INTERNATIONAL INTEGRATION AND MONETARY POLICY COORDINATION

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Abstract

Typical arguments promoting the formation of coalitions of nations whose monetary authorities coordinate their policies presume that greater international integration of goods markets makes increased monetary coordination welfare-improving for coalition participants. However, this notion has not been explored in formal models in which some policymakers participate in such coalitions while others do not. This paper constructs a model of atomistic nations whose monetary authorities may conduct their policies under either rules or discretion. It is shown that the number of nations who benefit from and join a monetary policy-coordinating coalition generally is ambiguously related to the degree of integration of world goods markets.

INTERNATIONAL INTEGRATION AND MONETARY POLICY COORDINATION

It is widely perceived that the European Monetary System (EMS) has been a "success." For this reason, there is growing enthusiasm for continuation of the EMS and for possible expansion in the number of EMS participants. Nevertheless, some nations, notably Great Britain, continue to balk at participation in the EMS. In addition, full coordination of monetary policymaking has not extended outside the western part of the European subcontinent. Although there have been some clear steps taken in that direction, coordination among the monetary authorities of non-EMS developed countries appears generally to be very loose and often to be nonexistent.

Recent work has shown that there are good reasons that some countries may choose to coordinate their monetary policies while others may not. For instance, for some nations' policymakers the perceived political cost arising from sacrifice of sovereignty may outweigh other welfare gains that might arise. In addition, Rogoff (1985) has used the Barro-Gordon (1983) model of policy discretion and inflation to demonstrate that increased monetary coordination may not be welfare-improving if monetary authorities cannot make credible commitments to the private sectors of their home countries.

On the other hand, Oudiz and Sachs (1985) have shown that welfare may be lowered by policymaker precommitments to the private sectors of their economies if they do not coordinate their monetary policies, and Cooper (1985) and Canzoneri and

Henderson (1988) have demonstrated that full coordination with respect to both private sectors and other monetary policymakers can increase welfare of the coordinating nations.

Those who favor increased coordination of monetary policymaking generally argue that more nations should find it optimal to participate in coordination arrangements as economies around the world become more integrated. Indeed, this is the most common argument justifying the existence of the EMS (for instance, see Giavazzi and Giovannini, 1989). According to this view, increased trade across national boundaries and greater responsiveness of goods demands to changes in relative prices produces spillover effects on the welfare of nations that can be reduced by monetary policy coordination.

This paper evaluates these issues using a formal model. The analysis, which builds closely upon a two-country framework first considered by Canzoneri and Henderson (1988), explicitly considers two groupings of nations. One set of countries participates in a policy-coordinating coalition, while monetary policymakers in the remaining set of countries play Nash games with respect to each other and with respect to the nations that belong to the policy-coordinating coalition. For a "marginal country," the welfare derived from coordination participation is equal to welfare under insular policymaking. This condition is used to determine the portion of all countries that choose to participate in the coalition.

The relative size of the coalition turns out to depend positively on the propensity to import, holding the consumption

substitutability of domestic for foreign goods constant. The reason is that an enlarged propensity for nations to import increases the sensitivity of their welfare levels to inflationary money stock increases by coalition members and non-coalition policymakers. Greater coalition participation depresses the magnitudes of money stock settings by policymakers in both groups of nations, which thereby tends to offset the welfare loss that otherwise would occur with the advent of increased trade. It follows that if greater trade between nations were the only measure of international integration the arguments of proponents of increased monetary coordination would be unequivocally correct. Enlarged worldwide integration of markets for goods and services, however, also should lead to greater sensitivity of home goods demand with respect to relative prices of foreign goods, which reduces the adverse welfare effects of inflationary increases in home and foreign money stocks and thereby decreases the gains from coalition participation. Consequently, greater international integration along all dimensions will not necessarily lead to increased monetary policy coordination among nations.

I. The Model

The expositional model is a straight-forward extension of a version of the two-country model used by Canzoneri and Henderson (1988), and much of their notation is retained. Countries are of equal size and specialize in production of different goods. Each country is "small" relative to the rest of the world. For

convenience, countries are distributed uniformly along a unit interval. All variables are measured in logarithms. Country i produces its output according to the production function,

$$(1) \quad y_i = \bar{y} + (1-\alpha)n_i,$$

where y_i and n_i are output and employment in country i, $0 < \alpha < 1$, and $\bar{y} \equiv \ln[1/(1-\alpha)]$. The implied marginal productivity condition is

$$(2) \quad w_i - p_i = -\alpha n_i,$$

where w_i and p_i are country i's money wage and price level.

The demand for real money balances is assumed to be of a quantity-equation form:

$$(3) \quad m_i - p_i = y_i - \bar{y},$$

where m_i represents nominal money balances. The monetary authorities of all the countries use their money stocks as policy instruments. Each country's wage setters minimize $E(n_i)^2 = E(m_i - w_i)^2$, which yields the wage setting,

$$(4) \quad w_i = m_i^e.$$

The equilibrium condition for the market for the ith country's good is given by

$$(5) \quad y_i = (1/\delta)\int_0^1 z_j dj + (1-\beta)y_i - \beta\phi p_i + \beta\int_0^1 y_j dj + \beta\phi\int_0^1 p_j dj,$$

where

(6) $z_j \equiv e_j + p_j - p_i$

is the relative price of country j's good from the perspective of country i, e_j is the country i exchange value of country j's currency, $\beta > 0$ is the average propensity to import, $(1/\delta) > 0$ measures the magnitude of the relative price effect on domestic spending, and $\phi > 0$ measures nonneutralities arising from fiscal policy. The parameters β, δ, and ϕ are identical across countries. Finally, consumer prices in country i are given by

(7) $q_i = (1-\beta)p_i + \beta\int_0^1(e_j + p_j)dj.$

Solution of the model in terms of the money stock expectations yields

(8) $n_i = m_i - m_i^e$

and

(9) $$\begin{aligned} q_i &= p_i + \beta\int_0^1 z_j dj \\ &= m_i + \eta\phi(m_i - \int_0^1 m_j dj) + [\varepsilon(1-\phi) + \alpha - 1](m_i - m_i^e) \\ &\quad - \varepsilon(1-\phi)\int_0^1(m_j - m_j^e)dj, \end{aligned}$$

where $\varepsilon \equiv \beta^2\delta(1-\alpha)$ and $\eta \equiv \beta^2\delta$. Throughout, the value of q_i in the previous period is normalized at zero, so q_i is the rate of consumer price inflation. Each country's monetary authority sets its money stock with an aim to maximize

(10) $U_i = -\sigma(n_i - n^*)^2 - (q_i)^2,$

where $n^* > 0$ is an employment objective that is the same across nations.

Note that, as in Canzoneri and Henderson, an unanticipated increase in the money stock leads to an increase in n_i. In addition, an unanticipated increase in the value of m_i causes p_i to increase. Both of these effects, according to (5), together result in a excess supply of output in country i, leading to a *ceteris paribus* rise in the aggregate relative price, given by $\int_0^1 z_j dj$. Unanticipated increases in other nations' money stocks raise foreign outputs and prices, causing qualitatively opposite effects on country i's aggregate relative price. An anticipated increase in m_i increases p_i, thereby causing, through the fiscal nonneutrality, a reduction in home good demand and a rise in the aggregate relative price. Anticipated increases in other nations' money stocks again have opposite effects on country i's aggregate relative price. The magnitudes of these relative price effects are higher for a larger value of β (a larger propensity to import), a greater value of δ (a smaller substitutability of home goods for foreign goods), and a larger value of ϕ (greater importance of fiscal nonneutralities).

Monetary policymaking and the resulting macroeconomic equilibria depend crucially upon the extent to which the monetary authorities coordinate their actions with respect to the private agents in their countries and with respect to one-another. It is assumed that a fraction θ of the countries choose to participate in a coalition that is able to achieve fully coordinated, policy-precommitment solutions, in that the participating countries seek to maximize joint welfare and exercise private-sector and international commitments that are credible. In contrast, the

policymakers in the remaining portion $(1-\theta)$ of the countries play discretionary Nash games with respect to each other, the other fraction of policymakers θ, and their countries' private sectors.

Suppose that countries indexed i and k belong to the coalition of coordinating nations, so that they are distributed within the interval between zero and θ. However, countries indexed j and ℓ do not and lie between θ and unity. For the ith member of the coordinating coalition, consumer price inflation is

$$q_i = m_i + \eta\phi(m_i - \int_0^\theta m_k dk - \int_\theta^1 m_j dj) + [\varepsilon(1-\phi)+\alpha-1](m_i - m_i^e) - \varepsilon(1-\phi)\int_0^\theta (m_k - m_k^e)dk - \varepsilon(1-\phi)\int_\theta^1 (m_j - m_j^e)dj.$$

However, because these nations' policymakers are able to credibly precommit, $m_i^e = m_i$ and $m_k^e = m_k$ for all i and k such that $0 < i,k < \theta$. Therefore, consumer price inflation for the ith country reduces to

$$(11)\quad q_i = m_i + \eta\phi(m_j - \int_0^\theta m_k dk - \int_\theta^1 m_j dj) - \varepsilon(1-\phi)\int_\theta^1 (m_j - m_j^e).$$

For the countries indexed j and ℓ $(\theta < j,\ell < 1)$ that experience discretionary, noncoordinated policymaking, consumer price inflation is

$$(12)\quad q_j = m_j + \eta\phi(m_j - \int_0^\theta m_i di - \int_\theta^1 m_\ell d\ell) + [\varepsilon(1-\phi)+\alpha-1](m_j - m_j^e) - \varepsilon(1-\phi)\int_\theta^1 (m_\ell - m_\ell^e)d\ell.$$

II. Monetary Policy Choices

In this paper, coordination is modeled as bilateral maximization of utility across each pair of countries distributed

within the coalition interval $0 < i,k < \theta$, which implies that only a symmetric coordinated equilibrium is considered. If policymakers for nations i and k seek to maximize joint utility on a bilateral basis, they set the marginal rate of substitution with respect to their money stocks equal to unity, which implies that $-(\partial U_i/\partial m_i)/(\partial U_i/\partial m_k) = 1$ for all i and k less than θ. In addition, because all countries in the coalition are able to exercise credible commitments, $m_i^e = m_i$ and $m_k^e = m_k$. Finally, in a symmetric equilibrium, $m_i = m_k = \hat{m}$. Given these conditions, the symmetric-cum-commitment equilibrium setting of the money stocks for coalition countries is given by

$$(13)\quad \hat{m} = [1 + (1+\eta\phi)\eta\phi(1-\theta)]^{-1}(1+\eta\phi)(1-\theta) \times [\eta\phi\tilde{m} + \varepsilon(1-\phi)(\tilde{m} - \tilde{m}^e)],$$

where $\tilde{m}$ and $\tilde{m}^e$ are the symmetric, Nash-equilibrium, actual and expected money stock choices of non-coalition policymakers, to be derived below. Note that, if $\theta = 1$, so that all policymakers participate in the coalition, $\hat{m} = 0$, which duplicates the solution for the analogous case in Canzoneri and Henderson's two-country model. However, for the general case where $0 < \theta < 1$, $\hat{m}$ depends on the choices of non-coalition policymakers.

For countries in the interval $\theta < j,\ell < 1$, country-specific welfare is maximized taking all other nation's decisions as given but recognizing that members of the coordinating coalition will conduct committed monetary policies. The symmetric Nash solution for the money stock setting of a non-coalition member can be shown to be

$$(14)\quad \tilde{m} = (1 + \eta\phi)^{-1}(\tau\sigma n^{*} + \eta\phi\theta\hat{m}^{e}),$$

where $\tau \equiv [\eta\phi + \varepsilon(1-\phi) + \alpha]$. For the special case in which no nations participate in a policy-coordination coalition, $\theta = 0$ and $\tilde{m} = \tau\sigma n^{*}$, which duplicates the Canzoneri-Henderson result for the analogous case in a two-country framework. However, for the general case where $0 < \theta < 1$, the money stock setting of a non-coalition policymaker takes into account the anticipated money stock setting of coalition nations.

Since there are no shocks in this model, the *ex post* money stock settings are equal to their anticipated values. Consequently, $\hat{m} = \hat{m}^{e}$ and $\tilde{m} = \tilde{m}^{e}$ may be substituted into (13) and (14), and the resulting expressions may be solved for the reduced-forms for $\tilde{m}$ and $\hat{m}$:

$$(15)\quad \tilde{m} = \{1 + \eta\phi[1 + \eta\phi(1-\theta)]\}^{-1}[1 + (1+\eta\phi)\eta\phi(1-\theta)]\tau\sigma n^{*}$$

and

$$(16)\quad \hat{m} = \{1 + \eta\phi[1 + \eta\phi(1-\theta)]\}^{-1}(1+\eta\phi)\eta\phi(1-\theta)\tau\sigma n^{*}.$$

Equation (16) implies that, although members of the policy-coordinating coalition use rules rather than discretion, they generally experience spillover effects resulting from sovereign, discretionary policymaking by non-coalition nations. Likewise, (15) indicates that the non-coalition policymakers experience spillover effects from the coordinated policymaking of coalition participants.

III. Coalition Participation and Goods-Market Integration

It is now possible to undertake a determination of the equilibrium size of the policy-coordinating coalition relative to the total number of nations. A nation will choose to join the policy-coordinating coalition as long as its welfare as a coalition member exceeds the welfare it would experience under insular policymaking, but it will be satisfied with insularity if the reverse is true. This implies that, for a "marginal country," the welfare derived from being in the coalition is equal to the welfare that arises under insularity.

For the coalition participant, welfare is given by

$$(17)\quad \hat{U} = -\sigma(n^*)^2 - (\hat{q})^2,$$

where

$$(18)\quad \hat{q} = [1 + \eta\phi(1-\theta)]\hat{m} - \eta\phi(1-\theta)\tilde{m}.$$

For the nation whose monetary authority conducts discretionary, insular policy, welfare is

$$(19)\quad \tilde{U} = -\sigma(n^*)^2 - (\tilde{q})^2,$$

where

$$(20)\quad \tilde{q} = [1 - \eta\phi(1-\theta)]\tilde{m} - \eta\phi\theta\hat{m}.$$

Note that (18) implies that, while an increase in the money stock of a coalition nation raises consumer price inflation in the coalition nation, an increase in the money stock in a non-

coalition nation reduces CPI inflation. The reason for these contrasting effects are the opposing effects that changes in the respective money stocks have on the aggregate relative price; see equations (9) and (11). Similar reasoning lies behind the constrasting money stock effects on CPI inflation in a non-coalition country. It follows that a coalition country would benefit, *ceteris paribus*, from greater monetary expansion by non-coalition policymakers, and *vice versa*.

Setting (17) equal to (19) in turn implies that an equality of (18) and (20) must hold for the marginal country; that is, inflation is equalized across both groupings of nations, so that there is no incentive for any of the symmetrically structured nations to enter or leave the coordinating coalition. Substituting (15) and (16) into (18) and (20) and imposing this condition yields the equilibrium value of θ:

$$(21)\quad \theta^{*} = 1 - \{1 / [(\eta\phi)^{2}(1+\eta\phi)]\}.$$

The determination of θ^{*} is shown diagrammatically in Figure 1. The upward-sloping schedule in Figure 1 is the equation $\tilde{q} - \hat{q} = 1 - (\eta\phi)^{2}(1+\eta\phi)(1-\theta)$, or the difference in the groups' respective inflation rates as a function of θ. The equilibrium value of θ given by equation (21) is the point at which this schedule crosses the horizontal axis, so that $\tilde{q} - \hat{q} = 0$.

[FIGURE 1 GOES HERE]

Note that there is an interior solution for θ^{*} even though there are no costs associated with coalition participation. The intuition behind this result can be seen by referring to Figure

2. The figure depicts reaction functions for the coalition and non-coalition members for extreme and intermediate values of θ, where the reaction functions of a coalition participant and of an insular policymaker are labeled $\hat{R}$ and $\tilde{R}$, respectively. The $\hat{R}$ schedule is defined by $\hat{m} = [(1+\eta\phi)(1-\theta)\eta\phi]\tilde{m}/[1+(1+\eta\phi)\eta\phi(1-\theta)]$, while the $\tilde{R}$ schedule is given by $\tilde{m} = [\tau\sigma n^{*} + \theta\eta\phi\hat{m}]/(1+\theta\eta\phi)$. As θ rises in value, the $\hat{R}$ schedule shifts leftward and exhibits an increased slope, which in turn is always greater than or equal to unity (the slope of the dashed 45-degree line), while the $\tilde{R}$ schedule, which crosses the origin, rotates downward. This produces a locus of Nash equilibrium points for various values of θ that contains the three specific equilibrium points e_0, e_θ, and e_1 that are illustrated. Hence, as θ rises in value the money stock choices of both coalition and non-coalition policymakers decline in magnitude. (These conclusions can also be derived algebraically by differentiating (15) and (16) with respect to θ).

[FIGURE 2 GOES HERE]

Because the CPIs of coalition nations are increasing in coalition money stock choices and decreasing in non-coalition money stock decisions, while the converse is true for non-coalition CPIs, neither point e_0 nor point e_1 in Figure 1 generally depict equilibrium values for θ. Therefore, θ^{*} generally will lie between zero and one, as implied by the expression in (21), at a point such as e_θ in the figure. Indeed, the value for θ^{*} if e_θ were the optimal point would be the ratio of the length of arc e_θ-e_0 to the length of arc e_1-e_0.

Equation (21) indicates that a rise in the value of $\eta\phi$ increases θ^*, implying that there would be a resulting rise in the proportion of nations that choose to participate in the policy-coordinating coalition. Geometrically, this may be seen in Figure 1 from the fact that a rise in $\eta\phi$ would rotate the $\tilde{q}$ - $\hat{q}$ schedule rightward along the horizontal axis. Alternatively, in Figure 2 a rise in $\eta\phi$ would shift the $\tilde{R}$ schedule leftward leftward and reduce its slope while increasing the slope of the $\hat{R}$ schedule. It can be shown that these comparative statics effects would shift the entire e_0-e_1 arc in Figure 2 upward and lengthen this arc in greater relative magnitude to the upper right of the diagram, as compared to a very slight lengthening to the lower left. Hence, a new arc e_θ-e_0 would be have a greater length relative to the new arc e_0-e_1, implying an increase in the magnitude of θ^*.

To see the economic intuition behind the algebra and geometry, note that as θ increases toward a value of unity, the coalition money stock $\hat{m}$ approaches a value of zero while the non-coalition money stock $\tilde{m}$ also approaches its smallest possible value (see Figure 2). Reference to equations (18) and (20) indicates that a rise in the magnitude of $\eta\phi$ increases the sensitivities of the coalition and non-coalition CPIs to the values of $\hat{m}$ and $\tilde{m}$. By reducing $\hat{m}$ and $\tilde{m}$, a rise in θ thereby tends to offset automatically the CPI inflation effects, and the resulting welfare variations, of the increase in $\eta\phi$, thereby

balancing the welfare outcomes for coalition and non-coalition members at the new, higher value of θ.

In turn, the reason that the CPIs of the two groups of countries are more sensitive to the respective money stock values is that an increase in $\eta\phi$ could arise from an increase in β, which corresponds to a rise in the average propensity to import, a rise in δ, which implies lower goods substitutability in consumption, or an increase in ϕ, which indicates an enlarged importance of fiscal nonneutralities. As discussed in section II, any of these three possible parameter variations increases the sensitivity of a country's aggregate relative output price to changes in home and foreign money stocks, increasing the money stock effects on the country's levels of CPI inflation and welfare.

A rise in the importance of fiscal nonneutralities increases the sensitivity of a country's CPI inflation and welfare levels to the money stock choices of coalition and non-coalition policymakers. Indeed, in this model the existence of nonneutralities is the driving force behind the relative price effects of anticipated monetary policy choices. Hence, as nonneutralities become more empirically relevant the relative price effects of money stock settings on CPI inflation and welfare are increased, leading to an increase in the size of the policy-coordinating coalition.

An increase in the propensity to import across nations implies a *ceteris paribus* rise in desired trade. The relative importance of foreign goods in the home country's CPI thereby

increases, magnifying the CPI effects and welfare effects of coalition and non-coalition policymakers' money stock settings and leading to a compensating increase in the size of the policy-coordinating coalition. An increased level of trade between nations is one measure of enlarged international output-market integration, so by this measure increased monetary policy coordination is an equilibrium response.

However, greater integration of goods markets across nations also should increase the sensitivity of the demand for home goods in response to variations of the price of home goods relative to foreign goods. This effect would tend to reduce the relative price effects of money stock settings by coalition and non-coalition policymakers, implying relatively smaller effects on CPI inflation and welfare of enlarged money stock choices by both groups of policymakers. Since greater coalition participation tends to reduce the money stocks of coalition and non-coalition members alike, fewer nations are induced by greater substitutability of home and foreign goods to join the policy-coordinating coalition, *ceteris paribus*. According to this measure of increased international integration, the equilibrium size of the policy-coordinating coalition decreases.

On net, then, the implication of greater international output-market integration for the relative size of the policy-coordinating coalition theoretically is ambiguous. This result, of course, does not rule out the possibility that real-world parameter values may fall within a range such that the equilibrium level of monetary policy coordination is positively

related to an overall increase in international integration. However, it does imply that *a priori* claims that greater world trade and goods substitutability in international consumption necessarily imply a need for increased policy coordination are not necessarily correct.

IV. Conclusion

It often is argued that greater policy coordination should be undertaken as markets around the world continue to become more integrated. However, prior to the recent developments in the literature on rules versus discretion formal evaluations of this common claim could not be undertaken. This paper has built upon those developments to show that the argument is not necessarily correct. The equilibrium size of a monetary policy-coordinating coalition of nations is ambiguously related to increased integration of world output markets.

Obviously, the finding of an equivocal relationship does not mean that proponents of greater monetary policy coordination are necessarily incorrect. However, this conclusion does indicate that the burden of proof for claims that increased coordination is unambiguously desirable is greater than many coordination proponents might otherwise have recognized.

Furthermore, it seems likely that inclusion of other factors that have been ignored in this paper would further complicate matters. For instance, the atomistic-nation assumption used in the analysis, which is very useful analytically because the resulting symmetry makes the analysis quite tractable, clearly is

violated by the real world in which we live. In reality, there obviously is considerable lumpiness in the relative sizes of countries. It seems unlikely that the results forthcoming from this paper would not be made more equivocal by accounting for asymmetry in sizes of nations. Of course, an analysis that allows for differences in sizes also would be less tractable or would require significant simplifications that would also lessen the generality of any forthcoming conclusions.

In addition, as in most of the literature on rules versus discretion, the analysis conducted in this paper assumed that fiscal policy is unaffected by time inconsistencies in the conduct of monetary policy. When fiscal policy responds endogenously to time inconsistencies in monetary policy, a system of rules, or coordination, may be less desirable, as demonstrated by Alesina and Tabellini (1987). An additional factor that could complicate the case for increased coordination of monetary policymaking is the potential welfare-reducing role of fiscal coordination, discussed by Tabellini (1990). Allowing for such fiscal-monetary interactions would certainly modify the analysis and could make the implications of increased international integration for monetary coordination even less straightforward.

Finally, the model above considered only countries whose policymakers are either entirely committed or are completely uncommitted with respect to their private sectors and other policymakers. Hence, "partial-precommitment" settings like those envisioned by Rogoff and by Oudiz and Sachs were not considered in the analysis above. Such environments likely would yield

further ambiguities for international integration and coordination. However, Canzoneri and Henderson provide arguments for questioning the extent to which results forthcoming from such partial-precommitment environments are likely to be of practical interest. Consequently, of the various iterations of possible policy settings that might be considered, the one analyzed in this paper may indeed be of greatest significance.

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Figure 1

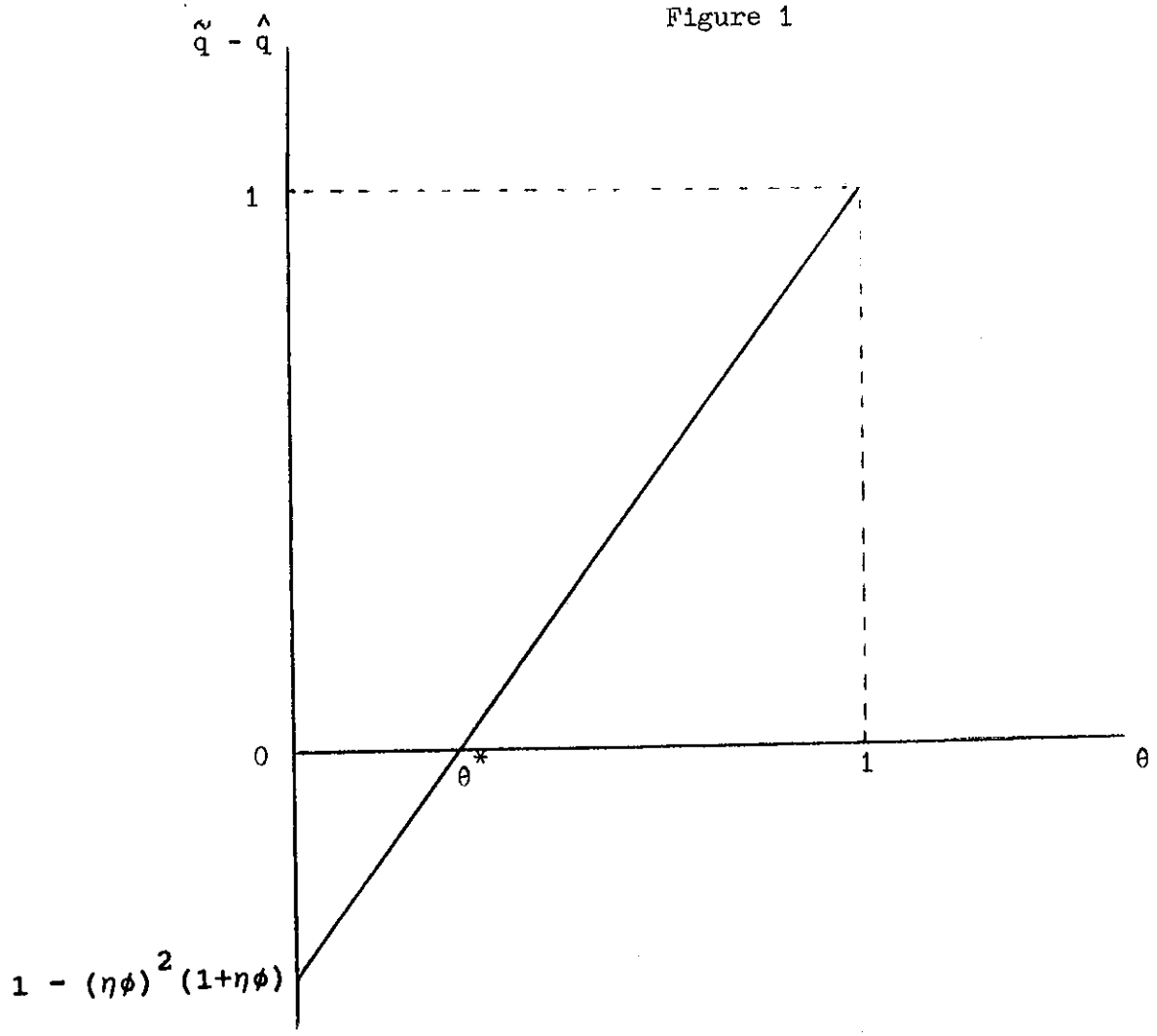
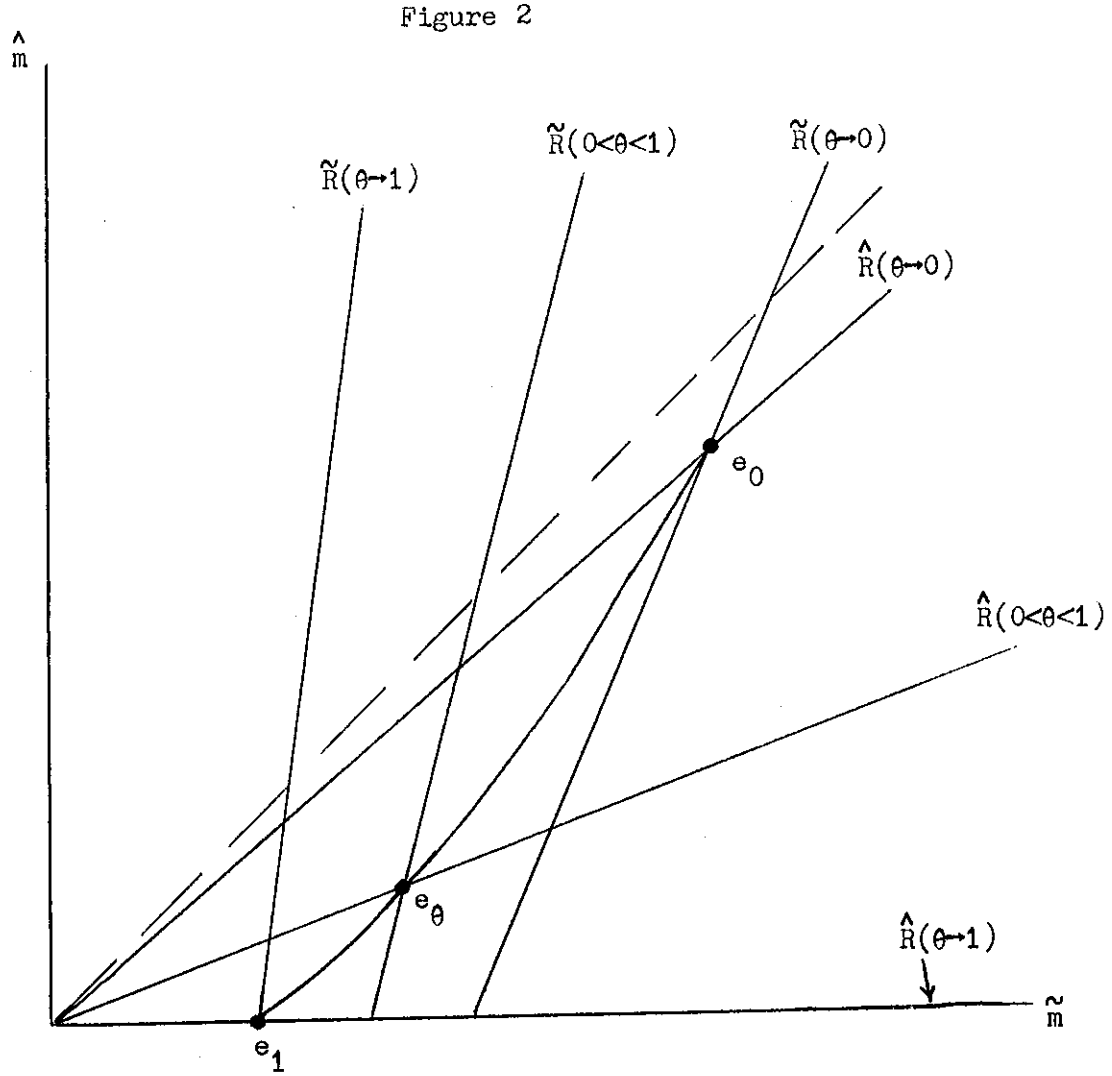


Figure 2


$\hat{m}$
$\tilde{R}(\theta \to 1)$
$\tilde{R}(0<\theta<1)$
$\tilde{R}(\theta \to 0)$
$\hat{R}(\theta \to 0)$
e_0
$\hat{R}(0<\theta<1)$
e_θ
$\hat{R}(\theta \to 1)$
$\tilde{m}$
e_1