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"Some Macro Implications of Risk"

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6th Draft

SOME MACRO IMPLICATIONS OF RISK

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Macro theory typically assumes that the stock of capital demanded depends inversely on the discount rate the business sector applies to its expected cash flows, and similarly the quantity of real balances demanded depends inversely on the discount rate people use in cash-holdings decisions. Both decisions involve risk, but macroeconomics has lacked an explicit theory showing how risk affects these decisions. This paper integrates a simple version of the capital asset pricing model (CAPM) into a rather conventional rational expectations model, to study macro effects of risk and to provide a macro explanation of the returns distributions usually taken as given in the CAPM.

Firms face disturbances from unanticipated fluctuations in real aggregate demand, and all money holders are subject to stochastic fluctuations in the inflation rate. These risks are modelled with the CAPM, focusing on correlations of rates of returns on various assets. The integrated model gives short- and long-run real effects of changes in the mean and variance of inflation, in the variance of real disturbances to the economy, and in fiscal policy; it does not, however, examine explicitly the transition from the short to long run. Thus, the model can investigate some effects of variances that could not be considered in earlier rational expectations models (Lucas [1972], Sargent [1973], Sargent and Wallace [1975]) where such variances do not affect the unconditional means of endogenous variables.

The model provides a macro framework for some problems in finance. For example, it predicts an increase in expected inflation due to increased monetary growth has a negative effect on returns to equity. Fama and Schwert (1976) found a negative empirical relationship between rates of return to stocks and measures of expected inflation; Fama (1980) and Geske and Roll (1981) offer explanations.

Some results follow from questions about variances seldom explicitly investigated in macro models: an increase in the variance of disturbances to aggregate demand causes a fall in output and the capital stock. This is because such an increase raises the "beta" of real capital and hence the discount rate used in capital accumulation decisions. An increase in the variability of inflation by itself leads to an increase in the capital stock; it makes capital more attractive relative to real balances and thus lowers capital's beta. However, the variability of inflation is likely so highly correlated with real disturbances to aggregate demand (Logue and Sweeney [1981]) that real output and the capital stock fall, on balance.

Some results contradict previous work: an increase in the mean inflation rate leads to a reduction in the capital stock and real output here, while Tobin (1965), Lucas (1975), Fischer (1979) and others show the capital stock and output rising. An increase in mean inflation reduces real balances and hence makes real capital a larger fraction of the "market basket" that the economy must hold. This in turn raises the beta and required rate of return applied to capital accumulation decisions and hence reduces the steady state capital stock. These results arise because, (a) there are assets beyond capital and real balances, and (b) capital and real balances are not gross substitutes (as they are in, say, Tobin [1969]).

Some traditional results are confirmed: an increase in government spending (financed by taxation in the short run or not) "crowds out" private investment, raising the real interest rate and also the discount rate used in investment decisions, and reducing both income and the capital stock.

This paper makes no attempt to derive jointly the macro and CAPM formulations from some more fundamental analysis, or the adjustment path of the system. Indeed, the difficulties in handling intertemporal CAPMs (e.g., Ross [1978]), even in the absence of macro complications, would make such a task much more formidable than what is attempted here. Nevertheless, the macro and CAPM "stories" combined here do not seem grossly inconsistent. In fact, they are complimentary; the macro analysis provides the disturbances' distributions, taken as parametric by the CAPM, while the CAPM allows explicit incorporation of the effects of risk in the macro analysis.

Section 1 describes the model, particularly its CAPM elements. Section 2 discusses the business sector, and shocks to it from aggregate demand disturbances; Section 3 discusses the relationship of these shocks and inflationary shocks. Section 4 analyzes equilibrium in financial markets. Sections 5 and 6 discuss effects of parametric changes in, respectively, the long and short run. Section 7 offers one test of the model, using a rather standard money demand function that incorporates inflation risk. Section 8 provides a summary and conclusions.

1. Description of the Model

The model includes five markets--for money, a one-period indexed government bond, equity in firms, labor services and a single output that can be consumed or added to the capital stock. At the start of each period, the price level, the value of equity in firms, and the short-term real rate of interest are jointly set to equate the expected value of aggregate demand to the full-employment level of output and to clear financial markets. By the end of the period, output and financial markets revise views and adjust prices, thus beginning a new period. All prices are based on rational expectations, but *ex post* often are incorrect. For example, the money stock may grow faster than expected, or money demand randomly decrease, causing higher inflation than expected. Similarly, government or private demand for output may be higher than expected, reducing business inventories below optimum levels and causing the somewhat expensive process of rebuilding them. Unexpected inflation is the major component of risk to holding money balances, unexpected shifts in aggregate demand the major component of risk to equity. (Realistically, aggregate supply shocks such as technological change or some OPEC decisions are also components of equity risk, and can easily be incorporated in the analysis.) However, sources of risks are generally not independent: some unexpected growth in the money supply will finance unexpected increases in government spending; some random decreases in money demand will finance higher consumption.

Unintended inventory changes are reversed through changed labor demand, unemployment and output. The model considers only equilibrium states, ignoring such transitory dynamics and their accompanying price level and yield changes; this is for convenience, and falsifies no important result.

Elements of the CAPM In the CAPM,[1/] appropriate discount rates for real investment and money holding decisions are

(1) $RR_F = r + \beta_F[E(R_{MKT}) - r]$

(2) $RR_m = r + \beta_m[E(R_{MKT}) - r]$,

where RR_F is the required real rate of return on the business (firm) sector's activities, RR_m the required rate on real money balances, r the risk-free real rate of interest, $E(R_{MKT})$ the expected real rate of return of society's entire risky portfolio (the "market" basket, that is, both equity and money balances), and β_F and β_m coefficients relating the variability of real returns on the particular asset to the variability of the market's return. (Table 1 defines the major variables used.)

The discount rates RR_F and RR_m can be applied to the expected real returns on the assets, or decisions makers set

$$(3) \quad E\left[\frac{\partial(\text{Present Value of Real Cash Flows})}{\partial K}\right] = RR_F$$

$$(4) \quad U'[M/P, y] - E(\Delta P/P) = RR_m, \qquad U' = RR_m + E(\Delta P/P).$$

K is the capital stock. The expected real rate of return on holding real balances is the marginal utility (U') of these balances (taken as non-stochastic and depending on the money stock, M, the price level, P, and real output, y) less the expected rate of inflation, $E(\Delta P/P)$.

One CAPM variant (Merton [1980]) assumes society requires a constant marginal cost of risk[2/] a>0, where the standard deviation of the actual rate of return for the market $\sigma_{R_{MKT}}$, measures risk of the market's real rate of return, so

$$(5) \quad E(R_{MKT}) = r + a\sigma_{R_{MKT}}.$$

With zero variability (risk), $E(R_{MKT})$ would simply equal the risk free real rate r.

The "beta" slope coefficients in (1) and (2) are

$$(6) \quad \beta_F = \frac{Cov(R_F, R_{MKT})}{\sigma^2_{R_{MKT}}}$$

$$(7) \quad \beta_m = \frac{Cov(R_m, R_{MKT})}{\sigma^2_{R_{MKT}}},$$

where the COV(·) are covariances of actual real rates of return on the assets and the market as a whole. Substituting (6) into (1) for β_F gives

$$(8)\quad RR_F = r + \frac{\text{Cov}(R_F, R_{MKT})}{\sigma^2_{R_{MKT}}} [E(R_{MKT}) - r]$$

and substituting (5) into (8) for $E(R_{MKT})$ gives

$$(9)\quad RR_F = r + \frac{\text{Cov}(R_F, R_{MKT})}{\sigma^2_{R_{MKT}}} [r + a\sigma_{R_{MKT}} - r] = r + a \frac{\text{Cov}(R_F, R_{MKT})}{\sigma_{R_{MKT}}} .$$

Similarly,

$$(10)\quad RR_m = r + a \frac{\text{COV}(R_m, R_{MKT})}{\sigma_{R_{MKT}}} .$$

The discount rates depend positively on a, and the Cov(·)s, and negatively on $\sigma_{R_{MKT}}$; sections 2 and 3 examine the Cov(·)s and $\sigma_{R_{MKT}}$.

Return on the Market Basket of Risky Assets The only assets available to society in non-zero net amounts are shares in firms and money balances. Government issues a risk free, one-period indexed bond with the market-determined real rate r. Assume these bonds are redeemed through perfectly foreseen patterns of taxation, and there is effectively a zero net stock of them in existence at all times.[3/] The actual real rate of return on the market (R_{MKT}) is simply a weighted average of the actual real rates on money (R_m) and equity (R_F). Thus,

$$(11)\quad R_{MKT} = \frac{m}{w} R_m + \frac{v}{w} R_F,$$

where v is the real value of equity in firms, m the quantity of real balances, and w the (non-human) real wealth of society, w = m + v. Thus,

$$(12)\quad E[R_{MKT}] = \frac{m}{w} E[R_m] + \frac{v}{w} E[R_F].$$

Properties of $\sigma^2_{R_{MKT}}$ require discussion of the business sector.

2. The Business Sector

Firms forecast sales S and adopt pricing policies to try to set S equal to the current full-employment output, y, or they set E(S) = y. Extra costs arise from deviations of S from y. For example, if y > S, some unsold output is lost to wastage, with the rest carried as inventory at positive costs. If S > y, then inventories sink below optimum levels, to be rebuilt with costly accelerated production, extra hiring, overtime, etc. Thus, the short-run equilibrium level of output, y, often differes from its long-run level $\overline{y}$, due to inventory fluctuations that affect labor demand (as for example Blinder, [1979]), with these output and employment fluctuations causing extra real costs. For any level of y, let these real costs equal $c\left[\frac{S - y}{y}\right]^2 y$, where c is a positive constant. Thus these costs depend on the squared percentage deviation of S from y, and (proportionately) on y.

Real "profits" π or real net income, then, are

$$(13)\ \pi = \{\overline{\pi} - c[(S - y)/y]^2\ y\},$$

where $\overline{\pi}$ is the level of π if S = y at the full-employment, general equilibrium level $\overline{y}$. Assume

$$(14)\ \frac{S - y}{y} = u,$$

where u is a white noise (Section 3 derives u); thus, there are no patterns in forecast errors, consistent with rational expectations. Hence,

$$(15)\ E[\pi_t] = [\overline{\pi} - c(\sigma_u^2)y_t].$$

The discount rate RR_F is used to evaluate the sequence of expected real profits $E[\pi_t]$. Assume that the economy is in steady state, or $E[\pi_t]$ is the same for all t. Then, the real value of the business sector is

$$(16)\quad v = \frac{\bar{\pi} - c\sigma_u^2 y}{RR_F} .$$

v is established at the start of the current period. The actual real rate of return R_F during the period is composed of π divided by the real value of equity, plus the change in v from this period to the next. Thus, R_F is

$$(17)\quad R_F = \frac{\bar{\pi} - c(u^2)y}{v} + \frac{\Delta v}{v} .$$

From (16), with a given RR_F and σ_u^2, v can vary only if firms change y and K. In the short run these are fixed and hence $\Delta v \cong 0$, and in the long run $\Delta v = 0$ with the steady state y and K. Hence, $\Delta v \neq 0$ only on the traverse to steady state, which is not examined here. This explicitly assumes the wealth consequences of any u are felt fully in period t (even if adjustments to disturbances occur over several periods).

<u>Determination of RR_F and RR_m</u> From (9) and (10), finding RR_F and RR_m requires $\sigma^2_{R_{MKT}}$, $Cov(R_F, R_{MKT})$, and $Cov(R_m, R_{MKT})$. The real return on the market, from (4), (11), (12), (17) and the discussion surrounding them, is

$$(18)\quad R_{MKT} = \frac{m}{w}(U' - \frac{\Delta P}{P}) + \frac{v}{w}\left[\frac{\bar{\pi} - c(u^2)y}{v}\right] ;$$

thus,[4/]

$$(19)\quad \sigma^2_{R_{MKT}} = (\frac{m}{w})^2\ \sigma^2_{\Delta P} + (\frac{y}{w})^2 c^2 2\sigma_u^2\sigma_u^2 .$$

The covariance of R_F and R_{MKT} can be shown to be

$$(20)\quad \mathrm{Cov}(R_F, R_{MKT}) = \frac{y}{v}\frac{y}{w}\, c^2 2\sigma_u^2\sigma_u^2.$$

From (9), then

$$(21)\quad RR_F = r + a\frac{(y/v)c^2 2\sigma_u^2\sigma_u^2}{\{(m/y)^2\sigma_{\Delta P}^2 + c^2 2\sigma_u^2\sigma_u^2\}^{\frac{1}{2}}}\,.$$

Similarly, $\mathrm{Cov}(R_m, R_{MKT}) = \frac{m}{w}\,\sigma_{\Delta P}^2$, and

$$(22)\quad RR_m = r + a\frac{(m/y)\sigma_{\Delta P}^2}{\{(m/y)^2\sigma_{\Delta P}^2 + c^2 2\sigma_u^2\sigma_u^2\}^{\frac{1}{2}}}\,.$$

It is worthwhile exploring $\underline{u}$, $\Delta P/P$ and their relations in more detail.

3. Structure of Disturbances to the Economy

First consider $\underline{u}$. Aggregate demand S equals consumption C, plus investment I, plus government demand G. Suppose the economy is in steady state, with I = 0. Then, at the full employment level of output, y, ex ante goods market equilibrium requires

$$(23)\quad y = E(C) + E(G) = E(S).$$

Suppose

$$(24)\quad G_t = \bar{G} + e_t y,$$

where $\bar{G}$ is a constant, e_t is a white noise error term, with the disturbance ey proportionate to the scale of the economy as measured by $\underline{y}$. Let C depend on real disposable income and on $\underline{r}$,

(25) $C = C(y - t, r) + \xi y, \qquad C_r < 0,$

and let $C(\cdot)$ be linear homogenous in $(y - t)$,

(26) $C = (y - t)C(1, r) + \xi y, \qquad 1 > C(1, r) > 0,$

where ξ is a white noise error term, and t real taxation. At a given price level, P, m depends on randomness in the money supply. Suppose

(27) $m_t + E(m_t) + \varepsilon_t \cdot y,$

where ε_t is a white noise. Given $E(S) = y$,

(28) $S_t - y = u_t y = \{e_t + \xi_t\}y.$ Thus,

(29) $E\left[\frac{S_t - y}{y}\right]^2 = \sigma_u^2 = \sigma_\xi^2 + \sigma_e^2,$

because there is no reason for autonomous shifts in the consumption function (ξ) to be correlated with unforeseen changes in government spending (e). (e and ε should show positive correlation.)

The rate of inflation is, directly from this LM curve,[5/]

(30) $\frac{P_{t+1} - P_t}{P_t} = \frac{\Delta P}{P} = \delta + (\varepsilon_t - \omega_t)/(m/y),$

where δ is the trend rate of growth of the money supply, ε_t the random component of money supply growth and $\omega_t y$ a white noise term on growth of the real money demand function. Thus,

(31) $\sigma_{\Delta P}^2 = \{\sigma_\varepsilon^2 + \sigma_\omega^2\}/(m/y)^2$

because unforeseen disturbances to money demand and supply (ω and ε) should be orthogonal. Increases in σ_ω^2 should tend to show up in increases in σ_ξ^2 and increases in σ_e^2 should tend to be associated with increases in σ_ε^2.

It is clear, then, that increases in σ_u^2 and $\sigma_{\Delta P}^2$ are likely to occur simultaneously. This is an extremely important consideration for empirical work. Nevertheless, it is useful to consider such shifts one at a time.

4. <u>Equilibrium in Financial Markets</u>

The long run system (with zero investment) can be described by

(1') $y = E(C) + E(G) = (y-t)C(1, r) + G$ (IS curve)

(2') $\frac{v}{y} = \frac{\bar{\pi}/y - c\sigma_u^2}{RR_F}$ (firm valuation equation)

(3') $U'(m,y) - E(\Delta P/P) = RR_m$ (LM curve)

(4') $RR_F = r + a\frac{(y/v)c^2 2\sigma_u^2\sigma_u^2}{\{(m/y)^2\sigma_{\Delta P}^2 + c^2 2\sigma_u^2\sigma_u^2\}^{\frac{1}{2}}}$ (equity discount rate)

(5') $RR_m = r + a\frac{(m/y)\sigma_{\Delta P}^2}{\{(m/y)^2\sigma_{\Delta P}^2 + c^2 2\sigma_u^2\sigma_u^2\}^{\frac{1}{2}}}$ (real balances discount rate)

(6') $y = y(RR_F, \sigma_u); \; y_1, y_2 < 0$ (aggregate supply curve).

The model is completed with the aggregate supply function (6'). In (6') the higher is RR_F, the lower the long run level of operations that the business sector plans on; the higher is σ_u, the higher are (long run) average costs and the lower the scale of operation. (6') depends on the capital stock demand function[6/]

$$K^d = K(RR_F, \sigma_u); \quad K_1, K_2 < 0.$$

An increase in σ_u, affecting K through both RR_F and σ_u, can be offset by a reduction in <u>r</u> that reduces RR_F enough to offset the impact of σ_u by itself (K_2) on K^d.[7/]

(1') - (6') can be solved for the six unknowns, $\underline{y}$, $\underline{r}$, $\underline{m}$, $\underline{v}$, RR_F, RR_m.

The strategy is to analyze the equilibrium in the r, y plane, similar to traditional IS-LM analysis. This requires solving for $\underline{m}$, $\underline{v}$, RR_F and RR_m in (2') - (5') in terms of $\underline{r}$, $\underline{y}$, and parameters. First, the behavior of m/y and RR_m in (3') and (5') is found with $E(\Delta P/P)$, $\underline{r}$, $\sigma_{\Delta P}$ and σ_u taken as parameters. These results are then used to examine the behavior of v/y and RR_F in (2') and (4'). The relevant results for m/y, v/y and RR_F are summarized in the reduced forms

$$\frac{m}{y} = M[E(\Delta P/P),\ r,\ \sigma_{\Delta P}, \sigma_u]; \quad M_1, M_2, M_3 < 0; \quad M_4 > 0:$$

$$(32) \quad \frac{v}{y} = V[E(\Delta P/P),\ r,\ \sigma_{\Delta P}, \sigma_u]; \quad V_1, V_2, V_4 < 0; \quad V_3 > 0:$$

$$RR_F = R[E(\Delta P/P),\ r,\ \sigma_{\Delta P},\ \sigma_u]; \quad R_1, R_2, R_4 > 0; \quad R_3 < 0.$$

These results are used with IS and aggregate supply curves ([1'] and [6']) to help determine equilibrium values of $\underline{r}$ and $\underline{y}$ in Sections 5 and 6.

The results in (32) can be seen as follows. The curves labelled U'U' and $RR_{m_1}RR_{m_1}$ in Figure 1(a) show combinations of m/y and RR_m satisfying respectively equations (3') and (5').[8/] In (3'), $d(m/y)/dRR_m < 0$ as intuitively required. In (5'), $dRR_m/d(m/y) > 0$ since an increase in m/y raises the numerator proportionately more than the denominator. Increases in $\underline{r}$ or $\sigma_{\Delta P}$ do not affect U'U', but shift $RR_{m_1}RR_{m_1}$ to the right to $RR_{m_2}RR_{m_2}$ ($\partial RRm/\partial\sigma_{\Delta P} > 0$, $\partial RRm/\partial r > 0$ for any m/y), thus reducing m/y and raising RR_m; an increase in σ_u—with $\sigma_{\Delta P}$ constant--causes $RR_{m_1}RR_{m_1}$ to shift to the left, so m/y rises as RR_m falls. In Figure 1(b), an increase in $E(\Delta P/P)$ shifts the curve $U_1'U_1'$ to the left to $U_2'U_2'$ ($\partial RR_m/\partial E(\Delta P/P) < 0$ for any m/y); the curve $RR_{m_1}RR_{m_1}$ does not shift, and thus m/y and RR_m both fall. This shows the results for $M(\cdot)$ in (32).

The curves V_1V_1 and $RR_{F_1}RR_{F_1}$ in Figure 2 show values of v/y and RR_F that satisfy equations (2') and (4'), respectively.[9/] While both have negative slopes, suppose $RR_{F_1}RR_{F_1}$ is steeper than V_1V_1, <u>as required for stability</u>.[10/] The results for V(·) and R(·) in (32) follow.

(a) <u>An increase in $E(\Delta P/P)$</u> has no effect on (2') and VV does not shift. For any v/y, from (4') $\partial RR_F/\partial(m/y) < 0$ and from (32) $\partial(m/y)/\partial E(\Delta P/P) > 0$; hence in (4') $\partial RR_F/\partial E(\Delta P/P) > 0$. Thus, the RR_FRR_F curve shifts to the right, v/y falls and RR_F rises. Intuitively, the rise in $E(\Delta P/P)$ reduces m/y, raises the correlation of R_F and R_{MKT}, and hence raises RR_F and reduces v/y.

(b) <u>An increase in $\sigma_{\Delta P}$</u> affects (4') directly and through its effect of reducing m/y, as (32) shows. Assuming that m/y is inelastic with respect to $\sigma_{\Delta P}$, an increase in $\sigma_{\Delta P}$ causes (m/y) $\sigma_{\Delta P}$ to rise. (2') is unaffected. Thus, the VV curve does not shift, but the RR_FRR_F curve shifts to the left. That is, a rise in $\sigma_{\Delta P}$ increases the attractiveness of holding equity, so RR_F falls and v/y rises.

(c) <u>An increase in $\underline{r}$</u> does not affect (2'). However, it directly and indirectly affects (4'); for any v/y, an increase in $\underline{r}$ raises RR_F, and also reduces m/y, and thus indirectly also serves to increase RR_F. Hence, the RR_F curve shifts to the right, and RR_F rises while v/y falls.

(d) <u>An increase in σ_u</u>. In (4'), $\partial RR_F/\partial\sigma_u > 0$, and $\partial RR_F/\partial(m/y) < 0$, but from (32) $\partial(m/y)/\partial\sigma_u > 0$; the net effect is thus ambiguous. However, assuming m/y is not highly elastic, the net effect is an increase in RR_F, or at any v/y the RR_FRR_F curve shifts to the right. Since the VV curve shifts down, the increase in σ_u^2 makes equity less attractive, so RR_F rises and v/y falls.

5. Long Run Effects

The reduced forms (32) can be used to find the effects on r and y of changes in $E(\Delta P/P)$, $\sigma_{\Delta P}$, and σ_u and G/y. For this purpose, divide (1') by y to give

$$(1'')\quad 1 = (1-t/y)C(1,r) + G/y \; .$$

Figure 3 shows (1") as the IS curve, whose slope

$$dr/dy = -\frac{-C(\cdot)d(t/y)/dy + d(G/y)/dy}{(1-t/y)C_r}, \qquad C_r < 0,$$

depends on how G/y and t/y vary with y: if G/y and t/y are constant, the IS curve is horizontal; if G and t are constant, the IS curve has a negative slope.[11/] (6') is shown as the long run aggregate supply curve AS in Figure 3; AS is steeper than IS if the system is stable. Using (32), rewrite (6') as

$$(6'')\quad y = y^* (R[E(\Delta P/P),\, r,\, \sigma_{\Delta P},\, \sigma_u],\, \sigma_u).$$

(1") and (6") show that shifts in G/y and/or t/y affect the position only of the IS curve, while changes in $E(\Delta P/P)$, $\sigma_{\Delta P}$ and σ_u affect only the AS curve.

In this (validly) dichotomized model, the IS and AS curves determine long run r and y. The price level adjusts to run the LM curve (not shown) through the IS-AS intersection.

Table 1 summarizes some results discussed below.

An Increase in the Expected Rate of Inflation (δ Rises) Suppose $E(\Delta P/P)$ rises, because δ rises. This reduces the demand for money and in response actual m/y will fall (from (32)). This reduction in m/y raises β_F and causes RR_F to rise, or the AS curve to shift down as in Figure 3, to show that a lower r is required to maintain production at y_1. Since IS_1 doesn't shift (from (1")), long-run y unambiguously falls; hence, it is clear from (6') that RR_F rises, and K falls. The new LM curve (not shown) goes through the IS_1-AS_2 intersection in Figure 3.

These results directly contradict those of Tobin [1965], Lucas [1975], Fischer [1979] and others who find that an increase in inflation causes the capital stock and also real income to rise. They assume that $E(\Delta P/P)$ is a separate argument in the demand for capital, with a positive partial derivative; with only two assets, K and $\underline{m}$, an increase in $E(\Delta P/P)$ that reduces $\underline{m}^d$ must increase K^d. However, the present model has a third asset, risk-free government bonds; an increase in $E(\Delta P/P)$ reduces $\underline{m}^d$ here, causes an equal increase in demand for these bonds, and no change in K^d. In particular, the stochastic structure of this model implies K and $\underline{m}$ are not gross substitutes, the assumption Tobin [1969] uses to derive a negative effect of $E(\Delta P/P)$ on K^d in multi-asset models. One way of viewing this result is that it calls into question Tobin's pervasive assumption that all assets are gross substitutes.

The present model assumes that the capital stock does not depend on $E(\Delta P/P)$ but on RR_F. $E(\Delta P/P)$ does not enter RR_F directly (equation (4')), but affects RR_F through m/y. When $E(\Delta P/P)$ rises and m/y falls, the share of equity in the economy's portfolio rises, and thus the return on equity becomes more highly correlated with the market. This higher β_F raises RR_F for any given $\underline{r}$ and thus reduces the steady state levels of $\underline{y}$ and the capital stock.

An Increase in $\sigma_{\Delta P}$ (σ_ε and/or σ_ω Rise) A rise in $\sigma_{\Delta P}$ initially reduces RR_F in (32) since it makes equity returns less correlated with those of the overall market. Hence, the AS curve shifts up ($dr/d\sigma_{\Delta P} = -R_1/R_3$ from (6') and (32)), showing that $\underline{r}$ would have to rise to reduce RR_F to its previous value. $\underline{y}$ unambiguously rises, showing that RR_F falls and K rises. (Again, the new LM curve goes through the new IS-AS intersection.)

An Increase in σ_u (σ_ξ,σ_e and/or σ_ε Rise) An increase in σ_u reduces the real return on equity for any given discount rate RR_F; thus, through this alone, AS would shift down (see (6')). However, an increase in σ_u raises RR_F (see (32)), so the AS curve unambiguously shifts down, as in Figure 3. (From (6') and (32), the vertical shift in AS is $dr/d\sigma_u = -(y_1R_4 + y_2)/y_1R_2 < 0$, since y_1, $y_2 < 0$, R_2, $R_4 > 0$.) Thus y unambiguously falls, as do RR_F and K.

An Increase in G/y (t/y Rises Equally) G is raised to make government's share of the economy (G/y) larger, and t rises equally. The IS curve shifts up to show a higher r is required to discourage C in order for G/y to rise. The AS curve is unchanged, so r rises, and y and K fall.

6. Short Run Analysis

This section uses the ad hoc procedure of examining the impact effects of parametric changes in lieu of attempting an analysis in terms of a dynamic CAPM.

For this analysis, use (2'), (3'), and (4'), and (5') with y evaluated at its initial value $\bar{y}$. In addition, modify the IS curve (1') to include investment, or $y = (y - t)C(1,r) + G + g(K^d - K)$. $(K^d - K)$ is the difference between the desired and actual stocks of capital, with $1 > g > 0$ a fractional adjustment coefficient, so that $I^d = g(K^d - K)$.

An Increase in the Expected Rate of Inflation As before, a rise in $E(\Delta P/P)$ reduces m/y and thus raises RR_F, so the AS curve shifts down in Figure 4 as $dr/dE(\Delta P/P) = - R_1/R_2 < 0$ (where R_1, $R_2 > 0$). The rise in RR_F reduces K^d and thus I^d, so there is a downward shift of the IS curve of $dr/dE(\Delta P/P) = - R_1/[R_2 + C_r(y-t)/gK_1] < 0$, where C_r, $K_1 < 0$. The new intersection of the IS and (vertical) $\bar{y}$ curves determines r in the short run. Clearly r must fall. (The LM curve, not shown, runs through the intersection of IS_2 and the given

$\bar{y}$ line.) Since IS does not fall as far as the AS curve, r does not fall enough to make firms satisfied with their current levels of production and capital stock. Hence, $K^d < K$, and $I^d = g(K^d - K) < 0$. Over time, K and y fall, and r rises. Note that there is no reason r may not fall to a negative level.[12/] This fits with the long run analysis where the steady state K is lower and r may be lower and even negative.

Increases in $\sigma_{\Delta P}$, σ_u and G/y The above methods can be used to show that an increase in $\sigma_{\Delta P}$ causes r and I^d to rise. An increase in σ_u causes both r and I^d to fall. A rise in G/y causes r to rise and I^d to fall. Thus, all three give results consistent with the long run predictions derived above.

7. Some Empirical Evidence The preceding sections provide a large number of testable implications. Discussed and tested here is the demand for money.

Equations

(4) $U'[M/P, y] = RR_m + E(\Delta P/P)$

and

(10) $RR_m = r + a\dfrac{Cov(Rm, R_{MKT})}{\sigma_{R_{MKT}}}$

give

(33) $U'[M/P, y] = r + E(\Delta P/P) + a\dfrac{Cov(\cdot)}{\sigma_{R_{MKT}}}$

$$= r + E(\Delta P/P) + a\rho\,\sigma_{\Delta P}, \qquad \partial U'/\partial M/P < 0,\ \partial U'/\partial y > 0$$

where $Cov(\cdot) = \rho\,\sigma_{\Delta P}\,\sigma_{R_{MKT}} = \rho\sigma_{R_m}\,\sigma_{R_{MKT}}$.

Supposing

(34) $U'[M/P, y] = b_0 - b_1 \ln(M/P) + b_2 \ln y; \qquad b_0 \gtrless 0;\ b_1, b_2 > 0,$

then (33) and (34) give

$$(35)\quad \ln(M/P) = \frac{1}{b_1}(b_0 - r) + \frac{b_2}{b_1}\ln y - \frac{1}{b_1}E(\Delta P/P) - \frac{a\rho}{b_1}\sigma_{\Delta P}.$$

If a lagged engogenous variable, $\ln(M/P)_{-1}$, is included in (35), then

$$(36)\quad \ln(M/P) = d_0 + d_1 \ln y + d_2\, E(\Delta P/P) + d_3 \ln(M/P)_{-1} + d_4\, \sigma_{\Delta P} + \text{error},$$

$$d_0 = \frac{1}{b_1}(b_0 - r),\ d_1 = b_2/b_1,\ d_2 = -\frac{1}{b_1},\ d_4 = -\frac{a\rho}{b_1},$$

has a commonly used form (for example, Goldfeld [1973, 1975], B. Friedman [1978]), save for inclusion of the risk variable $\sigma_{\Delta P}$ and $E(\Delta P/P)$ in place of an interest rate variable. Estimation of (36) presumes a, r and ρ are constant. Likely this is not so over time, but it is interesting to estimate (36) anyway, since bias is likely to be towards insignificance of estimated slope coefficiency.

Key issues are measurement of $\sigma_{\Delta P}$ and $E(\Delta P/P)$, which are of course unobservable. Cuickerman and Wachtel [1979] used both Livingston and University of Michigan survey data to estimate $E(\Delta P/P)$ and $\sigma_{\Delta P}$. Klein [1976] used a moving average of variance of past inflation around a moving average of inflation to form an estimate of future variability; Blejer [1978] uses a moving average of absolute differences of past inflation to estimate future inflation variability. Klein mentions unsatisfactory results from using residuals from an estimated ARIMA process for inflation to proxy variability of inflation. Engle [1980] estimates a model of inflation that models errors as ARCH (autoregressive conditional heterosckedastic) to estimate movements in the variance of the unforecastable component of inflation.

Results reported here use University of Michigan survey data. The average of survey responses is used to estimate $E(\Delta P/P)$, and the cross-sectional variance of response at t is used to form the variable $RISK_t$. Because of timing of data collection, it is unclear whether $RISK_t$ or $RISK_{t-1}$ should be used (and $RISK_A \equiv [(RISK_t - RISK_{t-1}) \div 2]$ was also used). Table 2 shows estimates of (36) for M1 with RISK excluded, with $RISK_t$, $RISK_{t-1}$ and $RISK_A$. Sweeney [1981] shows that when Cochrane-Orcutt or Hildreth-Lu techniques are used to adjust for first-order serial correlation in residuals in (36), there are multiple estimated values of ρ' in the (assumed first-order) error process that lead to minima in the standard error of the regression (SER). Empirically, minima with a high $\hat{\rho}'$ are associated with lower $\hat{d}_3$. Since the estimated speed of adjustment is $(1 - \hat{d}_3)$, these lower $\hat{d}_3$ are more reasonable under the presumption of rapid adjustment in the U.S.

It is common to find in equations without RISK that with a high ρ' and thus lower $\hat{d}_3$, the $\hat{d}_3$ is often insignificant, and coefficients for variables other than lny are often unstable and sometimes insignificant. The same pattern is found here. It seems that $RISK_{t-1}$ and $RISK_A$ work better than $RISK_t$. Even so, with the former risk definitions, $\hat{d}_4$ is not always significant, and it is somewhat unstable. However, experience shows that behavior of $\hat{d}_4$ compares rather well to any other parameter estimate in such equations, beyond perhaps that for lny.

This section presents an empirical test of only one of the many relationships discussed. Further, the test is dependent on strong assumptions about constancy of ρ, <u>a</u> and <u>r</u>. There are likely preferable proxies for $E(\Delta P/P)$ and $\sigma_{\Delta P}$. Nevertheless, the empirical results are both promising and consistent with theory.

8. Summary and Conclusions

In the earliest rational expectations macro models (e.g., Lucas [1972], Sargent [1973], Sargent and Wallace [1975]), changes in the variances of disturbances had no effect on unconditional means of real variables, essentially because a Lucas supply function was used where deviations of output from the given trend rate are due only to ex post mistaken price expectations. Similarly, the mean inflation rate had no real effects — the "super neutrality" assumption criticized by Tobin [1973] and others.

Later rational expectations models (e.g., Lucas [1975], Fischer [1979]) assumed the capital stock demand function had as positive arguments both the real rate of return on capital and the inflation rate. Thus, an increase in the mean inflation rate caused an increase in $\underline{y}$ and K, as Tobin [1965] (and others) had argued earlier. Increases in the variances of shocks to aggregate demand and inflation, however, still had no effect on the unconditional means of real variables.

In the model developed here, an increase in the mean inflation rate leads to a fall in $\underline{y}$ and K, rather than the rise found by Lucas, Fischer, Tobin and others. Increases in the variances of shocks to aggregate demand (σ_u^2) and inflation ($\sigma_{\Delta P}^2$) have systematic effects; a rise in σ_u^2 reduces $\underline{y}$ and K, while an increase in $\sigma_{\Delta P}^2$ by itself raises $\underline{y}$ and K. However, changes in σ_u^2 and $\sigma_{\Delta P}^2$ are likely highly correlated. Indeed, Logue and Sweeney [1981] find on a cross-country basis that the mean inflation rate, the variance of measured inflation and the variance of real growth rates are all significantly positively correlated. This evidence suggests, in the context of the present model, that high inflation as well as unanticipated variability in monetary and fiscal policy, will lead systematically to reductions in (trend) $\underline{y}$ and K, as well as in productivity, real wages and employment.

FOOTNOTES

1/ See, for example, Sharpe [1970].

The assumption of a risk-free real one-period interest rate greatly facilitates exposition but is not crucial. In particular, the β relationships in (1) and (2) hold with E(r) substituted, where r is now the real yield on the minimum-variance zero-beta portfolio that is orthogonal to the market portfolio.

2/ This linear relationship of return to risk is for convenience only. The same qualitative results hold if increases in risk cause accelerating increases in ER_{MKT}, as in (following Merton [1980])

$$ER_{MKT} = r + a_1 \sigma^2_{R_{MKT}}, \quad a_1 > 0.$$

Thus, paralell to (9) below,

$$RR_F = r + \frac{Cov(R_F R_{MKT})}{\sigma^2_{R_{MKT}}} [a_1 \sigma^2_{R_{MKT}}]$$

$$= r + a_1 Cov(R_F R_{MKT}).$$

An increase in shocks to the business sector unambiguously raises $Cov(R_F R_{MKT})$; the text's results are reinforced. See the discussion in Sections 4 and 6 below.

3/ This assumption simplifies the analysis but is not important for any of the macro results developed below.

4/ Assume u is normally distributed, $Eu = 0$. Then, even if the covariance of $\Delta P/P$ and u is non-zero, the covariance of $\Delta P/P$ and u^2 is zero, since covariance is a linear relationship. Assume the true linear relationship is $(\Delta P/P)_t = bu_t + e_t$, where $b > 0$ and $e(ue) = 0$. If $\Delta P/P$ is estimated as a linear function of u^2, $(\Delta P/P)_t = b'u^2_t + e'_t$,

$$\text{plim } \hat{b}' = \text{plim } \frac{(bu + e)u^2}{u^4} = \frac{bE(u^3)}{E(u^4)} = 0$$

since $E(u^3) = 0$ for normal variates.

The text's results also use the fact that $E(u^4) = 3\sigma^2_u \sigma^2_u$ is u is normal.

Both the assumptions that u is normal and affects π symmetrically can be relaxed but the resulting complications are tedious and not very interesting.

The net shock to excess real money supply in period t is $(\varepsilon - \omega)y$. The necessary inflation, between t and t+1, to reduce this to zero is

$$\frac{\Delta P}{P} = (\varepsilon - \omega)\frac{y}{m} = (\varepsilon - \omega)/(m/y).$$

To this is added the trend money supply growth rate, δ. Note that this explicitly assumes ε and ω are permanent, not transitory, shocks. Further, the effects on price are also ignored of changes in output, income and employment due to reducing or rebuilding stocks altered by aggregate demand disturbances; this is solely for convenience and alters no important results.

6/ This demand function is the basis of the AS function in equation (6'). If the production function suppresses the labor market and makes y depend only on K, $y = f(K)$, $f' > 0$ and $f'' < 0$ in the relevant range, then

$$y = f[K(RR_F, \sigma_u)], \qquad \text{and} \qquad y_1, y_2 < 0$$

as in the text.

7/ Thus,

$$K_1\left\{\frac{dRR_F}{dr}\frac{dr}{d\sigma_u} + \frac{dRR_F}{d\sigma_u}\right\} + K_2 = 0$$

or

$$\frac{dr}{d\sigma_u} = - K_1\left[\frac{dRR_F}{d\sigma_u} + K_2\right] \div K_1 < 0,$$

since $\frac{dRR_F}{dr} = 1$ from (4').

8/ In the short run with y constant, either m or $\frac{m}{y}$ can be analyzed. In the long run with y variable, the analysis holds strictly if $U'(\cdot)$ is homogeneous of degree zero in m and y. However, in the general case where only $\frac{\partial U'}{\partial m} < 0$, $\frac{\partial U'}{\partial y} > 0$ is assumed, the same qualitative results hold.

9/ In the short run analysis of Section 6, full-employment y is fixed at $\bar{y}$ and $\bar{\pi}$ cannot alter. Thus, from (2')

$$\frac{d(v/y)}{dRR_F} = - \frac{(\bar{\pi}/y) - c\sigma_u^2}{(RR_F)^2} = - \frac{v}{y}\,\frac{1}{RR_F} < 0.$$

In the long run, K can vary and thus so will y. K will vary inversely with changes in RR_F (but also will vary inversely with σ_u even if RR_F is constant). Thus, in the long run,

$$\frac{d(v/y)}{dRR_F} = -\frac{(\bar{\pi}/y) - c\sigma_u^2}{(RR_F)^2} + \frac{\frac{\partial\bar{\pi}/y}{\partial RR_F}}{RR_F} = \frac{1}{RR_F}\left[-\frac{v/y}{RR_F} + \frac{\partial\bar{\pi}/y}{\partial RR_F}\right]$$

$$= \frac{1}{RR_F}\,\frac{v/y}{RR_F}\left[-1 + \frac{\partial\bar{\pi}/y}{\partial RR_F}\,\frac{RR_F}{v/y}\right] < 0,$$

on the presumption that $\bar{\pi}/y$ is inelastic relative to RR_F.

10/ Consider a dynamic system where for any v/y, RR_F is determined by the $RR_F RR_F$ curve (Figure 2). Then with the curves V_1V_1 and $RR_{F_1}RR_{F_1}$, an arbitrary displacement of the market value from $(v/y)_1$ to $(v/y)_2$ will induce $RR_{F_3} > RR_{F_1}$ · RR_{F_3} will cause v/y to start to rise, and thus RR_F; the system moves up $RR_{F_1}RR_{F_1}$ to the equilibrium.

However, if the VV curve through the point $(v/y)_1$, RR_{F_1} were steeper than $RR_{F_1}RR_{F_1}$, v/y would begin to fall at RR_{F_3} and the system would move away from equilibrium.

Further, if the VV is steeper than $RR_F RR_F$ curve, some counterintuitive results arise. For example, an increase in $\bar{\pi}/y$, due say to technical progress causes the ratio v/y to fall in Figure 2 in the short and long run. Further, if the increase in $\bar{\pi}/y$ led to no change in the expected marginal physical product of capital, VV steeper than RR_F would lead to a fall in K as RR_F rose.

11/ The steady state r might be a constant. This possibility is suggested by perfect foresight models (Sidrauski [1966], Brock [1974], Sweeney [1980]) where each individual maximizes a welfare function

$$\sum^{\infty}[1/(1+\delta)]^t U(c_t, m_t),$$

where $U(\cdot)$ is the given instantaneous utility function, c_t is current consumption and m_t current real balances, and δ the parametric discount rate. In the long run, whatever is $E(\Delta P/P)$ or G/y, $r = \delta$. In the following experiments, such a constant long run r changes no important result.

12/ This, of course, requires a positive nominal interest rate and hence

$E(\Delta P/P) > 0$.

Note that $r < 0$ does not imply $RR_F < 0$. Indeed, starting from an $RR_F < 0$, the fall in r perhaps to below zero might be necessary to maintain RR_F.

REFERENCES

Blejer, M., [1979] "The Demand for Money and the Variability of the Rate of Inflation: Some Empirical Results," International Economic Review, Vol. 20, No. 2, June, pp. 545-49.

Brock, W., [1974] "Money and Growth: The Case of Long Run Perfect Foresight," International Economic Review, Vol. 15, No. 3, 750-77.

Cuickerman, A., and P. Wachtel, [1979] "Differential Inflationary Expectations and the Variability of the Rate of Inflation: Theory and Evidence," American Economic Review, September, pp. 515-609.

Engle, R. F., [1980] "Estimates of the Variance of U.S. Inflation Based Upon the ARCH Model," U. C. San Diego mimeo, July.

Fischer, S., Jr., [1979] "Anticipations and the Nonneutrality of Money", Journal of Political Economy 87 (April), 225-252.

Klein, B., [1977] "The Demand for Quality-Adjusted Cash Balances: Price Uncertainty in the U.S. Demand for Money Function," Journal of Political Economy, Vol. 85, pp. 692-715.

Logue, D., and R. J. Sweeney, [1981] "A Note on Inflation and Real Growth: Some Empirical Results," Journal of Money, Credit and Banking (November).

Lucas, R. E., Jr., [1972] "Expectations and the Neutrality of Money," Journal of Economic Theory 4 (April), 103-24.

_______, [1975] "An Equilibrium Model of the Business Cycle," Journal of Political Economy 83 (December), 1113-44.

Merton, R., [1980] "On Estimating the Expected Return on the Market: An Exploratory Investigation," Journal of Financial Economics 8 pp. 323-61.

Ross, S., [1978] "The Current Status of the Capital Asset Pricing Model (CAPM)," Journal of Finance (June), Vol. 33, No. 3, 885-901.

Sargent, T., [1973] "Rational Expectations, the Real Rate of Interest, and the Natural Rate of Unemployment", Brookings Papers on Economic Activity 2, 429-72.

_______, and N. Wallace, [1975] "'Rational Expections', the Optimal Monetar-Instrument, and the Optimal Money Supply Rule," Journal of Political Economy 83 (April), 241-54.

Sharpe, W., [1970] Portfolio Theory and Capital Markets, New York.

Sidrauski, M., [1966] "Rational Choice and Patterns of Growth in a Monetary Economy," American Economic Review, 57 (May), 534-44.

Sweeney, R. J., [1980] "Anticipated Counter-Cyclical Monetary Policy," unpublished Claremont MS.

Tobin, J., [1965] "Money and Economic Growth," Econometrica, 33 (October), 671-84.

________, [1973] Comment on Sargent [1973], Brookings Papers on Economic Activity 2, 477-78.

________, [1969] " A General Equilibrium Approach to Monetary Theory." Journal of Money, Credit and Banking, 1, February, 15-29.

Table 1

Variable

Parameter Increased	Long Run RR_F	Long Run y	Long Run K	Long Run v/y	Short Run RR_F	Short Run r	Short Run I^d	Short Run v/y
$E(\Delta P/P)$	+	-	-	-	+	-	-	-
$\sigma_{\Delta P}$	-	+	+	+	-	+	+	+
σ_u	+	-	-	-	+	-	-	-
$G/y\ (=t/y)$	+	-	-	-	+	+	-	-

RR_F: real discount rate used in business capital expenditure decisions

y: short-run, full-employment real GNP

$\bar{y}$: long-run, full-employment real GNP

K: capital stock

r: one-period, risk-free real rate of interest

I^d: investment demand

v/y: real value of equity in firms, per unit of real output

$E(\Delta P/P)$: expected rate of inflation

$\sigma_{\Delta P}$: variance of inflation rate

σ_u: variance of real disturbances

G/y: share of government expenditures in y

t/y: taxes as a fraction of y

e: shock to government expenditures

ξ: shock to consumption function

γ: shock to taxation

ε: shock to real money supply

δ: trend rate of growth of money supply

ω: shock to real money demand

β_F: beta for equity

β_m: beta for real balances

ER_{MKT}: expected real rate of return on the market

a: real price of risk

m: real balances

S: real sales

R_F: actual real return on equity

R_m: actual real return on real balances

Table 2

Period	N	RISK excluded SER	RISK excluded $\hat{\rho}'$	RISK excluded $\hat{d}_3$	$RISK_t$ SER	$RISK_t$ $\hat{\rho}'$	$RISK_t$ $\hat{d}_3$	$RISK_t$ $\hat{d}_4$	$RISK_{t-1}$ SER	$RISK_{t-1}$ $\hat{\rho}'$	$RISK_{t-1}$ $\hat{d}_3$	$RISK_{t-1}$ $\hat{d}_4$	$RISK_A$ SER	$RISK_A$ $\hat{\rho}'$	$RISK_A$ $\hat{d}_3$	$RISK_A$ $\hat{d}_4$
QIII52-QIV79	110	.5851	1.0	.465 (5.43)≠	.5408	.23	.973 (46.47)	-.216 (5.80)	.5267	.25	.964 (45.93)	-.234 (6.27)	.5155	.26	.964 (46.43)	-.269 (6.69
					.5927	1.0	.516 (6.11)	-.0585 (1.04)	.5834	1.0	.519 (6.24)	-.126 (2.27)	.5707	.99	.501 (6.03)	-.248 (2.69
QIII55-QIV79	98	.5385	.99	.517 (6.01)	.5098	.25	.991 (41.3)	-.249 (5.39)	.4513	.33	.976 (42.31)	-.309 (7.37)	.4629	.30	.989 (42.99)	-.331 (7.06
					.5413	.99	.517 (5.91)	.784 (.011)								
QII55-QII76	82	.4770	.38	.934 (29.24)	.4696	.33	.962 (30.2)	-.267 (1.9)	.4708	.35	.956 (29.75)	-.242 (1.77)	.4648	.36	.968 (28.90)	-.387 (2.27
		.5050	.91	.558 (5.82)	.5053	.89	.604 (6.46)	-.152 (.99)	.4955	.93	.513 (5.30)	-.304 (2.03)	.4879	.92	.555 (5.90)	-.653 (2.57
QI65-QII76	47	.5488	1.02	.437 (3.75)	.5536	1.02	.445 (3.76)	-.0376 (.51)	.4563	.33	.983 (25.87)	-.310 (5.69)	.4728	.34	.989 (24.85)	-.393 (5.21
									.4707	1.03	.548 (5.24)	-.245 (4.09)	.4796	1.03	.559 (5.18)	-.389 (3.82
QI65-QIV72	32	.4767	.65	.498 (2.90)	.4742	.62	.551 (3.18)	-.142 (1.15)	.4427	.59	.443 (2.70)	-.363 (2.36)	.4279	.57	.535 (3.48)	-.565 (2.82
QI70-QII76	26	.7171	.11	.977 (14.80)	.6911	-.15	.998 (20.11)	-.233 (2.05)	.6878	.01	.959 (16.17)	-.160 (1.77)	.6528	-.09	.965 (19.05)	-.314 (2.56
		.7234	.97	.179 (.88)	.7329	.97	.170 (.82)	.0595 (.66)	.7330	.96	.214 (1.02)	-.0553 (.67)	.7215	.97	.203 (.99)	-.147 (1.06
QI73-QII76	14	.5568	.91	.146 (.597)	.5852	.91	.139 (.538)	.0322 (.25)	.3954	1.02	.612 (3.61)	-.302 (4.08)	.4399	-.12	.957 (11.83)	-.439 (3.49
									.4220	.40	1.08 (8.97)	-.378 (3.71)	.5071	.96	.425 (1.68)	-.323 (1.94

$\ln m_t = d_0 + d_1 \ln y_t + d_2 E(\Delta P/P)_t + d_3 \ln m_{t-1} + d_4$ RISK

≠ t - statistics are in parentheses.

Figures in the SER column are the SER x 100.

Estimates in the $\hat{d}_4$ columns have been multiplied by 1,000.

Data: NBER Database. m is the deflated M1.

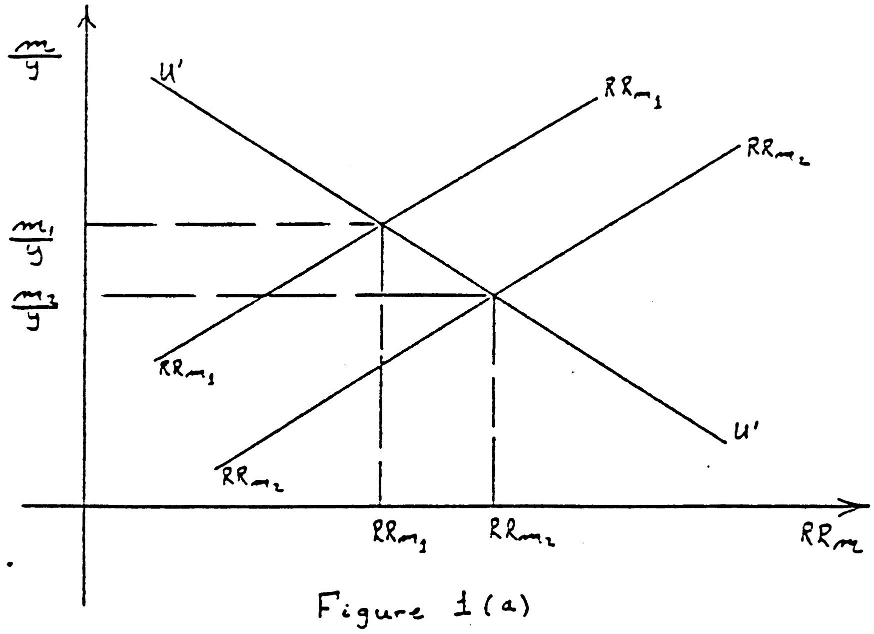
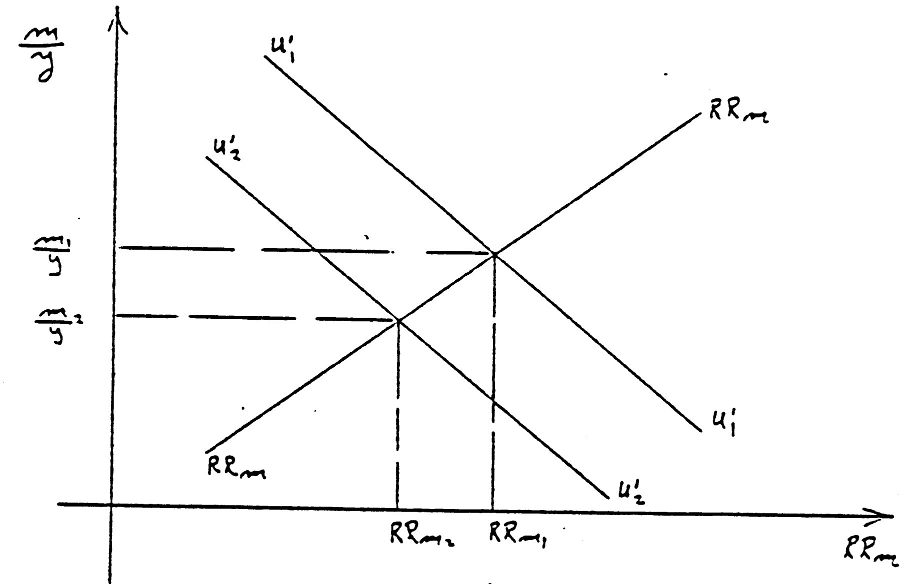


Figure 1(a)



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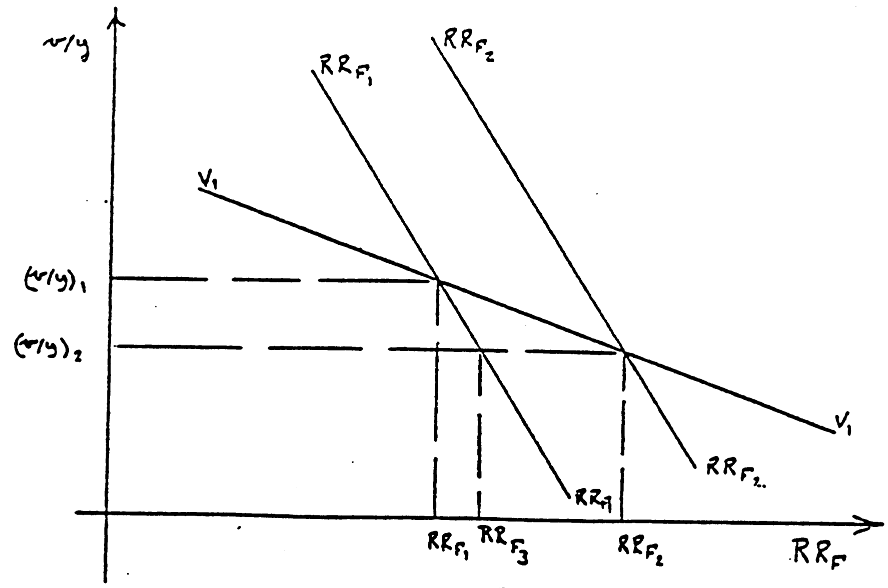

Figure 2

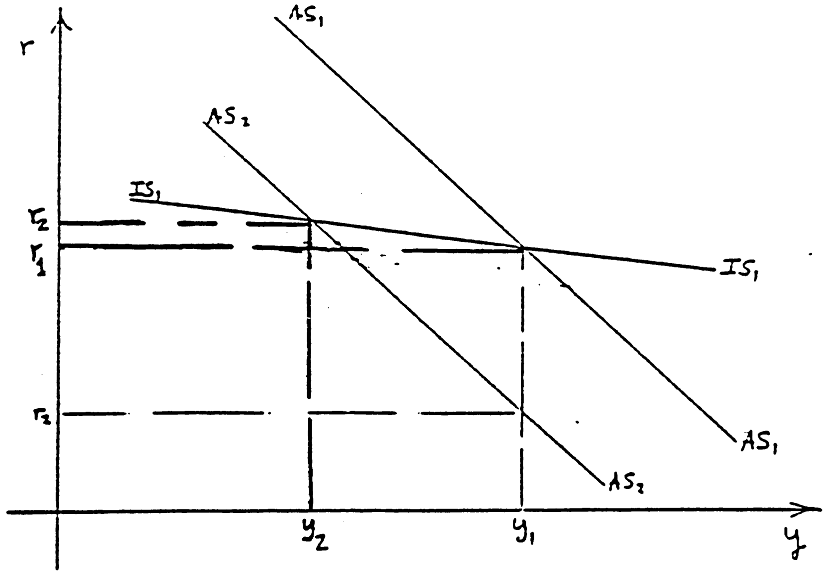

Figure 3

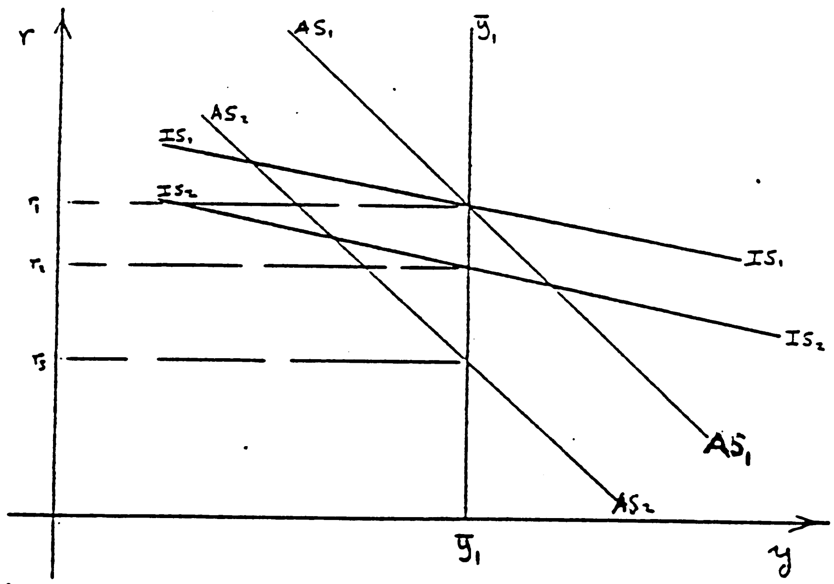

Figure 4