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The Mechanics of Intervention in Exchange Markets

ANATOL B. BALBACH

ON January 4, 1978 the Treasury and the Federal Reserve System, in conjunction with the Exchange Stabilization Fund, announced that they would intervene in foreign exchange markets to prevent a speculative decline in the international value of the U.S. dollar.[1] This announcement has been happily received by European and Japanese central banks and has elicited lively discussion in the news media. The stated purpose of intervention is to eliminate "speculative" swings in the value of the dollar. But it is also clear that if such speculation has indeed affected the value of the dollar, it has been unidirectional for the past nine months as the international value of the dollar has been declining steadily and, at times, precipitously. This has been particularly true with respect to the Deutsche mark, Swiss franc, British pound and Japanese yen. Thus intervention in this article is viewed as the *buying* of dollars in foreign exchange markets by U.S. and foreign governments and central banks.

There have been many assertions with respect to the issue of intervention. There are those who argue that U.S. intervention will have contractionary effects on the U.S. money stock and will not cause expansionary pressures on the money stock of other countries. It is also argued that U.S. intervention will produce a different impact on U.S. interest rates than that produced by foreign intervention. The purpose of this article is to consider the validity of these propositions by examining the mechanics of intervention in foreign exchange markets. The issue discussed here is not whether intervention is desirable or whether it is, or will be, successful. Nor is the purpose to evaluate what ultimate impact it will have on economic activity in the United States and abroad.

The Framework for Analysis

To isolate the impact of foreign exchange intervention on U.S. and foreign money stocks and U.S. interest rates, without getting involved in possible or probable reactions by fiscal and monetary authorities, four assumptions are made.

1. The U.S. Treasury deficit is unaffected by foreign exchange intervention. Specifically, this implies that if foreigners buy more Treasury securities than they did prior to intervention, fewer Government securities will be sold to the domestic sector. It is also assumed that Treasury deposits at Federal Reserve Banks will, on average, remain at the same level. If intervention increases these deposits, the increase will be spent or sales of Treasury securities in domestic markets will decline.

2. Monetary authorities here and abroad do not undertake monetary actions to offset the impact of intervention. Thus, if intervention causes domestic bank reserves to increase, permitting commercial banks to expand their loans and consequently the money stock, central banks will not start selling securities in the open market to reduce bank reserves by an equivalent amount.

3. Foreign central banks immediately convert their dollar holdings (deposits at Federal Reserve Banks) into U.S. Treasury securities.

4. Gold reserves will not be used for intervention.

The first two assumptions are dictated by the scope of this analysis. The purpose is to isolate the pressures that result from intervention, not how governments react to these pressures. The third assumption is simply consistent with historical evidence — except for gold, foreign central banks minimize their holdings of noninterest-bearing assets. And the fourth assumption arises from current practices as evidenced by swaps of the type just arranged.

Accounting techniques can be used to demonstrate the impact of intervention itself, without consideration of further repercussions. To trace the financial flows that result from intervention, the balance sheets of the U.S. Treasury, Federal Reserve Banks, and a representative Foreign Central Bank, along with the consolidated balance sheets of U.S. commercial banks and foreign commercial banks, are used.[2] In practice, intervention in foreign exchange markets can be undertaken by three distinct institutions: foreign central banks, the Federal Reserve System, and the Ex-

[1]Federal Reserve Press Release, January 4, 1978.

[2]This analysis could be extended to the balance sheets of the public, but the results of intervention itself would be identical.

Exhibit I

Foreign Central Bank Intervention

	U.S. Treasury (UST)		Federal Reserve Banks (FRB)		U.S. Commercial Banks (cb)		Foreign Central Bank (FCB)		Foreign Commercial Banks (fcb)	
(1)			res. −100 Dep. of FCB +100		res. −100	Dep. of fcb −100	Dep. of FCB at FRB +100	res. +100	res. +100 Dep. of fcb in US −100	
(2)	Dep. of UST at FRB +100	Treas. sec. of FCB +100	Dep. of FCB −100 Dep. of UST +100				Dep. of FCB at FRB −100 Treas. sec. of FCB +100			
(3)	Dep. of UST at FRB −100	Treas. sec. of cb −100	Dep. of UST −100 res. +100		res. +100 Treas. sec. of cb −100					
(Net)		Treas. sec. of FCB +100 Treas. sec. of cb −100			Treas. sec. of cb −100	Dep. of fcb −100	Treas. sec. of FCB +100	res. +100	res. +100 Dep. of fcb in US −100	

change Stabilization Fund. This last institution can intervene by using three types of assets: deposits at Federal Reserve Banks, Treasury Securities, or Special Drawing Rights (SDR) at the International Monetary Fund. Thus there are five separate cases to analyze, three of which are initiated by the Exchange Stabilization Fund.

Intervention by Foreign Central Banks

Foreign central banks can support the value of the dollar (keep their own currency from appreciating) by simply creating their own currency denominated deposits and using them to buy dollars in the foreign exchange market. Such action increases the demand for dollars on the foreign exchange market and raises the price of the dollar in terms of this foreign currency. This type of intervention was widely practiced during 1977, as foreign central banks accumulated upward of $30 billion in dollar denominated assets.

For the sake of balance sheet brevity, the following abbreviations will be used: U.S. Treasury (UST), Federal Reserve Banks (FRB), Foreign Central Bank (FCB), Exchange Stabilization Fund (ESF), foreign commercial banks (fcb), U.S. commercial banks (cb), and commercial bank reserves (res).

In Exhibit I, transaction (1) is the process of intervention — the purchase of dollar deposits by the Foreign Central Bank. We shall assume throughout all following transactions that sellers of dollars are foreign commercial banks. This assumption is made for the sake of simplicity only, and final results would not be affected if the sellers of dollars were the U.S. or foreign public. Thus intervention in the foreign exchange market means that the Foreign Central Bank buys dollar deposits of foreign commercial banks at U.S. commercial banks and pays for them by crediting foreign commercial bank reserves. The Foreign Central Bank deposits its dollar proceeds at Federal Reserve Banks. When this dollar draft is cleared, U.S. commercial banks lose reserves.

Transaction (2) shows the conversion of Foreign Central Bank deposits at Federal Reserve Banks into Treasury securities. It is assumed here that the Foreign Central Bank buys these securities directly from the Treasury. If it were to buy them in the open market, the final impact on reserves and interest rates would be identical.[3] Thus the security holdings of the Foreign Central Bank increase, its deposits at Federal Reserve Banks decrease, and Treasury deposits at Federal Reserve Banks increase.

Since we have assumed that the Treasury will not increase the level of its deposits at Federal Reserve Banks, in transaction (3) this increase in deposits is used to buy Treasury securities from U.S. commercial banks, or more likely, the Treasury will simply sell fewer securities in domestic markets. The results of such reduced sales are equivalent to transaction (3).

[3]The purchase of Treasury securities in the open market would increase U.S. commercial bank reserves. An increase in the demand for Treasury securities by the Foreign Central Bank would produce effects on interest rates identical to transaction (2) where the supply of securities was reduced.

When U.S. commercial banks clear the check from the U.S. Treasury, their reserves rise.

The net effects of Foreign Central Bank intervention are that the Treasury has financed some of its expenditures through a sale of its securities to a Foreign Central Bank, foreign commercial bank dollar holdings have decreased, the U.S. commercial bank portfolio of Treasury securities has decreased, and foreign commercial banks have exchanged their dollar assets for domestic reserves.

Since foreign commercial bank reserves have increased, there is pressure to increase the rate of growth of the foreign money stock. U.S. commercial bank reserves have not changed, but since the Treasury has sold some of its securities directly to a Foreign Central Bank, it doesn't have to sell them in the domestic credit market. Interest rates on U.S. Government securities can therefore be expected to be lower than they would have been in the absence of intervention.

Intervention by the Federal Reserve System

Since intervention to prevent the dollar from declining requires foreign currencies with which to buy dollars, the swap network must be activated. Swap arrangements permit the U.S. Treasury or the Federal Reserve to borrow foreign currencies while (in effect) giving dollar denominated deposits at the Federal Reserve Banks as collateral. In practice, these deposits are usually converted into Treasury Securities, primarily of the nonnegotiable type. The acquired foreign currencies are then used to buy dollars in the foreign exchange market.

In Exhibit II, transaction (1) depicts the acquisition by the Federal Reserve System of foreign denominated deposits at the Foreign Central Bank. The Foreign Central Bank credits the Federal Reserve account and in return receives Treasury securities which are paid for by the Federal Reserve System in the form of a credit to the Treasury's account at the Federal Reserve. This transaction does not affect bank reserves in either country. In transaction (2) the Federal Reserve System buys dollar denominated deposits of foreign commercial banks at U.S. commercial banks and pays for them with its foreign currency deposits at the Foreign Central Bank. When the Federal Reserve payment is cleared, foreign commercial banks experience an increase in reserves. Meanwhile, when the foreign commercial bank draft on dollar deposits is cleared, U.S. commercial bank reserves decline. In transaction (3) the Treasury disposes of its increased balance at Federal Reserve Banks by buying Treasury securities from U.S. commercial banks (as in the previous case, this transaction is in lieu of a decrease in Treasury borrowings in private markets). This raises U.S. commercial bank reserves.

The net result of this type of intervention is identical to the one produced by Foreign Central Bank intervention: foreign commercial bank reserves expand, U.S. commercial bank reserves do not change, and there is downward pressure on the interest rates of U.S. Treasury securities.

Intervention by the Exchange Stabilization Fund

The Exchange Stabilization Fund was created in 1934 specifically for the purpose of intervening in

Exhibit II

Federal Reserve Intervention

	U.S. Treasury (UST)		Federal Reserve Banks (FRB)		U.S. Commercial Banks (cb)		Foreign Central Bank (FCB)		Foreign Commercial Banks (fcb)	
(1)	Dep. of UST at FRB +100	Treas. sec. of FCB +100	Dep. of FRB at FCB +100	Dep. of UST +100			Treas. sec. of FCB +100	Dep. of FRB at FCB +100		
(2)			Dep. of FRB at FCB −100	res. −100	res. −100	Dep. of fcb −100		Dep. of FRB at FCB −100 res. +100	res. +100 Dep. of fcb in US −100	
(3)	Dep. of UST at FRB −100	Treas. sec. of cb −100		Dep. of UST −100 res. +100	res. +100 Treas. sec. of cb −100					
(Net)		Treas. sec. of FCB +100 Treas. sec. of cb −100			Treas. sec. of cb −100	Dep. of fcb −100	Treas. sec. of FCB +100	res. +100	res. +100 Dep. of fcb in US −100	

Exhibit III

Exchange Stabilization Fund Intervention by Using FRB Deposits

	U.S. Treasury (UST)		Federal Reserve Banks (FRB)		U.S. Commercial Banks (cb)		Foreign Central Bank (FCB)		Foreign Commercial Banks (fcb)	
(1)			SDR cert. +100	Dep. of ESF at FRB +100						
(2)				Dep. of ESF at FRB −100 Dep. of FCB at FRB +100			Dep. of FCB at FRB +100	Dep. of ESF at FCB +100		
(3)				res. −100 Dep. of ESF at FRB +100	res. −100	Dep. of fcb in US −100		Dep. of ESF at FCB −100 res. +100	res. +100 Dep. of fcb in US −100	
(4)	Dep. of UST at FRB +100	Treas. sec. of ESF +100		Dep. of ESF at FRB −100 Dep. of UST at FRB +100						
(5)	Dep. of UST at FRB +100	Treas. sec. of FCB +100		Dep. of FCB at FRB −100 Dep. of UST at FRB +100			Dep. of FCB at FRB −100 Treas. sec. of FCB +100			
(6)	Dep. of UST at FRB −200	Treas. sec. of cb −200		res. +200 Dep. of UST at FRB −200	Treas. sec. of cb −200 res. +200					
(Net)		Treas. sec. of ESF +100 Treas. sec. of FCB +100 Treas. sec. of cb −200	SDR cert. +100	res. +100	res. +100 Treas. sec. of cb −200	Dep. of fcb in US −100	Treas. sec. of FCB +100	res. +100	res. +100 Dep. of fcb in US −100	

exchange markets during the fixed exchange rate regime. While the Fund is owned by the U.S. Treasury, it is a separate entity with its own financial resources and with its own account at Federal Reserve Banks. The bulk of its assets consists of Special Drawing Rights and nonnegotiable Treasury securities. The impact of its intervention depends upon the type of assets that it uses. If it uses Treasury securities or its deposits at Federal Reserve Banks, then it must acquire foreign currencies in a manner similar to the Federal Reserve. If it uses SDR, which are accepted by central banks, it can sell them outright to the Foreign Central Bank for foreign currency denominated deposits. Consequently, Exchange Stabilization Fund intervention will be discussed in three parts: using deposits at Federal Reserve Banks, using Treasury securities, and using SDR. In these transactions one additional assumption must be made: the Exchange Stabilization Fund also minimizes its noninterest bearing assets and holds minimal balances at the FRB.

Using FRB Deposits — Since the Exchange Stabilization Fund has minimal deposits at the FRB, it can acquire them by selling SDR *certificates* to the Federal Reserve and receiving deposits in return (Exhibit III, transaction (1)). In transaction (2) the Exchange Stabilization Fund writes a check on its account at the Federal Reserve Bank and acquires foreign currency denominated deposits at the Foreign Central Bank. It then uses this account (transaction (3)) to buy dollar denominated deposits of foreign commercial banks at U.S. banks and deposits these proceeds at Federal Reserve Banks. This transaction increases foreign commercial bank reserves and reduces the reserves of U.S. commercial banks. Since the Exchange Stabilization Fund now has an increase in its balances at the Federal Reserve, it will use these balances to buy securities from the Treasury (transaction (4)). In transaction (2) the Foreign Central Bank accumulated additional deposits at Federal Reserve Banks and uses these deposits to buy securities from the

Treasury (transaction (5)). Transactions (4) and (5) increase Treasury deposits at Federal Reserve Banks, and the Treasury uses these deposits to buy Treasury securities from U.S. commercial banks (this transaction is again in lieu of selling fewer securities in the future).

The net effect of this intervention is an increase in foreign commercial bank reserves and an increase in the reserves of U.S. commercial banks. Since the demand for Treasury securities (by the Exchange Stabilization Fund) increases and the supply decreases, these transactions produce a downward pressure on Treasury security yields.

Using Treasury Securities — This set of transactions assumes that the Exchange Stabilization Fund sells its Treasury securities directly to the Foreign Central Bank. If the Fund were to sell these securities in the open market or to the Federal Reserve System, and if Foreign Central Banks were subsequently to buy these securities, the results would be the same.

In transaction (1) of Exhibit IV, the Exchange Stabilization Fund sells its Treasury securities to the Foreign Central Bank and acquires a foreign deposit. In transaction (2) it uses its foreign currency denominated deposit to buy dollars from foreign commercial banks and deposits these dollars at its account at the Federal Reserve Bank, which causes reserves of U.S. commercial banks to contract. Intervention-induced transactions could stop here, and the net effect would be an increase in foreign commercial bank reserves and a decrease in reserves of U.S. commercial banks. There would be no effect on Treasury security yields since no securities were traded in the market.

However, the asset mix of the Exchange Stabilization Fund has changed; they have less Treasury securities and higher deposits at Federal Reserve Banks. If the Fund desires to maintain the same asset mix and the same income as prior to intervention, it would activate transaction (3) in which it would buy Treasury securities in the market thereby increasing U.S. commercial bank reserves.[4] Under these circumstances the net effect of intervention would again be an increase in foreign commercial bank reserves, no change in U.S. commercial bank reserves, and downward pressure on Treasury security yields.

Using SDR — In transaction (1) of Exhibit V, the Exchange Stabilization Fund sells SDR to the Foreign Central Bank and receives a foreign currency denominated deposit. In transaction (2) it spends this deposit to buy dollar deposits from a foreign commercial bank and transfers these deposits to Federal Reserve Banks. Again, since the Exchange Stabilization Fund keeps its dollar assets mainly in the form of Treasury securities, it will buy such securities (transaction (3)) and

[4]If the Exchange Stabilization Fund were to buy securities directly from the U.S. Treasury, it would have increased Treasury balances at Federal Reserve Banks. This would have caused the Treasury to buy its securities in the market or reduce its sales of new securities. These transactions would have produced changes in commercial bank reserves and interest rates identical to transaction (3).

Exhibit IV

Exchange Stabilization Fund Intervention Using Treasury Securities

	U.S. Treasury (UST)		Federal Reserve Banks (FRB)		U.S. Commercial Banks (cb)		Foreign Central Bank (FCB)		Foreign Commercial Banks (fcb)	
(1)	Treas. sec. of FCB +100 Treas. sec. of ESF −100						Treas. sec. of FCB +100	Dep. of ESF at FCB +100		
(2)			res. −100 Dep. of ESF at FRB +100		res. −100	Dep. of fcb in US −100		Dep. of ESF at FCB −100 res. +100	res. +100 Dep. of fcb in US −100	
(3)	Treas. sec. of cb −100 Treas. sec. of ESF +100		Dep. of ESF at FRB −100 res. +100		Treas sec. of cb −100 res. +100					
(Net)	Treas. sec. of FCB +100 Treas. sec. of cb −100				Treas. sec. of cb −100	Dep. of fcb in US −100	Treas. sec. of FCB +100	res. +100	res. +100 Dep. of fcb in in US −100	

Exhibit V

Exchange Stabilization Fund Intervention by Using SDR

	U.S. Treasury (UST)		Federal Reserve Banks (FRB)		U.S. Commercial Banks (cb)		Foreign Central Bank (FCB)		Foreign Commercial Banks (fcb)	
(1)							SDR +100	Dep. of ESF at FCB +100		
(2)				res. —100 Dep. of ESF at FRB +100	res. —100	Dep. of fcb in US —100		Dep. of ESF at FCB —100 res. +100	res. +100 Dep. of fcb in US —100	
(3)	Dep. of UST at FRB +100	Treas. sec. of ESF +100		Dep. of ESF at FRB —100 Dep. of UST at FRB +100						
(4)	Dep. of UST at FRB —100	Treas. sec. of cb —100		Dep. of UST at FRB —100 res. +100	res. +100 Treas. sec. of cb —100					
(Net)		Treas. sec. of ESF +100 Treas. sec. of cb —100			Treas. sec. of cb —100	Dep. of fcb in US —100	SDR +100	res. +100	res. +100 Dep. of fcb in US —100	

the U.S. Treasury will use these additional deposits to buy securities from U.S. commercial banks (transaction (4)). The net result of this type of intervention produces an increase in foreign commercial bank reserves and no change in U.S. commercial bank reserves. Furthermore, it lowers yields on Treasury securities.

Summary and Conclusions

The techniques described above exhaust the most frequently used methods of buying dollars in foreign exchange markets. Except for the case in which the Exchange Stabilization Fund is willing to issue additional SDR certificates, there are several results of intervention which are common to all the remaining methods:

1. In the absence of domestic fiscal and monetary policy actions to offset the impact of intervention, all intervention to support the dollar will lead to an expansion in foreign commercial bank reserves, pressure to expand the money stock and presumably upward pressure on the rate of inflation in affected countries.

2. Under the same conditions the reserves of U.S. commercial banks will not be affected and will not produce expansionary or contractive effects on the U.S. economy through monetary channels.

3. In all of these cases, and assuming no change in Treasury expenditures and receipts, there would be a decline in Treasury securities sold in the domestic market or an increase in the demand for such securities. This would exert downward pressure on U.S. Treasury security yields.

4. From the standpoint of economic repercussions caused *purely* by the acts of intervention, there is absolutely no difference in whether the intervention is undertaken by foreign central banks or by U.S. authorities.

5. In general, intervention in foreign exchange markets to support the value of the U.S. dollar is possible only through the cooperation of foreign central banks and their willingness to accept upward pressures on their commercial bank reserves. At the same time, as long as foreign central banks keep their dollar holdings in the form of U.S. Treasury securities, intervention will produce no impact on U.S. commercial bank reserves.

The exception is the case where the Exchange Stabilization Fund issues SDR certificates to the Federal Reserve and uses acquired deposits to intervene in foreign exchange markets. This method produces an increase in both foreign *and* U.S. commercial bank reserves.

A Tax-Based Incomes Policy (TIP): What's It All About?

NANCY AMMON JIANAKOPLOS

SUBJECT corporations to higher corporate income tax rates if they give pay raises which are too large. This is the essence of a plan devised by Governor Henry C. Wallich of the Federal Reserve Board and Sidney Weintraub of the University of Pennsylvania.[1] Their proposal to use the tax system to curb inflation is called "TIP," an acronym for tax-based incomes policy. As inflation continues to plague the economy, many economists feel that the traditional tools of monetary and fiscal policy are inadequate to handle the situation and have recommended direct measures to stop wage and price increases.[2] The Wallich-Weintraub plan has received considerable attention as a policy measure which might be capable of dealing with the problem of inflation.[3]

Before adopting a program such as TIP, it is important to understand clearly how the proposal would operate and, more importantly, whether it would achieve the desired results. The first part of this article describes the functioning of TIP and the rationale for such a program as envisioned by Wallich and Weintraub. The rest of the article is devoted to an assessment of whether TIP would accomplish its stated objectives.

HOW WOULD TIP OPERATE?

According to the plan presented by Wallich and Weintraub, TIP would be centered on a single wage guidepost established by the Government.[4] The acceptable percentage wage increase could be set somewhere between the average increase in productivity throughout the economy (asserted to be around 3 percent) and some larger figure which incorporates all or part of the current rate of inflation. The ultimate aim of the guidepost is to bring wage increases in line with nationwide productivity increases.

The TIP guidepost is directed at wages only, although the tax is levied on corporate profits. The basic assumption behind TIP is that monetary and fiscal policies have been ineffective because they have not been able to prevent labor from obtaining wage increases in excess of productivity gains, even when there is significant unemployment in the economy. Furthermore, Wallich and Weintraub contend that empirical evidence supports the view that price in-

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[1]Wallich and Weintraub first collaborated on this idea in Henry C. Wallich and Sidney Weintraub, "A Tax-Based Incomes Policy," *Journal of Economic Issues* (June 1971), pp. 1-19.

[2]See, for example, "Another Weapon Against Inflation: Tax Policy," *Business Week*, October 3, 1977, pp. 94-96; "Debate: How to Stop Inflation," *Fortune* (April 1977), pp. 116-20; Lindley H. Clark, Jr., "Uneasy Seers: More Analysts Predict New Inflation Spiral or Recession in 1978," *Wall Street Journal*, December 2, 1977.

[3]See, for example, U. S. Congress, Congressional Budget Office, *Recovery With Inflation*, July 1977, p. 40; U. S. Congress, Joint Economic Committee, *The 1977 Midyear Review of the Economy*, 95th Cong., 1st sess., September 26, 1977, p. 76; "Well-Cut Taxes Should Be Tailored," *New York Times*, December 21, 1977.

[4]Unless otherwise noted, all descriptions of TIP in this article are based on Wallich and Weintraub, "A Tax-Based Incomes Policy"; Henry C. Wallich, "Alternative Strategies for Price and Wage Controls," *Journal of Economic Issues* (December 1972), pp. 89-104; Henry C. Wallich, "A Plan for Dealing With Inflation in the U.S.," *Washington Post*, August 21, 1977; Sidney Weintraub, "An Incomes Policy to Stop Inflation," *Lloyds Bank Review* (January 1971), pp. 1-12; and Sidney Weintraub, "Incomes Policy: Completing the Stabilization Triangle," *Journal of Economic Issues* (December 1972), pp. 105-22.

creases have been a constant markup over unit wage increases. Therefore, if wage increases can be kept down, price increases will also be held down.

The corporate income tax system would be employed to enforce the TIP guidepost. Corporations which grant wage increases in excess of the guidepost would be subject to higher corporate income tax rates based on the amount that wage increases exceed the guidepost.

In order to understand how TIP would operate, consider the following example. Suppose the guidepost for wage increases is set at, say, 5 percent for a particular year. In the base year, Corporation A had a total wage bill of $100,000 and in the following year granted increases which brought its total wage bill to $108,000 — an 8 percent increase. Assuming no change in either the number or composition of the employees, this 8 percent increase is 3 percentage points above the guidepost. This excess would then be multiplied by a penalty number. If, for instance, the penalty was set at 2, the corporate tax rate of Corporation A would be increased by 6 percentage points (3 percentage point excess times penalty number of 2). Thus, instead of paying 48 percent of its profits in taxes, the existing corporate tax rate, Corporation A would have to pay 54 percent of its profits, as a penalty for acceding to "excessive" wage demands.

Wallich and Weintraub argue that because of competitive forces this additional tax could not be shifted forward to prices.[5] They, therefore, believe that such a tax penalty would cause corporations to deal more firmly with labor. In their view the penalty would ultimately restrain the rate of wage increases and, hence, reduce the rate of inflation.[6] Since wage increases would be curbed, corporations would not have higher costs to pass through in the form of price increases, thereby eliminating a major "cost-push" element of inflation. Furthermore, since the increases in incomes of workers would more closely approximate increases in productivity, there would be smaller increases in spending, reducing the "demand-pull" aspect of inflation.

Wallich and Weintraub acknowledge certain difficulties in computing the corporation's wage bill. One method which they believe would overcome many of these difficulties would be to construct an index of wages, rather than using the gross dollar figure. Using this method, wages, fringe benefits, and other related payments would be computed for each job classification and skill level and divided by the hours worked at each level. These wage figures would then be combined into an index weighted by the proportion of each of these classifications in the entire corporation. Changes in this index would then be compared to the guidepost in order to assess whether the corporation would be penalized.

Administrative problems are not neglected by Wallich and Weintraub. They recognize that the tax laws must be specific and "airtight" in order to avoid loopholes. However, it is argued that TIP would not involve establishing a new bureaucracy. Most of the data necessary to administer TIP are already collected for corporate income tax and employee payroll tax purposes.

One of the principal merits of TIP, in the view of Wallich and Weintraub, is that it would not interfere with the functioning of the market system. They argue that there would be no direct controls or distortions to the pricing mechanism. Firms would still be free to grant large wage demands, but would face the penalty of a higher corporate tax rate.

Rather than a short-term plan to curb inflation, TIP is envisioned to be a long-term means of reducing the rate of price increase. However, TIP is not intended to function by itself. Both Wallich and Weintraub see it as a supplement to "appropriate" monetary and fiscal policies. In addition, if labor contends that TIP would hold down wages while allowing profits to increase, Wallich proposes the implementation of an excess profits tax. This could be accomplished by increasing the basic corporate tax rate to keep the share of profits in national income constant.[7]

WOULD TIP WORK?

The TIP proposal has two principal objectives:

(1) to curb inflation, and

[5]See Richard A. Musgrave and Peggy B. Musgrave, *Public Finance In Theory and Practice* (New York: McGraw-Hill Book Company, 1973), Chapter 18, pp. 415-29, who contend that empirical evidence is inconclusive in determining whether the corporate income tax is shifted.

[6]Studies by Yehuda Kotowitz and Richard Portes, "The 'Tax on Wage Increases': A Theoretical Analysis," *Journal of Public Economics* (May 1974), pp. 113-32, and Peter Isard, "The Effectiveness of Using the Tax System to Curb Inflationary Collective Bargains: An Analysis of the Wallich-Weintraub Plan," *Journal of Political Economy* (May-June 1973), pp. 729-40, analyze the effect of TIP on an individual firm and conclude that theoretically TIP should lead to lower wage settlements for an individual firm.

[7]Other adjuncts proposed for TIP include a payroll tax credit designed to entice workers to accept lower wages. See Lawrence S. Seidman, "A Payroll Tax-Credit to Restrain Inflation," *National Tax Journal* (December 1976), pp. 398-412.

(2) to avoid interfering with the functioning of the market.

Given these aims of TIP, one can analyze whether TIP will, in fact, be able to accomplish its goals. Other issues raised by TIP, such as the costs of implementation and the ability of firms to avoid the tax penalty of TIP, will not be discussed here.[8]

Would TIP Curb Inflation?

TIP is based on the assumption that most of the inflation in the economy is of a "cost-push" nature. Inflation occurs, according to this framework, because labor is able to attain wage increases in excess of increases in productivity. Business is not capable of resisting, or finds it does not pay to resist, labor's demands. Faced with higher costs, businesses pass these costs through in the form of higher product prices. As prices rise, further wage increases are granted, forming the basis of a wage-price spiral. TIP is proposed as a measure which will intervene in this process and bring inflation to a halt.

As the Congressional Budget Office stated in a recent study, the assumption that inflation is the result of "cost-push" is "a conjectural notion at best."[9] A major challenge to the concept of "cost-push" rests on empirical evidence supporting an alternative theory of the cause of inflation. According to this other view, ongoing increases in the general price level (inflation) are primarily the result of excessive increases in the rate of monetary expansion.[10] Lags exist between the time when the money stock is increased and when prices rise. In this framework, the observed relationship between the rate of wage increase and the rate of price increase is explained as part of the adjustment process through which prices increase in response to increases in the money stock. This view does not deny the "cost-push" phenomenon, but contends that it is consistent with the view that inflation is ultimately caused by money growth.[11]

When the stock of money is increased faster than the rate of increase in production, people find themselves with larger cash balances than they desire to hold. In order to bring their cash balances down to desired levels, they will spend the money, thereby bidding up prices on goods and services, and the general price level will rise. As long as the stock of money increases faster than the demand for money, inflation will persist, even if TIP manages to hold down wages temporarily.

Conversely, just as inflation is caused by excessive growth of the money stock, the only way to stop inflation is to reduce the growth of the money stock. As the rate of monetary expansion is reduced, people will have cash balances below their desired levels. They will reduce their rate of spending in order to build up these balances. As spending (demand) falls, the rate of inflation will decrease. Prices are "sticky," and just as it took several years to build up the current rate of inflation, it will take several years for inflation to wind down. One of the by-products of reducing inflation is a temporary idling of resources, since prices do not tend to be flexible in the short run. This is a cost of reducing inflation which must be borne, just as there are costs imposed on society as inflation mounts.

The idea that there are certain "key" wages in society, such as union wages, to which other wages and prices adjust, confuses the *motivation* for increasing the money stock with the *cause* of inflation.[12] If certain unions are able to attain large wage increases, even in the face of falling demand, the prices of the products produced by this labor will increase. As prices increase, less of this product will be demanded and the use of the resources (labor and capital) which produce this product will be decreased. Unemployment will rise as resources are freed to work in the production of other products whose prices are lower. The relative prices of products will change, but the average price level will be unchanged.

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[8]For a discussion of implementation problems, see Gardner Ackley, "Okun's New Tax-Based Incomes-Policy Proposal," Survey Research Center, Institute for Social Research, The University of Michigan, *Economic Outlook USA* (Winter 1978), pp. 8-9. Although Ackley deals with the anti-inflation proposal put forward by Arthur Okun, he notes that the critique also applies to the Wallich-Weintraub proposal.

[9]Congressional Budget Office, "Recovery With Inflation," p. 41.

[10]Empirical support of this view for the period 1955 to 1971 is presented by Leonall C. Andersen and Denis S. Karnosky, "The Appropriate Time Frame for Controlling Monetary Aggregates: The St. Louis Evidence," *Controlling Monetary Aggregates II: The Implementation*, Federal Reserve Bank of Boston, Conference Series No. 9, September 1972, pp. 147-77. Additional evidence for the period 1971 to 1976 is found in Denis S. Karnosky, "The Link Between Money and Prices — 1971-76," this *Review* (June 1976), pp. 17-23.

[11]See Leonall C. Andersen and Denis S. Karnosky, "A Monetary Interpretation of Inflation" in Joel Popkin, ed., *Analysis of Inflation: 1965-1974*, Studies in Income and Wealth, Vol. 42, National Bureau of Economic Research, Inc. (Cambridge, Massachusetts: Ballinger Publishing Company, 1977), pp. 11-26.

[12]This argument draws on Armen A. Alchian and William R. Allen, *University Economics: Elements of Inquiry* (Belmont, California: Wadsworth Publishing Company, Inc., 1972), pp. 684-85.

However, if the Federal Reserve policymakers keep a close watch on these "key" industries and see an increase in idle resources (unemployment) in these industries, they may take actions to alleviate the unemployment by increasing the money stock. The increases in spending resulting from monetary expansion will bid up average prices and return relative prices to a position similar to that prior to the granting of the wage demands. It was as a consequence of the excessive wage demands that policy actions were *motivated*, but it was monetary expansion which *caused* the subsequent inflation.

Some proponents of TIP base their support on the belief that TIP will reduce *expectations* of inflation. Lower expectations of inflation in the future, according to this view, will lead to lower demands for wage increases and eventually lower prices. However, expectations of inflation do not cause inflation.[13] It is ongoing inflationary forces in the economy, excessive rates of monetary expansion, which lead to expectations of future inflation. Curbing inflationary expectations requires curbing the underlying forces which cause them.

Wallich and Weintraub agree that TIP is a supplement to, not a substitute for, "appropriate" monetary and fiscal policy. However, the character of their "appropriate" monetary policy is questionable. In the basic article which outlined TIP, Wallich and Weintraub stated, ". . . the proposal is conceived as a supplement to the familiar monetary-fiscal policies so that the economy might operate closer to full employment without the inflationary danger of excess demand and 'overheating.'"[14] Indeed, in a later article Weintraub is more specific: "Given a suitable incomes policy to align wages (and salaries) to productivity, monetary policy would be released to make its contribution to full employment. . . Full employment requires ample money supplies for its sustenance."[15] Thus, it appears that "appropriate" monetary policy, in the view of Wallich and Weintraub, is expansionary; however, a restrictive monetary policy is necessary to curb inflation.

This disparity in determining the appropriate character of monetary policy points out another problem with TIP. Given the lag time involved in the functioning of monetary policy, it might appear in the short run that TIP is, at least temporarily, holding down prices. If, at the same time, the Federal Reserve increases the rate of monetary expansion, inflationary pressures will actually be augmented. An incomes policy, such as TIP, gives policymakers the illusion of taking corrective measures against inflation when, in fact, reducing the rate of monetary expansion is the only way to accomplish that goal. In summary, it appears that TIP would not be effective in reducing inflation and could make matters worse by fostering inappropriate monetary policy.

Would TIP Interfere With the Market?

Wallich and Weintraub argue that TIP would not interfere with market pricing because no ceilings are placed on any wages or prices. TIP operates through the tax system, yet it is based on a *single* guidepost for every firm and industry. They contend that a single guidepost is appropriate because in competition all comparable workers would earn the same wage. TIP, therefore, is only imposing what competition would achieve.

The problem with this argument is that it is only true if all industries are in equilibrium and remain there. In a growing, changing economy, equilibrium prices and wage rates are changing. Prices and wages are constantly moving toward new equilibria; hence, there is no reason to believe that each sector in the economy would be at equilibrium when TIP was imposed or would remain there afterward. In the U. S. economy, demands and tastes of consumers are constantly shifting and the technology and products offered by business are also changing. As a consequence, the equilibrium prices of some goods are rising (houses, for example) while others are falling (electronic calculators). In addition, some firms are growing, making large profits, and seeking additional labor, while others are declining, earning very little profit, and contracting their labor forces.

Imposing a single wage guidepost would distort the price system. It does not matter whether the guidepost is imposed through the tax system or by direct fines and penalties. Those firms which are growing or are adapting to changing consumer tastes have an incentive to hire scarce resources (capital and labor) away from other firms, but they would be penalized either through a lower rate of return, if they grant "excess" wage demands, or by a barrier to growth if they adhere to the guidepost. Consequently, in some instances labor would not be compensated in accord

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[13]Weintraub supports this contention in Weintraub, "Incomes Policy: Completing the Stabilization Triangle," p. 116.

[14]Wallich and Weintraub, "A Tax-Based Incomes Policy," p. 1.

[15]Weintraub, "Incomes Policy: Completing the Stabilization Triangle," p. 110.

with the demand for its services. In other cases, firms would not be able to attract all the labor they desired. Relative prices would, therefore, be distorted by the establishment of a single guidepost for all firms and industries.

The TIP proposal would lead to a misallocation of resources. Prices, when allowed to operate freely, offer signals of where demand is increasing and where demand is falling. Resources move to those industries or firms where they will receive the highest compensation. The TIP proposal would obscure these price signals and, hence, resources would not move to where they would be used most efficiently. The economy would suffer since production would be lower than it would be otherwise.

The distortions in the economy caused by TIP could have a very long lasting effect. Capital (plant and equipment) is allocated by the market to those firms which have the highest rate of return. The TIP proposal would reduce the rates of return of those firms which are growing, and capital would not be adequately allocated to them. Capital generally tends to have a relatively long life. Once it is misallocated, as a result of TIP, it would not be easy to reallocate it to a more efficient use. Thus, TIP could have serious long-term consequences, as a result of the distortions it would cause in the price system.

CONCLUSION

TIP is an incomes policy designed to reduce inflation without interfering with the market system. The essence of the proposal is to subject corporations to higher corporate income tax rates if they granted pay increases in excess of a single Government-mandated guidepost.

TIP would not be successful in reducing the rate of inflation because it is based on the premise that inflation is largely a "cost-push" phenomenon — higher wages leading to higher prices, which lead to still higher wages. Inflation, however, is caused primarily by excessive growth of the money stock. The TIP proposal, therefore, deals only with the symptoms of inflation, rather than attacking inflation at its root.

TIP would distort the market pricing system because the imposition of a single wage guidepost would not allow relative prices to adjust fully to change. This would lead to inefficiencies and a lower level of production than would be otherwise attainable.

Inflation is a serious problem, and there are no magic solutions. There may be a temporary reduction in the apparent rate of inflation with TIP, but eventually leaks will develop in the system and prices will rise anyway. The only way to stop inflation is to reduce the rate of monetary expansion.

Does the St. Louis Equation Now Believe in Fiscal Policy?

KEITH M. CARLSON

THE "St. Louis equation" was developed in 1968 in an article in this *Review* by Leonall Andersen and Jerry Jordan.[1] The St. Louis equation is an estimated relationship (using the Almon procedure) between changes in total spending (GNP) and changes in the money supply and high-employment Federal expenditures. The focus of the Andersen-Jordan article was on the relative impact of monetary and fiscal actions. They rejected the propositions that the response of economic activity to fiscal actions relative to monetary actions was (1) larger, (2) more predictable, and (3) faster. In fact, their results suggested that the overall effect of fiscal actions was relatively small and not statistically significant. It was this result that generated considerable controversy among members of the economics profession.[2] The conventional wisdom of the time was that fiscal actions (whether in the form of a maintained increase in expenditures or a tax cut) did have an impact on economic activity, with a multiplier usually estimated at about 1.5 or greater.[3]

In a recent article, Benjamin Friedman published updated estimates of the St. Louis equation.[4] According to Friedman, the St. Louis equation now "believes in" fiscal policy. He presented results showing that the St. Louis equation yields a significant government spending multiplier of about 1.5 when estimated with data through second quarter 1976. This result conforms with neo-Keynesian thinking. At the same time, Friedman duly noted that with these updated estimates the relatively strong impact of monetary actions continues to hold.

The Friedman results are indeed interesting, and deserve closer examination. Those who accept the

[1]Leonall C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," this *Review* (November 1968), pp. 11-24.

[2]No attempt is made here to give a complete bibliography on the St. Louis equation. Among the earlier articles, see Frank de Leeuw and John Kalchbrenner, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization — Comment," this *Review* (April 1969), pp. 6-11; Richard G. Davis, "How Much Does Money Matter? A Look at Some Recent Evidence," Federal Reserve Bank of New York *Monthly Review* (June 1969), pp. 119-31; E. Gerald Corrigan, "The Measurement and Importance of Fiscal Policy Changes," Federal Reserve Bank of New York *Monthly Review* (June 1970), pp. 133-45; and Edward M. Gramlich, "The Usefulness of Monetary and Fiscal Policy as Discretionary Stabilization Tools," *Journal of Money, Credit, and Banking* (May 1971), pp. 506-32.

[3]See, for example, Frank de Leeuw and Edward M. Gramlich, "The Federal Reserve-MIT Econometric Model," *Federal Reserve Bulletin* (January 1968), pp. 11-40; James S. Duesenberry, Gary Fromm, Lawrence R. Klein, and Edwin Kuh, eds., *The Brookings Quarterly Econometric Model of the United States* (Chicago: Rand McNally, 1965); Michael K. Evans and Lawrence R. Klein, *The Wharton Econometric Forecasting Model*, 2nd Enlarged Edition (Philadelphia: University of Pennsylvania, 1968); Maurice Liebenberg, Albert A. Hirsch, and Joel Popkin, "A Quarterly Econometric Model of the United States: A Progress Report," *Survey of Current Business* (May 1966), pp. 425-56; and Daniel M. Suits, *The Economic Outlook for 1969*, Papers Presented to the Sixteenth Annual Conference on the Economic Outlook at the University of Michigan (Ann Arbor: University of Michigan, 1969), pp. 1-26.

[4]Benjamin M. Friedman, "Even the St. Louis Model Now Believes in Fiscal Policy," *Journal of Money, Credit, and Banking*, (May 1977), pp. 365-67. Also see William G. Dewald and Maurice N. Marchon, "A Modified Federal Reserve of St. Louis Spending Equation for Canada, France, Germany, Italy, the United Kingdom, and the United States," forthcoming in *Kredit und Kapital*.

original St. Louis evidence regarding the relative strength of monetary and fiscal actions do not question the importance of fiscal actions; such actions do have economic impact over a certain period. However, the size of the steady-state multiplier is in dispute. In particular, past estimates of the St. Louis equation showed that there was a short-run impact for fiscal actions, but this impact washed out over time. If the fiscal action were accompanied by a change in the rate of monetary expansion, there would be an effect, but this would be attributable to the monetary action.

To deal with Friedman's results, the St. Louis equation is examined for the original sample period from 1953 through 1969, and then compared with updated estimates through 1976. On the basis of this examination, it is found that in light of developments since 1969, the form in which the original St. Louis equation was specified is no longer statistically appropriate. The St. Louis equation was originally estimated in arithmetic first difference form (with a constant), that is, all variables were defined as first differences in dollar amounts. Examination of the statistical properties of this specification indicates that at least one of the assumptions of least squares estimation appears to be violated when the experience from 1969 to 1976 is added to the data set. An alternative specification estimated with data through 1976 is offered which appears to satisfy the assumptions of least squares estimation, and in the process the original conclusions about the impact of fiscal actions are found to hold.

UPDATING THE ORIGINAL ST. LOUIS EQUATION

The original St. Louis equation, as published in November 1968, was estimated with data from I/1952 through II/1968. A later version, published in April 1970, used I/1953 through IV/1969 as the sample period.[5] This second version served as the fundamental relation in the "St. Louis model." This model was an extension of the original St. Louis equation — extended to include determination of prices, output, unemployment, and interest rates.

There are several possible explanations of Friedman's results, including the effect of data revisions. Since the original presentation of the St. Louis equation, many data revisions have occurred. The net effect of these data revisions on the estimated coefficients is summarized in Table I. An update of the equation using revised data through 1976 is presented in Table II as a prelude to an examination of the factors contributing to the "appearance" of a significant fiscal multiplier.

The Estimates

In Table I, consider first a comparison of the St. Louis equation as published in April 1970 with a recent version estimated over the same original sample period. All constraints and the number of lags are maintained. At issue here is whether all the revisions of the National Income Accounts (NIA) and the money supply have altered the conclusions regarding the relative impact of monetary and fiscal actions drawn from the original St. Louis equation.

Table I

EFFECT OF DATA REVISIONS ON ST. LOUIS EQUATION
Based on Data Available in April 1970 and Feb. 1978
(Sample Period: I/1953—IV/1969)

$$\Delta Y_t = \text{constant} + \sum_{i=0}^{4} m_i \Delta M_{t-i} + \sum_{i=0}^{4} e_i \Delta E_{t-i}$$

	April 1970 Estimate*		Feb. 1978 Estimate*	
m_0	1.22	(2.73)	1.37	(2.96)
m_1	1.80	(7.34)	1.92	(7.62)
m_2	1.62	(4.25)	1.58	(3.96)
m_3	.87	(3.65)	.63	(2.59)
m_4	.06	(.12)	−.24	(−.52)
Σm_i	5.57	(8.06)	5.26	(8.01)
e_0	.56	(2.57)	.48	(2.32)
e_1	.45	(3.43)	.52	(4.07)
e_2	.01	(.08)	.15	(.81)
e_3	−.43	(−3.18)	−.40	(−3.07)
e_4	−.54	(−2.47)	−.67	(−3.22)
Σe_i	.05	(.17)	.07	(.21)
Constant	2.67	(3.46)	2.32	(2.82)
R^2	.66		.69	
S.E.	3.84		3.97	
D.W.	1.75		1.93	

* t statistic shown in parentheses

Symbols are defined as follows:
ΔY: dollar change in GNP
ΔM: change in money stock (M1)
ΔE: change in high-employment expenditure
R^2: coefficient of multiple determination
S.E.: standard error of the regression
D.W.: Durbin-Watson statistic

[5] Leonall C. Andersen and Keith M. Carlson, "A Monetarist Model for Economic Stabilization," this *Review* (April 1970), pp. 7-25.

Table I indicates that the effect of all data revisions since April 1970 has been slight. The sum effect of monetary actions (Σm_i) is slightly smaller, but the pattern of time distribution among these coefficients continues to hold. Similarly, for fiscal actions, the effect of data revisions is very small. The sum effects on total spending of the independent variables continue to be dominated by the money variable. The summary statistics indicate a slightly larger R^2, an improved Durbin-Watson statistic, but a larger standard error of the regression. In general, there is nothing to indicate that data revisions have changed the fundamental conclusions drawn from the original St. Louis equation.

The equation was then estimated through 1976, with 1953 maintained as the beginning of the sample period.[6] These estimates are shown in Table II. The total effect of monetary actions continues to be important when the equation is estimated through 1976. The sum effect of monetary actions is somewhat smaller — 4.48 for the period through 1976, compared with 5.26 for the earlier period. Probably the most interesting feature of these updated estimates is that even though the sum effect of monetary actions did not appear to change much, the pattern of the lag distribution changed substantially. Originally the effect peaked for the change in money lagged one quarter (ΔM_{t-1}), but for the sample period extended through 1976, the peak came on ΔM_t, and only ΔM_t and ΔM_{t-1} are significant.

Table II

EFFECT OF UPDATING ST. LOUIS EQUATION

$$\Delta Y_t = \text{constant} + \sum_{i=0}^{4} m_i \Delta M_{t-i} + \sum_{i=0}^{4} e_i \Delta E_{t-i}$$

	Sample Period: I/1953—IV/1969		Sample Period: I/1953—IV/1976	
m_0	1.37	(2.96)	2.24	(4.04)
m_1	1.92	(7.62)	1.55	(4.39)
m_2	1.58	(3.96)	.43	(.88)
m_3	.63	(2.59)	.07	(.21)
m_4	−.24	(−.52)	.40	(.70)
Σm_i	5.26	(8.01)	4.48	(5.98)
e_0	.48	(2.32)	.34	(1.83)
e_1	.52	(4.07)	.25	(1.80)
e_2	.15	(.81)	.21	(1.34)
e_3	−.40	(−3.07)	.36	(2.65)
e_4	−.67	(−3.22)	.48	(2.47)
Σe_i	.07	(.21)	1.64	(4.50)
Constant	2.32	(2.82)	.45	(.35)
R^2	.69		.70	
S.E.	3.97		7.55	
D.W.	1.93		1.77	

All symbols and abbreviations are defined in Table I.

Examination of the coefficients for the change in high-employment Federal expenditures (ΔE) indicates a much greater change for the updated version of the equation. The sum effect of fiscal actions climbed from .07 with data through 1969 to 1.64 with data through 1976. Furthermore, the t statistic for the sum effect of fiscal actions is statistically significant in the 1953-76 regression. It is this result that Friedman emphasized.

A Critique of These Updated Estimates

To better understand what underlies these changed results, the error pattern of the St. Louis equation is examined in greater detail. This error pattern is shown in Chart I for the equation as estimated for the original sample period through IV/1969, and for the updated version through IV/1976.

The IV/1969 version shows extreme errors only for those periods associated with major strikes. Such is not the case, however, for the updated version. There are three periods that stand out — I/1975, III/1975, and I/1976. The equation performs poorly in these periods, yet these quarters were not associated with major strikes.

A crucial assumption in linear regression is that the variance of the error term is constant. Examination of the errors for the period I/1975 through I/1976 suggests that this assumption might be violated. If this is so, in the absence of collateral information about the relationship between the nonconstant error variances, the power of the standard t and F tests becomes indeterminate.[7] If, for example, these errors are positively correlated with the size of the deviation of the independent variables about their means, there is increased probability of incorrectly rejecting the null hypothesis of no significance.[8] That is, a particular coefficient would be incorrectly judged to be significant.

[6]Friedman also gave estimates for the sample period beginning in I/1960. This was also done as a part of this study. However, none of the conclusions reached here was affected by this change in sample period.

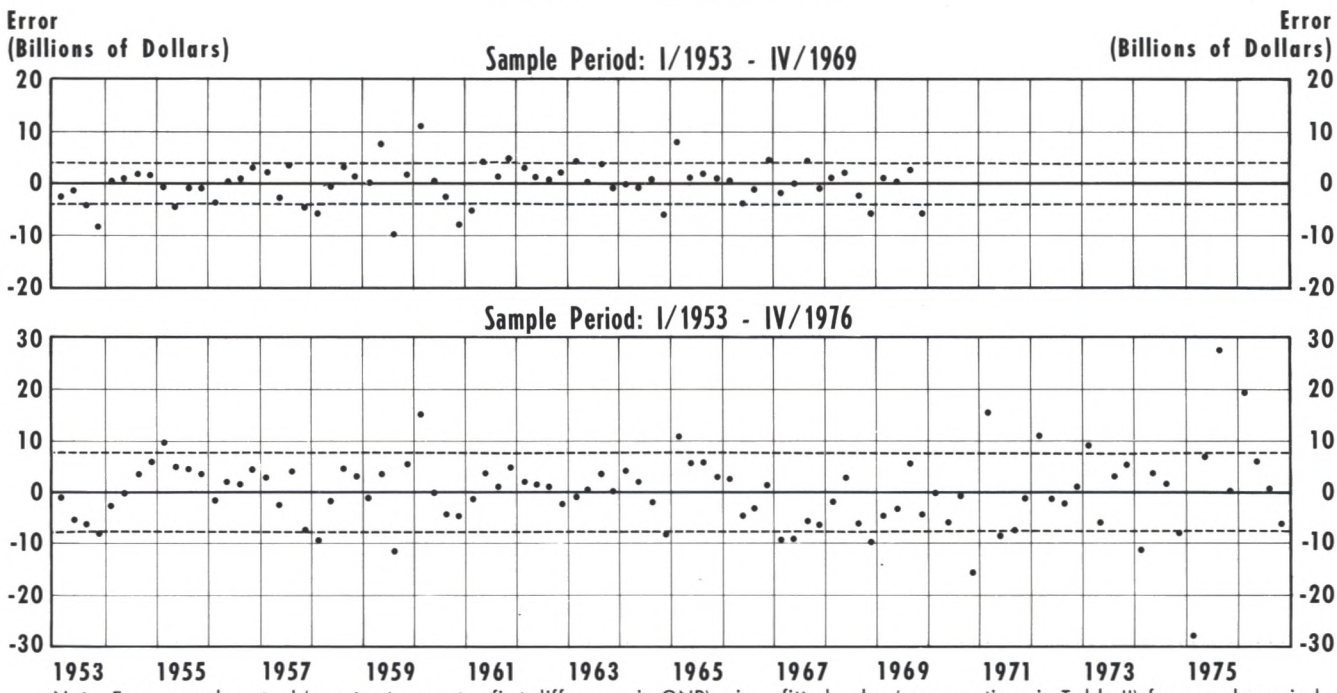
[7]For further discussion, see Jan Kmenta, *Elements of Econometrics* (New York: Macmillan, 1971), pp. 249-69.

[8]*Ibid.*, p. 256.

Chart I

Error Pattern of St. Louis Equation

First Difference (ΔY) Specification



Note: Error equals actual (quarter-to-quarter first difference in GNP) minus fitted value (see equations in Table II) for sample period indicated. Dashed horizontal lines indicate plus-minus the standard error of the regression (3.97 for I/1953-IV/1969 and 7.55 for I/1953-IV/1976).

To determine if the assumption of constant variance in the error term is being violated, a statistical test was conducted for the sample period ending in IV/1969 and the one ending in IV/1976. These results are shown in Table III using the Goldfeld-Quandt test for homoscedasticity.[9] The assumption of homoscedasticity (constancy of error variances across all observations) is not rejected with this specification of the equation for the sample period ending IV/1969, but is rejected for the period ending IV/1976. In general, the St. Louis equation, as estimated in its original first difference form, but updated through 1976, does not now appear to satisfy the requirement of least squares estimation that the variance of the error term be constant. Given the evidence of nonconstancy of the error variances and the absence of reliable information about the relationship among the error variances, confidence in the significance of the estimated coefficients is reduced. One way around this problem is to seek an alternative specification which satisfies this assumption of least squares.[10]

AN ALTERNATIVE SPECIFICATION

Updating the original St. Louis equation suggests the emergence of statistical problems — problems which were not present when the equation was first estimated in 1968 and 1969. Rather than cling to that specification, an alternative is examined in an effort

[9]S. M. Goldfeld and R. E. Quandt, "Some Tests for Homoscedasticity," *Journal of the American Statistical Association* (June 1965), pp. 539-547.

[10]To determine the direction of the bias in the estimates of the standard error of the regression coefficients, the results from the 1976 regression were ranked according to the size of the independent variables and then grouped to compute error variances. Correlation of these error variances with the squared deviations of the group means from the overall mean yielded the following:

	Correlation Coefficient	
	8 Groups of 12 Observations Each	12 Groups of 8 Observations Each
ΔE	.90	.55
ΔM	.83	.67

These results, although not conclusive, suggest that the estimates of the standard errors are biased downward, that is, the associated t statistics are biased upward. See Kmenta, p. 256.

Table III

RESULTS OF THE GOLDFELD-QUANDT TEST FOR HETEROSCEDASTICITY

(ΔY Version of Equation)

Sample Subgroups	Null Hypothesis	Alternative Hypothesis	Critical F	Calculated F	Test Result
I/53—IV/76					
A: III/67—IV/76 B: I/53—II/62	$H_0: V(\epsilon_t)_A = V(\epsilon_t)_B$	$H_a: V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;35,35)} = 2.24$	F=3.57	H_0 rejected
A: I/65—IV/76 B: I/53—IV/64	$H_0: V(\epsilon_t)_A = V(\epsilon_t)_B$	$H_a: V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;45,45)} = 2.02$	F=5.30	H_0 rejected
I/53—IV/69					
A: II/63—IV/69 B: I/53—III/59	$H_0: V(\epsilon_t)_A = V(\epsilon_t)_B$	$H_a: V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;24,24)} = 2.66$	F= .89	H_0 not rejected
A: III/61—IV/69 B: I/53—II/61	$H_0: V(\epsilon_t)_A = V(\epsilon_t)_B$	$H_a: V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;31,31)} = 2.35$	F= .46	H_0 not rejected

Symbols:

$V(\epsilon_t)$: variance of residuals

A, B: subgroups where A is suspected of having larger residual variance than B

F: Snedecor's F, test statistic for independence of two chi-square distributed random variables. Subscripts in parentheses refer to level of significance and degrees of freedom in numerator and denominator.

to avoid these specification problems.[11] The alternative chosen here is to express all variables in the equation in rates-of-change form.[12]

In their original article, Andersen and Jordan suggested that a rate-of-change specification might be preferable.[13] At that time both specifications gave essentially the same results with regard to the relative impact of monetary and fiscal actions. They opted for the first difference form because it gave direct estimates of multipliers which, at the time, were more commonly used than elasticities in summarizing the economic impact of changes in policy variables.

The Estimates

Estimates of the St. Louis equation in rate-of-change form for the two sample periods are shown in Table IV. The pattern of estimated coefficients as the

Table IV

ALTERNATIVE SPECIFICATION OF ST. LOUIS EQUATION

$$\dot{Y}_t = \text{constant} + \sum_{i=0}^{4} m_i \dot{M}_{t-i} + \sum_{i=0}^{4} e_i \dot{E}_{t-i}$$

	Sample Period: I/1953—IV/1969		Sample Period: I/1953—IV/1976	
m_0	.30	(2.06)	.40	(2.96)
m_1	.47	(5.90)	.41	(5.26)
m_2	.38	(3.01)	.25	(2.14)
m_3	.09	(1.19)	.06	(.71)
m_4	−.16	(−1.10)	−.05	(−.37)
Σm_i	1.08	(4.95)	1.06	(5.59)
e_0	.07	(1.77)	.08	(2.26)
e_1	.09	(3.63)	.06	(2.52)
e_2	.03	(.75)	.00	(.02)
e_3	−.09	(−3.68)	−.06	(−2.20)
e_4	−.16	(−4.07)	−.07	(−1.83)
Σe_i	−.06	(−.88)	.03	(.40)
Constant	3.22	(4.04)	2.69	(3.23)
R^2	.53		.40	
S.E.	3.25		3.75	
D.W.	1.85		1.78	

All symbols and abbreviations are defined in Table I. except the dot over a variable signifies compounded annual rate of change.

[11] There are various methods of avoiding the statistical problems discussed here, so it cannot be said with certainty that the alternative specification chosen here is "the correct one." However, if an alternative is found to satisfy the assumption of homoscedasticity, along with the other assumptions of least squares, more confidence can be placed on the estimated regression coefficients from that specification than in the original one.

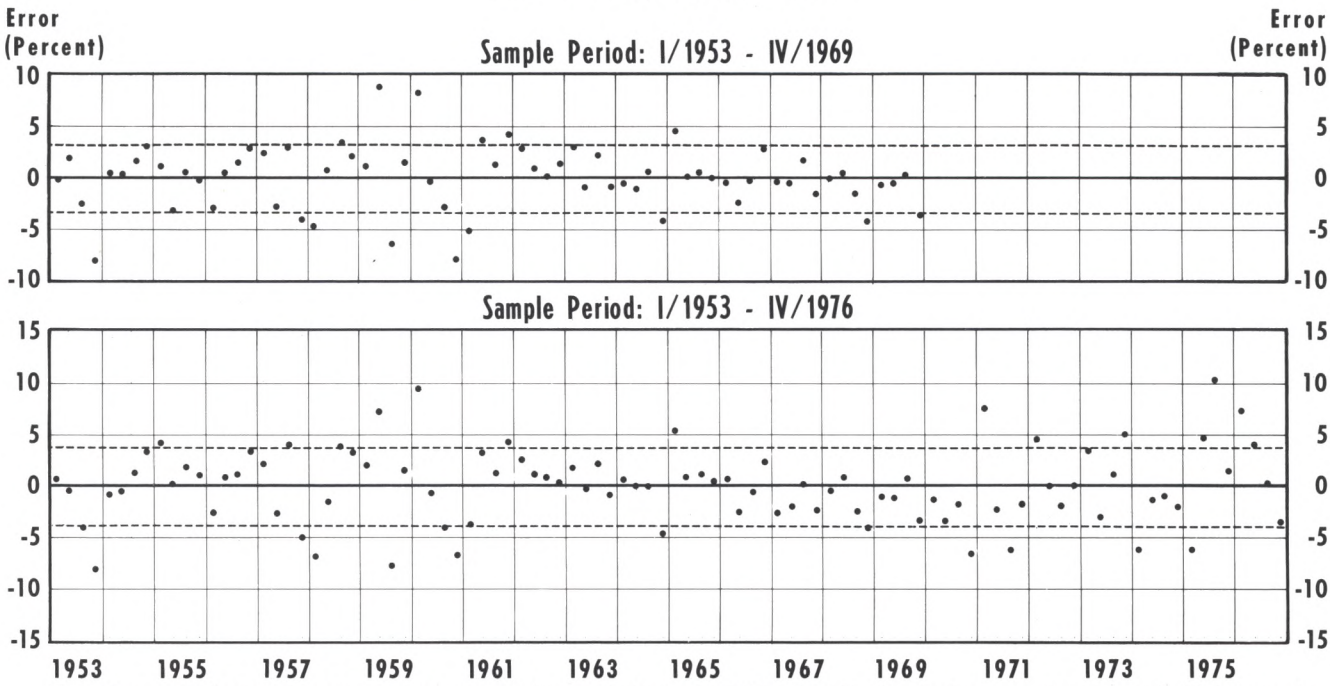
[12] Since the primary problem with the arithmetic first difference (including a constant) specification seems to be one of heteroscedasticity when the sample period is extended through 1976, an attempt was made to identify the source of the problem. To see whether a specification error may be the source of the problem, the Brown-Durbin-Evans test for constancy of the regression coefficients over time was applied to the first difference specification. The hypothesis of constancy of the coefficients was not rejected for the original sample period, but rejected for the extended period. However, for the rate-of-change specification, the hypothesis of constancy of the coefficients was accepted for both the original and extended sample periods. See R. L. Brown, J. Durbin, and J. M. Evans, "Techniques for Testing the Constancy of Regression Relationships Over Time, with Comments," *Journal of the Royal Statistical Society, Ser. B* (1975), pp. 149-92.

[13] Andersen and Jordan, "Monetary and Fiscal Actions," fn. 10, p. 16.

Chart II

Error Pattern of St. Louis Equation

Rate of Change (Ẏ) Specification



Note: Error equals actual (quarter-to-quarter annual rate of change in GNP) minus fitted value (see equations in Table IV) for sample period indicated. Dashed horizontal lines indicate plus-minus the standard error of the regression (3.25 for I/1953-IV/1969 and 3.75 for I/1953-IV/1976).

equation is updated differs substantially from those presented for the first difference form in Table II. The sum effect of both monetary and fiscal actions changes little. Although there is some bunching of the coefficients towards $t = 0$, the coefficient on $\dot{M}_{t-1}$ is still the peak quarter of effect.

Examination of the estimates of the fiscal effect indicates that the sum effect changes from negative to positive as this specification is updated. However, the total of the fiscal effect is not significantly different from zero for either the original or extended sample periods. The distribution of the lag coefficients is little changed as the equation is updated through 1976, in contrast to the first difference specifications in Table II.

Analysis of the Error Pattern

The results of updating the St. Louis equation in rate-of-change form differ substantially from those in first difference form (Chart II). Using rates of change instead of first differences appears to satisfy the assumption of constant error variances. The results of the Goldfeld-Quandt test are shown in Table V. For each of the test periods, the null hypothesis of constancy in the error variances is not rejected. By reason of this argument, there is no reason to suspect bias in the estimated standard errors for this specification. The sum effect for the monetary variable is significant, but for the fiscal variable it is not.

SUMMARY AND CONCLUSION

Benjamin Friedman has published results showing that the St. Louis equation now "believes in" fiscal policy. This conclusion was based on updated estimates of the equation in its originally published first difference form. Friedman's conclusion is shown to be suspect on statistical grounds. Estimation of that equation in arithmetic first difference form no longer appears to be acceptable because there is evidence of nonconstant error variance. Hence, it is difficult to assess the statistical reliability of any conclusions about the impact of monetary and fiscal actions based on estimates with that form of the equation.

To correct these statistical problems, the St. Louis equation was reestimated in rate-of-change form. All other properties of the specification were maintained,

Table V

RESULTS OF THE GOLDFELD-QUANDT TEST FOR HETEROSCEDASTICITY

($\dot{Y}$ Version of Equation)

Sample Subgroups	Null Hypothesis	Alternative Hypothesis	Critical F	Calculated F	Test Result
I/53—IV/76					
A: III/67—IV/76 B: I/53—II/62	H_0: $V(\epsilon_t)_A = V(\epsilon_t)_B$	H_a: $V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;35,35)} = 2.24$	F=.78	H_0 not rejected
A: I/65—IV/76 B: I/53—IV/64	H_0: $V(\epsilon_t)_A = V(\epsilon_t)_B$	H_a: $V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;45,45)} = 2.02$	F=.97	H_0 not rejected
I/53—IV/69					
A: II/63—IV/69 B: I/53—III/59	H_0: $V(\epsilon_t)_A = V(\epsilon_t)_B$	H_a: $V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;24,24)} = 2.66$	F=.34	H_0 not rejected
A: III/61—IV/69 B: I/53—II/61	H_0: $V(\epsilon_t)_A = V(\epsilon_t)_B$	H_a: $V(\epsilon_t)_A > V(\epsilon_t)_B$	$F_{(.01;31,31)} = 2.35$	F=.21	H_0 not rejected

Symbols:

$V(\epsilon_t)$: variance of residuals

A, B: subgroups where A is suspected of having larger residual variance than B

F: Snedecor's F, test statistic for independence of two chi-square distributed random variables. Subscripts in parentheses refer to level of significance and degrees of freedom in numerator and denominator.

that is, the number of lags, the constraints and degree of polynomial, and the definitions of the variables. This alternative specification satisfied the least squares assumptions concerning constancy in the error variance. With this rate-of-change alternative preferred on statistical grounds, the original empirical conclusion regarding the steady-state effect of fiscal actions was not altered. The evidence does not support the contention that the St. Louis equation now "believes in" fiscal policy.