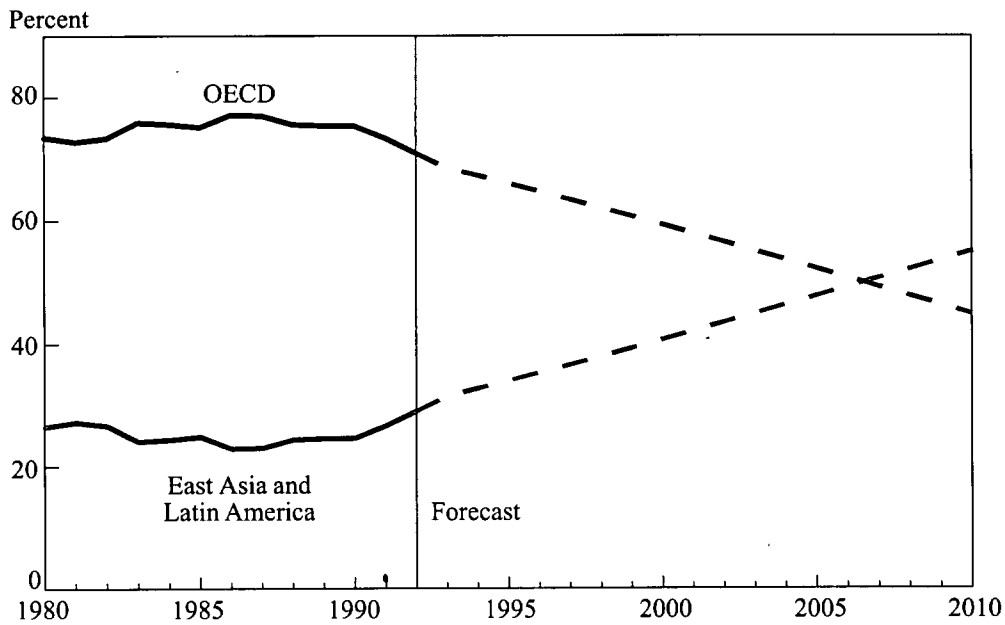
Note: Standard error in parentheses.

consistently conducts more trade with these countries than would be predicted by obvious trade factors.[22] For example, the residual term may capture the unquantifiable effects of favorable trade relationships, political orientation, or gradual trade liberalization.

The objective is to predict export flows from the United States to two separate groups of countries: the developing nations of East Asia and Latin America, and the developed nations of the OECD. Therefore, two separate gravity equations are estimated, one for each of the two groups of trading partners. The details of the estimation procedure are described in the appendix.

The estimated regression equations are presented in Table 5. As expected, the coefficients on U.S. GDP are positive because the more output the United States produces, the more exports it can supply. The foreign income coefficients are positive for the developed and developing nations, indicating that higher foreign income raises the demand for U.S. exports. The coefficients on the distance variables are negative because countries located farther from the United States have higher transportation costs imbedded in the price of U.S. exports. Foreign population growth creates a larger market for U.S. exports, making the expected sign of the population coefficient positive.[23] In fact, the reported population coefficient is positive for the OECD. The reported population coefficient is negative, however, for the developing countries. This may reflect the lingering impact of stringent trade barriers that were part of import substitution policies in Latin American countries.[24] Many other empirical studies using gravity equations have also reported negative foreign population coefficients

Chart 3
Actual and Predicted U.S. Exports
Share of total U.S. exports to selected trading partners



Source: Actual data from International Monetary Fund 1994. Predicted data are fitted values from gravity regressions (see text).

(Leamer; Summary).

These gravity equations are used to forecast the future shares of U.S. exports to the developing and developed nations considered in this article. The future or out-of-sample values of the independent variables are computed using nominal output and population growth forecasts (Table 4). Given these values, the predicted levels of U.S. exports are generated in two steps. First, the estimated equations (Table 5) are used to compute separate time series of predicted values for each country in the two groups of trading partners. Second, predicted aggregate time series of U.S. exports to each country group are computed by summing the predicted time series of all nations in each group.

The gravity regressions estimated here clearly support the view that the share of U.S. exports to East Asia and Latin America will continue to grow faster than the share of U.S. exports to the OECD (Chart 3). The forecasts indicate that the share of U.S. exports to East Asia and Latin America will exceed the share of U.S. exports to the OECD by the year 2007. Given that only a portion of all Latin American and East Asian developing countries are included in this study, it is possible that this succession could happen sooner. Therefore, the results presented are consistent with similar forecasts made by the Office of the U.S. Trade Representative. The important point is not the specific year in which the succession will occur, but that East Asia and Latin America will be the primary growth markets for U.S. exports in the coming years.

CONCLUSIONS

Two important trends have emerged in recent U.S. export performance. First, U.S. exports have been increasing rapidly relative to total U.S. output. Second, a geographic shift in the direction of U.S. exports is occurring as the developing nations of East Asia and Latin America are consuming an increasing share of U.S. exports. These developing nations have accounted for most of the recent growth in U.S. exports.

Several factors have contributed to this geographic shift in U.S. exports. Aggregate real income growth has been faster in East Asia and Latin America than in the industrialized nations of the OECD. Thus, spurred by strong domestic investment and per capita income growth in East Asia and Latin America, the market for U.S. exports in these developing nations has expanded rapidly. These fundamental economic trends have been augmented by increased trade liberalization in East Asia and Latin America, which has allowed U.S. exports greater access to developing markets.

The shift in U.S. exports to East Asia and Latin America is likely to continue in the future. The economic fundamentals underlying rapid income growth in East Asia remain in place, while continued trade liberalization promises greater access to U.S. exports in these burgeoning markets. Through measures like the NAFTA and the GATT, trade liberalization is also opening markets to U.S. exports in Latin America. In addition, continued policy reforms and strong population growth will keep Latin American markets expanding rapidly.

Forecasts presented in this article confirm that U.S. exports to these developing nations will continue to grow faster than U.S. exports to the OECD in coming years. The share of U.S. exports to East Asia and Latin America is likely to surpass the share of U.S. exports to the OECD during the first decade of the 21st century. These forecasts are contingent on current trade liberalization and policy reform trends. The emergence of protectionism or reversal of current policy reforms, while unlikely at present, would damage world growth and impair the prospects for U.S. exports.

APPENDIX

This appendix outlines the procedures used to generate the forecasted shares of U.S. exports to developed and developing countries.

Estimation of gravity equations

Gravity equations were estimated using annual data from a sample of countries in each of two groups: the developed countries of the OECD, and the developing countries of East Asia and Latin America.[25] The estimation procedure comprised two steps.

First, annual gravity equations were estimated for each of the two groups. For each year, t, in the 1980-91 sample period, the gravity equations took the form:

$$(1) \quad x_i^t = \beta_1 + \beta_2 y_i^t + \beta_3 n_i^t + \beta_4 d_i + e_i^t, \qquad i = 1,..., N_j;\ j = 1, 2,$$

where the subscript i indexes the N_1 countries in the developed group and the N_2 countries in the developing group. The dependent variable x_i^t represents U.S. exports to country i in year t. Similarly, y_i^t represents nominal GDP in country i expressed in U.S. dollars, n_i^t represents the population of country i, and d_i represents the distance in miles from country i to the United States.[26] All variables were expressed in logarithms.

The second step in the estimation procedure incorporated the estimated residual term $\hat{e}_i^t$ from the annual regressions in step one. The estimated residual from the prior year was used to capture unquantifiable factors, like political orientation, that affect trade. The estimated residual was included as an independent variable in a set of annual gravity equations used to compose a system of seemingly unrelated regressions (SUR). To be specific, the following set of equations was simultaneously estimated:

$$(2) \quad x_i^{1981} = \beta_1 y_{US}^{1981} + \beta_2 y_i^{1981} + \beta_3 n_i^{1981} + \beta_4 d_i + \beta_5 \hat{e}_i^{1980} + \varepsilon_i^{1981}$$

$$\vdots$$

$$x_i^{1991} = \beta_1 y_{US}^{1991} + \beta_2 y_i^{1991} + \beta_3 n_i^{1991} + \beta_4 d_i + \beta_5 \hat{e}_i^{1990} + \varepsilon_i^{1991},$$

where y_{us}^t is U.S. nominal GDP and $\hat{e}_i^{t-1}$ is the once-lagged residual from equation (1). The coefficients in system (2) were restricted to be equal for each year in the sample. Thus, the SUR technique reduced the system of annual regressions to a single estimated equation over the 1981-91 sample period. The SUR technique also accounts for any contemporaneous correlation in the error terms (Kmenta). Such correlation occurs if a factor affecting one country's demand for U.S. exports affects other countries' demand for U.S. exports.

Computation of export shares

Using the estimated coefficients from equation (2), predicted export shares were computed for both developing and developed countries.

First, for each country in the two groups (developed countries and developing countries), the estimated coefficients were used to compute predicted (fitted) values. The predicted values, U.S. exports to each nation, were then aggregated by country group for the 1993-2010 forecast period:

$$\hat{X}_j^t = \sum_{i \in j} \hat{x}_i^t, \quad (3)$$

where $\hat{x}_i^t$ represents the fitted values for country i in country group j. The aggregate predicted values $\hat{X}_j^t$ were then used to compute the shares in Chart 3.

ENDNOTES

[1] Melcher and Kelly report that from the first quarter of 1993 to the first quarter of 1994, exports from the Midwest rose at twice the national rate.

[2] The industrialized economies are generally considered to be the member nations of the Organization for Economic Cooperation and Development (OECD). The OECD nations are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. Although it became a member of the OECD on May 18, 1994, Mexico would still be more accurately considered a developing nation by virtually all observers. In addition, for the sample period examined, Mexico was not a member of the OECD. Therefore, in this article Mexico is classified as a developing country in Latin America. Iceland is excluded from the analysis. Since the article is written from the perspective of U.S. trade, the term OECD is understood to exclude the United States.

The developing countries in East Asia considered in this article include China, Hong Kong, Indonesia, the Republic of Korea (South Korea), Malaysia, the Philippines, Singapore, and Thailand. Latin America's developing countries considered here include Argentina, the Bahamas, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, Peru, Trinidad and Tobago, and Venezuela. Although they exclude some countries, these regional definitions are economically comprehensive in that they include all nations that have a significant trading relationship with the United States, as indicated by the data in the *Direction of Trade Statistics* (International Monetary Fund 1994).

[3] Recent reform efforts have also focused attention on economic development in the economies of Eastern Europe and the former Soviet Union (Barkema). However, these studies have generally concluded that the progress of reform in those countries will be slow and uneven. In addition, many organizations do not strictly classify Eastern Europe and the former Soviet Union as developing economies, categorizing them separately as "formerly socialist economies" or "economies in transition" (World Bank 1993). For these reasons, Eastern Europe and the former Soviet Union are excluded from the analysis of this article.

Another nation often mentioned as a potential economic power is India. However, India is not included in this article for two reasons. First, India is not located in the geographic regions that are the focus of this article. Second, despite its formidable potential for economic growth, India has actually consumed a steadily declining share of U.S. exports since 1964.

[4] Given the prevailing fixed exchange rate system, the dollar was overvalued in the sense that the supply of dollars greatly exceeded the private demand for dollars (*Economic Report of the President*).

[5] The link between lower trade barriers and higher trade volumes has been well established (Harris).

[6] Although the discussion here is focused on tariff protection,

there are other non-tariff barriers (NTBs) that nations often employ to restrict imports. Some of the more common NTBs are quotas, "voluntary" export restraints, and local content requirements. The GATT has also been instrumental in working to reduce NTBs through the principle of transparency. This principle calls for countries to convert NTBs into tariffs that are transparent or easily identified. The idea behind transparency is that trade barriers must be clearly identified before they can be lowered or eliminated.

[7] A restrictive monetary policy and an expansionary fiscal policy combined to drive up real interest rates in the United States relative to the rest of the world. Thus, aided also by increased investment risk in Latin American debtor countries, foreign demand for U.S. assets rose. The tight U.S. monetary policy also reduced expectations of U.S. inflation. All of these factors combined to increase the demand for the U.S. dollar and raise its value relative to other currencies (*Economic Report of the President*).

[8] In comparing levels of per capita GDP between countries, an exchange rate is needed to state all measures of income in terms of a common currency. Accurate comparisons require that this exchange rate reflect the differences in purchasing power of the respective currencies. This is especially important for comparisons between developing and developed countries. Converting data at conventional exchange rates tends to understate the income of developing countries (Summers and Heston). Therefore, all per capita GDP figures used in this article are calculated from data that were converted using purchasing power parity exchange rates. For an explanation of purchasing power parity, see Hakkio.

[9] Chirinko and Morris note that there is a direct positive relationship between investment and economic growth across a large sample of countries.

[10] In terms of the Solow or neoclassical growth model, an increase in an economy's investment will increase the equilibrium capital-to-labor ratio. The economy will move to a higher point along the production function, thus increasing the equilibrium output-to-labor ratio, that is, productivity. For an illustration of this model, see Branson.

[11] Young identifies high investment to GDP ratios, increased educational attainment, and a transfer of labor from low to high value-added sectors as the primary factors underlying the strong productivity growth in East Asia.

[12] Private investment can be "crowded out" if it is inversely related to interest rates. Increased government spending will raise interest rates if the government borrows to finance its spending or if financial market participants believe that the government will have to borrow more in the future. Higher interest rates generally depress investment because most investment spending is financed by borrowed funds. For a more detailed discussion of crowding out, see Gordon.

[13] Capital flight occurred primarily because governments attempted to fix the value of their currencies at overvalued exchange rates. Once again, Latin America was much more severely affected than East Asia. In Argentina and Mexico, for example, about two-thirds of the increase in gross external debt went to finance private capital flight (Sachs). The corresponding figure for Korea and Indonesia was an average of 15 percent.

[14] Import-substituting industrialization is the policy of restricting imports of manufactured goods in order to encourage the development of domestic manufacturing industries. This policy was widely practiced in many developing countries, especially in Latin America, after World War II. Import substitution was implemented in response to an anticipated slackening of demand for the primary goods which predominated among developing country exports (Balassa and others). Most economists, however, now consider import-substituting industrialization to be a flawed development policy because it is based on the infant industry argument. Proponents of the infant industry argument contend that nascent manufacturing industries in developing countries cannot initially compete with established industries in developed countries. Therefore, proponents advocate the use of trade barriers to restrict imports and "protect" infant industries until they can develop a comparative advantage. For a discussion of the problems with the infant industry argument and import substitution, see Krugman and Obstfeld.

[15] Seven Latin American nations have acceded to the GATT since 1980. These nations are Colombia, Belize, Mexico, Antigua and Barbuda, Venezuela, Bolivia, and Costa Rica (OECD 1992).

[16] These growth forecasts, like any other, are based upon a number of different assumptions regarding future economic conditions. Most importantly, the forecasts reflect continued moderate growth and low inflation in the industrialized nations, conditions which are expected to keep world interest rates at relatively low levels. These forecasts come from the World Bank (1994b), which also computed forecasts under the assumption of rising world interest rates and protectionist trade pressures. Even under these pessimistic assumptions, East Asia's annual real GDP growth is forecast to be 7.1 percent over the next ten years. Due to its larger debt exposure and greater dependence on foreign capital, Latin America's real output growth is more severely affected under the pessimistic scenario, growing at an annual rate of 0.8 percent.

[17] Edwards 1994 identifies 1988 as the beginning of a widespread reform era in Latin America.

[18] Lardy points out that total U.S. exports to China are probably even somewhat higher than reported by official data, since some U.S. goods exported to Hong Kong actually end up as reexports to China.

[19] Private capital flows to Latin America reached a low point of $6.3 billion in 1986. Since that time, private capital flows to Latin America have steadily increased, reaching an estimated $37.6 billion in 1992, an increase of almost 600 percent over six years (OECD 1993).

[20] As discussed earlier in the article, population is an important determinant of aggregate income. Therefore, countries with large populations are likely to consume more U.S. exports than countries with small populations.

[21] In this article, distance is measured as the number of miles from Kansas City, Missouri, to one of the major industrial cities in each relevant country. Kansas City was chosen as the reference point because it is a large city that is closest to the geographic center of the United States. The cities chosen as reference points in the other countries are: Sydney, Australia; Vienna, Austria; Brussels, Belgium; Winnipeg, Canada; Santiago, Chile; Beijing, China; Bogota, Colombia; Copenhagen, Denmark; Quito, Ecuador; Helsinki, Finland; Paris, France; Frankfurt, Germany; Athens, Greece; Hong Kong; Jakarta, Indonesia; Dublin, Ireland; Rome, Italy; Tokyo, Japan; Luxembourg-Ville, Luxembourg; Kuala Lumpur, Malaysia; Mexico City, Mexico; Amsterdam, the Netherlands; Wellington, New Zealand; Oslo, Norway; Panama City, Panama; Manila, the Philippines; Lisbon, Portugal; Singapore; Seoul, South Korea; Madrid, Spain; Stockholm, Sweden; Bern, Switzerland; Bangkok, Thailand; Port-of-Spain, Trinidad and Tobago; Ankara, Turkey; London, United Kingdom; Caracas, Venezuela. The distance measures are from Fitzpatrick and Modlin.

[22] The inclusion of the lagged residual variable improves the fit (increases the R^2), but does not significantly alter the parameter estimates. The objective here is to use the estimated regression equation to accurately predict trade flows. Therefore, the inclusion of the lagged residual term is justified for the sake of improved fit.

[23] Brada and Méndez also suggest that a large export market better compensates exporters for the cost of acquiring information and establishing a sales and distribution network.

[24] For countries that adopt import substitution policies, as many in Latin America have done since World War II, the population coefficient in a gravity equation should be negative. That is, foreign countries with import substitution policies and large populations may have sufficient economies of scale to support import substituting industries, thus reducing the demand for U.S. exports. This conclusion was supported by exploratory regression analysis. When separate gravity equations were estimated for East Asia and Latin America, the population coefficient was positive for East Asia and negative for Latin America.

[25] For a list of the countries in each group, see note 2.

[26] For more details on the distance measurements, see note 21.

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