The Royal Swedish Academy of Sciences has decided to award the
Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel, 1999

to Professor **Robert A. Mundell**, Columbia University, New York, USA

for his analysis of monetary and fiscal policy under different exchange rate regimes and his analysis of optimum currency areas.

Robert A. Mundell was born in Canada in 1932. After completing his undergraduate education at the University of British Columbia and the University of Washington, he began his postgraduate studies at the London School of Economics. Mundell received his Ph.D. from M.I.T. in 1956 with a thesis on international capital movements. After having held several professorships, he has been affiliated with Columbia University in New York since 1974.

Robert Mundell's most important contributions were made in the 1960s. During the latter half of this decade, Mundell was among the intellectual leaders in the creative research environment at the University of Chicago. These were exciting times at Chicago and many of his students from this period have become successful researchers in the same field, building on Mundell's foundational work.

Mundell's scientific contributions are original. Yet, they quickly transformed research in international macroeconomics. Characterized by uncommon foresight about the future development of international monetary arrangements, they became increasingly relevant in the policy-oriented discussion of monetary and fiscal policy and exchange rate systems. The impact of Mundell's ideas was enhanced by the simplicity and clarity of his exposition, whether in algebraic or geometric form. A sojourn at the research department of the International Monetary Fund, 1961-1963, apparently stimulated Mundell's choice of research problems; it also gave his research additional leverage among economic policymakers.

This survey begins by describing Robert Mundell's most important contributions: his analysis of stabilization policy in an open economy and his development of the theory of optimum currency areas. After a brief account of some of his work in other fields, it is asked how well Mundell's research – several decades later – stands up to contemporary scrutiny.

1. Stabilization Policy

In a series of papers published in the early 1960s – reprinted in his book *International Economics* (1968) – Robert Mundell developed his analysis of monetary and fiscal policy in open economies.

a. The Mundell-Fleming Model

In a pioneering article on the short-run effects of stabilization policy, Mundell (1963a) addresses the short-run effects of monetary and fiscal policy in an open economy. Mundell extended the so-called IS-LM model for a closed economy, originally developed by the 1972 economics laureate John Hicks, by introducing foreign trade and capital movements. The model highlights the response of capital movements to interest differentials and the response of net exports to the relative prices of domestic and foreign goods – the real exchange rate. The analysis is deceivingly simple, with sharp and numerous conclusions. Mundell demonstrated that the effects of stabilization policy hinge on the international mobility of financial assets. In particular, he demonstrated that the policy effects depend crucially on the exchange rate regime: under a floating exchange rate, monetary policy becomes powerful and fiscal policy powerless, whereas the opposite is true when the exchange rate is fixed. To illustrate the model and its results, it is useful to consider a particular special case.

Perfect capital mobility

In the interesting special case with perfect capital mobility, Mundell's model for a small open economy is summarized by three equilibrium conditions:

$$Y = G + A(Y,\ r,\ e) \qquad (1)$$

$$D + R = L\,(Y,\ r) \qquad (2)$$

$$r\ =\ r^{*}. \qquad (3)$$

According to equation (1), national income Y is given by aggregate demand, the sum of public expenditures G and private demand A. Private demand, in turn, depends (positively) on national income and (negatively) on the domestic interest rate r. As prices are assumed to be sticky in the short run, the exchange rate e determines the relative price between domestic and foreign goods; hence private

demand also depends – through net exports – (positively) on *e*. The left-hand side of equation (2) defines the supply of money (the money stock) as $D + R$, the sum of the central bank's holdings of domestic government bonds *D* and foreign securities (foreign exchange reserves) *R*. In equilibrium, the money supply corresponds to the private demand for money *L*, which depends (positively) on national income and (negatively) on the interest rate. Under perfect capital mobility, domestic and foreign financial assets are perfect substitutes. According to (3), arbitrage on the market for financial assets will then bring about parity between the domestic interest rate r and the foreign interest rate r^* (given static expectations about the exchange rate). If the domestic interest rate falls below (rises above) the foreign rate, an incipient outflow (inflow) of capital equates the two rates.

The stabilization policy instruments *G* (fiscal policy) and *D* (monetary policy) are exogenous variables controlled by the government and the central bank. Finally, the relation between the exchange rate e and the currency reserve *R* depends on the type of exchange rate regime.

Fixed exchange rates

Under a *fixed exchange rate*, the central bank defends a certain, given level of the exchange rate. At this level, the central bank must satisfy the public's demand for foreign currency by intervening in the foreign exchange market, which leads to shifts in its reserves. Formally, e is thus given exogenously, whereas *R* becomes endogenous under a fixed exchange rate.

Expansive fiscal policy measures – such as increasing public expenditures *G* – raise the level of domestic activity and national income without being impeded by crowding out in the form of rising interest rates and a stronger exchange rate. Formally, national income *Y* is determined directly by equation (1), since r is given by the world market and e by the exchange-rate commitment. This means that the money supply in the economy adjusts to changes in the demand for domestic liquidity as the central bank intervenes in the foreign-exchange market, by varying *R*, so as to stabilize the exchange rate. Formally, *R* is determined recursively by equation (2), for a given *D*.

Monetary policy measures – variations in *D* by means of so-called open market operations, i.e., sales or purchases of government bills or bonds – now turn out to be futile. The exchange rate cannot be kept stable at a given interest rate unless neutralizing interventions are undertaken on the currency market. An expansive monetary policy (higher *D*), for example, tends to reduce the domestic interest

rate. But this immediately generates an outflow of capital, expanding the demand for foreign currency; when the central bank provides this foreign currency, it reduces domestic liquidity. In this way, changes in *D* are entirely offset by counteracting changes in *R*. As in the case of other financial-market disturbances, monetary policy does not affect the total supply of money, but only the composition of the central bank's assets.

Floating exchange rates

A floating exchange rate, on the other hand, is determined by the market: the central bank refrains from currency interventions and maintains currency reserves at a given level. Formally, *R* is thus an exogenous constant, whereas *e* becomes endogenous in the model. Monetary policy now becomes a powerful tool. An expansive monetary policy now raises economic activity because tendencies towards an outflow of capital and lower interest rates now weaken the exchange rate, which in turn encourages net exports. Formally, national income *Y* is determined recursively by equation (2), whereas equation (1) pins down the exchange rate *e*.

Fiscal policy becomes powerless, however. Its effect on demand, when monetary policy is unchanged (no change in the value of *D*), is wholly offset by counteracting changes in the net-export component of private demand *A*, in response to capital flows and exchange rate changes. As in the case of disturbances in private demand, changes in *G* only affect the composition of aggregate demand.

Analytical foresight

Floating exchange rates and high capital mobility accurately describe today's monetary regime in many countries. But in the early 1960s, when Mundell published his contributions, an analysis of their consequences must have seemed like an academic curiosity. Since the late 1940s, almost all countries had been linked together in a global system of fixed exchange rates, as a result of the so-called Bretton-Woods Agreement. Furthermore, international capital movements were highly curtailed, largely by extensive capital and foreign-exchange controls. During the 1950s, however, Mundell's own country – Canada – had begun to ease these restrictions and allowed its currency to float against the US dollar. His far-sighted analysis became increasingly relevant over the next ten years, as

international capital markets opened up in the course of the 1960s and the Bretton Woods System broke down in the early 1970s.

Extensions

Mundell also considered other versions of the model. For instance, when capital mobility is less than perfect, the arbitrage relation in (3) above is replaced by a capital-flow equation; now, the powerless policy instruments regain some of their effects on economic activity. In the case of two large economies, the world interest rate is not given, but determined in world financial markets; policy then has international spillover effects, the directions of which depend on the policy instrument and the exchange rate regime.

The Fleming connection

Marcus Fleming (who died in 1976) was Deputy Director of the research department of the International Monetary Fund for many years; he was already a member of this department during the period of Mundell's affiliation. At approximately the same time as Mundell, Fleming (1962) presented similar research on stabilization policy in open economies. As a result, today's textbooks refer to the Mundell-Fleming model. In terms of depth, range and analytical power, however, Mundell's contribution predominates.

b. Monetary Dynamics

In contrast to the dominant research tradition in this period, Mundell did not stop at the short-run effects of stabilization policy. Monetary dynamics is the key theme in a number of significant articles. Several of these articles are reprinted in the aforementioned book *International Economics* (1968); a few others are gathered in a second volume entitled *Monetary Theory* (1971).

The principle of effective market classification

Mundell emphasized differences in the speed of adjustment on different markets: the principle of effective market classification. Later on, such differences were highlighted by his own students and others – for instance, Rudiger Dornbusch

(1976) and Pentti Kouri (1976) – to show how the exchange rate can temporarily "overshoot" in the wake of certain disturbances. This principle is a common theme in many of Mundell's writings.

International adjustments and the balance of payments

An important problem in Mundell's work concerned the adjustment of the economy to imbalances in the balance of payments. In the postwar period, research on these imbalances had accentuated the effects of relative prices on the *flows* in foreign trade. Moreover, it had been based on *static*, *real* economic models. Inspired by David Humes's classic mechanism for international price adjustment (the *gold-specie flow*) which focused on *monetary* factors and *stock* variables, Mundell instead formulated *dynamic* models to describe how prolonged imbalances could arise and be eliminated.

In several contributions, Mundell (1960, 1968) demonstrated how, under fixed exchange rates, an economy will gradually adjust over time as surpluses and deficits in the balance of payments generate changes in the money stock. With sluggish capital movements, for example, an expansive monetary policy will reduce interest rates and raise domestic expenditures. The subsequent balance of payments deficit will generate monetary outflows, which in turn lower domestic demand, thereby pushing the balance of payments back towards equilibrium. Over time, the price level will also adjust and the real economic effects of monetary policy will disappear.

This work on monetary dynamics was extended by Mundell's own students and by other researchers. The approach became known as the *monetary approach to the balance of payments*; important contributions are collected in Frenkel and Johnson (1976). For a long time, the monetary approach was regarded as a kind of long-run benchmark for analyzing stabilization policy in open economies. The insights from this analysis have frequently been adopted in practical economic policymaking – particularly by IMF economists.

Under floating exchange rates, tendencies towards payments imbalances instead trigger changes in the exchange rate, but the adjustment of the economy over time is governed by the same forces. Once again, Mundell's contributions paved the way for a new literature: the monetary approach to exchange rates. A number of papers on this topic are included in a special issue of the *Scandinavian Journal of Economics* (1976).

Assigning policy instruments to targets

Mundell's analysis of monetary dynamics focused on another aspect that contrasted sharply with the prevailing theory of stabilization policy. This theory, which had been formulated by Jan Tinbergen and James Meade (economics laureates in 1969 and 1977, respectively), referred to a world where all economic policies in a country are determined simultaneously and coordinated by the same hand.

By contrast, Mundell (1962) used a simple dynamic model to examine how each of two instruments, the national budget and the interest rate, should be directed towards either of two targets, external and internal balance, in order for the economy to converge towards these objectives over time. This implies that each of two different authorities – the government and the central bank – is given decentralized responsibility for its own stabilization policy instrument. Mundell's conclusion was simple and straightforward. To prevent the economy from becoming dynamically unstable, responsibility should be assigned in accordance with the relative effects of the two instruments on the relevant markets; i.e., assignment should be guided by the principle of effective market classification. In Mundell's specific fixed-exchange rate model, monetary policy should be assigned to equilibrium in the balance of payments (external balance) and fiscal policy control of aggregate demand (internal balance).

Mundell's analysis emphasized the link between targets and instruments, rather than the rationale for decentralization itself. But by explaining the conditions for decentralization, he anticipated the idea which, long afterwards, has become generally accepted, namely that the central bank should be given decentralized responsibility for price stability.

Influence on research

Mundell's dynamic models were highly stylized and his analyses frequently relied on simple phase diagrams. For many reasons, his contributions nevertheless proved to be a watershed for research in international macroeconomics. He introduced a meaningful dynamic approach, by making an unambiguous distinction between stock and flow variables, and by clearly describing the stock-flow interaction during an economy's dynamic adjustment to a stable long-run equilibrium. Mundell's research also initiated the necessary rapprochement between Keynesian short-run analysis, where prices are assumed to be rigid, and classical long-run analysis, where prices are assumed to be flexible. Subsequent research has continued to build on this intellectual heritage. Nowadays, analytical

work in international macroeconomics conventionally relies on dynamic models, which incorporate better microeconomic foundations, additional types of financial assets, and richer models of the dynamic adjustment of prices and the current account.

The incompatible trinity

The short-run and long-run analyses carried out by Mundell arrive at the same fundamental restrictions for monetary policy. With (i) *free capital mobility*, monetary policy can be oriented towards an (ii) *external target* – such as controlling the exchange rate – or (ii) a *domestic target* – such as controlling the price level – but not both at the same time. This so-called incompatible trinity has become self-evident for academic economists; today, this insight is also shared by the majority of participants in the practical debate on stabilization policy.

2. Optimum Currency Areas

As indicated above, fixed exchange rates within the framework of the Bretton-Woods system predominated the world economy in the early 1960s. At the time, a few researchers did in fact address the advantages and disadvantages of fixed vs. floating exchange rates, even though this was regarded as rather academic subject matter. A national currency, however, was considered an axiom. In his article on optimum currency areas, Mundell (1961) radically reformulated the problem of different exchange rate systems, by posing a new and fundamental question. Under what circumstances is it advantageous for a number of regions to relinquish their monetary sovereignty in favor of a common currency?

Labor mobility

In effect, Mundell merely notes the advantages of a common currency: lower transaction costs in trade and less uncertainty about relative prices. The disadvantages are described in a more elaborate way. He emphasizes the difficulty of maintaining full employment when changes in demand or other "asymmetric shocks" require a reduction in real wages in a particular region. Mundell stressed the importance of high labor mobility to offset such disturbances. Indeed, he characterized an optimum currency area as a set of regions among which the

propensity to migrate is high enough to ensure full employment when one of the regions faces an asymmetric shock.

Later work

Other researchers, such as Ronald McKinnon (1963) and Peter Kenen (1969), developed Mundell's approach by identifying additional criteria for optimum currency areas: capital mobility, regional specialization and a common tax-transfer system. The way Mundell formulated the problem has continued to influence generations of economists.

Increasing relevance

Over the years, inquiries into what constitutes an optimum currency area have continued to gain relevance in practical economic policymaking. Due to increasingly higher capital mobility in the world economy, regimes with a temporarily fixed, but adjustable, exchange rate have become more fragile; such regimes are also being called into question. Many observers view a currency union or a floating exchange rate – the two cases Mundell's article dealt with – as the most realistic alternatives. Needless to say, Mundell's problem and analysis have also attracted attention in connection with plans to introduce a common European currency. Researchers who have examined the economic advantages and disadvantages of EMU have adopted his approach as an obvious starting point. Indeed, one of the key issues in this context is labor mobility in response to asymmetric shocks.

3. Other Contributions

The Mundell-Tobin effect

Mundell has made other renowned contributions to macroeconomic theory. He has shown that higher inflation can induce investors to lower their cash balances in favor of increased real capital formation; see Mundell (1963b). As a result, even expected inflation has real economic effects. A similar argument was introduced by 1981 economics laureate James Tobin (1965). Accordingly, this effect of inflation has been labeled the Mundell-Tobin effect.

Mobility of goods and factors

Mundell has also made significant and lasting contributions to the theory of international trade. He has shown how international mobility of labor and capital tends to equalize the prices of goods among countries, even if foreign trade is limited by trade barriers; see Mundell (1957). This result can be seen as the mirror image of the well-known Heckscher-Ohlin-Samuelson result that free trade of goods tends to bring about equalization of factor rewards among countries, even if international capital mobility and migration is restricted. Free international factor mobility is a perfect substitute for free trade in commodities, in the sense that global production and consumption will be the same in both cases. The

prediction from these results is obvious. Trade barriers stimulate international mobility of labor and capital, whereas restrictions on the international mobility of these factors stimulate trade in goods.

4. Mundell's Contributions in Retrospect

In retrospect, Mundell's theory of stabilization policy undoubtedly has its limitations. The original Mundell-Fleming model, as in all macroeconomic research at the time, made highly simplified assumptions about the importance of expectations in financial markets; it also assumed complete price rigidity in the short run. These limitations have been addressed. Dornbusch (1976) for example, showed that gradual price adjustment and rational expectations can be incorporated into the analysis without significantly changing the results.

Neither Mundell's short-run analysis nor his dynamic models are derived from rigorous microeconomic foundations. They disregard, for instance, the intertemporal aspect of firms' and households' decisions. This is a drawback particularly in fiscal policy analysis, where it precludes adequate analyses of the effects of budget deficits – which sometimes weaken rather than strengthen the exchange rate (contrary to the predictions of the Mundell-Fleming model).

Later research has addressed these shortcomings as well. In a recent and noteworthy monograph, Obstfeld and Rogoff (1996) demonstrate how models with better microeconomic foundations and rational expectations can be used to study the effects of stabilization policy originally examined by Mundell; the authors are careful to point out the extent to which their results coincide with Mundell's. In its dynamic orientation, the "new open economy macroeconomics" is obviously influenced by the Mundellian tradition. New modeling techniques

have not really replaced the Mundell-Fleming model, however, which – in its modern incarnation – remains the workhorse for policy-oriented analysis.

As indicated above, Mundell's approach to the problem of optimum currency areas is still very influential, both among academics and policymakers. In addition to the approach, in general, his emphasis on labor mobility remains particularly relevant today.

5. Summary

Robert Mundell has established the foundation for the theory that still dominates in practical considerations of monetary and fiscal policy in open economies. His work on monetary dynamics and optimum currency areas has inspired generations of researchers. Although dating back several decades, Mundell's contributions remain outstanding and constitute the core of teaching in international macroeconomics.

Mundell's research has had such a far-reaching and lasting impact because it combines formal – but still accessible – analysis, intuitive interpretation, and results with immediate policy applications. Above all, Mundell chose his problems with uncommon – almost prophetic – accuracy in terms of anticipating the future development of international monetary arrangements and international capital markets. Mundell's contributions serve as an excellent illustration of the value of basic research. At a given point in time, academic achievements may seem rather esoteric; not long afterwards, however, they may take on great practical importance.

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