# Flexible Commitment or Inflation Targeting for the U.S.?

Based on a speech given by President Santomero to the Money Marketeers, New York, NY, June 10, 2003

BY ANTHONY M. SANTOMERO

The idea of creating a framework for explicit inflation targeting in the U.S. has recently become a topic of considerable discussion. The key question is: Could inflation targeting improve on the U.S. economy's performance? President Santomero thinks inflation targeting makes sense for the U.S., in principle. But he cautions that several important issues must be worked out before an explicit targeting regime is established. In this quarter's message, he discusses these issues — in particular, calibrating the target and reconciling inflation targeting with the Fed's mandate to foster not just price stability but also full employment.

Price stability is the primary focus of central banks, as it should be. Economic theory and recent experience show us that maintaining a reasonably stable price level promotes long-term growth, helps economies run more efficiently, and enhances their capacity to absorb exogenous shocks in the short run. These benefits arise partly because price stability helps the marketplace infer changing fundamentals and distinguish them from transitory disturbances and partly because it improves the central bank's ability to conduct effective monetary policy.

Over the past decade or so, a number of central banks around the world have, to good effect, adopted inflation targeting as a means of achieving both price stability and credibility as inflation fighters. The monetary authorities of more than 20 countries, including New Zealand, the United Kingdom, and Canada have adopted explicit inflation targets.

Over roughly the same period, the Fed has achieved price stability in the U.S. without inflation targeting. Rather, it has evolved a less restrictive approach — an approach I call "flexible commitment." By flexible commitment I mean that our current policy's commitment to low inflation never precludes an active response to economic disturbances. The Fed's approach has implicitly targeted low inflation, though it does not embody a numerical inflation target. Moreover, it has been constructive in managing inflation expectations. Indeed, it has passed a crucial test of any good monetary policy: It has established the Fed's credibility for maintaining low inflation.

For over 20 years, the U.S. economy has performed quite well under this policy regime — dramatically better than it did in the high inflation environment of the 1970s. In fact, the Federal Reserve's current approach to monetary policy has done a good job of meeting the Fed's dual goals of price stability and full employment — goals set by law.

Nonetheless, the idea of creating a framework for explicit inflation targeting in the U.S. has recently become a topic of considerable discussion. Some have spoken for it, some against it. The key question is: Could inflation targeting improve on the U.S. economy's performance going forward?

My position is that inflation targeting makes sense in principle for

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the U.S. It is the next logical step on the path the Fed has been traveling for the past two decades — a path toward greater transparency and clarity. If properly implemented, it would increase public confidence in the Fed's commitment to reasonable long-term price stability in the U.S. It would also strengthen monetary policy as a stabilization tool in a low-inflation environment. Moreover, while I do not think the U.S. faces a serious risk of deflation, inflation targeting would also help to avoid this risk should it arise.

At the same time, I recognize there are several important issues that must be worked out before an explicit inflation targeting regime could be established. Two are particularly important. One is calibrating the inflation target — that is, choosing the target price index, target inflation range, and target horizon — so as to reinforce, rather than undermine, the credibility of the Fed's commitment to price stability. The second is properly reconciling inflation targeting with the Fed's mandate to foster not only price stability but also full employment.

As we shall see, these are related issues. We need to move carefully yet concretely on these two fronts before we implement inflation targeting, if we are to realize the promise of better economic performance. With proper implementation, inflation targeting makes sense for the U.S. — in practice as well as in principle — and I would support it.

## THE CANADIAN EXPERIENCE WITH INFLATION TARGETING

Our neighbors to the north speak well of explicit inflation targeting. In Canada, the economic boom at the end of the 1980s, together with an oil-price shock and the introduction of a goods and services tax, led to fears that inflation would escalate. Against this backdrop, the Canadian government and the Bank of Canada agreed on explicit targets for reducing inflation in 1991.

The first formal targets aimed to bring inflation down to 2 percent by December 1995. Inflation declined more quickly than anticipated and was already closing in on its target by January 1992 — almost four years ahead of schedule. Since then, with year-over-year inflation almost always in the 1 to 3 percent target range, the policy has been widely regarded as a success. Moreover, the Bank of Canada and many academics contend that inflation targeting contributed to the country's improved economic performance.

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Interestingly, the major lesson drawn from the Canadian experience with inflation targeting relates to credibility and inflation expectations. After inflation fell to 2 percent, expectations began to closely track the announced inflation target. With the low inflation target becoming increasingly credible, the nature of inflation in Canada began to change. During the 1990s, inflation became less responsive to short-run supply and demand excesses as well as to relative price shocks. Canada also enjoyed increased stability in its real economy. When compared with the preceding decade, the first decade of inflation targeting showed less volatility in both output growth and the unemployment rate. In short, inflation targeting worked as an automatic stabilizer in response to a whole range of economic disturbances.

The Canadian experience points to the potential benefits of explicit inflation targeting in the U.S. It suggests that institutionalizing an explicit target, by adding precision to inflation objectives and thus enhancing the transparency and accountability of central bank policy, can both stabilize prices and improve overall economic performance.

However, a U.S. shift to an inflation targeting regime would entail important implementation issues unique to our environment. We would be implementing inflation targeting after having achieved price stability and credibility. Other countries implement inflation targeting as a means to achieve those objectives. Moreover, inflation targeting in the U.S. must recognize the Fed's dual goals of price stability and maximum sustainable economic growth. Unlike the Federal Reserve, many inflation-targeting central banks have a single mission of price stability.

These implementation issues are more than technical. They lie at the core of how such a system might effectively work in the U.S. context. Let me elaborate.

## THE CURRENT U.S. POLICY FRAMEWORK

While the Fed has not adopted explicit inflation targeting, the policy strategy it has followed over the past 20 years generated many of the benefits inflation targeting offers. The Fed greatly increased its credibility for maintaining low and stable inflation and achieved an enviable record of output

growth. It became more proactive in heading off inflationary pressures, even as it sought to ensure continued growth by responding aggressively to financial shocks and demand variations. At the same time, the Fed has become increasingly transparent — an important component of maintaining a credible commitment to low and stable inflation.

My colleague Ben Bernanke, a Fed Governor, has described the current policy framework as "constrained discretion." But, as I mentioned, I prefer the term flexible commitment. Under flexible commitment, the central bank has been free to adjust monetary policy to stabilize output and employment during short-term disturbances, while maintaining a strong commitment to keeping inflation under control.

Flexible commitment incorporates the idea that low and stable inflation is a key outcome of successful monetary policy. Yet, it has not offered an explicit inflation target, nor has it reported quantitatively on our successes or failures. Nonetheless, the Fed has achieved what is essentially price stability and also has stabilized inflation expectations.

The Philadelphia Fed's *Survey of Professional Forecasters* clearly confirms well-anchored long-term inflation expectations. In 1991, we began asking survey participants for their 10-year inflation expectations. The median forecast was that CPI inflation would average 4 percent over the next 10 years. As core inflation declined, inflation expectations declined along with it. Declining inflation expectations are one reason we were able to achieve remarkable economic growth in the 1990s even as trend inflation slowed to its lowest level since the early 1960s. In 1999, our survey's 10-year CPI inflation expectation settled in at 2-1/2 percent. It has stayed there ever since. The Fed's aggressive actions to lower the federal funds rate in 2001 and 2002 did not elevate survey participants' long-run inflation expectations. The recent dip in core inflation did not diminish them. I take this as a positive sign that the Fed's commitment to maintaining reasonable price stability is a credible one in the mind of the public.

This stabilization of expectations is crucially important. Indeed, recent history suggests the commitment to long-run price stability has enhanced the Fed's short-run flexibility to respond to shocks, as well as monetary policy's effectiveness in offsetting shocks. Because the Fed's aggressive actions to lower the federal funds rate in 2001 and 2002 did not elevate long-run inflation expectations, long-term interest rates came down with short-term rates. Clearly, the decline of both long- and short-term rates helped stabilize the economy.

> In an environment where we have achieved credibility, should we institutionalize it?

But we have not always been successful. Recall the 1970s. Early in the decade, inflation began to rise, and the Fed failed to establish itself as a champion of price stability. The public's inflation expectations became unstable. Inflation and inflation expectations spiraled upward. Economic performance deteriorated. The Fed, concerned about the potential impact on employment and economic activity, initially avoided undertaking the strong policy actions necessary to break this destructive cycle. It was not until Fed Chairman Paul Volcker led the economy into disinflation in 1979-82 that the Fed began to regain credibility. Unfortunately, regaining credibility was costly. We suffered two recessions during those years.

## SHOULD WE MOVE TO INFLATION TARGETING NOW?

Under both Chairman Volcker and Chairman Greenspan, the Fed worked hard to restore low and stable inflation. Their efforts proved successful in giving the Fed credibility as an inflation fighter. This was done using the strategy that I described as flexible commitment — one with an implicit objective of price stability rather than an explicit inflation target. In the face of well-anchored inflationary expectations, the question now is whether this is the time to adopt an explicit target. In an environment where we have achieved credibility, should we institutionalize it?

I believe a properly specified inflation target can help ensure the continuation of our recent success. It can protect us from repeating the mistakes of our past without unduly constraining our ability to respond to short-run shocks. An explicit inflation target would place some check on Fed actions, helping to lock in the Fed's hard-won credibility. But we must recognize that inflation targeting in the U.S. might differ from the systems used abroad for two reasons: (1) the U.S. has already achieved price stability, and (2) the U.S. has the dual goals of price stability and full employment.

Nonetheless, we can learn from other countries' successful experience as well as from the academic literature on this subject.

## THE ACADEMIC LITERATURE

One key lesson of the academic literature is that, in theory, inflation targeting is the best strategy for achieving both Fed policy objectives: low, stable inflation and full employment. Indeed, it is difficult to write

down a macroeconomic model that does not lead to some sort of inflation targeting as the optimal monetary policy approach for achieving these two goals — not surprising, given that more-than-transitory deviations from full employment will, with a lag, mean changing inflation.

Another idea theorists emphasize is that of transparency. The Federal Open Market Committee (FOMC) recognizes that transparency plays an important role in achieving our policy objectives and goals. Any policy action can have very different effects, depending on what the private sector infers about the information that induced policymakers to act, about policymakers' objectives, and about their likely future actions. Accordingly, FOMC statements have been made more explicit and more direct, and votes are now released at the end of meetings.

Greater transparency in policymaking, along with a commitment to reasonable long-run price stability, has enhanced Fed credibility. As I mentioned earlier, credibility has given the Fed greater flexibility to respond to economic and financial shocks. The benefit of transparency and credibility is evident in the recent movement of the fed funds rate to a 40-year low. A 525-basis-point reduction in the funds rate with no damaging rise in inflationary expectations would have been unimaginable 20 years ago.

The positive results of this approach to monetary policy are evident. The documented decline in economic volatility in the mid-1980s occurred at the time the Fed conquered inflation, started achieving credibility for lower inflation, and brought inflationary expectations under control. While I do not believe better monetary policy is the entire story, it certainly played an important role.

If implemented carefully, explicit inflation targeting can reinforce the effectiveness of monetary policy. It would enhance our transparency, make it easier for the public to understand monetary policy, and further improve expectations dynamics.

We know that public perceptions about longer-run monetary policy affect the effectiveness of short-run policy actions. Specifically, the effectiveness of current monetary policy is influenced by expectations of future policy actions and expectations of long-term inflation. Inflation targeting would anchor these expectations more firmly, making price stability easier to achieve in the long term and increasing the central bank's ability to stabilize output and employment in the short term. Explicit inflation targeting in the U.S. might also deliver a more lucid explanation of policy, reduced uncertainty in financial markets, and increased popular support for the Fed. The interaction between credibility and policy actions is a key ingredient to implementing effective monetary policy. Proper implementation and design are therefore crucial if explicit targeting is to fulfill its promise.

An inflation target has to be calibrated in terms of three components: an inflation measure, a target range, and a time period over which average inflation is to fall within that range.

## INFLATION TARGETING AS THE POTENTIAL NEXT STEP

Inflation targeting would be an evolutionary, rather than a revolutionary, step in the Fed's policy strategy. Against the background of flexible commitment, as I have described it, the Fed could simply quantify what it means by price stability — a goal it has been pursuing for almost a generation and, most would agree, has now achieved. The Fed would then include in its regular testimony before Congress a report on its success or failure in achieving that numerical target. These steps would move the Fed farther along the path to greater transparency and accountability — a path along which it has already been moving.

But to say inflation targeting is an evolutionary step is not to say it is an easy one. Simply announcing a numerical target is not enough. A number of important implementation issues are essential to the success of inflation targeting in the U.S. Given our nation's already low and stable inflation rate, these issues are more substantive for us than they would be for a country experiencing high inflation. If we are to coax additional gains from being explicit, we must pay careful attention to the design of the targeting framework.

An inflation target has to be calibrated in terms of three components: an inflation measure, a target range, and a time period over which average inflation is to fall within that range. Given the Fed's dual mandate to achieve price stability and full employment, we need to consider carefully several issues relevant to the choice of components for an inflation target.

The first issue is this: It is widely accepted that pursuing policies to stabilize output and employment in the face of temporary shocks can create greater short-run variance in inflation. So how does the Fed set an explicit range for an inflation target that is firm enough to impart credibility to its

long-run price stability goal, yet flexible enough to accommodate its short-run stabilization goal?

Research suggests that central banks face a quantifiable short-run tradeoff between the variance in inflation and the variance in economic activity (output and employment). Thus, to properly and optimally implement inflation targeting, we must allow for some variability in inflation.

This means that inflation would equal its targeted value only on average. The question arises: over what time frame should we measure that average? A second question is: how much variability should we allow around the average? Of course, the answer will depend on the time frame. A two-year average can be targeted more precisely than a quarterly average. Thus, implementation is likely to require a target range and time horizon pair.

The particular pair the FOMC selects must hinge on practical considerations, such as information lags and the underlying volatility of economic disturbances, along with our understanding of how the economy works. The target range/time horizon pair may be subject to change, but only infrequently. For explicit targeting to improve on our current procedure, the target horizon and target range must be set in a way that enhances both credibility and performance.

The second issue relevant to the implementation of inflation targeting is this: The target range/time horizon pair, to some extent, will influence the Fed's flexibility in reacting to shocks. In a perfect world of full information and complete credibility, everyone would be able to discern the Fed's optimal response and observe whether it has followed through. But this is not a perfect world. Maintaining credibility will require adherence to the target range/time horizon specification, which could impose some constraints on flexibility. Thus, a careful consideration of how best to set our targets is required to carry out our dual mandate.

Similarly, the occurrence of an improbably large shock could make hitting the target range technically impossible or extremely costly. In such cases attempting to maintain the targeting regime may not be socially desirable.

At times, there may be a temptation to re-contract by changing the components of the inflation target or by temporarily relaxing its parameters. But such re-contracting would erode credibility and leave us with less effective monetary policy than we have achieved thus far. So I believe that careful design is important if explicit inflation targeting is to prove effective.

> We must address the implementation concerns before moving to an explicit inflation target.

Finally, there is a third issue surrounding the implementation of inflation targeting by the Fed. Again, it emanates from the Fed's dual mandate to achieve price stability and full employment. This time it is the issue of symmetry. If the Fed sets an explicit inflation target, will the public expect the Fed to establish explicit targets for other economic variables as well?

From an economist's point of view, this kind of symmetry would not be reasonable. Long-run inflation is under the control of the central bank. Potential GDP growth and the natural rate of unemployment are not. Further, the central bank can target only one variable and that variable is long-run inflation. While we believe that reasonable price stability, by which we mean low and stable inflation, is a necessary condition for achieving maximum sustainable growth and full employment, the central bank must take the long-run values of other variables as given.

Nonetheless, recognizing the Fed's capacity to conduct countercyclical monetary policy, we might argue that the Fed should establish near-term targets for real growth or unemployment. However, in the real world of daily ups and downs, it would be difficult, if not impossible, for the Fed to keep such variables within some meaningful range.

I believe that establishing dual numerical targets would be a mistake, even though the Fed has dual goals. Trying to establish numerical targets for both inflation and real growth or unemployment would almost surely end up undermining, rather than reinforcing, the Fed's ability to achieve price stability and conduct effective countercyclical policy. Accordingly, if inflation targeting were deemed likely to fuel calls for targeting other macroeconomic variables, I would not endorse it.

In short, I am in favor of inflation targeting in principle. However, I strongly believe we must address the implementation concerns I set forth, before moving to an explicit inflation target.

## INFLATION TARGETING VS. PRICE PATH TARGETING

Before closing, I want to discuss an important difference between two explicit price stabilization strategies currently being debated in the academic literature: inflation targeting and price path targeting. The two terms are often used interchangeably in the popular press, but the distinction between them is important.

Stated simply, inflation targeting targets the rate of inflation. Under an inflation targeting regime, if inflation rises temporarily above target, it must then be brought back down. However, the price level remains permanently above its targeted level. Price level targeting, by contrast, means that any deviations from the prescribed price level path must be offset in the future so as to return the price level to its target value. Thus, price level stability is more rigid and less forgiving than inflation targeting.

Recent research has suggested price path targeting may achieve better economic outcomes in an environment of zero-inflation or deflation. Indeed, Governor Bernanke recently suggested that the Bank of Japan adopt a price-level target.

It has been argued that when inflation is very close to zero and demand is weak, price path targeting is more effective than inflation targeting in staving off deflation. Suppose inflation falls below target in the current period. Under inflation targeting, the price of goods and services today does not change relative to their expected future price. But under price path targeting, the lower price level today makes goods and services cheaper today relative to their expected future price. This encourages consumption and increases demand today. Also, firms — knowing that prices will be a lot higher later — would be less likely to cut prices. Both effects mitigate the dangers of deflation.

By design, price path targeting is much more constraining than inflation targeting. Deviations in the price level due to external shocks of any kind must be offset in order to achieve the target price level at some pre-determined point in the future. The costs of doing so are not considered. But in actuality, such a policy regime is likely to lead to more pressure for relaxing the parameters of the target than an inflation targeting regime. This alone would undermine stability of the policy regime and in the long run reduce its credibility. For this reason, I cannot advocate price path targeting for the U.S. at this time.

Nonetheless, research on price path targeting is still in its early stages. And we have no empirical evidence on how effective it would be in comparison to inflation targeting. Accordingly, I do find this research interesting and worth pursuing, at least at a theoretical level.

## CONCLUSION

In conclusion, I believe the FOMC should seriously consider inflation targeting. I would like to see work on implementation issues begin so that we may consolidate the gains made by flexible commitment and increase the efficacy of policy even further.

Some have suggested that our recent success in achieving price stability speaks against implementing inflation targeting. The U.S. economy has been able to realize price stability and anchor inflation expectations under a policy of flexible commitment. Why change now?

I believe we have reached a point where institutionalizing inflation targeting simply makes good sense from an economic perspective. In short, it is a reasonable next step in the evolution of U.S. monetary policy, and it would help secure full and lasting benefits from our current stable price environment. Evolving to explicit inflation targeting from our current implicit target has significant potential benefits, and the costs may be minimal if we can implement it in a constructive manner.

Clearly, proper implementation of inflation targeting is crucial to its success. That, in turn, requires more research and analysis. It also requires more public debate and discussion.

I believe the FOMC should seriously consider inflation targeting.

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# Crises, Contagion, and Coordination:
## A Summary of the 2002 Philadelphia Fed Policy Forum

BY LORETTA J. MESTER

John Murray, Urban Bäckstrom, Robert Parry, and Anthony Santomero

On November 22, 2002, the Federal Reserve Bank of Philadelphia held its second annual Philadelphia Fed Policy Forum, "Crises, Contagion, and Coordination: Issues for Policymakers in the Global Economy." This event, sponsored by the Bank's Research Department, brought together a group of highly respected academics, policymakers, and market economists, for discussion and debate about issues monetary policymakers must grapple with in our increasingly global economy. The Policy Forum was not intended to be a traditional academic conference on monetary policy, nor was it intended to be a discussion of issues relevant to the next FOMC meeting. Rather, we took a longer-term perspective and tried to engage the right people in a discussion of current economic research and its implications for monetary policy. Our hope is that the 2002 Policy Forum is a catalyst for both greater understanding of today's global economy and more critical thinking about the role of policymakers in that global world.

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National economies are linked through trade in goods and services, cross-border flows of financial assets, and labor migration. Economic integration strengthens these ties. Reduction of trade barriers, financial innovations, and advances in communications and information flows have increased integration. Participants at the Policy Forum discussed a number of issues that policymakers must confront in our increasingly interdependent world: the importance of institutional arrangements in maximizing the benefits of economic and financial linkages, the factors that foment crises and foster contagion, the actions policymakers can take to prevent and contain crises, and the question of whether policy should be coordinated (or not). We were reminded that policymakers' actions affect incentives: the actions a policymaker takes to ameliorate a crisis may set up conditions that raise the likelihood or the cost of the next crisis. We were also reminded that while globalization has increased the level of interrelationship among economies and markets, financial crises and contagion are not new: they have characterized economies far into the past.

**Anthony M. Santomero**, president of the Philadelphia Fed, began the day by pointing out that as economies and financial systems around the globe have become more closely integrated, political and economic events abroad can have important economic implications at home. Policymakers must learn to cope with the challenges faced by globalization because it is here to stay. Economists recognize the benefits to national economies that globalization offers: the promise of higher returns and a lower variance in economic perfor-

mance than any one country could achieve on its own, the promise of more rapid output growth and higher living standards via greater exploitation of specialization and comparative advantage, and the promise of better diversification of financial risks. But at the same time, globalization has its shortcomings: greater potential for contagion and spread of economic and financial problems and reduced potency of domestic policy.

In Santomero's view, on balance, globalization is a strong positive for national economies. Policymakers can maximize the benefits and minimize the costs of global integration by creating infrastructures that allow markets to function efficiently, to contain the system in times of crisis, and to control the impact of cyclical fluctuations. Efficiency is fostered by having a legal system that establishes property rights and enforces contracts, and regulation that provides the basis for a well-functioning financial system. Policymakers should act to stabilize cyclical fluctuations and take actions that not only stabilize financial systems in time of crisis but are time consistent, so that they do not create expectations that deepen or even precipitate a crisis tomorrow. Santomero emphasized that the overarching question for policymakers as they act to strengthen markets, avoid and contain crises, and dampen business-cycle fluctuations is the degree to which effective performance requires international coordination of activities. This issue was taken up later in the day.

## FINANCIAL CRISES[1]

I had the pleasure of moderating the first session, which addressed several questions that emerged throughout the rest of the day as well. Are crises the inevitable consequence of globalization? If so, what, if anything, can policymakers do to lower the probability that a crisis will occur? What can policymakers do to limit the extent and lower the costs of a crisis once it occurs? The session's papers underscored the importance of recognizing that institutional arrangements can lead to actions that exacerbate moral hazard problems and the need to focus on policies that are time consistent. Indeed, the design of the institution, including its objective function, has important effects on feasible outcomes.

For me, the session underscored the fact that policymakers often face a tradeoff between the short-run benefits of their action — namely, stemming the crisis and avoiding lost output — versus its longer run cost that could arise if the institution distorts the incentives of financial markets. An important issue is whether institutions can be designed to give policymakers the incentive to avoid the temptation of going for the short-run benefits despite their long-run cost. Another important issue is the measurement of these costs and benefits. In the midst of a crisis, how can the policymaker be sure what that tradeoff is? If intervention succeeds in stemming a crisis, it is difficult to measure the long-run costs implicit in taking the action — the cost of incentive distortion. Crisis situations are often characterized by coordination failures. What determines whether such a coordinator will emerge?

**V.V. Chari** of the University of Minnesota began his presentation by reviewing some of the recent research on financial crises. In Chari's view, the central feature of the data on financial crises in emerging markets is that when a crisis hits there are substantial swings in capital and output. When times are good, capital flows strongly into the country. During a crisis, capital starts flowing out dramatically, so that there is a sharp swing in the current account. Similarly, output growth turns into contraction at the time of the crisis.

One theory consistent with the data is coordination failure among debtors: if a debtholder fears that the government will default on its debt if other debtholders choose to not roll over the country's debt, then it's rational for the first debtholder not to roll over the debt either. Even though all debtholders would be better off if they agreed to the rollover (since default would be avoided), the fact that they cannot coordinate leads to a worse outcome for all.

Another theory consistent with the data involves herd behavior. There are a number of players that might contemplate investing in an emerging market, for example, investment banks or mutual funds, and each has its own information on which to base its decision. If one small group decides not to invest or withdraws its investment, the others might be deterred from investing too, reasoning that the first group might have some important, negative information. That is, the investors move in herds, which can result in capital flight. Note that this can happen even if the inference is incorrect: it could be that if the information of all the players was aggregated, it would show that investing in the country is profitable.

These theories share some common elements: there is the possibility the government will default; debtholders may fear they may be expropriated; and debtholders' property rights are insecure. Chari draws three conclusions. (1) Crises are here to stay, since these common elements are inherent in the process of emerging markets striving to become

[1] Many of the presentations reviewed here are available on our web site at www.phil.frb.org/conf/policyforum2002.html.

more developed. (2) Some mechanism for restructuring and renegotiating sovereign debt in the event of a default or a threatened default, a so-called international bankruptcy court, can serve a useful social role, since it reduces the possibility of expropriation of some debtors by others. (3) Current direct lending policies of the International Monetary Fund (IMF) that involve lending to countries when they are threatened with a crisis are socially harmful because they mean debtholders don't monitor the debt as much as they would if there were no possibility for a bailout.

Chari explains why, in his view, the logic for having a domestic lender of last resort does not carry through to the international context. The logic for a domestic lender of last resort depends on the inherent fragility of the banking system: banks lend long but borrow short. This mismatch of maturities on their balance sheets creates a coordination problem: if enough depositors start to withdraw their funds, others find it in their interest to withdraw as well, causing the bank to fail. If that failure is contagious, other banks might fail, too. The lender of last resort can stem the systemic failures of banks that would be healthy if they were not experiencing heavy withdrawals.

In the international context, governments do not have to have mismatched assets and liabilities to carry on their functions; hence, in Chari's view, an international lender of last resort that would choose which countries to bail out is not necessary. Rather, in the event of a threatened financial crisis, it would be important to provide liquidity to the entire financial system. Chari argues that the appropriate institutions for providing this liquidity already exist: central banks. Moreover, the central banks have already shown they are able to coordinate in this fashion as evidenced by their response during the Russian debt default, when the central banks of the major powers coordinated on interest rate cuts.[2]

**Hyun Song Shin** of the London School of Economics continued the discussion by drawing some analogies between a seldom-described crisis that occurred in Europe in 1763 and the LTCM crisis of 1998 for the purpose of extracting some policy lessons. Many commentators have emphasized the failure of sophisticated risk-management methods in precipitating the 1998 financial crisis, but as Shin points out, many of the themes are actually very old and already present in the crisis of 1763 — namely, liquidity risk and aggregate risk.

He used London's Millennium Bridge to illustrate the problem of aggregate risk. On opening day, thousands of people were walking across the bridge to christen it when a gust of wind started the bridge swaying. As the people tried to balance themselves, this caused the bridge to sway even more, which caused the people to rebalance themselves, which caused more swaying, and so on, and a bad feedback loop was created. The bridge had to be shut down for 18 months for repairs. The engineers discovered that the bridge swayed violently if people all walked at the same cadence, and the rebalancing mimicked this cadence. Should the designers have taken this into account? The odds of a thousand random people walking in step are extremely small, but once the wind started, the people were not walking at random. Their steps were no longer random events.

The analogy to the LTCM crisis is apparent. The hedge fund LTCM matched a long position with a short position in a very similar asset and made a gain on the very slight difference in returns. By leveraging this many, many times, the fund could make a high return. Other firms copied very similar trading strategies. When a shock hit, the funds had to unwind leveraged positions to meet margin calls, which moved prices against everyone that had a very similar trading position, which caused more distress, which led to more margin calls, and so on. In Shin's view, it is incorrect to think that LTCM was just unlucky. Far from a probability of zero, collapse was a near certainty, given the right conditions. When there is aggregate risk, it is not possible for everyone to hedge away their risk; someone has to be holding the residual risk.

In the 1700s, the Netherlands was a preeminent trading nation in Europe. It was capital rich but had very few investment opportunities. Prussia was an emerging market hungry for capital. Trade was facilitated using bills of exchange, which enabled a string of interconnected obligations that mimicked a loan from Amsterdam to Berlin. But these linked the balance sheets of the merchants and bankers involved. Everyone's liability was exactly matched by a claim on someone else; that is, everyone had a perfectly hedged book. But this meant there was substantial liquidity risk: when a shock hit one claimant, it affected all.

Such a shock hit in 1763 when the Seven Years War ended, causing the price of war goods to decline. As collateral values fell, banks became distressed. Merchants' asset values fell.

[2] In the question-and-answer period, Charles Goodhart of the London School of Economics said he believes Chari overstates the extent of possible central bank coordination to handle crises. Goodhart, who was on the British monetary policy committee in 1998, said that to his knowledge, there was no policy coordination in 1998.

They needed to sell more of their assets to meet their obligations, and this caused prices to fall even more, creating a negative feedback effect. Banks began to fail in Amsterdam, then in Hamburg. Because of the web of linkages, the crisis spread to Berlin, Stockholm, and Russia, resulting in a massive number of bank failures. The crisis of 1763 involved aggregate risk: counterparty risk was correlated with credit risk. The crisis of 1763 also involved liquidity risk. Instead of the usual banking story in which distress is transmitted across banks via their liabilities (deposit withdrawals), here there was asset-side contagion: as asset prices fell, other traders got into distress.

In Shin's view, one lesson from the crises of 1763 and LTCM is that we need to take endogenous risk seriously. While we need to refine our mathematical methods and statistical techniques to extract the most information we can from past data, we also have to think about how all the interested parties are interlinked. Relying on past data, no matter how sophisticated the statistical methods, is not going to capture the correct prediction. When push comes to shove, historic correlations break down and credit risk and counterparty risk will suddenly strike together. Risk is inherent in the system as a whole, so we need to take aggregate risk seriously: it is not possible for everyone to hedge themselves perfectly. When the economy itself has risk, someone has to bear that risk somewhere; the question then becomes, who should bear that risk? Shin also underscored the importance of coordination, a theme in Chari's work and an important difference between the LTCM crisis and the crisis of 1763. The New York Fed acted as a coordinator of the creditors in the LTCM crisis. In contrast, no entity played the role of coordinator in the crisis of 1763, and there were dire consequences.

## FINANCIAL CONTAGION AND BUSINESS-CYCLE CORRELATION

The next session focused on the causes of contagion and how crises spread across regions of the world. Franklin Allen of the Wharton School, University of Pennsylvania, discussed how different institutional arrangements, in particular central bank and financial system arrangements, can affect the probability of contagion when financial systems are not fully integrated. Allen pointed out that most central banks today have a dual mandate of price stability and financial system stability. An exception is the European Central Bank (ECB), whose single goal is price stability. Financial stability is the responsibility of the national central banks in Europe. In Allen's view, this arrangement poses several problems. It precludes using monetary policy for financial stability aims. It makes it difficult to coordinate responses to a problem that starts in the banks in one European country but that could potentially spread to other countries. It makes it more difficult to handle contagion, since a national central bank may not internalize the problems contagion causes in other countries.

Allen's paper demonstrates the tradeoff between price stability and financial stability. Consider a world without contagion. Banks generally lend long and borrow short. If asset values fall, banks may find they have to liquidate assets early and take fire-sale losses in order to meet their obligations. A central bank can stave off the need for costly liquidations if it lends to the banking system. The money injection allows banks to meet their nominal obligations, and it also lowers the price level. In this case, financial stability and monetary stability are inconsistent. An alternative way to stem the panic is through fiscal policy: increase taxes on individuals and give the proceeds to the banks. In this case, financial stability and monetary stability are consistent.

But now consider a world with many regions whose banking systems are interlinked, and there is the possibility of contagion. Interbank markets and flexible exchange rates allow for risks — both asset risk and liquidity risk — to be shared across countries. But they also allow for the propagation of problems from one country's banking system to others if there is aggregate risk. If the central bank has the right incentives, it can correctly estimate the costs and benefits of intervening to stem the contagion. In Allen's view, the Euroland system does not have those correct incentives because: (1) the ECB, having responsibility only for price stability and not financial stability, cannot use monetary policy to ensure financial stability, and (2) the national central banks will pursue policies in their own national interests rather than in the interests of the whole group of nations; the cost-benefit calculation for intervening will be different from that for the whole group, which will lead to inefficient decision making.

Allen proposes that one way to solve this problem is to give the ECB the dual mandate of price stability and financial stability. In his view, at the present low levels of inflation that prevail in Europe, the cost of the inflation that would result from using monetary policy to stem a financial crisis would be less than the cost of a financial crisis. He also notes that the fixed exchange rate in Europe causes a large part of the problem. Flexible exchange rates would help stem contagion as long as domestic banks' liabilities are in domestic currency. A devaluation of


Kenneth Rogoff

the currency would allow banks to meet their liabilities and avoid costly liquidation of assets. Fiscal intervention could also solve the problem, but only if a single tax to bail out banks is levied across all the countries; this would entail coordination problems.

In Allen's view, a single currency area, such as the Euroland, that has separation of fiscal and monetary responsibilities has the potential problem of contagion: a small shock in one place can become a big problem everywhere. He urged that the creation of an integrated financial system in the Euro area be hastened, since that would ensure risk sharing across countries and financial stability from monetary policy or fiscal intervention in the same way as when there is a single country.

If we are to devise policies and institutions to try to prevent this type of contagion and systemic crises, it is important to know the causes of contagion and the channels through which a shock in one country can spill over and be transmitted to others. **Graciela Kaminsky** of George Washington University reviewed some of her recent work in this area, examining spillovers that occur in a matter of days or hours in countries with established financial systems. Kaminsky used daily data on stock market returns in the 1990s to measure turmoil as stock market returns in the tail of the distribution. Thus, very large decreases or declines in stock returns that occur in countries on the same day are evidence of spillovers. Kaminsky's results suggest that spillovers have regional characteristics. There was spillover across the countries of Asia in 1997, but not later in the 1990s. There was no spillover of turmoil from Asia to Europe in 1997, but in 1998, the sharp movements in the stock markets of Europe occurred on the same days. In Latin America, there were spillovers across countries in early 1999. Sometimes spillovers are worldwide, as they were in the fall of 1998. Often, when a financial-center country, for example, the U.S. or Germany, experiences turmoil, it is transmitted to the rest of the world. Problems occur synchronously in many emerging markets but generally only when a shock in one of them first influences a financial center.

In looking at crises over the past 200 years, Kaminsky noted (as had Chari earlier) that crises that entail contagion generally are preceded by a surge in capital flows. Once the shock hits, there is a sudden reversal of capital flows, then the crisis spreads through the world. Contagion does not occur when there is no activity in international financial markets or when there is a small amount of international lending.

Kaminsky distinguishes crises that are anticipated from those that are a surprise. The damage is much larger from an unanticipated crisis because there is no time for lenders to rebalance their portfolios ahead of the crisis. The crises in Mexico, Thailand, and Russia were not anticipated: these countries' sovereign debt had not been downgraded by Standard and Poor's in the 12 months before the crisis, and some were even upgraded. In contrast, the crises in Brazil, Turkey, and Argentina were anticipated: their debt was downgraded consistently in the months going into the crisis. This allowed investors and creditors to hedge some of their risk and scale back their exposure, thereby limiting the damage.

In Kaminsky's view, there is no clear solution to contagion and spillovers that happen very quickly. One can impose controls on capital mobility, but it is impossible to avoid capital flight.

## POLICY COORDINATION AND MONETARY POLICY DURING A CRISIS

Our third session concerned policy coordination and appropriate monetary policy in a crisis, a theme that ran through the first two sessions. In a world in which goods and financial markets are becoming increasingly interlinked, are problems created when each country sets its own monetary policy? Are stabilization gains from having separate currencies dissipated if monetary policies are not coordinated? According to **Kenneth Rogoff** of the International Monetary Fund and Harvard University, the answer is no. Rogoff's research suggests that, in most cases, the gains from monetary policy coordination are relatively small compared with the gains obtained if each central bank pursues an optimal monetary policy for macroeconomic stabilization in its respective country. That is, typically, the biggest gains are from getting your own house in order. Although the gains to international policy coordination would not be that large among the U.S., Europe, and Japan, little research has been done on the spillover effects to the rest of the world. For example, exchange rate volatility does not have first-order effects on these three areas, but it

could be significant to the rest of the world.

Rogoff emphasized that one cannot meaningfully discuss international monetary coordination in the absence of the underlying fiscal policy framework in the countries in question. Monetary policy cannot cure all the problems caused by poor fiscal policy, and a poor fiscal situation can limit the effectiveness of monetary policy. He notes that the welfare effects of alternative policies will differ, depending on the underlying distortions in the economy, for example, wage rigidities or nonoptimal tax systems. In closing, Rogoff pointed out that the exchange of ideas among central bankers, which one might characterize as a type of coordination, is valuable, since countries often face similar economic problems and issues.

**Martin Eichenbaum** of Northwestern University continued the discussion of the links between monetary and fiscal policy, focusing on the fiscal implications of banking and currency crises, the so-called twin crises. According to the classical view, currency crises arise when the government prints money to finance ongoing or prospective government deficits. These prospective government deficits might be caused by the costs of resolving a banking crisis, which can be very large. For example, the resolution costs of the Indonesian banking crisis have been estimated at over 60 percent of Indonesia's GDP. Indeed, three effects can raise the costs of resolving a banking crisis. A currency crisis that results in a devaluation of the country's currency raises the cost of resolving a banking crisis by reducing the residual value of banks, which typically have dollar liabilities and local currency assets and are unhedged. In addition, twin crises are typically followed by recessions in which tax revenues fall, exacerbating the fiscal implications of twin crises. Finally, there is a relative price effect. When the local currency depreciates, the dollar value of tax receipts falls. If this drop outweighs the drop in value of government spending on nontradable goods, this worsens the government's fiscal situation.

But there are two problems with the classical view of currency crises. First, it implies that inflation rates would be high after a currency crisis, but in reality, many crises are followed by moderate inflation rates. Second, it emphasizes the role of seignorage as an important source of government finance, but in reality, seignorage provides a limited amount of revenue.

A key insight from Eichenbaum is that printing money to generate seignorage is only one of the ways a government can pay for the fiscal costs of a twin crisis, and the method chosen will have implications for the post-crisis inflation rate. This recognition allows models of twin crises to be reconciled with the data. In addition to seignorage, the government could finance a banking system bailout by using explicit fiscal reform of raising taxes or cutting spending; deflating the real value of outstanding nonindexed nominal debt; using implicit fiscal reform of reducing the real value of government transfer commitments (for example, social security payments) that aren't fully indexed to foreign currency; defaulting on outstanding debt; and/or receiving an international bailout.

All of the methods of paying for the crisis, except for explicit default or explicit fiscal reform, require a depreciation of the currency — the government would need to abandon a fixed exchange rate regime to gain access to these revenues — and they involve some inflation. But the exact amounts depend on the mix of financing strategies used. If there is a significant depreciation of the country's currency to pay for the crisis, the post-crisis inflation rate need not be as high as when the country prints money to finance the costs of resolution. Eichenbaum concluded with a case study of the Korean twin crisis, showing that an extension of the model to include various methods of financing allows it to fit the data. It remains for future research to determine what leads different countries to adopt different financing strategies and what the welfare implications of those alternatives are.

**Lawrence Christiano** of Northwestern University turned the discussion to how a central bank should manage a financial crisis, such as the Asian crisis of 1997-98, in which the value of the country's currency is collapsing, there's a sharp reversal from capital inflows to outflows, and the domestic economy is falling into a recession. Consider a country that is borrowing in domestic currency to pay for labor and in international markets for foreign currency to purchase a foreign intermediate input. A crisis is triggered by collateral constraints suddenly becoming binding: firms need to borrow but the value of their assets does not permit them to borrow more. What's a central bank to do?


Martin Eichenbaum

One view, which Christiano characterized as the Krugman-Stiglitz view, advocates that the central bank cut interest rates, since the economy is falling into a recession. The interest-rate cut causes a reduction in the real interest rate used to discount future flows, so asset prices rise. If asset prices rise enough, the collateral constraint becomes less binding, firms can finance more of the intermediate input, and output can expand. An alternative view, which Christiano characterized as the IMF view, advocates against cutting interest rates in order to help stem capital flight. If the country cuts its domestic interest rate, its currency will depreciate and the value of a firm's assets in foreign currency will fall; hence, its purchases of the intermediate input must fall. Production contracts, and the economy may enter a recession.

Which is correct? The key is how asset prices respond to a cut in interest rates. Christiano's research suggests that that depends on how open the country's economy is, that is, how flexible its prices and factors of production are. Any relaxation in the collateral constraint makes it easier to bring in the foreign input, and if it is easy to move factors around, the foreign input can be combined with capital and labor and immediately be put to productive use. This, in turn, raises asset prices and the marginal product of capital. In this type of flexible economy, cutting the domestic interest rate in the face of a crisis is the better thing to do. But if the economy is inflexible, it cannot move its factors of production around very much, so the increase in the foreign input, which occurs when the collateral constraint is relaxed, cannot be put to productive use, so asset prices do not rise. In this case, cutting rates would be counterproductive; it would intensify the capital outflow but not raise asset values. Christiano's latest research suggests that in an economy in which resources are inflexible in the short run but flexible in the long run, the optimal strategy in the face of a crisis is to raise interest rates in the short run to stem capital flight but to lower rates in the long run. This appears to be what happens in crisis economies.

## POLICYMAKING IN A GLOBAL CONTEXT

Our final session brought together a panel of international policymakers to discuss the practical aspects of implementing monetary policy in a global context. **Robert Parry**, president of the Federal Reserve Bank of San Francisco, made the point that in setting monetary policy, the Federal Reserve's primary focus is on the U.S. economy and its goals remain maximum sustainable output and employment and price stability. The integration of goods and financial markets has made conditions in other countries more prominent in the Fed's deliberations, but for the most part, the effects on policymaking are at the margin; globalization has not severed the connections between monetary policy and the U.S. economy.


Graciela Kaminsky

In Parry's view, globalization has not changed the goals or conduct of U.S. monetary policy to any great extent. This is because foreign events rarely have a large effect on the U.S. economy, since: (1) our economy is large so shocks in foreign economies matter less for us than for smaller countries, (2) there is still a substantial home bias in our demand for goods, services, and assets, so changes in foreign demand have only a small effect on aggregate demand in the U.S., and (3) our flexible exchange rate regime allows us to use interest rates to conduct monetary policy. But there have been a few instances when U.S. monetary policy has responded to foreign developments, for example, during the global financial crises of the late 1990s.

Parry also made the point that growing interdependence of national economies makes it increasingly important to pay attention to the actions of foreign policymakers, and he agreed with Rogoff that there is value in the formal and informal meetings that Federal Reserve staff members have with the staffs of other central banks around the world. Such information exchange enables the Fed to better forecast global economic conditions that affect the U.S. economy. The meetings also allow officials to get to know one another so that if an event occurs in which cooperation is needed, it is easier to effect. Parry said that agreements to coordinate monetary policy actions do not typically occur at such meetings. On the other hand, there is a great deal of coordination of regulatory policy in financial markets in recognition of the fact that problems in one country's financial sector can be quickly transmitted to other countries' financial systems through debt defaults or contagion.

**John Murray**, adviser to the governor of the Bank of Canada, concurred that running independent monetary policies across countries has benefits. According to Murray, the Bank of Canada has a skeptical attitude toward policy coordination, even though economies have become

more integrated and there have been a series of crises. He agreed with Rogoff that policy coordination may be good in concept, but that in practice, it is better for central bank policymakers to focus on their own domestic objectives. This, despite that fact that in contrast to the U.S., Canada is a small, open economy.

Canadian monetary policy operations are guided by three precepts: the importance of keeping your own house in order with respect to price stability and full-employment growth; the importance of transparency and credibility to eliminate unnecessary uncertainty and doubt; and the importance of a flexible exchange rate, which helps insulate the economy from external shocks. In periods of extreme instability, international coordination may offer some gain, but in Murray's view, good domestic policies should help keep these occurrences to a minimum.

**Urban Bäckstrom**, governor of the Central Bank of Sweden, endorsed Murray's statements and went on to discuss how central bankers can go about putting their houses in order. He believes that central bankers have made much progress in focusing on price stability and increasing transparency and that their next major issue will be financial stability. What can policymakers do to mitigate financial cycles? As Bäckstrom explained it, financial cycles would seem to evolve from excessive optimism: credit expansion feeds into asset prices, lowering the cost of capital, which stimulates investment and leads to an economic boom. Eventually, the investments are found not to be sustainable, since they do not generate profits, and the structure collapses. The economy moves from boom to bust, and there may be banking and/or currency crises.

Bäckstrom said two conventional pieces of policy advice for central bankers in preventing financial cycles are moral suasion and prudential regulation. Central bank policymakers might warn market participants they are becoming overly optimistic in their expectations about future cash flows. While such moral suasion may be worth a try, Bäckstrom is skeptical that a market can be talked down when it is rushing to new heights. There are also problems with prudential regulation. In Bäckstrom's view, most financial crises stem not from individual banks' getting into difficulties and affecting others by contagion but from many institutions' acting similarly. Also, prudential regulation is based on perceptions of risk, which are not independent of the credit and asset-price cycle itself. Apparent risk declines as collateral values rise during the upturn in the cycle, even though actual risk builds up as the expansion and leverage continues. Bank supervisors are aware of this problem and are trying to address it, but for Bäckstrom, whether improved prudential regulation, supervisory practices, and risk-management techniques will be enough to avoid financial cycles in the future is an open question.

Bäckstrom would like researchers to explore the possible use of monetary policy in preventing large financial cycles, noting that price stability is not, by itself, sufficient to ensure financial stability. There is little to prevent the emergence of cycles in the prices of real and financial assets that are not included in the measure of inflation. He acknowledged that there are arguments against a central bank's trying to respond to changes in asset prices that do not lead to inflation in the prices of goods and services (for example, how does the central bank know that a bubble is a bubble and not a reflection of fundamentals?) and that a central bank should not target asset prices per se. But he proposed that the central bank be observant when notable increases in assets prices are one of several imbalances building up in the economy, even when inflation is contained. Bäckstrom said he considers the use of monetary policy in trying to prevent financial cycles to be consistent with the central bank's mandate to achieve long-run price stability.

## SUMMARY

The 2002 Policy Forum generated lively discussion among the program speakers and audience participants on a number of issues that policymakers must confront in this increasingly interdependent world. Our hope is that the ideas raised will spur further research and foster a greater understanding of today's global economy.

We will hold our third annual Philadelphia Fed Policy Forum, "Managing the Recovery in Uncertain Times," on November 14, 2003. You will find the agenda on page 17.

**Changes in the Use of Electronic Means of Payment: 1995-2004**

Loretta J. Mester

April 14, 2006

In "The Changing Nature of the Payments System: Should New Players Mean New Rules?" (*Business Review*, Federal Reserve Bank of Philadelphia, March/April 2000), I presented some data from the 1995 Federal Reserve Survey of Consumer Finances on the use of electronic banking. This survey of more than 4,000 households, which is designed to be representative of all households in the U.S., is redone every three years. Attached are updates of the statistics indicating how the usages of various means of electronic payment have changed between 1995 and 2004.

As seen in Exhibit 1, usage of electronic forms of payment, including ATMs, debit cards, automatic bill paying, and smart cards, has risen from about 78 percent of households in 1995 to about 90 percent of households in 2004. Debit card use, which doubled between 1995 and 1998, continued to increase rapidly and now stands at nearly 60 percent of all households. Increases were seen in all categories by age, income, and education. Use of direct deposit and automatic bill paying showed somewhat smaller increases, with the percentage of households now using automatic bill paying over double what it was in 1995. Nearly 75 percent of households have an ATM card. The question on smart cards was dropped from the survey in 2004; usage remained low in 2001, with less than 3 percent of households having a smart card they could use for purchases. There was a small increase in the percentage of households that use some type of computer software to manage their money: from 18 percent in 2001 (the first year this question was asked) to about 19 percent in 2004. Respondents under 60 years old, those with higher income, and those with college degrees are more likely to use a computer for money management.

As seen in Exhibit 2, households that do business with at least one financial institution have continued to shift from paper-based methods of conducting this business to automated methods. A sizable fraction of households, over 75 percent, still report that one of the main ways they deal with at least one of their financial institutions is in person; this percentage held steady between 2001 and 2004 but is down from 1995. Overall use of electronic means of doing business – either ATM, phone, fax, direct deposit and payment, other electronic transfer, and/or computer – continued to increase between 2001 and 2004, but not as sharply as the sizable rise seen between 1995 and 1998. In 2004, 89 percent of households used an electronic method as one of their main ways of conducting business, and differences by income and education have become less pronounced. There remains, however, a large difference in the popularity of ATMs across age groups: over 79 percent of those under 30 years old use ATMs as one of their main ways of conducting business, while less than 40 percent of those over 60 years old use them. Still, the usage by those over 60 has more than doubled since 1995.

The largest increase was seen in the percentage of households that use a computer, the Internet, or an online service to do business. In 2004, over 33 percent of households used these methods, up from less than 4 percent in 1995. Youth, high income, and a college degree continue to be associated with a higher incidence of computer banking, but the computer remains a less popular means of doing business with financial institutions compared with other methods.

# Exhibit 1, Part 1
## Percent of U.S. Households That Use Each Instrument: 1995, 1998, 2001, and 2004[a]

| | ATM[b] | | | | Debit Card | | | | Smart Card[b] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 |
| **All Households** | 62.5% | 67.4% | 69.8% | 74.4% | 17.6% | 33.8% | 47.0% | 59.3% | 1.2% | 1.9% | 2.9% |
| **By Age:** | | | | | | | | | | | |
| **Under 30 years old** | 72.3% | 75.6% | 78.1% | 83.0% | 24.4% | 45.0% | 60.6% | 74.4% | 1.8% | 2.6% | 2.6% |
| **Between 30 and 60 years old** | 68.6% | 76.1% | 76.8% | 82.3% | 19.7% | 38.6% | 53.4% | 67.6% | 1.5% | 2.3% | 3.3% |
| **Over 60 years old** | 44.2% | 41.9% | 48.9% | 51.6% | 9.6% | 16.0% | 24.6% | 32.5% | 0.3% | 0.5% | 2.1% |
| **By Income[c]:** | | | | | | | | | | | |
| **Low income** | 38.5% | 45.9% | 46.8% | 53.0% | 7.0% | 19.7% | 29.2% | 41.2% | 0.7% | 1.5% | 1.9% |
| **Moderate income** | 61.5% | 64.4% | 67.4% | 73.4% | 16.0% | 31.6% | 46.3% | 57.4% | 0.6% | 3.1% | 3.0% |
| **Middle income** | 70.9% | 72.0% | 75.2% | 78.3% | 20.5% | 36.6% | 50.0% | 64.3% | 1.3% | 2.0% | 2.4% |
| **Upper income** | 77.2% | 82.3% | 83.7% | 86.5% | 25.1% | 43.8% | 57.8% | 69.3% | 1.8% | 1.7% | 3.7% |
| **By Education** | | | | | | | | | | | |
| **No college degree** | 54.7% | 60.1% | 63.7% | 67.4% | 14.3% | 29.2% | 42.3% | 54.9% | 0.8% | 1.8% | 2.4% |
| **College degree** | 80.4% | 82.1% | 81.6% | 86.4% | 25.2% | 43.1% | 56.2% | 67.0% | 2.1% | 2.0% | 3.8% |

[a]The percentages reported are based on the population-weighted figures using the revised Kennickell-Woodburn consistent weights for each year. (For further discussion see the Survey of Consumer Finances codebooks at www.federalreserve.gov/pubs/oss/oss2/scfindex.html.) This exhibit reports percentages for all households.

[b]The questions on ATMs and smart cards asked whether any member of the household had an ATM card or a smart card, not whether the member used it. The other questions asked about usage. The question on smart cards was dropped from the 2004 survey.

[c]Low income is defined as less than 50 percent of the median household income; moderate income is 50 to 80 percent of the median; middle income is 80 to 120 percent of the median; and upper income is greater than 120 percent of the median. Each survey refers to income in the previous year. Median income was $32,264 in 1994; $37,005 in 1997; $41,990 in 2000; and $43,318 in 2003.

Source: 1995, 1998, 2001, and 2004 Survey of Consumer Finances data as of March 31, 2006, Federal Reserve System, and author's calculations.

## Exhibit 1, Part 2
## Percent of U.S. Households That Use Each Instrument: 1995, 1998, 2001, and 2004[a]

| | Direct Deposit | | | | Automatic Bill Paying | | | | Software[b] | | Any of the Methods: ATM, Debit Card, Smart Card, Direct Deposit, Automatic Bill Paying, or Software | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 |
| **All Households** | 46.7% | 60.5% | 67.3% | 71.2% | 21.8% | 36.0% | 40.3% | 47.4% | 18.0% | 19.3% | 77.7% | 85.5% | 88.4% | 90.4% |
| **By Age:** | | | | | | | | | | | | | | |
| **Under 30 years old** | 31.0% | 45.2% | 48.8% | 54.0% | 17.7% | 30.5% | 32.1% | 36.5% | 17.0% | 20.4% | 76.3% | 80.2% | 83.0% | 87.3% |
| **Between 30 and 60 years old** | 42.8% | 58.0% | 64.8% | 68.2% | 24.4% | 38.6% | 44.1% | 50.3% | 22.0% | 21.9% | 78.7% | 87.5% | 89.3% | 90.3% |
| **Over 60 years old** | 63.3% | 74.8% | 83.2% | 87.0% | 18.2% | 33.0% | 35.9% | 46.5% | 9.0% | 12.8% | 76.1% | 83.7% | 89.2% | 91.9% |
| **By Income[c]:** | | | | | | | | | | | | | | |
| **Low income** | 32.5% | 44.3% | 51.9% | 54.8% | 9.7% | 17.1% | 18.2% | 24.6% | 6.1% | 6.8% | 56.7% | 69.3% | 73.6% | 77.4% |
| **Moderate income** | 42.9% | 58.8% | 63.1% | 64.0% | 17.5% | 30.5% | 35.1% | 40.5% | 10.7% | 11.1% | 78.4% | 87.2% | 88.5% | 88.6% |
| **Middle income** | 48.3% | 66.1% | 65.7% | 73.2% | 23.4% | 42.8% | 45.1% | 52.8% | 16.3% | 17.8% | 85.1% | 89.4% | 92.3% | 95.1% |
| **Upper income** | 58.3% | 70.4% | 80.2% | 83.6% | 32.1% | 49.3% | 55.2% | 62.4% | 29.9% | 31.4% | 89.6% | 94.9% | 96.5% | 97.1% |
| **By Education** | | | | | | | | | | | | | | |
| **No college degree** | 40.3% | 54.4% | 61.8% | 64.3% | 18.1% | 30.2% | 33.7% | 39.5% | 10.9% | 12.4% | 71.4% | 80.7% | 84.7% | 86.2% |
| **College degree** | 61.0% | 72.6% | 78.0% | 83.2% | 30.1% | 47.7% | 53.2% | 61.1% | 31.8% | 31.3% | 91.8% | 95.1% | 95.6% | 97.5% |

[a]The percentages reported are based on the population-weighted figures using the revised Kennickell-Woodburn consistent weights for each year. (For further discussion see the Survey of Consumer Finances codebooks at www.federalreserve.gov/pubs/oss/oss2/scfindex.html.)

[b]The question on software asked whether the respondent or spouse/partner uses any type of computer software to help in managing their money.

[c]Low income is defined as less than 50 percent of the median household income; moderate income is 50 to 80 percent of the median; middle income is 80 to 120 percent of the median; and upper income is greater than 120 percent of the median. Each survey refers to income in the previous year. Median income was $32,264 in 1994; $37,005 in 1997; $41,990 in 2000; and $43,318 in 2003.

Source: 1995, 1998, 2001, and 2004 Survey of Consumer Finances data as of March 31, 2006, Federal Reserve System, and author's calculations.

Loretta J. Mester
April 14, 2006

# Exhibit 2, Part 1
## Percent of U.S. Households with at Least One Financial Institution Using Each Method Among the Main Ways of Conducting Business with at Least One of Their Financial Institutions[a]

| | In Person | | | | Mail | | | | ATM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 |
| **All Households** | 85.5% | 79.5% | 77.2% | 77.3% | 56.5% | 54.1% | 50.4% | 50.2% | 33.8% | 52.6% | 56.7% | 64.4% |
| **By Age:** | | | | | | | | | | | | |
| **Under 30 years old** | 77.0% | 73.7% | 71.5% | 72.9% | 58.2% | 51.9% | 50.5% | 44.2% | 53.0% | 68.8% | 72.6% | 79.3% |
| **Between 30 and 60 years old** | 86.8% | 81.8% | 78.6% | 77.3% | 62.1% | 60.4% | 56.6% | 56.3% | 37.7% | 61.5% | 65.0% | 72.0% |
| **Over 60 years old** | 86.7% | 77.2% | 76.8% | 79.5% | 44.0% | 39.9% | 36.0% | 39.1% | 16.2% | 22.3% | 29.8% | 39.8% |
| **By Income[b]** | | | | | | | | | | | | |
| **Low income** | 81.2% | 70.3% | 68.2% | 71.2% | 32.8% | 33.4% | 24.7% | 28.9% | 19.6% | 34.7% | 35.6% | 46.6% |
| **Moderate income** | 85.9% | 80.4% | 76.9% | 75.0% | 48.5% | 46.9% | 42.0% | 42.6% | 29.6% | 47.8% | 50.5% | 62.3% |
| **Middle income** | 85.7% | 81.4% | 78.6% | 77.7% | 56.9% | 56.4% | 58.4% | 56.0% | 37.7% | 54.1% | 60.7% | 65.7% |
| **Upper income** | 87.7% | 84.1% | 81.8% | 81.4% | 74.3% | 69.1% | 64.9% | 62.4% | 42.3% | 65.2% | 69.6% | 74.4% |
| **By Education** | | | | | | | | | | | | |
| **No college degree** | 85.8% | 79.2% | 75.1% | 76.9% | 49.4% | 48.2% | 43.5% | 44.1% | 27.4% | 45.1% | 50.1% | 59.1% |
| **College degree** | 84.8% | 80.2% | 81.1% | 78.0% | 71.2% | 65.2% | 63.0% | 60.1% | 46.7% | 66.7% | 68.8% | 72.9% |

[a]The percentages reported are based on the population-weighted figures using the revised Kennickell-Woodburn consistent weights for each year. (For further discussion see the Survey of Consumer Finances codebooks at www.federalreserve.gov/pubs/oss/oss2/scfindex.html.) Referring to each financial institution with which the household does business, the survey asked: "How do you mainly do business with this institution?" Respondents could list multiple methods, with the main method listed first. This exhibit reports for all households with at least one financial institution all the methods a respondent listed for each of the household's financial institutions. Note, the percentages do not add up to 100 percent across columns, since households could list more than one method and more than one financial institution. Previous versions of this chart reported for 1998 and 2001 on the main ways respondents did business with their depository financial institutions (i.e., commercial banks, trust companies, thrifts, and credit unions) rather than with any of their financial institutions.

[b]Low income is defined as less than 50 percent of the median household income; moderate income is 50 to 80 percent of the median; middle income is 80 to 120 percent of the median; and upper income is greater than 120 percent of the median. Each survey refers to income in the previous year. Median income was $32,264 in 1994; $37,005 in 1997; $41,990 in 2000; and $43,318 in 2003.

Source: 1995, 1998, 2001, and 2004 Survey of Consumer Finances data as of March 31, 2006, Federal Reserve System, and author's calculations.

Loretta J. Mester
April 14, 2006

# Exhibit 2, Part 2
## Percent of U.S. Households with at Least One Financial Institution Using Each Method Among the Main Ways of Conducting Business with at Least One of Their Financial Institutions[a]

| | Phone | | | | Computer | | | | Electronic[b] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 | 1995 | 1998 | 2001 | 2004 |
| **All Households** | 25.7% | 49.7% | 48.9% | 48.8% | 3.7% | 6.2% | 19.6% | 33.6% | 56.2% | 81.7% | 87.0% | 89.2% |
| **By Age:** | | | | | | | | | | | | |
| **Under 30 years old** | 20.8% | 45.4% | 45.9% | 43.2% | 5.2% | 8.3% | 22.9% | 42.2% | 66.7% | 81.0% | 85.2% | 89.2% |
| **Between 30 and 60 years old** | 28.1% | 54.3% | 52.4% | 51.4% | 4.5% | 7.6% | 24.2% | 39.8% | 59.9% | 85.1% | 89.4% | 90.9% |
| **Over 60 years old** | 23.0% | 40.6% | 42.4% | 45.7% | 1.2% | 1.6% | 7.3% | 15.4% | 43.4% | 73.9% | 82.4% | 85.4% |
| **By Income[c]:** | | | | | | | | | | | | |
| **Low income** | 13.5% | 28.8% | 29.2% | 30.0% | 1.3% | 1.5% | 4.8% | 14.0% | 35.3% | 65.4% | 73.8% | 78.7% |
| **Moderate income** | 18.6% | 42.5% | 42.8% | 44.8% | 1.8% | 2.7% | 11.2% | 22.5% | 48.5% | 80.1% | 84.2% | 84.8% |
| **Middle income** | 22.6% | 51.7% | 51.7% | 50.7% | 4.0% | 4.3% | 17.8% | 32.4% | 59.2% | 85.2% | 89.7% | 92.1% |
| **Upper income** | 37.9% | 64.9% | 61.4% | 60.0% | 5.9% | 11.5% | 32.5% | 49.4% | 70.8% | 91.0% | 94.5% | 95.6% |
| **By Education** | | | | | | | | | | | | |
| **No college degree** | 19.7% | 41.9% | 41.7% | 43.4% | 2.8% | 2.7% | 11.3% | 23.9% | 47.8% | 76.5% | 83.2% | 85.7% |
| **College degree** | 38.1% | 64.3% | 61.9% | 57.7% | 5.6% | 12.8% | 34.8% | 49.3% | 73.5% | 91.4% | 94.0% | 94.9% |

[a]The percentages reported are based on the population-weighted figures using the revised Kennickell-Woodburn consistent weights for each year. (For further discussion see the Survey of Consumer Finances codebooks at www.federalreserve.gov/pubs/oss/oss2/scfindex.html.) Referring to each financial institution with which the household does business, the survey asked: "How do you mainly do business with this institution?" Respondents could list multiple methods, with the main method listed first. This exhibit reports for all households with at least one financial institution all the methods a respondent listed for each of the household's financial institutions. Note, the percentages do not add up to 100 percent across columns, since households could list more than one method and more than one financial institution. Previous versions of this chart reported for 1998 and 2001 on the main ways respondents did business with their depository financial institutions (i.e., commercial banks, trust companies, thrifts, and credit unions) rather than with any of their financial institutions.

[b]In 1995, electronic refers to ATM, phone, payroll deduction and direct deposit, electronic transfer, or computer. In 1998, 2001, and 2004, electronic refers to ATM, phone (via voice or touchtone), direct deposit, direct withdrawal/payment, other electronic transfer, computer/Internet/online service, or fax machine.

[c]Low income is defined as less than 50 percent of the median household income; moderate income is 50 to 80 percent of the median; middle income is 80 to 120 percent of the median; and upper income is greater than 120 percent of the median. Each survey refers to income in the previous year. Median income was $32,264 in 1994; $37,005 in 1997; $41,990 in 2000; and $43,318 in 2003.

Source: 1995, 1998, 2001, and 2004 Survey of Consumer Finances data as of March 31, 2006, Federal Reserve System, and author's calculations.

# Trade Credit:
## Why Do Production Firms Act as Financial Intermediaries?

BY MITCHELL BERLIN

Trade credit remains the single largest source of short-term business credit in the United States and other nations around the world. Why do production firms act as financial intermediaries—a role usually reserved for banks? Mitchell Berlin focuses on explanations that view trade credit as a method of monitoring and enforcing loan contracts to relatively risky firms. He also examines explanations in which a firm's long-term supply relationship helps it to make better credit decisions than a bank would.

The United States has the most highly developed financial markets in the world. Yet, trade credit — credit granted by a selling firm to finance another firm's purchase of the seller's goods — remains the single largest source of short-term business credit. Despite its importance as a mechanism for financing inter-firm trade, trade credit receives less attention in the business press than developments in bank lending markets or corporate debt markets. But the key role of trade credit asserts itself whenever a well-known firm suffers severe financial problems. When a firm's suppliers begin to demand cash on delivery, the business press begins to speculate on whether the firm is headed for bankruptcy.

The numbers attest that trade credit plays a large role in firms' finance. One way to measure this is to look at firms as borrowers. Mitchell Petersen and Raghuram Rajan's 1997 article shows that *accounts payable* — funds owed *by* the firms in their sample to trade creditors — average 4.4 percent of sales for a sample of small U.S. firms and 11.6 percent of sales for a sample of large U.S. firms.[1] Another way to measure this is to look at firms as lenders, that is, to look at *accounts receivable* — funds owed *to* the firms in the sample by their customers. Accounts receivable represent nearly 7.3 percent of sales for small firms and 18.5 percent of sales for large firms.[2]

Firms in most other industrialized nations are comparably reliant on trade credit. Raghuram Rajan and Luigi Zingales report that in the G-7 nations,[3] accounts payable of a sample of large firms range from 17 percent of assets in France to 11.5 percent of assets in Germany — compared with 15 percent of assets for U.S. firms.[4] Accounts receivable range from 13.0 percent of assets in Canada to 29 percent of assets in France and Italy — compared with 17.8 percent in the U.S.[5] Data from the less developed world suggest that trade credit may be even more important for such nations.

Remarkably, until Petersen and Rajan's empirical work in the 1990s, economists could offer only sketchy,

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[1] The small firm sample is from the Fed's National Survey of Small Business Finance, conducted in 1988-1990, while the large firm sample is from Compustat. The median firm in the small business survey has sales of $300,000. Although Petersen and Rajan don't report which vintage of the Compustat database they use, the median sales figure for all Compustat firms in 1989 was just over $52 million.

[2] As Petersen and Rajan note in their 1997 article, trade credit is not a source of net credit for firms, since receivables exceed payables. The difference is the amount of receivables financed by other sources, e.g., bank loans.

[3] The Group of Seven (G-7) nations are Canada, France, Germany, Great Britain, Italy, Japan, and the United States. Established in 1985, this organization fosters economic cooperation among the largest industrial nations.

[4] The remaining nations are Japan (15.4 percent), Italy (14.7 percent), the U.K. (13.7 percent), and Canada (13.3 percent).

[5] The remaining nations are Japan (22.5 percent), Germany (26.9 percent), and the U.K. (22.1 percent).

anecdotal answers to the most elementary questions about trade credit: Who offers trade credit? Who takes trade credit? While their work made a giant step forward, getting some of the facts straight is only the first, necessary step in answering a basic question that occurs to any economist who thinks about trade credit: Why should a firm that specializes in production or sales act as a financial intermediary when specialized intermediaries like banks can (and do) provide working capital finance? Most puzzling, why should a firm borrow short term from a bank, then provide short-term credit to its customers? Why not cut out the middleman?[6]

While financial economists have proposed a number of explanations, I focus on those explanations that view trade credit as a method of monitoring and enforcing loan contracts to relatively risky firms. I also examine the explanations that hinge on the benefits of long-term supply relationships as an underpinning for flexible and differentiated credit decisions.

## HOW TRADE CREDIT WORKS

Consider Stocking Out, a fast-growing retail hosiery emporium with six outlets in the Philadelphia suburbs, and one of its major input suppliers Run/Don't Run (R/DR), a manufacturer of top-of-the-line athletic socks. R/DR makes a large monthly delivery of socks, and it may take anywhere from a few hours to a few weeks to sell the socks once they are on the shelves. Until the socks are sold, Stocking Out counts them as inventory on its books. How might Stocking Out pay for the unsold goods until the revenues from selling them arrive? The main possibilities are illustrated in the figure.

**Banks Offer Working Capital Loans.** One possibility is that Stocking Out takes out a working capital loan — a loan to finance inventories — from a bank and pays R/DR directly. The most typical arrangement is a revolving loan commitment, in which the bank sets a credit limit and the firm draws down and repays loans at prearranged terms, much like a credit card. For example, the loan commitment might stipulate a credit limit of $500,000 and a loan rate of prime plus 2 — that is, the prevailing prime rate plus 2 percent — when the borrower draws down $100,000 for three months. Until this loan is repaid, Stocking Out could still borrow up to $400,000, the unused balance of the loan commitment.

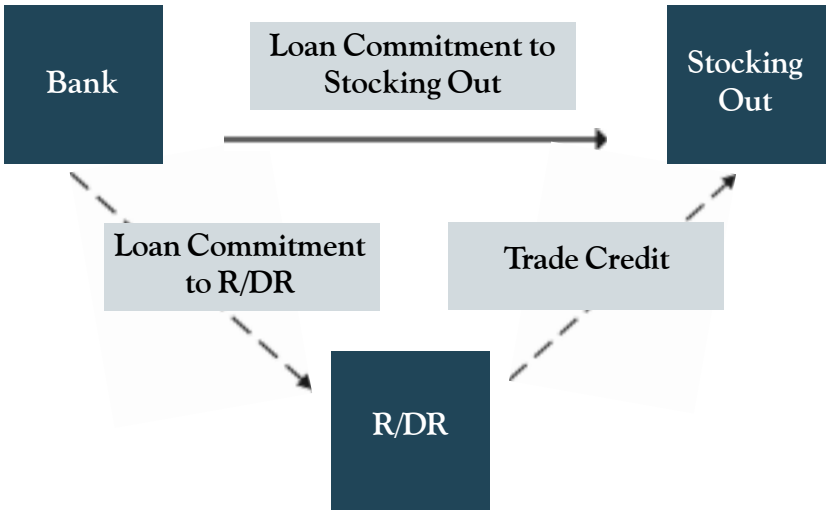
Unlike credit card agreements, loan commitments must be renewed or renegotiated at fixed intervals. For example, a common arrangement for risky borrowers is a loan commitment with a one-year maturity, and in many cases, the inventories purchased with the bank loan serve as collateral for the borrowings. The most notable feature of a loan commitment is its flexibility; the borrower has substantial discretion over the amount it borrows, the maturity of its borrowings, and how to use the funds it borrows.

> Why should a firm borrow short term from a bank, then provide short-term credit to its customers?

**Supplier Trade Credit Is Expensive If Not Repaid Quickly.** A second possibility is that R/DR provides

## FIGURE

Direct Bank Finance vs. Indirect Bank Finance of Trade Credit




[6] Rajan and Petersen are not, of course, the first economists to examine trade credit empirically. Notable early contributions that explicitly view bank loans and trade credit as substitutes include Alan Meltzer's article and Dwight Jaffee's book.

trade credit to Stocking Out. On R/DR's balance sheet, the dollars owed by Stocking Out are an asset called accounts receivable, while the trade credit appears on Stocking Out's balance sheet as a liability called accounts payable. Trade credit comes in a wide variety of terms, but there are two broad types of agreements.[7]

Under a *net contract*, Stocking Out promises to repay R/DR after a fixed period of time; 30 days is the most common maturity, according to Chee Ng, Janet Smith, and Richard Smith's survey results. This contract would be described as "net 30." Although the price Stocking Out pays for the goods will clearly be affected by R/DR's cost of providing credit to its customer, the net contract doesn't include an explicit loan rate.

Alternatively, Stocking Out and R/DR may use a more complicated two-part contract, in which Stocking Out receives a discount for paying within a fixed period, but then must pay the full price for the remaining term of the contract. For example, if the terms of the trade credit are "2/10 net 30" — the most common two-part contract in Ng, Smith, and Smith's survey — Stocking Out receives a 2 percent discount if it pays within 10 days of delivery (the *discount period)* but pays full price between days 11 and 30 (the *net period*).

This sounds like a good deal for Stocking Out, and it is if the credit is repaid within the first 10 days. But this is a *very expensive* form of borrowing if the firm takes longer than 10 days to repay. The implicit annual interest rate for such borrowings is nearly 45 percent. To see this, think about Stocking Out's cost of missing its payment on the 10th day and paying 20 days later. It has effectively chosen to pay 2 percent for 20 days. Thought about differently, if Stocking Out had paid on the 10th day, it could have invested the 2 percent discount on the pricing of goods for 20 days.[8] For the sake of comparison, the annualized interest rate on my credit card is 16.25 percent if I don't pay off the loan balance before the 15th of the month. We might also make a comparison with the rate on a bank loan to a firm without broad access to financial markets. At a time when the prime rate was 4.25 percent, a collateralized loan with a face value of less than $100,000 carried a loan rate of 5.35 percent per year.[9]

Thus, trade credit is expensive compared with a bank loan for any borrower who doesn't pay within the discount period. Not surprisingly, the evidence indicates that firms strongly prefer to borrow from a bank if bank credit is available. For example, in their 1997 article, Mitchell Petersen and Raghuram Rajan show that firms with unused bank credit lines have significantly lower accounts payable — that is, they use less trade credit. Also, firms with long-term relationships with a bank use less trade credit.

**Suppliers Are Financial Intermediaries.** How does R/DR finance its provision of credit to Stocking Out? To a significant extent, R/DR's bank actually finances this credit.[10]

Petersen and Rajan report that larger and older firms typically have larger accounts receivable; that is, they are large suppliers of trade credit. It is reasonable to view a firm's age and size as indicators of its creditworthiness.[11] One interpretation of Petersen and Rajan's results is that larger and older firms have easier access to external finance; they, in turn, act as intermediaries and extend trade credit to other, riskier firms. An even more explicit link between R/DR's access to bank credit and its provision of trade credit is Petersen and Rajan's finding that firms with larger credit lines also have larger accounts receivable. In particular, firms that have drawn down a larger share of their credit lines have even larger accounts receivable, consistent with the view that creditworthy firms effectively finance their provision of trade credit with bank loans.[12]

Jeffrey Nilsen's article examines different firms' use of trade credit during periods of monetary contraction,

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[7] Ng, Smith, and Smith's article documents the wide variety of trade credit terms. Interestingly, their survey data indicate that trade credit terms are much more standardized within industry groups than across industry groups. However, they don't make much progress in explaining cross-industry variation in contract terms.

[8] The formula for the annual interest rate is $[1/(1-\text{discount rate})]^{(\text{days in the year/days borrowed})} - 1 = (1.02)^{(365/20)} - 1$.

[9] Survey of Terms of Business Lending, March 20, 2003. A small "prime plus" loan is a relevant basis for comparison because firms that borrow above prime don't have access to broader financial markets and view a commercial bank as their cheapest source of funds.

[10] See Loretta Mester, Leonard Nakamura, and Micheline Renault's paper for an account of banks' comparative advantage in providing financing for accounts receivable.

[11] See Aubhik Khan's article for a summary of the evidence from the manufacturing sector that a firm's probability of survival increases with age and size.

[12] Bank financing is not the sole external funding source through which R/DR might finance this credit. Large firms also bypass the banking system altogether by selling securities backed by the cash flows from their receivables; that is, they also act as intermediaries between financial markets and the firms to which they grant trade credit. In some industries, providers of trade credit also sell their receivables at a discount to firms known as factors, which specialize in enforcing repayment. See Shehzad Mian and Clifford Smith's article about the variety of institutions involved in financing trade credit.

when banks become stingy and bond markets dry up for all but the most creditworthy firms. William Lang and Leonard Nakamura's article shows that monetary tightness leads to a "flight to quality," in which banks reduce their lending to risky firms. Nilsen demonstrates that in such tight conditions, trade credit usage increases for small firms but not for large firms that have credit ratings from agencies such as Moody's — firms that have the greatest access to bank loans and other sources of outside finance. Firms with access to outside sources of funds continue to tap these sources when credit is tight; they, in turn, provide credit to firms unable to borrow from a bank or sell bonds. That is, firms' role as intermediaries increases during tight financial conditions.

But this account raises a serious question: Why not cut out the middleman? Think about R/DR's bank. As a specialist in collecting funds from savers, the bank almost certainly has a lower cost of funds than the sock manufacturer. Also, banks are specialists in evaluating borrowers' credit risk. Why doesn't the bank simply use its funding advantage to lend *directly* to Stocking Out?

## TRADE CREDIT IMPROVES MONITORING AND ENFORCEMENT

In normal times, R/DR's managers don't lose much sleep over the possibility that Stocking Out will not pay for socks already delivered. But many contracts and institutions are best understood if we think about how well they deal with the stresses and strains of abnormal times. During the last year, Sam's Socks, which offers an entire line of hosiery and socks at discount prices, has placed an outlet within a mile of each of Stocking Out's locations. The Philadelphia economy has entered a downturn as the Christmas season approaches, and the combination of hard economic times and bare-knuckles competition has shrunk Stocking Out's revenues to the point where it is having difficulties meeting its payroll.

**It's Hard to Control How a Borrower Uses Money.** Assume first that Stocking Out has signed a loan commitment with a bank. The flexibility of a loan commitment is one of its main attractions to the borrower. Although the firm must establish that it is creditworthy when the loan commitment is signed — and the loan contract usually contains covenants that require the firm to maintain evidence of financial stability to stay in compliance — the firm has a lot of discretion about how to use the borrowed funds. It can respond quickly and efficiently to opportunities that require funds as they arise.

> Itís hard to control how a borrower uses money...Diverting goods is harder than diverting money.

In normal times, this flexibility is beneficial to the firm and to the bank — notably because the firm is willing to pay for it through the commitment fee and the loan rate. But under mounting financial pressure, Stocking Out might be tempted to exploit this flexibility to avoid cost cutting that may be necessary for the firm to cover its debts. For example, Stocking Out might be tempted to draw down the unused balance of its loan commitment to cover payroll costs when it should be laying off workers and shutting its worst performing stores.

This illustrates a problem stressed by Mike Burkart and Tore Ellingsen in their discussion paper. Cash is relatively easy to divert from its intended purpose.[13] Stocking Out's bank may find itself with an uncollectible loan unless lots of mothers-in-law buy lots of festive socks in the Philadelphia region this Christmas.

Of course, it is the bank's business to attempt to foresee situations like these when the initial commitment is signed and to design the commitment accordingly. Had Stocking Out and its banker foreseen Sam's take-no-prisoners business plan before the loan commitment was negotiated, the loan commitment would have been smaller, its covenants would have been tighter, and it would have had a shorter maturity. All of these would have limited Stocking Out's discretion to misuse funds. But the bank can't foresee every contingency. And if the bank had foreseen Stocking Out's troubles, it might simply have decided that the risks were too large to make a loan at all.

**Diverting Goods Is Harder Than Diverting Money.** Now assume that, in place of signing a bank loan commitment, Stocking Out finances its purchases from R/DR using trade credit provided at 2/10 net 30. Instead of lending money, R/DR provides credit in the form of goods, which are harder to divert than money, according to Burkart and Ellingsen. For example, most employees would refuse to accept hosiery in place of a paycheck, so Stocking Out could not use trade credit to meet payroll costs, and its ability to keep unprofitable stores operating is more limited than it would be with a loan commitment.

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[13] The problem of diversion of funds is more pervasive than this extreme example suggests. Diversion can refer to any use of funds that would reduce a lender's expected repayments.

Stocking Out may actually increase its access to credit by borrowing from its supplier rather than its bank, because borrowing goods instead of money permits the firm to make a credible commitment not to divert the loan for unprofitable purposes. So, trade credit may be the lowest cost way for Stocking Out to borrow, even though its bank has a lower cost of funds than R/DR. If a firm's temptation to divert funds for unprofitable purposes is greatest when it faces financial difficulties, Burkart and Ellingsen's model may help explain the empirical evidence that less creditworthy firms rely on trade credit and that trade credit usage increases when economic conditions are difficult and financial markets are tight.[14]

The structure of the two-part contract may also facilitate monitoring. The sharp rise in the cost of borrowing at 10 days acts as a tripwire: R/DR will notice immediately if payment isn't made by the 10th day, especially if Stocking Out seldom borrows into the net period. This view finds support in suppliers' responses to a survey conducted by Ng, Smith, and Smith. They report that one-half of the respondents from firms that offer two-part trade credit view payments beyond the discount period as a sign of financial difficulty.[15]

I've been comparing a standard bank lending arrangement to supplier-provided trade credit. See *Why Can't a Bank Duplicate Supplier-Provided Trade Credit?* for a discussion of why the

[14] In Burkart and Ellingsen's model, firms can also borrow using a mixture of bank loans and trade credit when potential diversion problems are moderate.

[15] The usefulness of payment beyond the discount period as a tripwire assumes that firms do not routinely make payments beyond the discount period. Petersen and Rajan's 1994 article shows that, in most industries, a significant majority of firms take advantage of the early payment discounts over 90 percent of the time.

## WHY CAN'T A BANK DUPLICATE SUPPLIER-PROVIDED TRADE CREDIT?

Consider the following imaginary "bank loan." The bank gives Stocking Out a check written out to R/DR, and the retailer must repay the bank the face value of the check within 30 days. If Stocking Out pays back the bank within 10 days, it receives a 2 percent discount on the amount of the loan.

Note, this arrangement is essentially identical to the 2/10 net 30 credit described in the text, except that the bank provides the credit rather than R/DR. Providing the loan in the form of a check payable to R/DR ensures that the loan can't be used for anything but purchasing goods from the manufacturer. This overcomes the problem that money is easier to divert than goods. The two-part structure of the contract provides identical incentives to Stocking Out for early payment, and the 10-day tripwire provides the bank with identical information about the retailer's financial health. Finally, since Stocking Out must get a new check to pay for the next delivery of goods, R/DR would have the same incentive to continue making shipments — or to refuse to make further shipments — in the event Stocking Out can't repay the bank within 30 days.

This contract won't work for two main reasons. The more important reason is that a single firm will have many different suppliers; that is, for *each* borrower the bank must monitor a *portfolio* of contracts, rather than a single contract. Supply arrangements differ across different types of suppliers: Some typically use a net 30 contract, others use 2/10 net 30, and yet others use 2/10 net 20. Firms also change suppliers. The amount of information required for the bank to appropriately design and monitor a constantly shifting portfolio of contracts for each firm in its loan portfolio would be prohibitive.

The second reason is that the firm and its suppliers will have incentives to collude against the bank. For example, a supplier may be willing to provide inputs to a firm — perhaps at an artificially high price — knowing the firm has a large risk of not repaying. The risk of default is shifted to the bank, while the supplier gains the benefits of the sale. Again, the bank would need a prohibitive amount of knowledge about each transaction to prevent collusion.*

*This argument is slightly misleading because any three-party interaction can generate incentives for two parties to shift risks to a third. In particular, a variant of this problem arises any time a firm uses both bank loans and trade credit. Bruno Biais and Christian Gollier's article examines the incentives for a firm and its trade creditors to act collusively against the firm's bank or for a firm and its bank to act collusively against trade creditors.

bank can't profitably duplicate R/DR's contract.

**Empirical Evidence.** To a large extent, the enforcement advantage of trade credit flows from the supplier-customer relationship, rather than from formal recourse to legal institutions and debtor-creditor law. For this reason, some researchers call trade credit a type of *informal finance,* in contrast to bank loans. Some of the most interesting empirical evidence that monitoring and enforcement concerns are central to understanding trade credit comes from recent cross-national studies of firms' borrowing patterns.

Asli Demirguc-Kunt and Vojislav Maksimovic's working paper finds that firms are more likely to rely on trade credit in countries where legal institutions are less efficient. So, in a country where judges are easily paid off or where the police powers of the state are weak, firms can't rely on the state to enforce loan contracts. Thus, they tend to rely more heavily on trade credit. Raymond Fisman and Inessa Love's article finds that industries that tend to depend on trade credit grow faster than other industries in nations with weak financial institutions.[16] The authors interpret this to mean that in the absence of factors associated with well-developed financial institutions — for example, transparent accounting standards and incorruptible legal institutions — industries less dependent on bonds or bank loans face fewer barriers to growth.

Nilsen's finding that small, unrated firms in the U.S. increase their use of trade credit during a monetary contraction also supports the view that enforcement concerns are important for explaining the use of trade credit. One reason that large, creditworthy firms take over a greater share of the job of providing credit to small, riskier firms is that they have an advantage in monitoring these firms when incentive problems are greatest. In effect, banks delegate the task of monitoring the riskiest firms. When financial conditions are less difficult, close monitoring is less important, and banks increase their share of the financing of working capital for riskier firms.

A study of Vietnamese firms shows that firms are more likely to provide trade credit to customers with whom they have exclusive buyer-seller relationships.

## LONG-TERM SUPPLY RELATIONSHIPS ARE IMPORTANT

The option to cut off shipments for nonpayment is a potentially powerful means for a trade creditor to force repayment, especially if a supplier provides its customer with a product that has no close substitutes. Even if a firm could find ready substitutes, the threat to withhold shipments will carry weight, since other suppliers may not provide credit if word gets out that the retailer's troubles are serious enough to affect its payments to trade creditors.

But a firm with a long-term supply relationship with its customer will not carry out this threat lightly because it has a natural interest in the long-term health of its customers. While R/DR doesn't want to throw money down the drain in a hopeless attempt to keep the retailer afloat, it also knows that Stocking Out provides R/DR more prominent shelf-space than it could ever hope for with Sam's. Its own profits are likely to be larger if Stocking Out retrenches to cut costs but stays in business and continues to purchase R/DR's goods in the future. In these circumstances, a supplier's interest in the long-term profitability of its important customers can be compared with owning shares of stock in a customer's firm.

R/DR may rationally continue to draw on its own sources of credit and provide trade credit when Stocking Out's bank wouldn't. Along with its long-run interest in the retailer's survival, R/DR may also have better information than a bank about some of Stocking Out's problems. For example, the producer will know better whether a decline in demand for R/DR's socks is an independent cause of the retailer's problems, since it sells through outlets other than Stocking Out.[17]

**Empirical Evidence.** Petersen and Rajan's article provides evidence that suppliers of trade credit are willing to continue to provide credit even to firms with negative profits, but only if their customers' sales are increasing. This is consistent with the view that

[16] The authors use the financial structure of firms in the U.S. as the standard for ranking industries according to their reliance on trade credit, arguing that firms in the U.S. secure funds in the most highly developed financial markets in the world. The view that the financial structure of U.S. firms is a reasonable standard for ranking firms relies on empirical evidence that industry group is the most important determinant of a firm's capital structure. That is, a textile manufacturer in one country tends to have a capital structure similar to that of a textile manufacturer in another country with very different financial laws and institutions.

[17] It should be noted that Stocking Out gains bargaining power to the extent that R/DR sees no ready substitute for Stocking Out as an outlet for its goods. I emphasize the potential gains to both firms from a close bilateral relationship. But with no ready substitute, R/DR may find it difficult to credibly threaten to withhold future deliveries. Benjamin Wilner's article emphasizes this aspect of trade credit.

suppliers are willing to provide credit to financially troubled borrowers, but only if the customer is likely to provide a continuing and growing demand for the supplier's goods. Similarly, a significant number of the firms surveyed by Ng, Smith, and Smith report that they are willing to extend the discount period, especially for long-term customers. A study of Vietnamese firms by John McMillan and Christopher Woodruff shows that firms are more likely to provide trade credit to customers with whom they have exclusive buyer-seller relationships. This supports the view that it is helpful to think of the supply relationship as being similar to owning shares in a customer's firm.

I have concentrated on two explanations for the use of trade credit: monitoring and enforcement advantages and the potential gains from long-term supply relationships. But trade credit is widely used across a range of industries; thus, in practice, there are likely to be multiple reasons for its use. (See *Other Theories of Trade Credit*.)

## SUMMARY

When a firm provides trade credit to a customer, it is acting as an intermediary. The firm is using its own funds or funds provided by a specialized financial intermediary — for example, a bank line of credit — and passing the credit on to its customers. This raises a fundamental puzzle: Why shouldn't the bank and the firm receiving the trade credit cut out the middleman altogether? Why not leave financing to the financing specialists and leave production and selling to the producers and sellers of goods?

Actually, there are good reasons for creditworthy firms to combine the supply of credit and goods to some of their less creditworthy customers. Suppliers may have advantages in monitoring and enforcing loan contracts. They may also be more flexible than banks when their customers face financial troubles because of the long-term nature of many supply relationships. These advantages may be particularly important in nations where creditors have difficulties collecting on debts because the rule of law is weak or the courts are easily corrupted. Recent cross-national studies — and a limited number of case studies — have shown that supplier-provided credit works comparatively well, even in countries where bank loans or other sources of finance are not easily available.

Since it is hard to transform a country's legal environment or banking system over any time horizon—much less in the short run—it is very tempting to draw policy prescriptions from these cross-national studies. Some policymakers view the empirical evidence as support for public policies to encourage trade credit in developing countries where it is not already prevalent. They hope that trade credit may offer a short cut to expand firms' access to finance in nations with weak legal institutions. But the evidence is only suggestive and offers no clear policy prescription. To address policy-related questions like these, researchers will have to understand in much more detail how and why trade credit works in those nations where it already flourishes.

## OTHER THEORIES OF TRADE CREDIT

Michael Brennan, Vojislav Maksimovic, and Josef Zechner's article explains trade credit as a method for firms to engage in price discrimination by combining the good along with credit. By law, firms are precluded from offering identical goods at different prices; offering the product along with subsidized credit may permit a firm to lower its price to firms whose goods are sensitive to changes in price.

Bruno Biais and Christian Gollier's article suggests that firms and banks have different types of information about firms that can be aggregated. In their model, firms are unable to secure a bank loan unless the bank lender sees that suppliers are willing to provide credit, because it needs the assurance the suppliers' information about the firm is favorable.

Murray Frank and Vojislav Maksimovic's working paper argues that trade creditors may have a comparative advantage over banks or other creditors in liquidating certain types of inventories. J. Stephen Ferris's article emphasizes that trade creditors can reduce transaction costs in the presence of uncertainties about delivery times and production needs. In particular, the use of trade credit reduces a firm's need to hold precautionary money balances.*

*See Petersen and Rajan's 1997 article for a discussion of some other theories.

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# The Long and the Short of It:
## Recent Trends and Cycles in the Third District States

BY THEODORE M. CRONE

Most discussions of business cycles focus on the national economy. But regional cycles are also important, and they can vary significantly from one region to another. Analysis of regional cycles can help businesses plan investments, project sales, decide whether to enter new markets, or identify trend growth in current ones. A look at the economies of the Third District states—Pennsylvania, New Jersey, and Delaware—illustrates how trends and cycles can differ even among neighboring states. In this article, Ted Crone traces the historical patterns of the three states' economies but warns that noting such patterns is not a substitute for detailed current analysis.

In early 2001, the longest economic expansion in U.S. history came to an end. The recession that followed served to remind us that even the most advanced economies continue to experience cycles of expansion and contraction. Most discussions of business cycles focus on the national economy. But regional cycles are important as well, and they can vary significantly from one region to another. For businesses whose markets are concentrated in one state or a few neighboring states, regional trends and cycles are crucial for projecting sales, planning production, and making capital investments. Businesses that want to diversify across states or regions seek to serve markets whose cycles do not always coincide with one another. Firms also need to identify trend growth in the markets they serve to make rational investment decisions.

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An analysis of the economies of the three states in the Third Federal Reserve District (Pennsylvania, New Jersey, and Delaware) illustrates how trends — long-run growth of economic output — and cycles — fluctuations around the trend — can differ even among neighboring states. Among the three District states, economic growth over the past two decades has been stronger in Delaware and New Jersey than in the nation; Pennsylvania's growth, however, has been weaker than the national average. But for each of the three states, trend growth has varied considerably over the past 20-some years. Also, economic downturns have generally been more severe in Pennsylvania than in the U.S. or in the neighboring states of New Jersey and Delaware, but this has not been true for each downturn. While historic patterns are helpful in analyzing state economies, trends can change and every business cycle is different; therefore, an understanding of historic patterns is important but only as a guide not as a substitute for detailed current analysis.

### MEASURING A STATE'S ECONOMY

Business writers and financial commentators often refer to "the U.S. economy," "the regional economy," or "the local economy." To what are they referring? It's not just the stock market; it's not just the banking industry; it's not just manufacturing. It is all of these and more. "The economy" in this sense includes all the activity that goes into providing the goods and services that a nation, a region, or a locality produces and distributes over a given period of time. At the national level, we measure economic activity every quarter by adding up the monetary value of all those goods and services; we call this measure gross domestic product (GDP).

But how do we measure a state's economy and calculate its growth? State governments and the

federal government produce a number of measures, and each has its advantages and disadvantages.

Gross state product (GSP), published by the national Bureau of Economic Analysis, is the state counterpart to gross domestic product for the nation. As such, it is the most comprehensive measure of output in a state. If GSP were available monthly or quarterly, it would be the ideal measure for establishing the trend and the cycles in a state's economy. Unfortunately, GSP is available only on an annual basis, and it is published with a considerable lag.[1] Since economic downturns are measured in months rather than years, changes in annual GSP are not a good measure of the length and depth of these downturns. Moreover, because GSP data are released with a lag, they are not useful for current analysis of the business cycle. But other state data are published more frequently and without such a long lag.

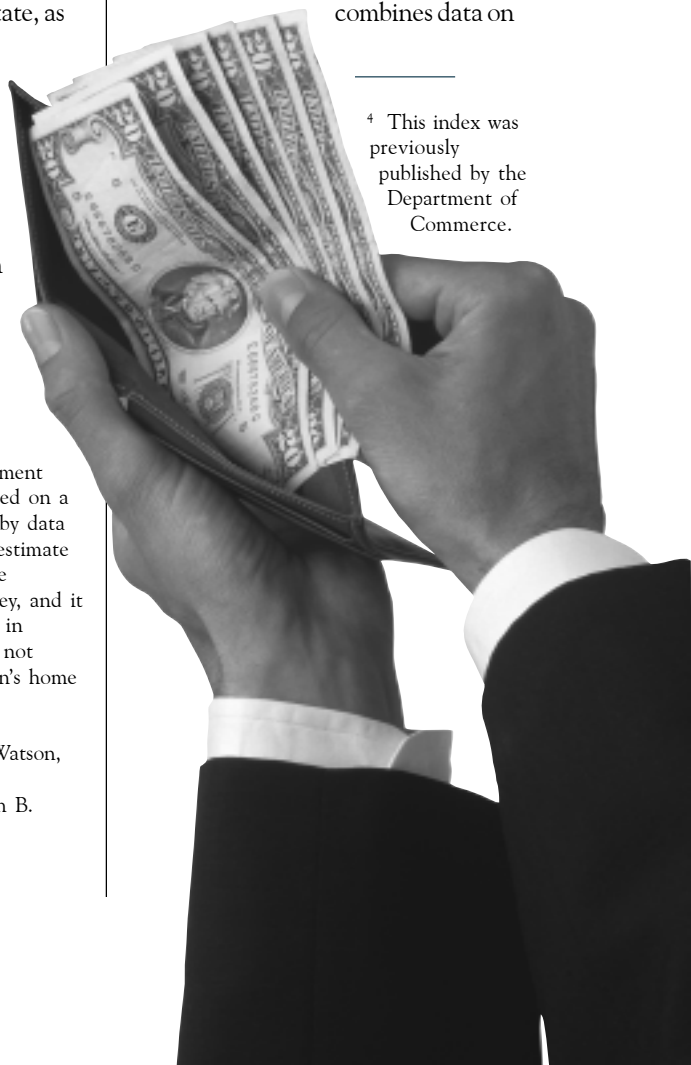
The Bureau of Economic Analysis also publishes personal income at the state level on a quarterly basis. Most components of personal income (for example, wages, proprietors' income, interest, and rent) represent payments to the workers, owners, or lenders who contribute in some way to production. These payments are measures of the value added in the economy.

But personal income also has some drawbacks as a measure of economic activity in the state. For example, transfer payments such as social security benefits and government pensions are included in personal income, but they do not represent payment for current production. Other components of personal income in a state, such as dividends, interest, and rents, may reflect production that took place outside the state and should not be included in a measure of the state's economic activity. Also, state personal income is published quarterly and with some lag. Quarterly data are better than annual data for analyzing business cycles, but monthly data would be preferable. Moreover, state personal income data are normally released about four months after the end of a quarter, so they are not as current as other data on the state's economy.

Personal income also has some drawbacks as a measure of economic activity in the state.

Monthly employment and unemployment data are published at the state level, and they are available before the end of the following month. Most analysts view the monthly nonfarm employment number, derived from a survey of establishments in the state, as the best current measure of a state's economic activity.[2] At the national level, the cyclical changes in nonfarm employment are highly correlated with changes in GDP with a slight lag,[3] and the monthly change in nonfarm employment is a major factor in dating the peaks and troughs of U.S. business cycles. But employment, or the total number of nonfarm jobs, is an imperfect measure of the output of a state's economy for a couple of reasons. First, the total number of jobs does not account for the number of hours worked. Second, a change in productivity — output per hour worked — can affect output without any change in employment.

The lack of a timely monthly indicator of output at the national or regional level has led to the search for a composite monthly index of economic activity that combines information from several indicators. Perhaps the best known composite index for the U.S. economy is the coincident index published by the Conference Board.[4] It combines data on



[1] When this article was completed in early 2003, the latest available GSP data were for the year 2000.

[2] There is a second statewide employment measure, residential employment, based on a household survey and supplemented by data from the establishment survey. This estimate of employment is less precise than the estimate from the establishment survey, and it includes residents whose jobs may be in neighboring states. These jobs would not contribute to production in the person's home state.

[3] See James H. Stock and Mark W. Watson, "Business Cycle Fluctuations in U.S. Macroeconomic Time Series," in John B. Taylor and Michael Woodford, eds., *Handbook of Macroeconomics, V.I-A.* (Elsevier, 1999), pp. 3-64.

[4] This index was previously published by the Department of Commerce.

nonfarm employment, personal income minus transfer payments, the Federal Reserve Board's index of industrial production, and manufacturing and trade sales.[5]

In the late 1980s, James Stock and Mark Watson developed an alternative index of monthly activity for the U.S. economy using essentially the same indicators but based on a statistical model to estimate the "underlying state of the economy."[6] Recently, the Federal Reserve Bank of Philadelphia published coincident indexes for each of the 50 states based on a Stock and Watson-type model.[7] Most of the data series that Stock and Watson and the Conference Board use for their indexes, however, are not available at the state level. The state indexes are based on monthly nonfarm employment, the unemployment rate, average hours worked in manufacturing, and quarterly wage and salary disbursements, adjusted for inflation.[8] For comparison purposes, I have also estimated a U.S. index using the same variables as in the state indexes.[9] The analysis of trends and cycles in the three states in the Third District is based on these indexes for the states and the comparable national index (Figure 1).

## DISTINGUISHING TRENDS FROM CYCLES

A classic recession is characterized by an absolute decline in output and other measures of economic activity. In the United States, the National Bureau of Economic Research (NBER) determines the official dates for the beginning and end of these recessions. The four official recessions since 1980 were marked by a decline in the U.S. economic activity index that I have constructed (Figure 1). Official recessions are indicated by the shaded bars in the figure. Besides official recessions, however, there are other periods when jobs become more difficult to find, growth in output slows even if output does not decline, and the unemployment rate rises slightly. We sometimes hear the refrain: "It may not be a recession, but it sure feels like one." In the midst of each of the last two expansions, the U.S. economy experienced a period of slow growth.[10] These

[5] The data for personal income and trade sales are adjusted for inflation.

[6] See James H. Stock and Mark W. Watson, "New Indexes of Coincident and Leading Economic Indicators," *NBER Macroeconomics Annual* (1989), pp. 351-94; James H. Stock and Mark W. Watson, " A Probability Model of the Coincident Economic Indicators," in Geoffrey Moore and K. Lahiri, eds., *The Leading Economic Indicators: New Approaches and Forecasting Records* (Cambridge University Press, 1990,) pp. 63-89. For a less technical description of this model, see Theodore M. Crone, "New Indexes Track the State of the States," Federal Reserve Bank of Philadelphia *Business Review*, January/February, 1994, pp. 19-31. Stock and Watson use the same monthly series as the Conference Board with one exception: They use total hours worked in nonagricultural establishments rather than nonfarm employment.

[7] Theodore M. Crone, "Consistent Economic Indexes for the 50 States," Federal Reserve Bank of Philadelphia, Working Paper 02-7/R (June 2003). Sufficient data are not available to calculate these indexes prior to 1979. These indexes can be found at www.phil.frb.org/econ/stateindexes/index.html.

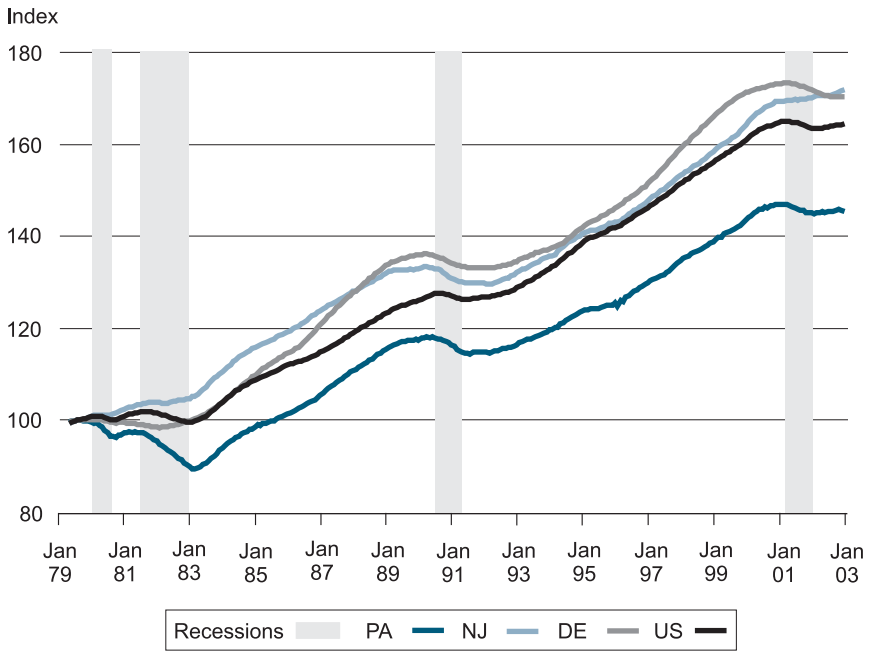
[8] Since the indexes are meant to reflect output at the state level, each state's index is adjusted so that the long-run growth in the index is equal to the long-run growth in the state's GSP.

[9] To make this national index comparable to the state indexes, the national wage and salary data are taken from the quarterly personal income report for the states, and the average increase in the U.S. index is set to the average for the combined GSP for all 50 states.

[10] In the long expansion of the 1980s, a period of slow growth occurred in 1985-86; in the expansion of the 1990s, a period of slow growth occurred in 1995. See Victor Zarnowitz and Ataman Ozyildirim, "Time Series Decomposition and Measurement of Business Cycles," The Conference Board, Economics Program Working Paper Series 01-04 (December 2001).

**FIGURE 1**

**Economic Activity Indexes**



periods are often called growth recessions because economic growth dips below its current trend.

To identify these growth recessions, we need to distinguish the current trend from the cyclical movement in economic activity. The simplest definition of trend growth is some long-run average, for example, the average growth of real GDP in the post-World War II period. This understanding of trend growth was common in the 1960s and 1970s. But it is not difficult to imagine that structural changes in the economy, such as a reduction of trade barriers, or changes in the rate of innovation and productivity growth could change trend growth. So in the 1980s some economists began to look for evidence of identifiable breaks in trend growth in the U.S. economy. Others thought of the trend as changing from one period to the next. This debate about how to characterize trend growth has not been settled.[11] It seems reasonable to assume, however, that trend growth can and does change over time. Marianne Baxter and Robert King have developed a commonly used statistical technique to separate a slowly evolving trend from the cyclical movements in any data series that exhibits trends and cycles.[12] I use their technique to separate trend from cycle in the economic activity indexes for the states and the nation.

## SIGNIFICANT DIFFERENCES IN TREND GROWTH AMONG THIRD DISTRICT STATES

A cursory glance at some common measures of economic activity illustrates how widely total growth has varied among Pennsylvania, New Jersey, and Delaware over the past 20-some years (Table 1). The table shows total growth for real GSP, real personal income, and nonfarm employment for each of the three states and the U.S. between 1979 and 2000.[13] By these measures, New Jersey and Delaware generally outperformed the nation while Pennsylvania lagged far behind. For example, real output (GSP) more than doubled in New Jersey and Delaware, but it increased at only about half that rate in Pennsylvania. There is only one exception to this pattern of slower than average growth in Pennsylvania and faster than average growth in Delaware and New Jersey. New Jersey's output and income grew faster than the nation's, but jobs grew more slowly. In effect, New Jersey's economy has shifted toward jobs with higher productivity and earnings.

Since trends can vary over time, the total growth reported in Table 1 does not indicate what trend growth would be for a state at any point in time. Figure 2 shows the trend components of the state and national indexes derived using Baxter and King's technique.

> Labor force growth varies more at the state level than at the national level.

Trend growth varies over time for all three states and the U.S., and it varies more for the states than for the nation.[14] It's not surprising that trends change more at the state level than at the national level. Growth in the labor force

[11] See Francis X. Diebold and Glenn D. Rudebusch, "Five Questions about Business Cycles," *Economic Review*, Federal Reserve Bank of San Francisco, 2001, pp. 1-15.

[12] See Marianne Baxter and Robert G. King, "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Times Series," *Review of Economics and Statistics*, 81(1999), pp. 575-93. Business cycles are represented by periods of slower-than-average growth followed by faster-than-average growth that last 18 months to eight years. Longer run movements in the data represent the trend. This technique also filters out short-term irregular movements in a series (less than 18 months).

[13] We chose this time span because the economic activity indexes we use in this article begin in 1979 and GSP is not available after 2000.

[14] Monthly trend growth for the U.S. ranges from 0.29 percent to 0.02 percent, with a standard deviation of 0.08 percent. For Pennsylvania, the range of monthly trend growth is 0.35 percent to -0.11 percent, and the standard deviation is 0.13 percent. For New Jersey, the range is 0.32 percent to 0.04 percent, and the standard deviation is 0.08 percent. For Delaware, the range is 0.41 percent to zero percent, and the standard deviation is 0.12 percent. Figure 2 plots the trend of the log of each index, so that the slope of the line is approximately the growth rate.

**TABLE 1**

**Total Growth for Measures of Economic Activity 1979-2000 (Percent)**

| | Real GSP | Real Personal Income | Nonfarm Employment |
|---|---|---|---|
| **US** | 89.5 | 70.8 | 45.7 |
| **PA** | 55.3 | 40.7 | 18.4 |
| **NJ** | 102.2 | 73.8 | 32.0 |
| **DE** | 107.8 | 80.3 | 63.6 |

is a major factor in how fast an economy can grow, and at the state level, growth of the labor force is affected not only by international migration but also by migration between the states. Therefore, labor force growth varies more at the state level than at the national level.[15] Also, firms can move more easily from state to state than they can from one country to another. These relocations can change the structure of a state's economy and its trend growth.

The most obvious feature in Figure 2 is the gap between the trend component in Pennsylvania's economy and the trends in the U.S. and the neighboring states.[16] The slower trend growth in Pennsylvania in part reflects very slow labor force growth in the state. On average, Pennsylvania's labor force increased only about 0.7 percent a year between 1979 and 2002. Moreover, the state's economy was traditionally dominated by manufacturing industries that were in decline in the last two decades of the 20th century, and in Pennsylvania, other industries did not expand to take the place of those that were on the wane.[17] Although Pennsylvania's trend growth has generally been slower than the nation's, it did surpass the national average for a four-year period in the mid-1980s and a two-year period in the late 1990s.[18] These episodes illustrate that even states like Pennsylvania with low overall trend growth can have spurts of growth that push them temporarily above the national average.

Among the three states in the Third District, New Jersey has had the most consistent trend growth over the past 22 years.[19] Higher productivity rather than increased employment generated most of the growth in New Jersey. However, in the period between January 1987 and November 1996, New Jersey's trend dropped below the national trend. It is difficult to pinpoint the causes of the lower trend in New Jersey during this period, but changes in federal and state tax laws may have played a role. Changes in the federal income tax law in 1986 lengthened the depreciation schedule for income-producing property. This change seems to have had a greater impact in New Jersey than in other states. The value of both residential and nonresidential construction contracts declined 60 percent or more in New Jersey after the 1986 tax changes. These declines were

[15] The standard deviation of the annual change in the labor force in Pennsylvania from 1979 to 2002 was almost twice the standard deviation of the change in the nation. In New Jersey, the standard deviation in the annual change in the labor force was almost two and a half times the standard deviation of the change in the nation, and in Delaware, the standard deviation of labor force growth was more than three and a half times the standard deviation of the national growth.

[16] Because the trend is a moving average, a large negative decline in the economy can result in a slower trend around that period. The two severe downturns in the early 1980s probably contributed to the lower trend for Pennsylvania in the early 1980s.

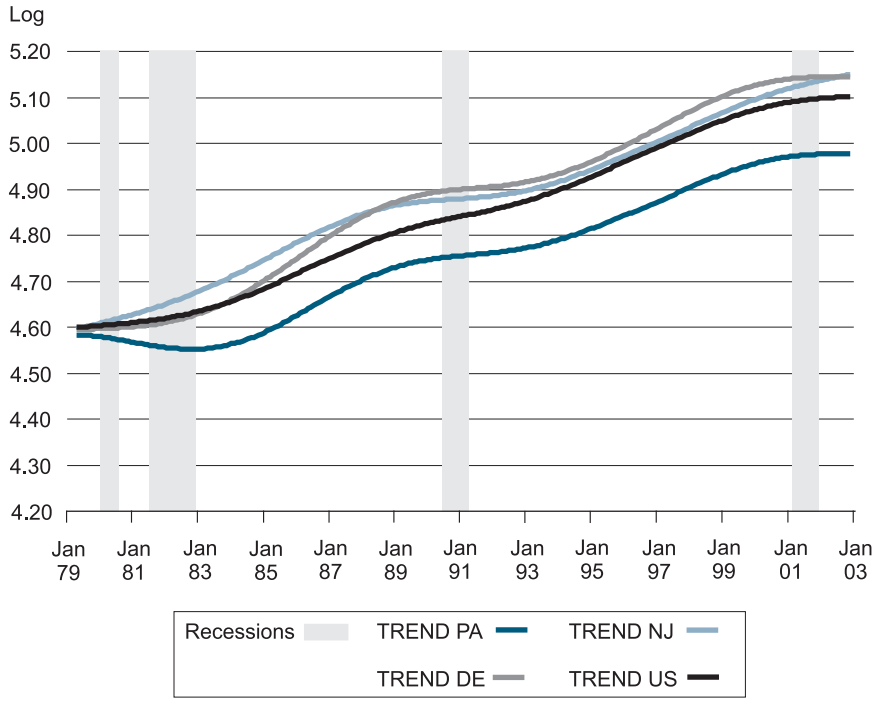
[17] For a discussion of some of the economic forces behind this decline in the state's manufacturing sector, see Theodore M. Crone, "Where Have All the Factory Jobs Gone—and Why?" Federal Reserve Bank of Philadelphia *Business Review* (May/June 1997).

[18] The state had higher trend growth than the nation from December 1984 to November 1988 and from June 1997 to October 1999. Since 1979, Pennsylvania has generally had slower trend growth than New Jersey; however, for a five-year period (August 1985 to November 1991), Pennsylvania had faster trend growth than New Jersey. In two short periods since 1979 (December 1990 to December 1992 and December 1999 to October 2002), Pennsylvania also had faster trend growth than Delaware.

[19] See footnote 14 for the ranges and standard deviations of monthly trend growth in the three states.

## FIGURE 2

### Trend Component of the Economic Activity Indexes



much greater than the declines at the national level. New Jersey state income taxes were also raised significantly in 1990 to cover a state budget deficit. This too may have slowed growth in the state's economy.

Trend growth has varied more in Delaware than in either of the other two states in the Third District. Delaware's faster overall growth is primarily due to very rapid trend growth in the mid- to late 1980s. In 1981 Delaware passed the Financial Center Development Act, which encouraged banks, especially credit card banks, to locate in the state.[20] This act had a profound effect on the structure of the state's economy. Jobs in the finance, insurance, and real estate sector increased between 8 percent and 18 percent every year between 1982 and 1988.[21] These high rates of growth were not sustained in the 1990s, but growth in the broad financial services sector in Delaware still outpaced growth at the national level. Jobs in finance, insurance, and real estate comprised only 5 percent of Delaware's jobs in 1981 but more than 12 percent in 2002.

Trend growth has varied not only among the three states in the Third District but within each state over time. But certain patterns stand out. Pennsylvania's trend has been significantly lower than that of the other two states, and Delaware's trend has varied more over time than the trends in the other two states.

[20] See Janice M. Moulton, "Delaware Moves Toward Interstate Banking: A Look at the FCDA," Federal Reserve Bank of Philadelphia *Business Review* (July/August 1983).

[21] This compares with growth rates between 1.5 percent and 5.5 percent for the U.S. in those years. Employment data on the components of the finance, insurance, and real estate sector in Delaware are not available prior to 1984.

## BUSINESS CYCLES IN THE THREE STATES: DIFFERENCES IN TIMING AND DEPTH

The classic understanding of a business cycle includes an expansion of economic activity followed by a recession or contraction and a revival of activity that leads to the next expansion.[22] In the classic definition of a business cycle, a recession is a period of sustained absolute decline in economic activity, and an expansion is a period of increasing levels of activity. The ability to distinguish between trends and cycles allows us to apply business-cycle analysis to those periods in which the cyclical component of the national or state economy is rising or declining. Figure 3 shows the cyclical components of the economic activity indexes for the United States and the three states in the Third District. Those periods in which the economy falls below its trend — i.e., when the line goes below zero — are called growth recessions. According to Figure 3 there have been two growth recessions in the national economy since 1979 that were not associated with classic recessions — one in the mid-1980s and one in mid-1990s.[23] However, since the economy tends to grow more slowly for some months before a classic or a growth recession, the cyclical component of the economy begins to decline before the beginning of the recession. We will refer to periods when the cyclical component is declining as cyclical downturns, and since the late 1970s, they have always been longer than the official recessions. We will refer to periods in which the cyclical component is rising as cyclical expansions.

In the classic definition of a business cycle, a recession is a period of sustained absolute decline in economic activity, and an expansion is a period of increasing levels of activity.

After recessions end and the overall economy begins to expand, the cyclical component may remain negative for several months even as it rises from its low point.

**Cyclical Downturns in the Tri-State Region.** How do the cyclical downturns in the three states compare to the national downturns? We can look at the peaks and troughs of the cyclical component of the state and national economic indexes as well as the total decline in the cyclical component in each downturn (Table 2). Pennsylvania has suffered the same number of cyclical downturns since 1979 as the U.S., and Pennsylvania's downturns have generally been the same length as or shorter than the corresponding national downturns.[24] But the timing of Pennsylvania's downturns differed somewhat from the timing of national downturns. Five of the six downturns since 1979 began earlier in Pennsylvania than in the U.S. And Pennsylvania's

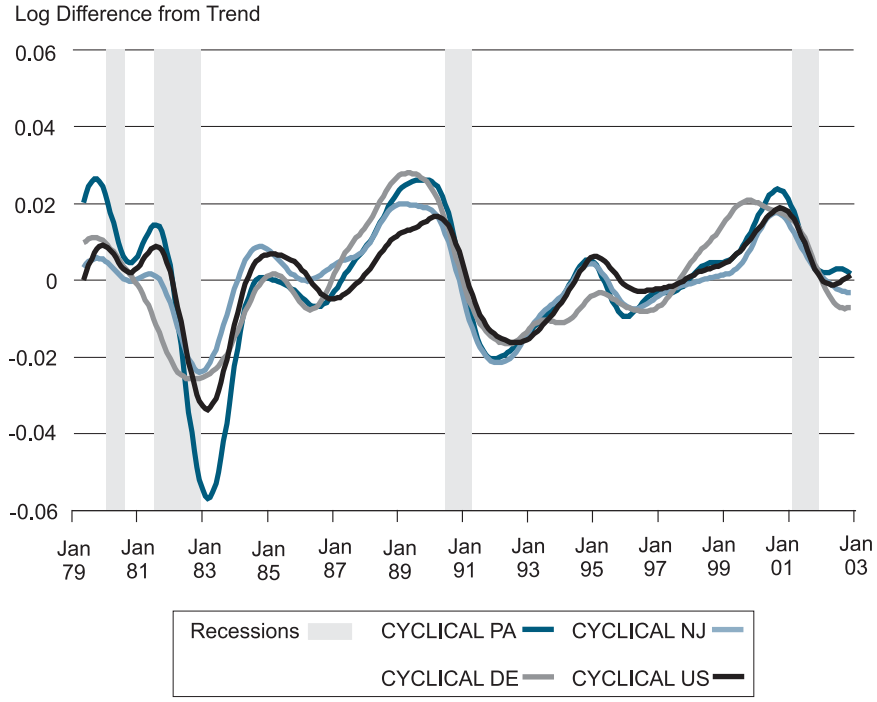
[22] The classic description is found in Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, NY: National Bureau of Economic Research, 1946.

[23] In their decomposition of trends and cycles in the U.S. economy, Zarnowitz and Ozyildirim (2001) find growth recessions in the U.S. economy during the same two periods.

[24] The exceptions are the downturn in 1979-80, which lasted two months longer in Pennsylvania than in the U.S., and the most recent cyclical downturn that began in 2000.

## FIGURE 3

**Cyclical Component of the Economic Activity Indexes**




## TABLE 2

**Changes in the Cyclical Components of Economic Activity Indexes During Cyclical Downturns**

| | PA | NJ | DE | US |
|---|---|---|---|---|
| Peak | Sep-79 | Sep-79 | Aug-79 | Nov-79 |
| Trough | Sep-80 | Oct-80 | | Sep-80 |
| Total % Change Peak to Trough | -2.2 | -0.6 | | -0.7 |
| Peak | Jul-81 | May-81 | | Jul-81 |
| Trough | Feb-83 | Nov-82 | Aug-82 | Feb-83 |
| Total % Change Peak to Trough | -6.9 | -2.5 | -3.6 | -4.2 |
| Peak | Nov-84 | Sep-84 | Feb-85 | Feb-85 |
| Trough | Jun-86 | Mar-86 | Apr-86 | Dec-86 |
| Total % Change Peak to Trough | -0.8 | -0.9 | -0.9 | -1.2 |
| Peak | Oct-89 | Feb-89 | Apr-89 | Mar-90 |
| Trough | Dec-91 | Feb-92 | May-92 | Aug-92 |
| Total % Change Peak to Trough | -4.6 | -4.1 | -4.4 | -3.2 |
| Peak | Nov-94 | Dec-94 | Mar-95 | Feb-95 |
| Trough | Jan-96 | Apr-96 | Aug-96 | Jun-96 |
| Total % Change Peak to Trough | -1.5 | -1.2 | -0.5 | -0.9 |
| Peak | Sep-00 | Aug-00 | Nov-99 | Oct-00 |
| Trough | — | — | — | — |

cyclical downturns have generally been more severe than the corresponding national ones; that is, the percentage decline in the cyclical component of the state's economy has been greater than the decline in the nation's economy.[25]

Like Pennsylvania, New Jersey has suffered the same number of cyclical downturns as the U.S. since 1979. Also, all New Jersey's downturns have begun earlier than their U.S. counterparts, and most have been shorter. New Jersey experienced less severe downturns than the nation through most of the 1980s. The two cyclical downturns between 1989 and 1996, however, were more severe in New Jersey than in the nation. This is the same period in which trend growth in New Jersey dipped below the national average, so the state's economic growth suffered on both counts.

The cyclical pattern in Delaware's economy has differed in a significant way from the patterns in the nation and the other two states in the Third District. Delaware suffered one long cyclical downturn between August 1979 and August 1982 — a period that spanned two downturns for the nation and for the other two states in the region. Despite the length of the cyclical downturn in Delaware in the early 1980s, the cyclical decline in Delaware was less severe than the decline at the national level between 1981 and 1983. From 1989 to 1992, however, the cyclical component of Delaware's economic activity index had a much larger percentage loss than the nation's. This downturn was also longer in Delaware than in the nation. But the length of the cyclical downturns in the three states has not always corresponded to their relative severity.

[25] The one exception is the downturn in Pennsylvania between November 1984 and June 1986. The decline in Pennsylvania was less than the decline at the national level.

**Cyclical Expansions in the Tri-State Region.** Just as Pennsylvania's cyclical downturns have been more severe than the national downturns, cyclical expansions in the state have also been stronger (Table 3). In short, Pennsylvania's economy is more sensitive to the business cycle than the U.S. economy. Part of the explanation for the more pronounced business cycles in Pennsylvania is that the state's economy is more heavily weighted toward the manufacturing sector than is the nation's.[26] And manufacturing industries are more cyclically sensitive than other industries. Just as economic downturns have tended to begin earlier in Pennsylvania than in the nation, three of the last five cyclical expansions have begun earlier in the state than in the nation, and the other two have begun at the same time.

New Jersey's cyclical patterns differed somewhat between the 1980s and the 1990s. In the 1980s, the state's cyclical expansions were shorter than the national expansions, and they were also weaker in terms of total growth (Table 3). That pattern was reversed in the 1990s: New Jersey's cyclical growth in expansion periods surpassed the nation's cyclical growth, and the state's expansions were the same length as or longer than the nation's. In both decades, however, New Jersey's expansions tended to begin earlier than the corresponding expansions at the national level, just as cyclical downturns tended to begin earlier in New Jersey.[27]

The pattern of cyclical expansions is more difficult to characterize in Delaware than in the other two states in the Third District. Delaware had fewer cycles than the nation in the 1980s. In two of Delaware's cyclical expansions — the one in the second half of the 1980s and the one in the second half of the 1990s — cyclical growth at the state level was greater than the national average. In the other expansion, cyclical growth at the state level lagged growth at the national level (Table 3). Finally, while most cyclical expansions have begun several months earlier in Delaware than in the nation, there is one exception. The expansion in the late 1990s began slightly later in Delaware.

**Timing of Cyclical Movements in the Region.** We have seen that cyclical downturns in Pennsylvania and New Jersey generally begin before the corresponding national downturns; the same is true of cyclical expansions in all three states in the region. But there are exceptions. So can we say that movements throughout the entire cycle for any of the states lead or lag movements at the national level?

Table 4 presents correlations between changes in the cyclical component of each state's index and changes in the nation's cyclical component during both downturns and expansions. The column marked "t" shows the correlation between changes in the same month for both the state and the nation. The columns to the left of "t" show correlations between changes at the national level and previous months' changes in the states. The columns to the right of "t" show correlations between the changes at the national level and future months' changes for the states. For example, the correlation between the change in the national cyclical component and the change in Pennsylvania's cyclical component six months earlier is 0.619 while the correlation between the

**TABLE 3**

**Changes in the Cyclical Components of Economic Activity Indexes During Cyclical Expansions**

| | PA | NJ | DE | US |
|---|---|---|---|---|
| Trough | Sep-80 | Oct-80 | | Sep-80 |
| Peak | Jul-81 | May-81 | | Jul-81 |
| Total % Change Trough to Peak | 1.0 | 0.2 | | 0.7 |
| Trough | Feb-83 | Nov-82 | Aug-82 | Feb-83 |
| Peak | Nov-84 | Sep-84 | Feb-85 | Feb-85 |
| Total % Change Trough to Peak | 5.9 | 3.3 | 2.8 | 4.1 |
| Trough | Jun-86 | Mar-86 | Apr-86 | Dec-86 |
| Peak | Oct-89 | Feb-89 | Apr-89 | Mar-90 |
| Total % Change Trough to Peak | 3.4 | 2.0 | 3.6 | 2.2 |
| Trough | Dec-91 | Feb-92 | May-92 | Aug-92 |
| Peak | Nov-94 | Dec-94 | Mar-95 | Feb-95 |
| Total % Change Trough to Peak | 2.6 | 2.6 | 1.3 | 2.3 |
| Trough | Jan-96 | Apr-96 | Aug-96 | Jun-96 |
| Peak | Sep-00 | Aug-00 | Nov-99 | Oct-00 |
| Total % Change Trough to Peak | 3.4 | 2.5 | 2.9 | 2.2 |

[26] In 2002, 15.1 percent of Pennsylvania's nonfarm employment was in manufacturing compared to 12.8 percent for the nation. In 1979, the gap was even wider—28.9 percent for Pennsylvania and 23.4 percent for the U.S.

[27] The one exception was the 1980-81 expansion that began later in New Jersey.

## TABLE 4

**Correlations Between Changes in Cyclical Component of U.S. Index and State Indexes at Various Leads and Lags of the State Index**

| | t-6 | t-5 | t-4 | t-3 | t-2 | t-1 | t | t+1 | t+2 | t+3 | t+4 | t+5 | t+6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PA** | 0.619 | 0.725 | 0.816 | 0.887 | 0.933 | **0.952** | 0.944 | 0.908 | 0.848 | 0.764 | 0.663 | 0.549 | 0.426 |
| **NJ** | 0.770 | 0.835 | 0.883 | 0.911 | **0.919** | 0.904 | 0.867 | 0.811 | 0.736 | 0.645 | 0.542 | 0.430 | 0.313 |
| **DE** | 0.673 | 0.683 | **0.685** | 0.680 | 0.666 | 0.644 | 0.615 | 0.578 | 0.534 | 0.486 | 0.434 | 0.378 | 0.320 |

change in the national cyclical component and the change in Pennsylvania's cyclical component one month earlier is 0.952. The current national change is more closely associated with the one-month earlier change in Pennsylvania than with the six-month earlier change.

All the correlations in Table 4 are positive, but the highest correlations are with state changes in months preceding the national change. In general, cyclical movements in the region precede cyclical movements at the national level — by one month for Pennsylvania, two months for New Jersey, and four months for Delaware. Moreover, changes in Pennsylvania have the highest correlations with changes at the national level, and changes in Delaware have the lowest correlations. Delaware may give us the earliest signal of a cyclical change at the national level but the signal is weak.

**Business-Cycle Patterns in the Three States: Opportunity to Diversify?** Table 5 shows correlations between changes in the cyclical components of the three state indexes. Cyclical movements in Pennsylvania and New Jersey are very similar; they are highly correlated. The correlation is not as strong, however, between New Jersey and Delaware, and it is weakest between Pennsylvania and Delaware. The weaker correlations between Delaware and the other two states suggest that there is some room for firms to diversify their markets within the tri-state region. This assumes, of course, that a firm's business is dependent on the local economy, such as might be the case for a small chain of restaurants or fitness centers. A manufacturing firm that sells its products nationwide could not protect itself from downturns in manufacturing by locating some of its facilities in Delaware.

### WHAT CAN WE LEARN FROM THIS ANALYSIS?

Most economic series show that Pennsylvania has had the weakest economy among the three states in the Third District in the last two decades. An analysis of trends and cycles shows that Pennsylvania's poor performance has been due not only to its lower trend growth but also to more severe cyclical downturns. The state's economy has been more volatile than the national economy. Both New Jersey and Delaware have had higher trend growth and, in general, less severe cycles than the nation. But this did not preclude them from having a much more serious downturn than the nation between 1989 and 1992.

Delaware's trend growth has been less consistent than that of the other two states, and cycles in Delaware have been considerably different from those in the other two states and the U.S. These differences may make it difficult to predict cyclical movements in Delaware, but differences in the cyclical components of the state indexes suggest that firms can find diverse markets in the tri-state region.

Finally, a careful reading of cyclical conditions in the region may provide an indication of what lies ahead for the national business cycle. In all three states, cyclical movements precede movements at the national level. The signals are strongest in Pennsylvania and weakest in Delaware.

The patterns illustrated in this breakdown of the states' economies into trends and cycles should only be a guide and not a substitute for careful analysis of current data. None of the three states has *always* had a higher or lower trend than the national average, and none of the states has been a safe haven in every economic downturn.

## TABLE 5

**Correlations Between Contemporaneous Changes in the Cyclical Component of the State Indexes**

| | Correlation |
|---|---|
| PA-NJ | 0.88 |
| PA-DE | 0.61 |
| NJ-DE | 0.76 |

# The Role of Inventories In the Business Cycle

BY AUBHIK KHAN

Changes in the stock of firms' inventories are an important component of the business cycle. In fact, discussion about the timing of a recovery following economic recessions often focuses on inventories. Aubhik Khan surveys the facts about inventory investment over the business cycle, then discusses two leading theories that may explain these observations.

Changes in the stock of firms' inventories are an important component of the business cycle. Alan Blinder, a former Governor of the Federal Reserve System, famously remarked that "the business cycle, to a surprisingly large degree, is an inventory cycle." Consistent with this perspective, much of the discussion about the timing of a recovery following economic recessions focuses on firms' stocks of inventories. Pundits suggest that production and employment cannot recover until firms' inventories fall, relative to their sales.

This article surveys the facts about inventory investment over the business cycle, then discusses two leading theories of inventory investment that may explain these observations. Theory that passes the test of observation may allow us, with some confidence, to predict future movements in the data. Theories that have sought to explain macroeconomic changes in inventory investment have generally focused on firms' attempts to (1) reduce the costs of adjusting their production level or (2) reduce the costs of placing orders for intermediate goods. While much of the research on inventories in the past 50 years has emphasized the cost of adjusting production, this approach has had well-known difficulties when confronted with the data. Recent work that has focused on reducing the fixed costs of ordering goods may provide a framework that is more consistent with the facts. At the same time, this recent work may produce new insights about the interaction between inventories and the macroeconomy. These two theories predict different behavior for aggregate production, sales, and inventory investment.

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## INVENTORIES SEEM TO BE IMPORTANT IN THE BUSINESS CYCLE

Figure 1 shows the business-cycle component of real gross domestic product (GDP) in the United States over most of the postwar period. We can think of movements in GDP as the sum of two components: the trend and the business cycle. The trend represents the average growth rate of the economy across surrounding years. The business cycle reflects short-term deviations from this trend: the expansions and contractions that make up the business cycle.[1,2] For comparison, recessions, as dated by the National Bureau of Economic Research, are shaded in the figure.

The figure also includes changes in the stock of private nonfarm inventories (private refers to nongovernment). The difference between *GDP*, the sum of all goods and services produced in the economy over a given period, and *final sales*, the sum of all goods and services sold, is known as *net inventory investment*. Net inventory

[1] Actually, any type of expenditure or output may be broken down into a business-cycle component and a trend. The process of isolating the business-cycle component is known as "detrending" or "filtering." The real quarterly series in the figure have been detrended with the Hodrick-Prescott filter using a smoothing parameter of 1600. For additional details, see Edward C. Prescott's paper.

[2] It then follows that a recession, in this approach to business cycles, is a period in which the economy is growing at rates that are lower than its trend. This contrasts with the conventional use of the term recession to describe a period of negative growth.

investment is a measure of goods that have been made but not sold to consumers nor used by a firm as an intermediate input into production.

A car made by Honda in Ohio, completed but retained unused in the factory, adds to Honda's stock of inventories. Steel bought by the same manufacturer but left unused is a raw material that also adds to Honda's stock of inventories. Nonfarm private inventories are essentially stocks of these final goods, intermediate inputs, materials, or supplies held by businesses. Changes in this component of total inventory investment account for most of the change in total inventories over the business cycle.

**Cyclicality and Volatility**. In organizing their thinking about the role of an economic variable such as inventory investment over the business cycle, economists focus on the *cyclicality* and *volatility* of the variable. A variable's cyclicality — formally, its correlation with real GDP — is a measure of how the variable changes over the business cycle. For example, net exports — that is, exports minus imports — are countercyclical: they fall as GDP rises during an expansion, and they rise as GDP declines in a recession.

In contrast, consumption and investment are pro-cyclical: they rise during expansions and fall, alongside GDP, in recessions. A significant correlation, whether positive or negative, between any economic variable and GDP suggests that the variable is cyclical in that it varies in a systematic way with GDP over the business cycle. This is not true of all economic variables. For example, government spending is acyclical: it shows no significant correlation with economy activity over the business cycle, neither rising nor falling systematically.

While the cyclicality of a variable measures the extent to which it rises or falls with GDP, volatility measures the size of the variable's total fluctuation over the business cycle.[3] Economic variables differ considerably in their volatility. For example, consumption of nondurable goods and services is far less volatile than GDP, while business investment and consumption of consumer durable goods are more volatile — i.e., they have bigger swings. Thus, investment fluctuates a lot more than does the consumption of nondurables and services as output rises and falls.

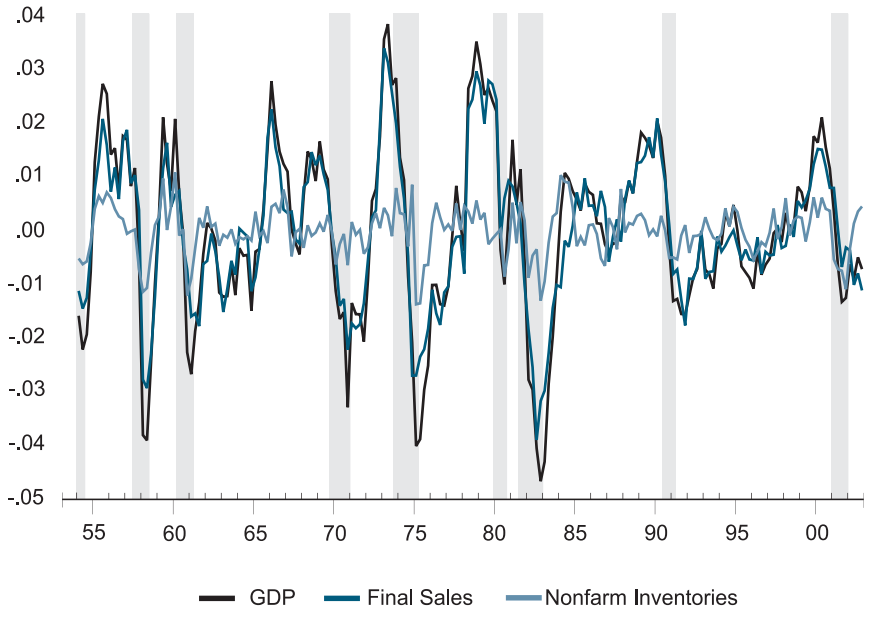
Net inventory investment is pro-cyclical (Figure 1). It moves along with GDP, rising during expansions and falling during recessions. This is a very important observation because it means that a common view of inventories — that they are goods that firms were unable to sell — can't explain most of the movements in inventories. In an expansion, inventories grow as consumption and investment grow. That is, when sales rise, inventories also rise. If inventories were mainly goods that firms couldn't sell, they would tend to rise when sales fell.

By definition GDP = Final Sales + Net Inventory Investment. Thus, any change in GDP must be attributable to either a change in final sales or a change in net inventory investment. Let's look at the fraction of the change in GDP that can be accounted for by changes in net inventory investment. To accomplish this, we divide the change in inventories during recessions by the corresponding change in GDP. The result is a number around one-half. Almost half of the fall

[3] Formally, we define volatility as the standard deviation of the business-cycle component of the quarterly data.

## FIGURE 1

### GDP, Final Sales, and Changes in Nonfarm Inventories



in production experienced by the U.S. economy during a recession may be explained by a reduction in net inventory investment. This is a surprisingly large fraction when one considers that net inventory investment is, on average, only around 0.5 percent of GDP. It indicates that inventory investment is extremely volatile.

**Adding to the Volatility of Output.** The pro-cyclicality and extreme volatility of inventory investment have led researchers to suggest that inventories are a destabilizing force. At its simplest, their argument is as follows. Inventory investment and final sales tend to move together: both rise during expansions, and both fall during recessions. Consequently, GDP varies by more than it would if inventory investment were constant or negatively correlated with final sales.

To understand this better, consider the following simple example. If final sales rise during odd years and fall during even years, while inventory investment rises (by the same amount) during even years and falls during odd years, there's no effect on GDP. Inventory investment and final sales move in opposite directions; they are negatively correlated. As a result, each offsets the change in the other. Production is smoothed.

Now, consider an alternative case in which both series rise during odd years. Since inventory investment moves with output, and since it's highly volatile, inventories substantially raise the volatility of GDP. Since final sales and inventory investment are indeed positively correlated, typically rising and falling at the same time, researchers have concluded that inventories are a destabilizing force in the economy. (See *Are Inventories Becoming Less Prominent?*) Changes in inventories magnify the effect of a change in final sales on domestic production.

## THE MYSTERY OF INVENTORIES

Economists are not satisfied merely to uncover the facts about inventories and the business cycle. Their primary goal is to explain these findings. Before we may begin to understand why firms change their holdings of inventories over the business cycle, we must have an understanding of why firms hold inventories at all. For economic theory, this has been more of a mystery than you might suppose.

Why would a firm produce goods but not sell them? Sales completed today give the firm income that it may invest. For example, even if the firm has no other immediate use for the funds, it might deposit them in an interest-earning account. A firm would forgo this interest income if it chooses not to sell its goods immediately.

But perhaps it isn't voluntary. You may think firms hold inventories only of finished goods they have been unable to sell. While firms do sometimes accumulate inventories of unsold goods because of weaker-than-expected demand, this can't be the central explanation of inventory holdings. First, remember that inventories rise when sales do. Second, goods that have been produced but not yet sold are only a fraction of the total stock of inventories. Firms also hold inventories of inputs they use to produce their goods, buying them before they need them.

The answer to the question of why firms forgo interest income must involve benefits derived from holding inventories. Holding stocks of inventories must somehow reduce a firm's cost of production, and these cost savings must exceed the forgone interest.

There are two theories of how production costs induce firms to hold stocks of inventories. The first, known as the *production-smoothing model* of inventories, emphasizes the costs of adjusting production. The second, known as the *(S, s) model* of inventories, emphasizes the costs of accepting deliveries. While each of these theories can explain why firms hold inventories, they are commonly applied to different types of inventories. Thus, the two theories are not mutually exclusive; both may be relevant to an understanding of the overall stock of inventories.

However, as with all science, the empirical relevance of these alternative theories can be assessed by evaluating their predictions against the data. The production-smoothing model and the (S, s) model generally have distinct predictions about the joint behavior of production, sales, and inventory investment.

## THE PRODUCTION-SMOOTHING MODEL

The production-smoothing model explains why a manufacturing firm holds stocks of goods produced but unsold. The model assumes that it is costly for the manufacturing firm to adjust production.

It is costly to buy and install new equipment or to uninstall and sell off previously installed equipment. Workers are costly to hire and train, and layoffs are also expensive. Since changing levels of output often involve changing the size of the labor force and purchasing new capital equipment, these *adjustment* costs are inevitable for a firm that changes its level of output over time. It's reasonable to assume that these costs of changing production levels actually increase with the size of the change. For example, a large increase in production requires hiring more workers and, thus, involves higher training costs. In any case, given these costs of adjusting production, if sales are volatile, a firm may prefer not to vary production to match the variation in sales. Instead, it may use inventories of already produced goods to offset the difference between production and sales.

## ARE INVENTORIES BECOMING LESS PROMINENT?

If inventories are indeed a destabilizing element of aggregate economic activity, perhaps the much heralded improvements in technology that have led to sharp declines in the inventory to sales ratio will eventually yield a less severe business cycle. Since inventories seem to explain so much of the decline in output during recessions, and since they amplify the effect of changes in final sales on GDP, as inventory levels decline, perhaps GDP will be subject to less severe fluctuations.

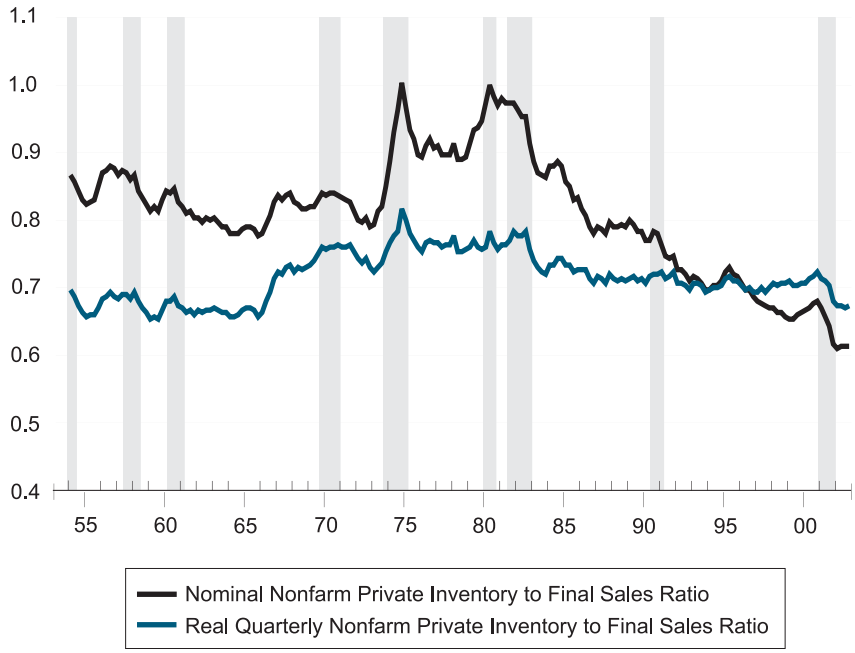
Arguments such as this have led economists to emphasize the decline in the inventory to sales ratio. In Figure 2, we see the nominal stock of inventories as a ratio of final sales. Clearly, it has declined sharply since the early 1980s. Many observers have regarded this decline as the result of improvements in technology and management methods that have allowed firms to reduce their holdings of inventories relative to their sales. This is less clear from the figure. First, we see that the inventory to sales ratio rose sharply in the 1970s. If technological innovation has reduced the ratio since the 1980s, what was the sharp technological regress in the 1970s? Second, and related, is the finding that the inventory to sales ratio was as low in the late 1960s as it was in the mid 1980s.

Even the decline in the importance of inventories is less clear than is commonly acknowledged. The figure also plots the real inventory to sales ratio, that is, the ratio when both inventories and sales figures have been divided by their price indexes. While the nominal inventory to sales ratio shows a clear negative trend over the past 20 to 25 years, the real inventory to sales ratio displays no corresponding decline! This implies that the price index for inventories has fallen more slowly than that for final sales. It would seem that changes in the relative price of intermediate inputs and materials and supplies, both components of the overall stock of inventories but not part of final sales, must account for the divergence between the real and nominal ratios of inventories to sales.

While I cannot suggest which ratio is more sensible, Figure 2 casts some doubt on some of the discussion of technological improvements' role in reducing demand for inventories. While both the financial press and policymakers have repeatedly mentioned the important role of improved management techniques, such as just-in-time production methods, in reducing firms' dependence on inventories, the real inventory to sales ratio in Figure 2 suggests caution before making sweeping generalizations. When examining the nominal inventory to sales ratio, we see that it rose before it fell, something that is hard to explain using technological improvement. The real ratio has not declined consistently over the past 20 years.

### FIGURE 2

**Quarterly Nominal and Real Inventory to Sales Ratios**



For example, a toy maker knows that sales are always higher during the Christmas season. However, since it is expensive to hire a large number of workers in the last quarter of the year, the toy company may produce more toys than it sells over the first nine months. During these nine months, production exceeds sales, and the toy company accumulates inventories. At the end of the year, when demand rises, the toy factory has fewer workers than it needs to satisfy sales. But even though production is lower than Christmas sales, the company can sell off its accumulated inventories to meet the increased demand. Accumulating inventories from January through September lets the toy maker smooth production relative to sales; that is, production is less volatile than sales, and when sales rise, inventories fall.

The defining assumption of the production-smoothing model is that there are costs of adjusting the level of production in a firm and that these costs rise in proportion to the extent of the adjustment. The central prediction of the production-smoothing model is that, at least to the extent that there are fluctuations in the demand for a firm's products, its production will vary less than its sales, and when its sales are high, inventories will be reduced. If all firms behave this way, we should see, for the economy as a whole: (1) GDP *less* volatile than final sales and (2) a *negative* correlation between final sales and inventory investment.

**The Dilemma with Inventories as a Buffer Against Changes in Sales.** There are two difficulties with the production-smoothing model (Table 1). The first row of the first column shows a measure of the volatility — the standard deviation — of the business-cycle component of GDP. The first rows of the next two columns report the relative volatility of final sales and net inventory investment. The relative volatility of final sales is the ratio of the standard deviation of final sales divided by that of GDP itself. This gives us a measure of how much sales fluctuate relative to GDP. For example, we see that the relative volatility of final sales is 82 percent of that of GDP. At least at the aggregate level, production is *more* volatile than sales.

In the third row of the second column, we also find that the correlation between final sales and inventory investment is actually *positive*. Both the higher variability of production and this correlation contradict the predictions of the basic production-smoothing model described above. If production is more volatile than sales, inventories are not effective in smoothing production. This evidence — which also holds for countries other than the U.S. and for individual industries and even for firms — offers no support for the view that smoothing production is an important motive for holding inventories.

**Attempts to Adapt the Model to Fit the Facts.** By adjusting the production- smoothing model to fit the data, both Valerie Ramey and Martin Eichenbaum have developed solutions to the problems with the basic production-smoothing model.

In her paper, Ramey suggests that firms may actually prefer to bunch their production because unit costs fall as they produce more. This is known as increasing returns. Ramey and Daniel Vine studied an interesting example of increasing returns in the automobile industry that is a result of contracts between manufacturers and labor unions. They argued that these contracts broadly imply that if an automobile manufacturer employs workers for less than 40 hours in any given week, it must also pay them 85 percent of the earnings lost in working less than a full week, but only if the workers work at all.[4]

Consider the following example, which highlights the implications of such a wage contract. Assume that an automobile manufacturer sells 75 cars a week. If its workers work a full week (40 hours), they produce 100 cars.

[4] Thus, if a worker is paid $10 an hour and is employed full time for 40 hours, he is paid $400 for the week. However, if he is employed for 35 hours, he is paid $350 for the time he worked and 85 percent of the $50 he would have earned for the five hours he did not work or $392.50 in total. Finally, if he does not work at all in a week, he is not paid at all.

**TABLE 1**

**GDP, Final Sales, and Inventory Investment**

| | GDP | Final Sales | Net Inventory Investment |
|---|---|---|---|
| Percent Standard Deviation Relative to GDP | 1.675 | 0.824 | 0.282 |
| Correlation with GDP | 1.000 | 0.951 | 0.653 |
| Correlation with NII | 0.653 | 0.410 | 1.000 |

Data are quarterly U.S., 1954.1 – 2002.4, seasonally adjusted and chained in 1996 dollars. GDP and final sales are reported as percentage standard deviations, detrended using a Hodrick-Prescott filter with a weight of 1600. Net inventory investment in private nonfarm inventories $x_t$, is detrended relative to GDP; the detrended series is $(x_t - \bar{x}_t) / \bar{y}_t$, where $\bar{x}_t$ is the HP-trend of the series and $\bar{y}_t$ is the trend for GDP.

One possible production plan would be to employ all workers for only 30 hours a week. But if, instead, they are employed full time for three weeks, then laid off every fourth week, the manufacturer will have lower labor costs. Moreover, this second option implies that production varies across weeks, while sales do not. Production has become more variable than sales because of increasing returns.[5]

Martin Eichenbaum considers an alternative: the effect of random changes in unit costs that are independent of the quantity produced. This theory is different from the assumption of increasing returns; it does not assume that unit costs fall with quantity produced but that they rise and fall unexpectedly over time. Examples of such unexpected changes in firms' production costs include, but are not limited to, changes in input prices, such as a rise in oil prices, and poor weather. A sudden rise in oil prices that is not expected to last very long may give a transportation company an incentive to temporarily reduce its shipments. An unexpectedly cold winter will lead construction companies to defer as much building as they can. Such random changes in costs lead to random changes in production and do so independently of fluctuations in sales. Thus, production becomes more volatile, and if these cost shocks are sufficiently large, it may become more volatile than sales.

Both Ramey's increasing returns model and Eichenbaum's cost shocks model modify the production-smoothing model, making it more consistent with the data. In each instance, the positive co-movement between final sales and inventory investment is restored, and production becomes more variable than sales.

Regardless of whether the production-smoothing model can be reconciled to observation, a second difficulty remains. This model may apply to a relatively small fraction of the firms that hold inventories because the model is based on a manufacturing firm that produces, then stores as inventories, finished goods that it will sell later.

Inventories of finished manufactured goods are only 13 percent of the total stock of inventories in the economy (Table 2). The remaining two-thirds of inventories held in the manufacturing sector are intermediate inputs into production. The inventories held in the wholesale and retail sectors are largely finished goods, but production smoothing may not be best suited to explain the inventories held in these sectors. One reason is that firms in these sectors do not produce the goods they sell.[6]

## THE (S,s) MODEL OF INVENTORY ACCUMULATION

Surprisingly, given its widespread use by macroeconomists studying inventory accumulation, the original model developed by economists to

[5] If the firm chooses to employ its workers for four weeks, having them work just 30 hours each week, it will have to pay them for 38.5 hours a week, or 154 hours in total, for a total cost of $1540. If, instead, the firm has them work full time for 40 hours during the first three weeks, then lays them off during the fourth week, it has to pay them for only 120 hours, or $1200 in total.

[6] However, V.V. Chari of the University of Minnesota and the Federal Reserve Bank of Minneapolis and Mitchell Berlin of the Federal Reserve Bank of Philadelphia have independently noted, in separate discussions with me, that long-term relationships between sellers and manufacturers may imply that the production-smoothing model is applicable to retail and wholesale inventories. In such settings, manufacturers may store their finished goods with sellers.

**TABLE 2**

**Sectoral Distribution of Private Nonfarm Inventories**

| | | Percentage of Total Stock of Inventories | STD (Inventory Investment) | Correlation (Inventory Investment, GDP) |
|---|---|---|---|---|
| Manufacturing | | 37 | 0.14 | 0.65 |
| | finished goods | 13 | | |
| | work in process | 12 | | |
| | materials & supplies | 12 | | |
| Trade | | | | |
| | retail | 26 | 0.12 | 0.32 |
| | wholesale | 26 | 0.09 | 0.35 |
| Other | | 11 | | |

Column 3, the percentages of the total stock of inventories, is taken from Ramey and West, 869, Table 4.

explain firms' holdings of inventories was not the production-smoothing model. It was the (S, s) model first formulated by Herbert Scarf of Yale University. While macroeconomists do not commonly use this model, Alan Blinder and Louis Maccini have argued that the (S, s) model provides a natural resolution to the empirical inconsistencies of the basic production-smoothing model without relying on increasing returns or cost shocks.

The (S,s) model obtains very different predictions because adjustment costs operate differently. Instead of assuming that adjustment costs increase smoothly with changes in production, in the (S, s) model, adjustments lead to fixed costs. Moreover, instead of arising during production, these costs are incurred when a firm either orders or undertakes delivery of goods.

A firm facing such costs will tend to order the relevant goods in large quantities but infrequently. By ordering more than is needed at any one time, the firm can hold stocks of the goods, thereby avoiding fixed order costs because the firm orders less frequently. By holding these stocks of goods, the firm reduces the overall cost of ordering.

For example, consider Honda again. In deciding the size of the quarterly steel order for Honda's Ohio plant, a manager must go over last quarter's production and forecast future sales. This takes a certain amount of managerial time that is largely independent of the size of the steel order. As such, the costs of ordering steel, which include the labor costs associated with the manager's efforts, are fixed costs. These costs are reduced when the firm orders infrequently — that is, when it places orders of sufficient size so as to not have to order again for some time. In other words, Honda will hold inventories of steel to reduce the fixed costs of ordering. As Herbert Scarf proved, a firm facing such fixed costs will allow its inventories to fluctuate between an upper level labeled *S* and a lower level labeled *s* — hence, the conventional label (S, s). S represents the level of inventories held by the firm after it has restocked. It then allows its stock to fall over time until it reaches the threshold s. At that time, another order is placed. Sometimes, the order costs are called adjustment costs.

The (S, s) model is flexible enough to be consistent with either positive or negative correlations between sales and inventories. To see this, assume there's a short-term increase in sales across a large number of firms selling the same product. Firms will reduce their inventories to meet the rise in sales. For some firms, the net effect is to reduce inventories. For firms with already low levels of inventories, this initial reduction means they reach their order threshold, s. As a result, they will adjust their inventories upward, raising them to S. Overall, some firms will increase inventories when sales increase, while others will reduce them. On average, the rise in sales could be associated with either an increase or a decrease in net inventory investment, depending on the size of the demand shock and different firms' current levels of inventories.

There is an interesting subtlety to the reasoning outlined above. A rise in the typical firm's inventories along with a rise in sales is more likely if many firms hit their re-ordering level. This is more likely to be the case when the increase in sales itself is large. Such large increases in sales move most firms to their lower threshold for inventories, causing them to readjust. In other words, inventories will tend to move with sales when the change in sales itself is large. Smaller increases in sales may be associated with a net reduction in total inventory holdings. Thus, the model predicts an interesting *nonlinearity*: we should expect inventories and sales to rise together when sales rise by a large amount, but the correlation may be negative for a small rise in sales.

In a formal analysis of (S, s) retail inventories, Andrew Caplin proved a positive correlation between final sales and inventory investment. For the reasons described above, this positive correlation raised the variability of production above that of sales. Caplin concluded, "The (S, s) theory thus contradicts the widely held notion that retail sector inventories act as a buffer, protecting manufacturers from fluctuating sales."[7] Caplin's work suggests that inventories may indeed destabilize the economy. However, his seminal analysis of retail sector inventories took final sales as given, rather than allowing them to be determined along with inventories, in general equilibrium. In general equilibrium, a complete assessment of the role of inventories would have to allow for feedback effects from the rest of the economy, which may change the behavior of final sales.

Overall, some firms will increase inventories when sales increase, while others will reduce them.

**(S, s) Inventories in a Model of the Business Cycle.** The (S, s) model of inventories provides us with a framework, broadly consistent with observation, to study the role of inventories over the business cycle. For

[7] See page 1396, paragraph 2, of Caplin's article.

example, it allows us to examine the central question of whether inventories destabilize the economy and exacerbate the movements in GDP. In a recent paper, Julia Thomas and I did just that.

Our approach, in common with other modern macroeconomic analysis, relied on building a model of the macroeconomy in which aggregate economic variables, such as production, consumption, investment, and employment, are the result of interactions between households and firms, much as in the actual economy. The essential feature of our model is that, in keeping with modern practice, we model the decisions of individual households and firms, summing these decisions to arrive at aggregate variables for the economy as a whole.

Our model included an (S, s) model of a firm's inventory investment. Simulating our model to produce artificial business cycles, we were able to explain roughly one-half of the observed volatility of inventory investment. More important, inventory investment and final sales moved together, as in the data, and production, as a result, was more volatile than sales. We also found that the relationship between inventories and GDP is not as straightforward as you might expect.

We compared two model economies, identical in most fundamentals, but with one difference. Firms in one economy had no adjustment costs and, thus, no need to hold inventories. Firms in the second economy faced the costs of purchasing inputs and, thus, had an incentive to hold inventories using an (S, s) rule, as described above. In this setting, we asked the question: If an economist were to observe two economies with firms and consumers that were essentially identical, but firms in one economy held higher inventory levels than firms in another economy, should we expect to observe more volatile sales in the economy with inventories?

Our answer is that there are really two effects. The first is straightforward. Remember the relationship GDP = Final Sales + Net Inventory Investment. As we discussed above, net inventory investment in the data is procyclical and volatile. It is also positively correlated with final sales. This tends to raise the variability of GDP above that of final sales. Increases in final sales are associated with increases in inventory investment, and given that both rise simultaneously, GDP rises more than final sales. This effect is in our model.

However, our model identified a second effect: the introduction of inventories reduces the volatility of final sales. Firms facing adjustment costs — the reason for the inventories in the first place — change production levels less frequently. This tends to offset the increase in the variability of GDP. Certainly, the introduction of inventories raised the variability of GDP directly, but there was an offsetting change in the volatility of final sales.

When the first effect dominates, more inventories lead to more volatile sales and increases in the variability of GDP. In contrast, when the second effect dominates, higher levels of inventories actually reduce the volatility of sales and, thus, GDP. Which effect dominates depends on how the many parameters of our model interact; however, we often found cases where increases in the level of inventories reduced the variability of GDP.

## CONCLUSION

Economics is full of puzzles, some of which take the form of disparities between the best available models and macroeconomic data. The production-smoothing model of inventory investment is an example of such a puzzle.

Inventory investment is procyclical and very volatile. Furthermore, it is positively correlated with final sales. As a result, the sum of these two objects, GDP, is more volatile than sales. The production-smoothing model assumes that since production is costly to adjust, firms hold inventories to smooth fluctuations in sales. The result is that simple versions of the model predict that production is less volatile than sales.

Some recent research has focused on alternative explanations of why firms hold inventories, and this has led to a renewed emphasis on the (S, s) model of inventory investment. The (S, s) model, which replaces the assumption that production is costly to adjust with the alternative assumption that there are costs of ordering goods, may overturn our thinking of inventories as existing to buffer changes in sales.

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# RESEARCH RAP

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## DATA REVISIONS AND THE IDENTIFICATION OF MONETARY POLICY SHOCKS

Monetary policy research using time-series methods has been criticized for using revised data that were not known to anyone during the actual period of empirical analysis. The Philadelphia Fed's real-time data set, developed by Dean Croushore and Tom Stark, however, gives researchers access to the original data releases that would have been used by analysts and policymakers in a given time period. How much of a difference does this information make to empirical analyses of monetary policy shocks?

This paper considers two approaches to addressing the fact that the macroeconomic data sets of econometricians are changing over time because of data revisions. The first approach is to assess the sensitivity of vector autoregression (VAR) estimates across different data vintages. The second approach considers a statistical model of data revisions and implements an alternative, real-time estimation strategy to overcome errors-in-variables biases. The authors conclude that the use of revised data in VAR analyses of monetary policy shocks may not be a serious limitation.

*Working Paper 03-1, "Data Revisions and the Identification of Monetary Policy Shocks," Dean Croushore, Federal Reserve Bank of Philadelphia, and Charles L. Evans, Federal Reserve Bank of Chicago*

## THE EFFECTS OF A BABY BOOM ON STOCK PRICES AND CAPITAL ACCUMULATION IN THE PRESENCE OF SOCIAL SECURITY

Is the stock market boom a result of the baby boom? In this paper Andrew B. Abel examines the long-term sustained increase in the value of the stock market over the period since 1980. He develops an overlapping generations model in which a baby boom is modeled as a high realization of a random birth rate and the price of capital is determined endogenously. A baby boom increases national saving and investment and thus causes an increase in the price of capital. The price of capital is mean-reverting, so the initial increase in the price of capital is followed by a decrease.

Social Security, according to the author, can potentially affect national saving and investment, though in the long run, it does not affect the price of capital.

*Working Paper 03-2, "The Effects of a Baby Boom on Stock Prices and Capital Accumulation in the Presence of Social Security," Andrew B. Abel, The Wharton School of the University of Pennsylvania; NBER; and Visiting Scholar, Federal Reserve Bank of Philadelphia*

## NON-EXCLUSIVE CONTRACTS, COLLATERALIZED TRADE, AND A THEORY OF AN EXCHANGE

Liquid markets in which agents have limited capacity to sign exclusive contracts, as well as imperfect knowledge of previous transactions by others, raise the risk of an agent promising the same asset to multiple counterparties and subsequently defaulting. In this paper, Yaron Leitner shows that in such markets an exchange can arise as a very simple type of intermediary whose only role is to set limits on the number of contracts that agents can report. In addition, reporting can be voluntary. In some cases, these limits must be nonbinding in equilibrium, and reported trades must not be made public. A costly alternative to an exchange is collateralized trade, and the gains from an exchange increase when agents have more intangible capital or when markets are more liquid.

*Working Paper 03-3, "Non-Exclusive Contracts, Collateralized Trade, and a Theory of an Exchange," Yaron Leitner, Federal Reserve Bank of Philadelphia*

## HOW STRONG IS CO-MOVEMENT IN EMPLOYMENT OVER THE BUSINESS CYCLE?

In this paper, the authors measure the degree of business-cycle co-movement in quarterly industry employment at state and regional levels. The analysis covers the years 1942 to 1995, a period that includes 10 national business cycles as defined by the National Bureau of Economic Research. The data indicate that there is co-movement in the business cycle across industries and across states but the degree of co-movement is relatively weak. The results suggest that the degree of co-movement across business cycles has risen over time and as regions have grown in geographic size. The authors present evidence that the measured degree of co-movement is sensitive to the chosen periodicity of the data and that there is much greater cohesion across states for a given industry than across different industries within a state.

An investigation into the sources of cross-state variation in the level of business-cycle co-movements reveals that important determinants include the strength of input-output linkages within each state, the different effects of monetary policy actions on each state's employment, and the degree of industrial diversity within a state.

*Working Paper 03-5, "How Strong Is Co-Movement in Employment Over the Business Cycle? Evidence from State/Industry Data," Gerald A. Carlino, Federal Reserve Bank of Philadelphia, and Robert H. DeFina, Villanova University*

## A SHORT-TERM MODEL OF THE FED'S PORTFOLIO CHOICE

What would happen if the Federal Reserve were to change the assets in its portfolio? In this paper, Dean Croushore creates a model in which the Fed, instead of using open-market operations in Treasury securities to increase the monetary base, engages in open-market operations in private securities or uses discount loans via a mechanism that allows banks to borrow as much as they would like at a fixed discount rate. The model demonstrates how a change in the Fed's portfolio would affect the economy's general equilibrium at a given point in time.

*Working Paper 03-8, "A Short-Term Model of the Fed's Portfolio Choice," Dean Croushore, Federal Reserve Bank of Philadelphia*