No. 9011

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Research Paper

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In a recent article, De Long and Summers (1986) introduce forward-looking, albeit sluggish, price adjustment into a standard Keynesian IS-LM model. They find that increases in the rate at which prices adjust toward their market-clearing levels can have a perverse, destabilizing impact on the economy.[1] While faster price adjustment always leads to more rapid elimination of any initial deviation of the economy from full-employment equilibrium, it is also true that the more quickly prices adjust, the farther any given demand-side shock will, at first, drive the economy away from full employment. For plausible parameter values, the latter effect dominates the former, so that additional price flexibility leads to greater variation in output.

The intuition underlying the De Long and Summers result is straightforward.[2] Suppose, for concreteness, that the intersection of the IS and LM curves is initially to the left of the full-employment level of output. Then the price level will gradually decline, increasing the real supply of money and shifting the LM curve to the right until full employment is restored. The more rapidly prices decline, the more rapidly the LM curve shifts and the more rapidly is full employment restored for any given initial deviation from full employment. If people are forward-looking in their price expectations, however, the magnitude of the initial deviation from full employment that results from a given demand-side shock will itself be a function of the speed of price adjustment. The greater is the expected rate of decline of prices, the lower is the nominal interest rate consistent with a

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[1] See also Flemming (1987), Scarth (1988), and Myers and Scarth (1990).

[2] For an alternative exposition of the De Long and Summers result, see Blanchard and Fischer (1989, pp. 546-48).

given real rate of return on bonds. Because the demand for output depends on the real, not the nominal, interest rate, the lower are inflationary expectations, the lower is the IS curve.[3] Provided the demand for money is interest sensitive (so that the LM curve slopes upward), the lower is the IS curve, the lower is output. It follows that rapid price adjustment tends to be destabilizing to the extent that it is anticipated.

Built into the standard Keynesian IS curve is the assumption that households make their consumption decisions myopically, as a function of current income, the current interest rate, and perhaps current real money balances. This myopia seems incongruous in a model in which price expectations are forward-looking, such as that of De Long and Summers. In any case, empirical studies have indicated that the consumption of a substantial fraction of households is governed by the permanent income/rational expectations hypothesis, according to which people look ahead when formulating their spending plans.[4] It is natural, then, to wonder whether faster price adjustment remains destabilizing in a world in which both price expectations and consumption decisions are forward-looking.

This paper develops a simple analytical framework that is reminiscent of the traditional IS-LM model, yet, unlike the traditional model, is fully consistent with forward-looking, maximizing behavior by households. In the new framework, the initial gap between output and its full-employment level

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[3] I assume here that the IS and LM curves are plotted with the nominal interest rate--not the real interest rate--on the vertical axis.

[4] Hall and Mishkin (1982) find that 80 percent of households behave in a manner consistent with the permanent income hypothesis. Campbell and Mankiw (1987) find that roughly half of households are forward-looking. According to Koenig (1990), much of the macro-econometric evidence against the permanent income hypothesis disappears when one allows for the existence of a real balance effect.

does not typically widen as price flexibility increases. Indeed, increased price flexibility is stabilizing for all reasonable parameter values. Intuitively, in the new framework it remains true that increased price flexibility results in more rapid convergence of output to its market-clearing equilibrium, for a given initial deviation from equilibrium. Therefore, a given initial deviation of output from its equilibrium will be associated with a smaller change in permanent income the more rapidly prices adjust. Given forward-looking households, however, the smaller is the change in permanent income, the smaller is the change in the demand for current consumption at any given real interest rate. Accordingly, to achieve a given initial deviation of output from its market-clearing level requires a larger and larger change in the real interest rate as price flexibility increases. To achieve a larger change in the real interest rate, in turn, typically requires a larger policy shock. Turning this result around, as price flexibility increases, any given change in policy tends to be associated with a smaller initial deviation of output from its market-clearing level. That is, increased price flexibility is generally stabilizing.

The Model

The representative household chooses time paths of real assets, a, and real money balances, m, to maximize a utility function of the form

$$\int_0^\infty u(c(t), m(t))\, e^{-\rho t} dt,$$

subject to

(1) $c = y + ra - \dot{a} - Rm + lumpsum\ transfers.$

Here, c and y denote household consumption and income, respectively, while R and r denote nominal and real rates of interest. The utility function, $u(\cdot,\cdot)$, satisfies standard concavity and differentiability assumptions. Further, consumption and real money balances are required to be normal goods.

The optimality conditions associated with this maximization are

(2) $\dot{u}_c/u_c = \rho - r$

and

(3) $u_m/u_c = R.$

Equation 2 is the continuous-time equivalent of the requirement in discrete time that the marginal rate of substitution between current and future consumption equal unity plus the real rate of interest. It is the embodiment of the permanent income hypothesis in a world of forward-looking consumers (Hall 1978). Equation 3 implies that the demand for real money balances is increasing in household consumption expenditure and decreasing in the nominal interest rate.

Output-market equilibrium requires that

(4) $y = c + g,$

where g denotes government expenditure on goods and services per household. We also know that

(5) $r = R - \pi,$

where π denotes the rate of price increase, and that

(6) $\dot{m}/m = \mu - \pi,$

where μ is the rate of growth of the nominal money supply. The level of full-employment output, denoted y^*, is exogenous, though not necessarily constant through time. Outside of market-clearing equilibrium, output is assumed to be demand-determined.[5]

Assuming that firms face a quadratic cost of changing output (McCallum, 1980) or a fixed cost of changing price (Mussa, 1981), and that there is a cost of being away from market-clearing equilibrium that is quadratic, one can show

(7) $\pi = \pi^* + \alpha ED,$

where α is a fixed, positive parameter and where π^* is the rate of inflation that would prevail at time t--given the future paths of government purchases, the money supply, and the level of full-employment output--if prices were

[5] This assumption is obviously more satisfactory when demand falls short of y^*, than it is when demand exceeds y^*.

completely flexible.[6] This formulation, while reminiscent of the traditional, expectations-augmented Phillips curve, avoids the serious inconsistencies inherent in that approach (Mussa 1981).

The following analysis is based on a version of equation 7 in which $ED(t) \equiv x(t) - x^*(t)$, where $x \equiv \ln(c)$, $x^* \equiv \ln(c^*)$, and c^* denotes the level of consumption in market-clearing equilibrium:[7]

$$\pi = \pi^* + \alpha(x - x^*). \tag{8}$$

Given that government purchases are exogenous, output exceeds its market-clearing level if and only if $x > x^*$. Thus, α serves as a measure of the sensitivity of the price level to excess demand in the output market. Intuitively, π^* is the rate of price increase that keeps demand and supply growing at the same rate. If the current price level is inappropriate, however, so that, for example, demand exceeds supply on the output market, prices increase at a rate somewhat in excess of π^*, tending to bring supply and demand back into line.

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[6] Also see Barro and Grossman (1976). Calvo (1983) derives a price adjustment rule of the form $\pi = -\beta ED$. It will become apparent that the difference between equation 8 and the rule proposed by Calvo is that the former allows for an instantaneous response of π to changes in π^*, while the latter does not. Thus, equation 8 allows for a greater degree of price flexibility than does the Calvo adjustment rule.

[7] Mussa and Barro and Grossman measure excess demand on the output market in a somewhat different way--as the gap between the market-clearing price level and the prevailing price level. (See Rotemberg (1983) for a critique of Mussa's derivation of this rule.) I think the formulation adopted here--used also by McCallum--is both more intuitive and more convenient than that of Mussa and Barro and Grossman. An appendix demonstrates that the findings obtained in this paper are unaffected when excess demand is measured by the price gap rather than the output gap.

Analysis of the Model: Dynamics

Together, equations 2-6 and equation 8 determine the evolution of the economy through time. In this section, we will examine how the economy returns to full-employment equilibrium, given an initial deviation from that equilibrium. We will see that, as in the conventional IS-LM framework, the more sensitive the price level is to excess demand in the output market, the more rapidly any initial deviation from full employment is eliminated.

Begin by differentiating equations 2, 3, 5, and 8 with respect to time to obtain

(9) $\dot{r} = (1/e_1)\ddot{x} - (e_2/e_1)(\dot{\mu} - \dot{\pi})$,

(10) $\dot{R}/R = (a_1/a_2)\dot{x} - (1/a_2)(\mu - \pi)$,

(11) $\dot{r} = \dot{R} - \dot{\pi}$,

and

(12) $\dot{\pi} = \dot{\pi}* + \alpha(\dot{x} - \dot{x}*)$,

where $e_1 \equiv -u_c/(u_{cc}c) > 0$ is the elasticity of intertemporal substitution, $e_2 \equiv (u_{cm}m/u_c)e_1$ is a measure of the sensitivity of the timing of consumption to changes in household liquidity, and $a_1 \equiv (u_{cm}c/u_m - u_{cc}c/u_c)/(u_{cm}m/u_c - u_{mm}m/u_m) > 0$ and $a_2 \equiv 1/(u_{cm}m/u_c - u_{mm}m/u_m) > 0$ are the elasticities of the demand for money with respect to consumption and the nominal interest rate, respectively.[8] In the special case in which consumption and money are separable in the utility function, $e_2 = 0$ and $a_2 = e_1 a_1$.

Suppose that $\dot{R}/R$ can be approximated by $\dot{R}/\hat{R}$ for some fixed $\hat{R} > 0$.[9] Then, equations 9, 10, and 11 can be combined to yield

$$(13) \qquad (\hat{R}/a_2)[a_1\dot{x} - \mu + \pi] = (1/e_1)[\ddot{x} - e_2\dot{\mu} + (e_1 + e_2)\dot{\pi}].$$

Similarly,

$$(13') \qquad (\hat{R}/a_2)[a_1\dot{x}* - \mu + \pi*] = (1/e_1)[\ddot{x}* - e_2\dot{\mu} + (e_1 + e_2)\dot{\pi}*].$$

Subtract equation 13′ from equation 13, use equations 8 and 12 to eliminate the terms involving inflation, and rearrange to obtain

$$(14) \qquad \ddot{z} + [\alpha(e_1 + e_2) - a_1 e_1\hat{R}/a_2]\dot{z} - (\alpha e_1\hat{R}/a_2)z = 0,$$

where $z \equiv (x - x^*)$ is the deviation of consumption from its full-employment level.

Equation 14 has a single convergent solution, $z(t) = z(0)e^{-\gamma t}$, where

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[8] Equation 9 is exact only if e_1 and e_2 are constants. Otherwise equation 9 must be regarded as an approximation valid in a neighborhood of steady state.

[9] No such approximation is required if one is willing to assume, a priori, that the interest <u>semi</u>-elasticity of money demand is constant.

$$(15) \quad \gamma \equiv \frac{1}{2}[\alpha(e_1 + e_2) - a_1 e_1 \hat{R}/a_2]$$

$$+ \frac{1}{2}\sqrt{[\alpha(e_1 + e_2) - a_1 e_1 \hat{R}/a_2]^2 + 4\alpha e_1 \hat{R}/a_2} > 0.$$

Using equation 15, it is readily verified that $\partial\gamma/\partial\alpha > 0$. Thus, the more sensitive the price level is to excess demand, the more rapidly any initial deviation of output from its full-employment level is eliminated.[10]

Analysis of the Model: Comparative Statics

In this section, I use a modified IS-LM analysis to illustrate how various shocks can cause the economy to deviate from its full-employment equilibrium. The LM schedule is of the Mankiw and Summers (1986) variety--a relationship between the nominal interest rate and consumption rather than the nominal interest rate and income. Similarly, the Euler equation governing the timing of consumption implies a negative relationship between consumption and the real interest rate that replaces the traditional IS schedule. The more rapid is the speed of price adjustment, the steeper is the modified IS curve. Consequently, a shift in the LM curve (perhaps due to a change in the money supply) will tend to have a smaller impact on output the more rapid is price

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[10] From equation 15, it follows that $\dot{z} = -\gamma z$ and, hence (using equation 12), that $\pi = \pi^* - \beta z$, where $\beta \equiv \alpha\gamma$. Thus, price adjustment in the current model is fully consistent with that derived by Calvo (1983) if the market-clearing inflation rate, π^*, is constant through time (see footnote 6). According to equation 13′, π^* will be constant through time if μ and x^* are time invariant. It is precisely on the case in which money growth and the full-employment level of consumption are constant that Calvo focusses most of his attention. Finally, with $\partial\gamma/\partial\alpha > 0$, it is also true that $\partial\gamma/\partial\beta > 0$. Thus, increased price flexibility in the Calvo sense (larger β) has the same qualitative impact on the speed of the economy's convergence to full employment as increased price flexibility in the sense of McCallum (larger α).

adjustment. The initial impact of such shocks as changes in the growth rate of government purchases and changes in the growth rate of real balances is also reduced by increased price flexibility, because the modified IS curve shifts vertically in response to these shocks by an amount that is independent of the speed of price adjustment. Thus, the steepening of the modified IS curve that is due to an increase in price flexibility has a stabilizing effect on the economy that tends to offset the destabilizing influence of the Mundell effect. Only for unrealistic parameter values is the net effect of increased price flexibility destabilizing.

The Modified IS-LM Framework. Equation 3 yields an LM curve that is upward sloping when plotted in $(x \times R)$ or $(c \times R)$ space, which shifts downward with increases in the money supply and upward with increases in the price level. Apart from the fact that it constitutes a relationship between consumption and the nominal interest rate--rather than income and the nominal interest rate--the LM curve defined by equation 3 is standard.[11]

In the usual textbook derivation of the IS curve, consumption demand is assumed to be an increasing function of income, a decreasing function of the real interest rate, and perhaps an increasing function of real money balances. In the present model, the timing of consumption is determined, instead, by equation 2. Expanding the left-hand side of equation 2, and rearranging terms results in

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[11] Mankiw and Summers (1986) present empirical evidence favoring consumption as the scale variable in the money-demand relationship.

(2′) $r = \rho + (1/e_1)\dot{x} - (e_2/e_1)(\mu - \pi)$.

Along the path to full-employment equilibrium, however, $\dot{z} = -\gamma z$ or, equivalently,

(16) $\dot{x} = \dot{x}* - \gamma(x - x*)$.

Substituting into equation 2′ and using equation 5, one obtains

(17) $R = \rho + \pi + \frac{1}{e_1}[\dot{x}* - e_2(\mu - \pi)] - \frac{\gamma}{e_1}(x - x*)$.

Subtracting inflation from both sides, equation 17 implies that there is a negative relationship between current consumption and the real interest rate--a relationship analogous to that between income and the real interest rate in the textbook Keynesian model. Intuitively, the lower consumption is relative to its full-employment level, the more rapidly consumption will tend to increase to close the gap (equation 16). Households are willing to defer consumption, however, only if the real interest rate is high (equation 2′).

Increases in $\dot{x}*$ tend to increase the growth rate of consumption and, so, put upward pressure on the interest rate, shifting the IS curve defined by equation 17 upward (to the right). For the same reason, an increase in $x*$ causes an equal rightward shift in the IS curve. (It follows that a decline in government purchases or in their rate of growth will tend to stimulate current consumption demand.) Increases in the growth rate of real money balances shift the IS curve downward if $u_{cm} > 0$ (so that $e_2 > 0$) and upward if $u_{cm} < 0$ ($e_2 < 0$).[12] Intuitively, when $u_{cm} > 0$, household spending is positively linked to household liquidity. Rising liquidity ($\mu - \pi > 0$), thus, makes it attractive to defer consumption even in the absence of a high return on savings.[13] Finally, plotted against the nominal interest rate and given the growth rate of real balances, the IS curve shifts upward one-for-one with increases in the rate of inflation.

As noted above, in standard Keynesian models, inflation-induced shifts in the IS curve tend to be destabilizing. The more rapidly prices adjust in response to excess demand, the larger is the jump in inflation triggered by any given shock to the economy. The larger the jump in inflation, the more the IS curve shifts, and the farther the economy is driven, initially, from full employment. According to equation 17, however, the slope of the IS schedule in the present model is not independent of the speed of price adjustment. In particular, a larger value of α implies a larger value of γ, which implies a steeper IS schedule. Intuitively, the more rapidly the price level adjusts, the more rapidly consumption converges to its market-clearing level. If consumption is below (above) its market-clearing level, it will increase (decrease) more rapidly the larger is α. But households are willing to tolerate a steeply rising (falling) consumption path only if the interest rate is high (low). Put another way, the more rapidly prices adjust, the more rapidly the economy returns to full employment, so the wider is the gap

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[12] There is considerable empirical evidence suggesting that if household consumption is indeed forward-looking, then $u_{cm} > 0$. See Koenig (1990).

[13] Thus, it is not changes in the <u>level</u> of real money balances but changes in their <u>rate of growth</u> that may shift the IS curve in the current analysis.

between current consumption and permanent income for any given level of current consumption. Households, however, are willing to tolerate a level of current consumption that is below (above) their permanent income only if the interest rate is high (low). Thus, as α increases the IS curve rotates clockwise about the point (x^*, R^*), where R^* is the nominal interest rate that would be observed if prices were completely flexible.

The steeper the IS schedule, the smaller is the impact of any given vertical shift in the IS curve (such as that caused by a jump in the rate of inflation) on equilibrium consumption. Increased price flexibility, therefore, is less likely to be destabilizing in the current model than in models in which household consumption decisions are made myopically.

For purposes of the comparative statics analysis that follows, I treat current and future levels of government purchases and the money supply as exogenous policy variables. From equation 13′, it follows that the market-clearing inflation rate, π^*, will also be exogenous.[14] Given π^*, the larger is consumption relative to its full employment level, the higher will be the actual inflation rate, π (equation 8). But the higher is the inflation rate, the more the IS curve defined by equation 17 shifts upward. Similarly, the smaller is x relative to x^*, the lower is the inflation rate, and the farther the IS curve of equation 17 shifts downward. So, if when constructing the IS curve one takes π^* as given, one obtains a schedule--call it the IS* curve--that is less negatively sloped than that obtained when π is taken as given:

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[14] Equation 13′ implies that

$$(18) \qquad \pi*(0) = \frac{e_1}{e_1 + e_2}\int_0^\infty [\frac{\hat{R}}{a_2}\mu(t) - \frac{e_2}{e_1}\dot{\mu}(t) + \frac{1}{e_1}\ddot{x}*(t) - \frac{\hat{R}a_1}{a_2}\dot{x}*(t)]\, e^{-t\hat{R}e_1/(a_2(e_1 + e_2))}dt.$$

$$(19) \qquad R = \rho + \pi* + \frac{1}{e_1}[\dot{x}* - e_2(\mu - \pi*)] - \frac{1}{e_1}[\gamma - \alpha(e_1 + e_2)](x - x*).$$

Indeed, using equation 15 one can show that if $a_1(e_1 + e_2) > 1$, then $\alpha(e_1 + e_2) > \gamma$, so that the IS* schedule is positively sloped. Conversely, if $a_1(e_1 + e_2) < 1$, then $\alpha(e_1 + e_2) < \gamma$, and the IS* schedule slopes downward. Estimates of the sensitivity of the timing of consumption to changes in the real interest rate and to changes in the growth rate of real money balances imply values of $(e_1 + e_2)$ that lie between 0.25 and 0.4, depending on the sample period and the measure of the real interest rate employed (Koenig 1990). Estimates of the elasticity of the demand for money with respect to consumption expenditures, a_1, have fallen between 1.0 and 2.0 (Mankiw and Summers 1986). As a practical matter, then, the IS* schedule is quite probably downward sloping.

Much like the IS curve defined by equation 17, the IS* schedule shifts upward in response to increases in $\dot{x}*$ and, one-for-one, in response to increases in $\pi*$ (given $\mu - \pi*$). It shifts to the right, one-for-one, in response to increases in x*. It may shift up or down in response to changes in $(\mu - \pi*)$, depending on the sign of u_{cm}.

The Initial Response of the Economy to Exogenous Shocks. The initial equilibrium of the economy can be found by solving the IS* and LM equations (equations 19 and 3) for x(0) (alternatively, c(0)) and R(0) as functions of M(0), $\mu(0)$, $\pi*(0)$, x*(0), and $\dot{x}*(0)$, then substituting back into equations 2′ and 8 to obtain r(0) and $\pi(0)$

$$(20)\qquad \Delta x(0) = A[\frac{\hat{R}}{a_2}\Delta M(0)/M(0) + \Delta\pi*(0) + \frac{1}{e_1}\Delta\dot{x}*(0)$$

$$+ \frac{1}{e_1}(\gamma - \alpha(e_1 + e_2))\Delta x*(0) - \frac{e_2}{e_1}(\Delta\mu(0) - \Delta\pi*(0))],$$

$$(21)\qquad \Delta R(0)/R(0) = A\frac{a_1}{a_2}[\Delta\pi*(0) + \frac{1}{e_1}\Delta\dot{x}*(0) - \frac{e_2}{e_1}(\Delta\mu(0) - \Delta\pi*(0))$$

$$+ \frac{1}{e_1}(\gamma - \alpha(e_1 + e_2))(\Delta x*(0) - \frac{1}{a_1}\Delta M(0)/M(0))],$$

$$(22)\qquad \Delta r(0) = A[\frac{1}{e_1}(\frac{\hat{R}a_1}{a_2} - \alpha)[\Delta\dot{x}*(0) - e_2(\Delta\mu(0) - \Delta\pi*(0))]$$

$$+ \frac{1}{e_1}(\gamma - \alpha e_2)[\frac{\hat{R}}{a_2}(a_1\Delta x*(0) - \Delta M(0)/M(0)) - \Delta\pi*(0)]],$$

$$(23)\qquad \Delta\pi(0) = A[\frac{\alpha\hat{R}}{a_2}\Delta M(0)/M(0) + (\frac{\hat{R}a_1}{a_2} + \frac{1}{e_1}(\gamma - \alpha e_2))\Delta\pi*(0) + \frac{\alpha}{e_1}\Delta\dot{x}*(0)$$

$$- \frac{\alpha\hat{R}a_1}{a_2}\Delta x*(0) - \frac{\alpha e_2}{e_1}(\Delta\mu(0) - \Delta\pi*(0))],$$

where $A \equiv [a_1\hat{R}/a_2 + (\gamma - \alpha(e_1 + e_2))/e_1]^{-1}$. From equation 15, A is greater than zero. Graphically, though the IS* curve may, in principle, be upward sloping, its slope never exceeds that of the LM curve.

For a given value of $(\mu(0) - \pi^*(0))$, increases in $\pi^*(0)$--perhaps due to an increase in expected future money growth or to a decrease in expected future growth in full-employment consumption--and increases in $\dot{x}^*(0)$--perhaps due to a reduction in the current growth rate of government purchases--shift the IS* schedule upward and, given a positively sloped LM curve, put upward pressure on both consumption and market interest rates (equations 20 and 21). With consumption demand rising relative to its full-employment level, inflation increases. When $\pi^*(0)$ rises, the increase in inflation more than offsets the rise in market interest rates, and the real rate of interest declines.[15] When $\dot{x}^*(0)$ rises, there are conflicting pressures on the real interest rate. More rapid growth in full-employment consumption leads directly to more rapid growth in actual consumption, putting upward pressure on the real interest rate. On the other hand, increases in the gap between actual and full-employment consumption tend to reduce the growth rate of actual consumption, putting downward pressure on the real interest rate (equations 2' and 16). The net effect on the interest rate is ambiguous.

Increases in the current money supply, M(0), stimulate consumption but have a depressing effect on market interest rates. The real interest rate falls and inflation rises. The predicted impact of changes in the money supply, thus, is quite conventional in the current model.

When the rate of money growth rises relative to the trend rate of inflation, the response of the economy depends very much on the sign of u_{cm} (hence, the sign of e_2). If $u_{cm} > 0$, increases in $(\mu(0) - \pi^*(0))$ shift the IS* schedule down, reducing consumption and the nominal interest rate. Because consumption falls relative to its market-clearing level, inflation declines. The change in the real interest rate is ambiguous. All these effects are reversed if $u_{cm} < 0$ and disappear if $u_{cm} = 0$.

What of fiscal policy? A cut in government purchases raises full-

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[15] Here--and in the discussions of the consequences of change in $x^*(0)$, M(0), and $(\mu(0) - \pi^*(0))$ that follow--I assume that the IS* schedule is downward sloping so that $\gamma - \alpha e_2 > \gamma - \alpha(e_1 + e_2) > 0$.

employment consumption, $x^*(0)$, shifting the IS* schedule to the right by an equal amount. With an upward-sloping LM schedule, actual consumption rises by less than full-employment consumption, putting downward pressure on inflation. With $x(0) < x^*(0)$, a pick-up in consumption growth is expected, and the real rate of interest must rise to choke off the borrowing that a rising consumption path would otherwise induce. Market interest rates also increase. So here government purchases and interest rates are inversely related, a result consistent with the observed behavior of interest rates in wartime (Mankiw 1987).

Is Increased Price Flexibility Stabilizing? Equation 20 can be rearranged to obtain

$$(20') \qquad \Delta z(0) = A[\frac{\hat{k}}{a_2}\Delta M(0)/M(0) + \Delta\pi^*(0) + \frac{1}{e_1}\Delta\dot{x}^*(0)$$

$$- \frac{\hat{k}a_1}{a_2}\Delta x^*(0) - \frac{e_2}{e_1}(\Delta\mu(0) - \Delta\pi^*(0))].$$

Note that the more steeply downward sloping is the IS* schedule (i.e., the greater is $\gamma/e_1 - \alpha(e_1 + e_2)/e_1$), the smaller is A and, consequently, the less consumption deviates from its market-clearing value in response to changes in $M(0)$, $\mu(0)$, $\pi^*(0)$, $\dot{x}^*(0)$, and $x^*(0)$. Increased price flexibility (a larger value of α) will thus reduce the initial disequilibrium induced by exogenous shocks to the economy if and only if it reduces the slope of the IS* schedule (increases $\gamma/e_1 - \alpha(e_1 + e_2)/e_1$).

If the slope of the IS curve (γ/e_1) were independent of the speed of price adjustment--as it is when household consumption decisions are made myopically--then increases in α would have an unambiguously destabilizing effect on the IS* schedule, making it less steeply downward sloping (reducing $\gamma/e_1 - \alpha(e_1 + e_2)/e_1$).[16] As noted above, however, in the current model the IS curve becomes more negatively sloped as price flexibility increases (i.e., γ/e_1 is increasing in α). This has a stabilizing effect on the slope of the IS* schedule, an effect that tends to offset the direct destabilizing impact of an increase in α.

Using the definition of γ (equation 15), one can show that the net impact of an increase in price flexibility will be to reduce the initial disequilibrium induced by exogenous shocks to the economy if and only if $a_1(e_1 + e_2)$ is less than unity, or, equivalently, if and only if the IS* schedule is downward sloping (so that a reduction in its slope implies a steepening). As noted above, empirically $a_1(e_1 + e_2) < 0.8$. As a practical matter, then, it seems quite unlikely that increased price flexibility is destabilizing.

Conclusion

Whether increased price flexibility is desirable or not depends critically on whether or not households are forward-looking in their consumption behavior. In a model that is neoclassical in every respect, except that the price level is slow to adjust to eliminate discrepancies between supply and demand, increased price flexibility not only results in more rapid elimination of any initial gap between output and its full-employment level, but it also typically reduces the size of the supply/demand

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[16] This statement is strictly true only if $e_2 > -e_1$ --a condition unlikely to be violated in practice. (See footnote 12.)

gap created by any given economic shock. Only for unrealistic parameter values does increased price flexibility have destabilizing tendencies.

This paper has also demonstrated that, in modified form, IS-LM analysis can have a place in tracing the behavior of an economy with forward-looking, maximizing households. In such a world, the IS and LM curves represent relationships between consumption and the interest rate, rather than income and the interest rate. Further, the IS curve shifts in response to changes in the level and current growth rate of full-employment consumption and becomes steeper with increases in price flexibility. It is the latter feature of the IS schedule that ensures that increases in price flexibility are stabilizing.

APPENDIX: Mussa's Price Adjustment Rule

In the model developed here, the price adjustment rule derived by McCallum (1980), equation 8, yields a price path that is entirely consistent with the adjustment rule adopted by Mussa (1981) and Barro and Grossman (1976) in which excess demand in the output market is measured by the gap between the market-clearing and the prevailing price levels. To see this, differentiate equations 2, 3, 5, and 8 logarithmically about the market-clearing equilibrium of the economy rather than with respect to time. Then, instead of equation 13, one obtains

$$(A.1) \quad (\hat{R}/a_2)[a_1(x - x*) + (p - p*)] = (1/e_1)[(\dot{x} - \dot{x}*) + (e_1 + e_2)(\pi - \pi*)],$$

where p and p* denote the logarithms of the prevailing and market-clearing price levels, respectively. From equation 16, however, $(\dot{x} - \dot{x}^*) = -\gamma(x - x^*)$ and, from equation 8, $(x - x^*) = (1/\alpha)(\pi - \pi^*)$. Hence, equation A.1 implies

$$(A.2) \quad \pi = \pi* - \alpha'(p - p*),$$

where $\alpha' \equiv \alpha A\hat{R}/a_2 > 0$, and A is defined as in equations 20 - 23.

Using equation 15, one can readily establish that $\partial\alpha'/\partial\alpha > 0$. Consequently, increased price flexibility in Mussa's sense is stabilizing under exactly the same conditions as increased price flexibility as defined by McCallum. In particular, for increases in α' to be stablizing, it is sufficient that $a_1(e_1 + e_2)$ be less than unity.

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