SHORT AND LONG-RUN EFFECTS OF MONETARY POLICY UPON REAL OUTPUT AND INFLATION

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Abstract

There is a consensus concerning the longer run effects of monetary and fiscal policy upon real output and inflation. (1) The trend rate of growth of output and level of employment rate are independent of the trend rate of money growth. (2) A change in the trend rate of money growth produces a corresponding change in the trend rate of inflation. A division of opinion concerns the shorter-run effects of monetary and fiscal policy upon real output and inflation, particularly when output is below capacity output. The competing schools of thought are the Keynesian, Monetarist and New Classical. In my recent work, it is argued that only the Monetarist hypothesis is consistent with U.S. data from 1957-80.

I describe a Monetarist explanation of short run variations in the growth of output and inflation. The resulting statistical equations are compared for the U.S. and Argentina. In my recent work, it was shown that these equations are quantitatively similar in the U.S. and Canada. The U.S.-Argentina comparison is quantitatively, but not qualitatively, different. (1) The same types of Monetarist equations explain the U.S. and Argentine levels of real GNP and inflation. (2) Inflation responds 3-4 times as fast to a change in the rate of monetary expansion in Argentina as it does in the U.S. (3) Monetary changes in Argentina are quickly dissipated into inflation changes rather than output changes, relative to what occurs in the U.S.

* Professor of Economics, Eastman Professor of Political Economy at Brown University. This paper draws heavily upon my *Monetarist, Keynesian and New Classical Economics* (Basil Blackwell, Oxford and NYU Press, 1982) and my current research with my graduate student, Roberto Domenech.

There is a consensus among economists concerning the longer-run effects of monetary and fiscal policy upon real output and the rate of inflation. A division of opinion exists concerning the shorter-run effects of these policies, particularly when the level of output is below capacity output: i.e., the unemployment rate exceeds its equilibrium rate. Where once Keynesian economics reigned supreme, three competing schools of thought now co-exist, each offering very different explanations for inflation and the growth of output in the shorter run. These schools are the Keynesian, New Classical and Monetarist. I describe the Monetarist explanation of short-run variations in the growth of real output and inflation, and indicate how the process seems to differ among countries: particularly the U.S.A. and Argentina.

I. *Areas of Consensus and Disagreement*

Propositions (1) and (2) summarize the consensus among macroeconomists concerning the effects of monetary policy upon the medium-run equilibrium of the macroeconomy. (1) The trend rate of growth of output and level of employment rate are independent of the trend rate of money growth. (2) A change in the trend rate of money growth produces a corresponding change in the trend rate of inflation. Table 1 illustrates the reasons for the consensus. Twelve countries are considered over a five-year period 1975-80 with respect to their trend rates of monetary expansion, growth of real GNP and inflation. During this five-year period, (a) the high inflation countries had on average higher trend rates of monetary growth than did the countries with lower trend rates of inflation. (b) For all countries, the trend rate of inflation (9% p.a.) was almost identical with the trend rate of monetary expansion (10.43% p.a.). (c) On average, a percentage point rise in the trend rate of monetary expansion raised the trend rate of inflation by the same amount. The regression coefficient of the trend rate of inflation on the trend rate of monetary expansion is approximately unity. This relationship accounts for 82% of the variance in the trend rates of inflation. There are, of course, other factors explaining the trend rate of inflation, as is evidenced by Germany, Switzerland and Japan; but these other factors do not explain more than 18% of the variance among countries. (d) There is no significant difference in the trend rates of growth of real GNP between the high and the low inflation countries. No relation exists between the rate of growth of output over a five-year period and either the rate of inflation or rate of monetary expansion over the same period.

Disagreement among macroeconomists concerns the effects of monetary and fiscal policy upon the trajectories of the unemployment rate, rate of growth of real GNP and rate of inflation between medium-run equilibria, or during periods of time less than five years. This disagreement can be seen by

Table 1

Rates of Inflation, Monetary Expansion and Growth of Real Output, Twelve Countries 1975-80

Country	*(1) Rate of Inflation GNP Deflator*	*(2) Rate of Monetary Expansion*	*(3) Rate of Growth Real GNP*	*(4) Col. (2) – Col. (3)*
Spain	17.9% p.a.	16.9% p.a.	2.0% p.a.	14.9% p.a.
Italy	17.5	20.7	3.8	16.9
U.K.	14.7	12.8	1.6	11.2
France	10.1	10.8	3.3	7.5
Sweden	10.3	13.9	1.3	12.6
Canada	8.9	7.9	2.9	5.0
U.S.A.	7.3	7.1	3.7	3.4
Netherlands	5.9	7.6	3.7	3.9
Belgium	5.4	5.5	2.8	2.7
Japan	4.4	8.5	5.1	3.4
Germany	4.0	8.3	3.5	4.8
Switzerland	1.6	5.2	1.7	3.5
mean	9.00	10.43	2.95	7.48
stand. deviation	5.34	4.77	1.13	5.06

Source: Federal Reserve Bank of St. Louis, International Economic Conditions.

comparing the propositions of the Keynesian, New Classical and Monetarist schools of thought.

Keynesians accept the following propositions: [K1] In an economy with underemployment of labor and capital, an increase in aggregate demand will increase output and employment without raising the rate of inflation. [K2] Both money-financed and bond-financed fiscal policy are effective in raising the rate of growth of output and lowering the unemployment rate. [K3] There is a significant social cost, in terms of unemployment and loss of real output, of policies to reduce the rate of inflation.

New Classical Economics (NCE) rejects Keynesian economics completely and fundamentally. Their Policy Ineffectiveness Proposition, denoted [NCE1] differentiates them from the other schools of thought. [NCE1] On average, the unemployment rate or rate of growth of real GNP is totally insensitive to demand management policies. An implication of this is [NCE2]: There are no expected social costs in terms of unemployment or growth rate of output of a policy which is understood will reduce the rate of growth of the money supply.

As far as the medium-run equilibrium is concerned, when output is at capacity or the unemployment rate is at its equilibrium value, Keynesians do not believe that demand management policies can increase the growth rate. The issue dividing the schools concerns a situation where the level of output is below capacity output. Can monetary or fiscal policy accelerate the return of output to capacity output?

What I define as a Monetarist view, propositions [M1] and [M2], is inter-

mediate between the poles of Keynesian and New Classical Economics. [M1] Past rates of growth of the money supply are the only systematic factors determining the rate of inflation. Contrary to the Keynesian view, a restrictive fiscal policy without a reduction in the rate of monetary expansion cannot reduce the rate of inflation. [M2] Contrary to the NCE, there is a significant social cost in terms of lost output and a rise in unemployment of a known monetary policy which attempts to reduce the rate of inflation. The magnitude of this cost depends upon the economy in a manner explained below and illustrated by comparing the U.S.A. with Argentina.

My strategy in *Monetarist, Keynesian and New Classical Economics* (Basil Blackwell, Oxford and NYU Press, 1982) was to develop a general model which can imply any one of the three schools of thought, depending upon different parameter specifications. Each school of thought is shown to be a special case of the general model, and disagreement can be resolved by testing alternative statistical hypotheses. My conclusions were as follows. (1) The Keynesian and NCE hypotheses are inconsistent with the U.S. data from 1953 to 1979, whereas the Monetarist hypotheses are consistent with these data. (2) One of my graduate students just completed research showing that the exact same conclusions apply to the Canadian economy. (3) The Monetarist inflation equation is valid not only for the U.S. and Canada, but also for the world as a whole during the period 1953-79.

There is no reason why the set of parameters which imply the Monetarist or any other school of thought should apply to all countries, and at all times within a given country. Some countries can control their money supplies, and in others the rate of monetary growth depends upon the state of the balance of payments. In some countries, the domestic rate of inflation is determined by those of their major trading partners rather than by internal monetary policies. The degree of government intervention in the price and wage setting process differs among countries. In some countries, there is a more predictable relation between government deficit spending, current money growth and inflation than in other countries. These differences profoundly affect the efficacy of monetary and fiscal policy and hence the dynamics of growth of output, the unemployment rate and rate of inflation between medium-run equilibria.

In this paper I briefly describe my monetarist explanation of variations in the growth of real output, unemployment and rate of inflation between medium-run equilibria and indicate how the process seems to differ between the U.S.A. and Argentina.

II. *A Monetarist Explanation of Growth, Unemployment and Inflation*

During a discussion with a biochemist, I realized that the way that a cell

or organism reacts to narcotics is mathematically similar to my monetarist view of how the macroeconomy adjusts to variations in the rate of monetary expansion. Living systems and economies show remarkable abilities to adjust to disturbances. There is a mechanism which leads to an adjustment, but at a cost to the system. Before providing my monetarist explanation, I describe how a cell responds to additions or withdrawal of morphine. The key to the two models is the following.

morphine corresponds to the rate of monetary growth $\mu(t)$
cAMP enzyme corresponds to the unemployment rate U(t)
adenylate cyclase corresponds to the rate of inflation $\pi(t)$.

A. *A Biochemical Analysis of the Effects of Narcotics upon a Cell*

Figure 1 described the effects of morphine (μ) upon the levels of cAMP enzyme activity (U(t)) and adenylate cyclase activity ($\pi(t)$). The latter feeds back upon the level of the cAMP enzyme, which is the main variable of interest. (See S. Scharma, W. Klee and M. Nirenberg, "Dual Regulation of Adenylate Cyclase Accounts for Narcotic Dependence and Tolerance," *Proc. Nat. Acad. Sci.*, USA, 72, No. 8, 3092-96, August 1975.) Initially, both the enzyme cAMP and adenylate cyclase are at their normal levels calibrated at 100. At time t = 0, morphine (μ) is added to the growth medium of the cell. Morphine depresses the enzyme level (U(t)), which produces a depressed narcotic condition.

During the period that the cells are exposed to morphine and narcotic depression occurs, an increase occurs in adenylate cyclase activity ($\pi(t)$). The latter compensates for the inhibition of the cAMP enzyme activity by the narcotic. After 1-2 days, the greater level of adenylate cyclase fully compensates for the narcotic; and there is morphine dependence and tolerance at t = 2. There is no longer any depressed enzyme activity.

If the morphine were withdrawn at time t = 2, a dramatic rise would occur in the level of cAMP enzyme activity U(t) since the enzyme is no longer depressed by the morphine. This "cold turkey" treatment produces severe discomfort. As a result of the unduly high level of the cAMP enzyme activity, adenylate cyclase activity is inhibited. This is a negative (stabilizing) feedback control. Eventually, the levels of both the cAMP enzyme and adenylate cyclase return to their original normal levels.

Figure 1. The rise in μ (rate of monetary expansion, morphine) from t = 0 to t = 2 initially depresses U (unemployment rate, cAMP enzyme). The rise in μ and depression of U stimulate a rise in π (rate of inflation, adenylate cyclase). The latter offsets the rise in μ so that U returns to its normal level, but there is a higher steady-state value of π.

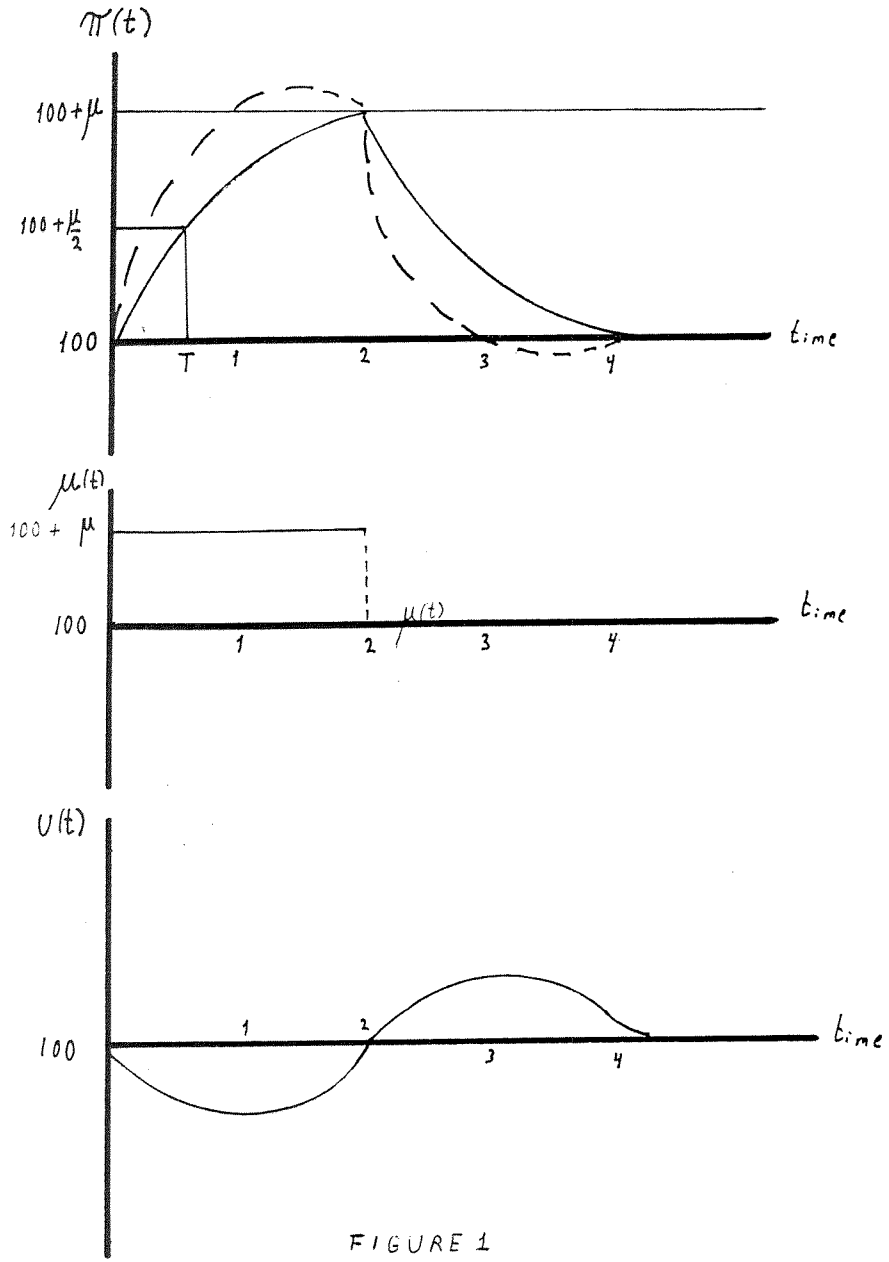

FIGURE 1

When μ is reduced to its normal level at t = 2, the value of U rises above its normal level. The decline in μ and rise in U induce a decline in π (inflation, adenylate cyclase) which offsets the effect of a reduced value of μ (rate of monetary expansion, morphine) upon U (unemployment rate, cAMP enzyme). Both U and π return to their normal levels.

The dotted curve π is the theoretical, and solid curve π is the empirical approximation. Time T is the half life of the effect of μ upon π.

If the morphine level were increased rather than decreased at t = 2, there would be a repetition of the process which occurred from t = 0 to t = 2. Narcotic dependence and tolerance would have been achieved by an even higher level of adenylate cyclase, necessary to offset the depressive effect of the higher morphine dosage upon the cAMP enzyme level.

Such a feedback process which compensates for the narcotic has its limits. In a living organism the steady rise in the production of adenylate cyclase, required to compensate for the depressive effects of the narcotic upon the cAMP enzyme activity, exerts great strains upon the respiratory system. After a specific point is reached, the respiratory system collapses, and the patient has died of an (o.d.) overdose of the narcotic.

B. *A Monetarist Transmission Mechanism* (Stein, 1982)

1. *The Genesis of Money Growth*

The response of an economy to high employment deficits financed by money creation is mathematically similar to the organism's response to the introduction of a narcotic. The driving force behind the inflationary process is the fiscal policy, measured by the ratio of the high employment deficit $F^H(t)$ to the stock of money M(t). The actual budget deficit F(t) is a dependent variable which reflects not only fiscal policy but also the state of the economy. For example, compare the annual surplus or deficit in the national income accounts budget with the annual high employment surplus or deficit in the U.S.

	Actual Budget	*High Employment Budget*
mean	–$55.1 billion	–$15.12
stand. dev.	40.9	11.52

There is almost four times as much variability in the actual budget than in the high employment budget. On a quarterly basis, from 1977.1 to 1983.2, the high employment budget only explains 59% of the variation in the actual budget; the remaining 41% is explained by cyclical factors, i.e., the deviation of output from full employment.

In the U.S. the growth of the money supply from year t-1 to year t, denoted by $\mu(t)$ is determined to a large extent by $F^H(t\text{-}1)/M(t\text{-}1)$ the ratio of the high employment deficit to the money stock M(t-1) in year t-1, for the

following reason. The government can finance its deficit either by issuing bonds to the public or by financing it with high-powered money (when the Treasury bonds are purchased by the monetary authority). When the deficit is financed by bonds sold to the public, the real rate of interest tends to rise because the public must be offered a higher yield to induce it to increase the fraction of its wealth invested in government bonds. The less willing the monetary authority is to permit the real rate of interest to vary when the government finances its deficit, the greater the fraction financed by high-powered money. On average in the U.S. from 1957-79 almost two thirds of the rate of monetary growth from year t-1 to t is explained by the ratio of the high employment deficit to the money stock in year t-1.

In the U.S. there is a simple reason why the rate of growth of the money stock from year t-1 to t is not related to the actual deficit or deviation of the actual from the high employment deficit. The actual deficit exceeds the high employment deficit, when the economy is depressed. To be sure, the higher deficit tends to be partially financed by high-powered money, which tends to raise the rate of monetary growth. However, when the economy is depressed the money multiplier (the ratio of the stock of money to high-powered money) tends to decline. These two effects tend to cancel each other, so that the main determinant of the growth of the money supply is the high employment deficit in the previous year. In Argentina and other high inflation countries, the cyclical factor in the budget deficit is relatively small and the high employment deficit is almost equivalent to the actual deficit. Hence, the growth of the money supply in Argentina from t-1 to t depends upon the ratio of the actual deficit to the money stock in t-1.

2. *The Transmission to Real Output, Unemployment and Inflation: Expansion*

The rise in the high employment deficit which is financed by money raises the rate of monetary expansion due to the growth of the monetary base. Insofar as the rate of monetary expansion rises above the existing rate of inflation, real balances (i.e., the purchasing power of money in terms of goods) rise. The crucial point is that prices change differentially (i.e., with a lag) so that the rise in the rate of monetary expansion above the current rate of inflation initially raises real balances.

When the ratio of real balances to wealth increases, there is initially an excess demand for bonds and equities. Security prices rise relative to the reproduction cost of investment goods. As a result of the rise in the Keynes-Tobin "q" ratio, the rate of capital formation is stimulated. Aggregate demand rises above the current level of output, and the Keynesian excess demand for goods is increased.

With the rise in the Keynesian excess demand for goods (C + I + G – Y), the rate of inflation in auction markets increases; and inventories are decreased in those markets where prices are less flexible. When the ratio of inventory to sales decreases below a certain point, the rate of price change rises. This view, that the overall rate of inflation rises with the rise in the Keynesian excess demand for goods which was produced by the rise in real balances, is quite different from the Keynesian view that prices will not rise relative to their trend when there are unemployed resources (i.e., when current output is below capacity output).

In addition to the Keynesian excess demand for goods, the rate of inflation of the GNP deflator depends upon the rate of inflation of nominal unit labor costs. Wage bargains are made over the anticipated real wage and reflect the current state of the labor market, measured by the unemployment rate. What I have called the asymptotically rational expected (ARE) rate of inflation hypothesis states that the rate of inflation of nominal unit labor cost responds with a lag (i.e., differentially) to the current rate of monetary expansion, given the current unemployment rate (state of the labor market).

A rise in the rate of monetary expansion in the current period does not raise the growth of nominal unit labor costs by the same amount in the subsequent period, for several reasons. First: there is a lag between the current rate of monetary expansion and the expected longer-run rate of monetary expansion which determines the expected trend rate of inflation. The greater the variability of the rate of monetary expansion, the less likely are people to translate a change in the current rate of monetary expansion into a change in the trend rate of monetary expansion. Second: there is a lag between the change in what is perceived as the trend rate of monetary expansion and the expected trend rate of inflation. Insofar as there are many, almost equally important, non-monetary factors which produce changes in the aggregate rate of inflation, the growth in nominal unit labor costs does not respond quickly to changes in the trend rate of monetary expansion. The asymptotically rational expectations (ARE) hypothesis emphasizes the *gradual* convergence of the inflation of nominal unit labor costs to the current rate of monetary expansion, given the current unemployment rate or growth of real output. The two lags cited above determine the speed of convergence.

These lags vary by country and within a country, depending upon the history of such processes. In the U.S. there have been many factors other than money growth which people associate with inflation; and money growth has been quite erratic. Therefore, a percentage point change in the current rate of money growth, whether or not it is anticipated, does not produce a percentage point change in the growth of nominal unit labor costs in the next period. In a situation where there is very little doubt that the high inflation is pro-

duced by high money growth, and the trend rate of growth of money is obvious, then changes in the current rate of monetary expansion should change the rate of growth of nominal unit labor costs with a short lag.

Combining the effect of a rise in the rate of monetary expansion upon (i) the Keynesian excess demand for goods and (ii) the growth of nominal unit labor costs, there are two important consequences. First: there is a rise in the actual rate of inflation, regardless of the slack in the economy. Second: prices rise faster than nominal unit labor costs. Real unit labor costs decline, and it is profitable for firms to hire more labor. The unemployment rate declines or the growth rate of output rises.

To summarize this scenario: a rise in the rate of monetary expansion above the current rate of inflation increases the rate of inflation and temporarily reduces the unemployment rate or raises the growth rate of output.

As long as the rate of inflation is below the rate of monetary expansion, the Keynesian excess demand effect and rise in the growth of nominal unit labor costs raise the rate of inflation. Consequently, the rate of inflation converges to the rate of monetary expansion in the manner described in Figure 1. The theoretical path is the broken curve and the empirical approximation is the solid curve.

The growth of nominal unit labor costs continues to rise because the asymptotically rational expected rate of inflation converges towards the rate of monetary expansion, and there is a tighter labor market. From time $t = 1$ to $t = 2$ (Figure 1), nominal wages rise at a faster rate than prices. Since real unit labor costs rise, the unemployment rate increases or growth rate of output declines. The economy converges to a higher rate of inflation of both prices and nominal unit labor costs, which have increased by the rise in the trend rate of monetary expansion. At time $t = 2$, the unemployment rate ($U(t)$) or growth of output has converged back to the steady-state value.

The rate of monetary expansion μ corresponds to the morphine and the unemployment rate (U) corresponds to the level of the cAMP enzyme activity. The rise in the rate of monetary expansion (morphine) which tends to depress the unemployment rate (cAMP enzyme) raises the rate of inflation π (adenylate cyclase activity). The rise in the rate of inflation offsets the effect of the rate of monetary expansion upon real unit labor cost and the unemployment rate. At the new steady state, the unemployment rate (cAMP enzyme) returns to its equilibrium (there is narcotic dependence and tolerance) but there is a higher rate of inflation (adenylate cyclase).

3. *Decelerating an Inflation*

Only if the rate of monetary expansion is reduced can the trend rate of inflation decline. Initially the reduction in the rate of monetary expan-

sion adversely affects the unemployment rate because the trend rate of inflation is high; however, the decline in the rate of monetary expansion will subsequently reduce the trend rate of inflation. The scenario is just the reverse of the earlier one (and corresponds to the withdrawal of the narcotic at $t = 2$).

When the growth of the money supply is reduced below the rate of inflation, real balances initially decline. The open-market sale which reduced the rate of monetary expansion raises the ratio of bonds to money. To induce the public to hold a higher ratio of bonds to money, the real rate of interest must rise. The rise in the real rate of interest lowers the value of equities and bonds relative to the price of newly produced investment goods. The decline in this "q" ratio produces a decline in the aggregate demand for goods. At the current level of output, the Keynesian excess demand for goods is decreased and an excess supply is produced.

The impact upon the rate of inflation is greatest upon the prices of raw materials and intermediate goods. Finished goods prices respond at a slower rate and may require that inventories rise before the rate of inflation is reduced.

For the reasons cited earlier, the growth of nominal unit labor costs does not decline very quickly to the decline in the rate of monetary expansion. First: there is a lag between the *current* rate of monetary expansion and the expected *trend* rate of monetary expansion which determines the expected *trend* rate of inflation. If the high employment deficit were reduced, then the expected trend rate of inflation would decline at a faster rate than if the growth of the money supply were reduced simply because a smaller fraction of the high employment deficit were financed by money (and a larger fraction were financed by bonds). Second: there is a lag between the change in what is perceived of as the *trend* rate of monetary expansion and the expected *trend* rate of inflation. If there were high rates of inflation for several years associated with high rates of monetary expansion and large budget deficits (as in Argentina), then inflation would be perceived of as a monetary phenomenon. A drastic reduction in the high employment deficits would shorten the lag between the decline in the current rate of monetary expansion and the growth of nominal unit labor cost. These two lags vary among countries and determine their different responses to changes in the rate of monetary expansion.

The net effect is that the inflation of nominal unit labor costs declines at a slower rate than the inflation of product prices. Real unit labor costs rise which raise the unemployment rate, and the growth of real output declines. (This corresponds to the rise in the cAMP enzyme level when the morphine is reduced.) The severity of the rise in the unemployment rate depends upon

how slowly the inflation of nominal unit labor costs decline when the rate of monetary expansion is reduced.

As a result of the decline in the rate of monetary expansion, there is an initial decline in real balances and a rise in the real rate of interest. In turn, there is (i) a downward shift in aggregate demand and (ii) a decline in the rate of inflation of nominal unit labor costs, as a result of the decline in the asymptotically rational anticipated rate of inflation and rise in the unemployment rate. These two factors interact to reduce the rate of price inflation towards the rate of monetary expansion. The unemployment rate rises for a while, and then converges to its equilibrium value which is independent of the rate of unemployment.

This monetarist explanation is intermediate between the views of the Keynesian and New Classical Economics schools of thought.

III. *International Similarities and Differences*

A. *The Inflation Equation*

A solution of the monetarist model sketched above implies (Stein, 1982, pp. 85-104) equation (1) for the rate of inflation $\pi(t)$ from period t-1 to t. The driving force is the growth of the monetary aggregate $\mu(t-1)$ from period t-2 to t-1. The monetary aggregate can either be the monetary base (high-powered money) or the money stock. The growth of the monetary aggregate affects the Keynesian excess demand for goods and rate of inflation of nominal unit labor costs to different extents in different countries. Equation (1) states that the predicted rate of inflation of the price level $E_{t-1}\pi(t)$ from period t-1 to t, where the expectation E is taken at time t-1, is a weighted average of the growth of the monetary aggregate $\mu(t-1)$ and rate of inflation $\pi(t-1)$, from period t-2 to t-1.

$$(1) \quad E_{t-1}\pi(t) = a\mu(t-1) + (1-a)\pi(t-1).$$

Coefficient "a" reflects the speed at which the rate of inflation converges to the growth of the monetary aggregate. As Figure 1 indicates, it takes T units of time for the rate of inflation to rise to half of its final level; hence T is called the half life. The value of T is $T = -.301/\log(1-a)$. The larger the coefficient "a" of the monetary aggregate, the shorter will be the half life and the faster will be the speed of convergence of the rate of inflation to the rate of monetary expansion.

Very similar semi-reduced form equations were estimated for the U.S., Canada and the world as a whole. The half life was in the neighborhood of one year in each case; and this equation explains 80-90% of the variation in the *annual* rate of inflation.

For the world as a whole $\mu(t-1)$ was measured as the growth of the money

supply from year t-2 to year t-1, less the long-term growth rate of output of 3.92% p.a. Tables 4.12 and Figure 4.13 (reproduced from Stein, 1982, pp. 149-50) compare the actual rate of world inflation $\pi(t)$ in year t with that predicted $E_{t-1}k(t)$ on the basis of information known no later than year t-1, during the period 1953-79. It states that all that is needed to predict the systematic (rather than the random) part of the rate of inflation from year t-1 to t are the rates of growth of the monetary aggregate and the price level from year t-2 to t-1. The actual and predicted rates of inflation are quite close together, except for 1974 when the actual rate exceeded the rate predicted by the monetarist model. This deviation was the supply shock which raised the world price level. From then on, the actual and predicted rates of inflation are quite close. My conclusion is that 89% of annual world inflation is a monetary phenomenon with only 11% explainable by supply shocks and other factors.

A comparison of the rate of inflation equation for Argentina and the U.S.A. sheds light upon the hypothesis concerning the speed of response, "a" or half life T, of inflation to the rate of monetary expansion.

Equation (1) was fitted to *quarterly* data in the U.S.A. from 1959:1 to 1982:4 and in Argentina from 1951:1 to 1980:4. The half life was approximately 1.44 quarters in Argentina and 5.281 quarters in the U.S. The speed of convergence of inflation to money growth was 3.67 times faster in Argentina than in the U.S.

On a quarterly basis, this semi-reduced form derived from my monetarist model explains 62% of the variance of price inflation in Argentina and 70% of the variance in the U.S.A. These are OLS estimates, but almost identical results are obtained when maximum likelihood iterative techniques are used. When the growth of the monetary base is used, instead of the growth of the money supply used in (1:US) or (1:ARG), very similar results are obtained.

U.S.A. 1959:1-1982:4

$$(1{:}US) \quad E_{t-1}\pi(t) = \underset{(s.e.)}{0.0043} + \underset{(0.0608)}{0.7819}\pi(t-1) + \underset{(0.0561)}{0.1236}\mu(t-1);$$

$$\bar{R}^2 \ .70; \ T = 5.281 \text{ quarters}$$

Argentina 1951:1-1980:4

$$(1{:}ARG) \quad E_{t-1}\pi(t) = \underset{(s.e.)}{0.0392} + \underset{(0.0930)}{0.5376}\pi(t-1) + \underset{(0.1211)}{0.3817}\mu(t-1);$$

$$\bar{R}^2 \ .62; \ T = 1.440 \text{ quarters}$$

My hypothesis is that in Argentina people have learned that inflation is

TABLE 4.12 *World rate of inflation $\pi_w(t)$ of the CPI, 1953—79, and predicted rates.*

Date t	$\pi_w(t)$ (% p.a.)	$E_{t-1}\pi_w(t)$	$E_{t-1}\pi_w(t)$	Date t	$\pi_w(t)$ (% p.a.)	$E_{t-1}\pi_w(t)$	$E_{t-1}\pi_w(t)$
1953	1.5	3.04	2.64	1967	4.2	4.95	4.2
1954	1.1	1.2	1.51	1968	4.4	4.13	3.64
1955	1.3	2.19	2.05	1969	5.2	5.39	4.41
1956	3.0	1.86	1.91	1970	6.0	5.6	4.59
1957	3.9	2.23	1.35	1971	5.9	5.43	4.14
1959	3,3	2.87	1.06	1972	5.8	7.74	6.06
1960	2.9	3.65	2.07	1973	9.6	8.5	7.77
1961	2.6	2.34	1.58	1974	15.3	10.8	8.87
1962	3.6	3.16	2.33	1975	13.4	12.6	8.28
1963	4.1	3.81	2.65	1976	11.1	12.3	8.58
1964	4.6	5.23	3.92	1977	11.4	12.3	9.88
1965	4.9	5.83	4.85	1978	9.7	11.4	9.53
1966	5.1	5.33	4.71	1979	11.0	11.0	9.90

Notes: The source for the first column is noted in table 4.9, where 1958 is missing. The second column is the prediction from regression equation (4.40). The third column is the prediction from dynamic ex-ante simulation equation (4.48b).

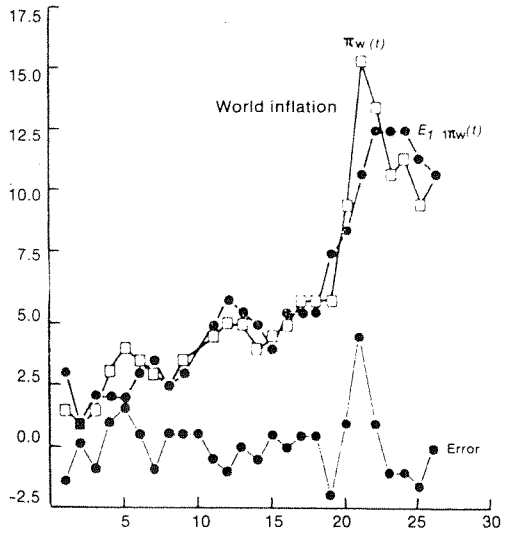

FIGURE 4.3

produced by large government expenditures. When the rate of monetary expansion rises, it signals the rise in the high employment deficit because: (i) the main determinant of the government deficit in Argentina is the high employment deficit rather than the cyclically induced deficit; and (ii) deficits are financed by money, because Argentina does not have a developed bond market. As a result, the anticipated rate of inflation is raised rather quickly, which leads to a rapid response in the growth of nominal unit labor costs. Price inflation responds quickly to the rise in the rate of monetary expansion, with a half life of 1.44 quarters.

In the U.S. there is a division of opinion whether inflation is produced by the high employment deficit, by monetary expansion, by exogenous supply shocks or by exogenous wage push factors. (i) A rise in the rate of monetary expansion does not signal a rise in the high employment deficit because the cyclically induced deficit is on average larger than the high employment deficit. (ii) Only part of the deficit is money financed; the rest is bond financed. (iii) There is little agreement that a rise in money growth in the next few quarters augurs a rise in the trend rate of inflation. The net result is that nominal unit labor costs do not change quickly when the rate of monetary expansion rises, so price inflation does not respond as quickly to rises in the rate of monetary expansion as they do in Argentina. The half life is 5.28 quarters or 3-4 times as long as it takes in Argentina.

B. *The Real GNP Equation*

The monetarist model implies (Stein, *loc. cit.*) equation (2) for the logarithm of real GNP denoted by y(t). It depends upon its value in the previous period y(t-1), the growth of the money supply less the rate of inflation from t-2 to t-1 denoted $[\mu(t\text{-}1) - \pi(t\text{-}1)]$ and a trend term. The growth of real balances $[\mu(t\text{-}1) - \pi(t\text{-}1)]$ shifts the aggregate demand curve for goods and produces a Keynesian excess demand for goods. Whenever there is a Keynesian excess demand for goods, prices rise at a faster rate than nominal unit labor costs. Real unit labor costs decline, and firms expand employment and output. A similar argument explains why output and employment tend to decline from t-1 to t when real balances decline from t-2 to t-1. In equation (2), the monetary aggregate is the growth in the money stock $\mu(t\text{-}1)$ from t-2 to t-1.

$$(2)\quad E_{t-1}y(t) = a_0 + a_1 y(t\text{-}1) + a_2[\mu(t\text{-}1) - \pi(t\text{-}1)] + a_3 t.$$

This equation has been estimated in several different ways, with very similar results: Equations (2:US) and (2:ARG), for the U.S. and Argentina respectively, were estimated using maximum likelihood iterative technologies to eliminate serial correlation.

U.S.A. 1959:1-1982:4

$$(2{:}US)\quad E_{t-1}y(t) = \underset{(s.e.)}{0.0831} + \underset{(0.0270)}{0.9885}y(t-1) + \underset{(0.0286)}{0.1303}[\mu(t-1)-\pi(t-1)] + \underset{(0)}{0.0t};$$

$$\bar{R}^2 \quad .998$$

Argentina 1951:1-1980:4

$$(2{:}ARG)\quad E_{t-1}y(t) = \underset{(s.e.)}{1.4900} + \underset{(0.0507)}{0.8316}y(t-1) + \underset{(0.0103)}{0.0356}[\mu(t-1)-\pi(t-1)] + \underset{(0)}{0.0t};$$

$$\bar{R}^2 \quad .996$$

The effect of a one percentage point rise in the growth of the money stock from t-2 to t-1 upon the logarithm of real GNP in time t is 3-4 times (.1303/.0356) greater in the U.S. than it is in Argentina.

Combining the results of the two sets of equations, I conclude the following. First: the same type of monetarist equations explains the U.S. and the Argentina levels of real GNP and inflation. Second: inflation responds 3.67 times as fast to a change in the rate of monetary expansion in Argentina as it does in the U.S. Third: a percentage point rise in real balances produces only 27% (= .0356/.1303) of the effect upon subsequent real GNP in Argentina as it does in the U.S. Consequently, monetary changes in Argentina are quickly dissipated into inflation changes rather than in output changes, relative to what occurs in the U.S. The reason may be that changes in money growth in Argentina are correctly associated in the public mind with changes in the high employment deficit; and the latter is correctly associated in the public mind with changes in the trend rate of inflation. Hence, the growth of nominal wages responds quickly to changes in the rate of monetary expansion. Real unit labor costs change by little so there is a weak effect upon output. In the U.S. the connections between money growth, high employment deficits and inflation are generally not accepted by the public and by many economists. Consequently, the growth in nominal unit labor costs does not respond as quickly to changes in the growth of monetary aggregates in the U.S. In terms of the biochemical analogue, narcotic tolerance and dependence occur much more quickly in high inflation Argentina than in low inflation U.S.

The monetarist model sketched here does not explain equally well the experiences of all countries. In some cases, when the growth of the domestic component of the monetary base is used instead of the growth of the money stock, both equations do well. In other cases, neither does well. Along with several of my graduate students, I am examining when they are valid (e.g., U.S., Canada, Argentina) and when they are invalid; and in the latter case, we are seeking better explanations.