Brazil, even "acceleration of inflation" would not keep inflation low. Friedman introduced what became the rational expectations approach of the 1970s, as in Sargent's analysis and recommendation (Section 3.9.2).

In response to Friedman, Solow cracked a joke, "…everything reminds Milton of the money supply. Well, everything reminds me of sex, but I keep it out of the paper," and went onto rehash many of the earlier points. But he also conceded at one place that guideposts and price controls can only work in the short run but not in the long run, stating that "exhortation or education or even arm twisting can also help to reduce, at least temporarily, the normal level of unemployment in the economy."[8]

4.4 COMBINING THE EAPC WITH DEMAND BASED INFLATION: A MODEL

Milton Friedman, in this debate with Solow, emphasized that inflation is a monetary phenomenon i.e. it is demand driven. However, in the same article he simultaneously introduced the natural rate and related EAPC concepts. How can inflation be *simultaneously* determined by demand (specifically money growth for Friedman) and also by the EAPC which, even when it is forward looking, is based on wage and cost increases?

We broadly discussed this issue earlier. The model and example below is meant to precisely reconcile these seemingly conflicting approaches. One needs to first start with the basic macroeconomic identity that we saw earlier in this chapter (Section 4.2):

π = Nominal GDP growth – Real GDP growth = $g(Y) - g(y)$.

Within the demand approach, Friedman's approach to the Quantity Theory of money postulates that, first and foremost, the central bank controls nominal GNP growth or $g(Y)$.[9] In the simplest, *extreme case* $g(Y) = g(M)$.

Assuming this extreme case for convenience, then by replacing g(Y) with $g(M)$ we get:

$\pi = g(M) - g(y)$ in period t,

Adding time subscripts, in effect, we now have two separate equations for inflation:

$\pi_t = g(M_t) - g(y_t)$ **(1) Quantity Theory** and

$\pi_t = \pi_{t-1} + \beta$[ADSGAP] **(2) EAPC,** (output version, assuming π Exp $(t) = \pi_{t-1}$)

Simultaneously, π cannot be determined by these two different equations. However, the two can be reconciled by a slightly modified EAPC equation, with a *delayed* ADSGAP effect:

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[8] The natural rate of unemployment idea is present in the writings of the Austrian economist Hayek and von Mises and was somewhat outlined in an article by Fellner (1959). Phelps' (1967) first exposition of the concept was in a paper on inflation expectations. B.R. Shenoy (Section 2.6) also wrote along these lines.

[9] This point needs to be stressed since the dominant view is that Quantity Theory is a theory of the long run, not short run. Only at full employment, and thus in the long run, does the Quantity Theory become a theory of inflation.

$$\pi_t = \pi_{t-1} + \beta\ [\text{ADSGAP}_{t-1}] \quad \textbf{(2)}'$$

In this equation, wages and hence prices (ignoring for convenience the difference), for this period, are **predetermined** based on contract. Wages are determined by last period's unemployment or labour demand situation. Spot markets for certain types of labour do exist, as for daily construction. However, in practice, this is how **most** wages are set – the firm agreed *last period* as to what wage is to be paid *this period*. Many prices too are set this way.

The rationale for this delayed ADSGAP effect was provided in Section 3.10. When prices and wages are fully predetermined, it is often mistakenly thought that inflation has its own momentum or inertia, whatever the demand conditions. An article pertaining to the Indian situation in 2012 quotes a leading Keynesian text stressing inertial inflation.[10]

In the simulation in Section 2.7, ADSGAP was changed exogenously, so as to return to zero in the long run. Real output level was computed from the Lokun linkage, while π was computed from the EAPC. Then nominal GNP growth $g(Y)$ was determined endogenously as the sum of $g(y)$ and π.

In this model, it is the reverse: Nominal GNP growth or $g(Y)$ is *exogenously* determined, say by the central bank. Given π based on last period's π and last period's ADSGAP, then $g(Y) - \pi$ determines $g(y)$. From this, we calculate aftOR, which will affect π in the next period.

Suppose, in period A suppose $g(Y) = g(M)$ is exogenously raised from 7.0% to 7.5%. Since π is unchanged from the start at 4%, the entire $g(Y)$ goes into increasing real output growth in Period A. Correspondingly, aftOR and thus ADSGAP rises by 0.5 points. In the next Period B, $g(Y)$ is raised to 8%. (For arithmetic convenience, the β coefficient here is taken as 2, a huge value). However, since π is rising in Period B due to the delayed ADSGAP impact from Period A, despite higher $g(Y)$, real GDP can only grow at 3%. This process repeats. Despite $g(Y)$ being exogenously raised gradually every period, as higher inflation feeds into the system, it takes larger amounts of nominal GDP growth for real GDP growth to stabilise at trend.

Inflation is, first and foremost, due to *excessive nominal GDP*. This in turn according to Friedman is due to high money growth. Thus inflation being a monetary phenomenon with $g(M)$ determining $g(Y)$ can be conceptually connected to the EAPC. Further, what appears to be cost push factors, whether or not inflation adjustments, are on closer examination due to delayed demand effects in the EAPC. Thus the seemingly contradictory EAPC and demand based approaches to inflation, within which the quantity theory falls, can be combined or reconciled.

[10] See Seshan (2012). The exact quotation from the Samuelson-Nordhaus text is, "The inflation rate itself has some inertia – that is a tendency not to move unless pushed – only because prices have a consistent momentum that translates into a stable rate of increase".

Table 4.A Delayed EAPC Model with Nominal GDP Growth Constraint

Period	$g(Y)$	ADSGAP Impact on π	π Adjustment	π	$g(y)$	y actual	y^*	ADSGAP
Start	7.0	0.0	4.0	4.0	3.0	200.0	200.0	0.0
A	7.5	0.0	4.0	4.0	3.5	207.0	206.0	0.5
B	8.0	1.0	4.0	5.0	3.0	213.3	212.2	0.5
C	9.0	1.0	5.0	6.0	3.0	219.7	218.5	0.5
D	10.0	1.0	6.0	7.0	3.0	226.2	225.1	0.5
E	10.5	1.0	7.0	8.0	2.5	231.8	231.9	0.0
F	11.0	0.0	8.0	8.0	3.0	238.8	238.8	0.0
G	11.0	0.0	8.0	8.0	3.0	246.0	246.0	0.0

In reality, the central bank cannot strictly control $g(M)$, let alone $g(Y)$. However, when there is inflation, suitable policies can *normally* lower $g(Y)$ in the desired direction. Hence this simulation is useful in further explaining how inflation is a demand based phenomenon. The links between $g(Y)$ and $g(M)$ are discussed in the next Section.

4.5 MONEY DEMAND, VELOCITY AND QUANTITY THEORY

4.5.1 Income and Velocity

This section has been added for completeness and to explain Milton Friedman's overall framework. The Quantity Theory of money is a major component of the sub-field of monetary economics. At low to moderate inflation rates, and barring abnormal circumstances involving huge direct changes in money supply, the Quantity Theory (QT) is weak. It is not been used in economic policy for over thirty years in major economies. The impact of monetary policy upon the economy under normal circumstances can be explained based on interest rates, without explicitly bringing in money supply. Nevertheless for abnormal circumstances, such as India's 2016 demonetization, concepts based on QT are useful.

The Quantity Theory specifies the link between the *stock of money* (currency and bank deposits in a modern economy) and the *flow of expenditures* or income which is nominal GNP(Y). In casual conversation when we ask someone "how much money do you make" we actually mean "how much income."In macroeconomics terminology we earn or make income, but we *hold money*. The tendency to confuse the two may have arisen because the cash that some people may receive on pay day as wages equals their income for the pay period. But money and income are quite different.

The crucial concept in Quantity Theory is the *income velocity* of money based on *money demand*. Individuals *choose to hold* some amount of money balances and circulate them to pay for their expenditures: this is called the demand for money. Thus if money stock is Rs. 100 and annual nominal GNP is say Rs 500, then each rupee, on average, has changed