

A Review of Some of the Economic Contributions of
Robert A. Mundell, Winner of the 1999 Nobel Memorial Prize
in Economics¹

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Introduction

Robert Mundell richly deserves a Nobel Memorial Prize in Economics. His contributions to the field of international monetary economics were path breaking and have stood the test of time well. He chose his problems with great foresight and penetrating intuition, imagining economies with features like perfect capital mobility, floating exchange rates and supra-national currencies at a time when these assumptions would have seemed literally fantastic to most. His work remains extraordinarily influential among academics and policy-makers.

As with many great scientists, Mundell's contributions have been unevenly spread over his lifetime. From the late 1950s through the mid 1960s Mundell produced an astonishing crop of creative work that remains influential through the present day. Much of his most significant work was collected in his justly celebrated treatise *International Economics*, published in 1968. Three of Mundell's achievements are particularly worthy of note. He single-handedly invented the concept of an optimum currency area, perhaps

¹ This paper is a revision of an earlier paper which evaluated the economic contributions of Robert Mundell. I thank Rich Lyons and Janet Yellen for comments.

his crowning glory. Mundell's work on the international aspects of monetary policy is also worthy of special praise, most notably the Mundell-Fleming model. At a more abstract level, his dynamic analysis of international macroeconomic phenomena has had a profound impact.

Below, I review some of the highlights of Mundell's work. I have made no attempt to summarize the entire corpus of his thinking, and have organized my thoughts by topic, not chronologically.

Optimum Currency Areas

Analyzing the relative merits of different monetary regimes is an important and timeworn issue in international economics; it occupies center stage in much of Mundell's work. In the 1950s much of the intellectual debate revolved around Friedman's celebrated case for flexible exchange rates. Virtually all countries had fixed their currencies to the American dollar and thus gold, as part of the post-war Bretton Woods system. Thus, Friedman's persuasive arguments in favor of floating rates would, at the time, have seemed to be debating a quintessentially academic issue. Mundell deepens the argument by taking it to a higher level of abstraction. Instead of arguing either for or against floating rates, he asked: should countries even face this choice? If Friedman was correct in arguing that the United States should float, why shouldn't California float its own currency? For that matter, why not Berkeley California? Is money intrinsically national? When should countries have their own currencies? Until very recently, even asking this question would have seemed to be an absurd exercise, since the relationship

between national and monetary sovereignty is so tight.² It would have seemed almost bizarre at the time when Mundell first worked on the problem.

Years ahead of any real practical debate on monetary unions, Mundell (1961b) posed the question “What is an Optimum Currency Area?” Perhaps more importantly, his answer has remained largely intact. Even more striking is the fact that the model used to frame the debate in both academic and policy circles remains essentially Mundell’s original intellectual framework. The concept of an optimum currency area (OCA) is one of Mundell’s greatest triumphs.

Mundell analyzes an optimum currency area in an environment with four potential imperfections: rigid prices, currency-specific transactions costs, idiosyncratic regional shocks, and labor immobility. There are advantages to large currency areas, including reduced transactions costs, and the reduced vulnerability of countries to real exchange rate shocks (e.g., those caused by speculative bubbles or protectionism). There are also disadvantages, principally foregoing counter-cyclic regional monetary policy. He finds the optimum currency area to be the “region”, the area within which labor is mobile so that migration ensures full employment. No matter what their views on the desirability of a particular currency union, most economists today use Mundell’s framework to frame the question.

Most subsequent academic analysis of optimum currency areas is merely refinement of Mundell’s original insight. For instance, Mundell ignores cross-border risk sharing. This can be accomplished either by the government (e.g., via a federal system of fiscal taxes and transfers) or through private asset markets. Mundell’s assumption of

² Indeed, the fact that currencies are largely a statement of political sovereignty is explicitly recognized in Mundell’s work.

incomplete risk sharing is perhaps arguable today, but not absurd; there is massive evidence of a “home-market” bias in asset markets that is only eroding slowly.³ There have also been a number of refinements or extensions of Mundell’s idea. McKinnon (1963) argued that domestic prices would, in fact, move quickly for small open economies after exchange rate changes, so that real and nominal exchange rate movements would diverge quickly. Kenen (1969) adds the effects of induced regional specialization; there have been a host of other extensions. Still, these are most appropriately viewed as refinements, not alternative theoretical vehicles. Indeed, one of the striking things about this literature has been the relatively minor nature of the changes to the basic conceptual framework. The contrast with other areas of economics is noticeable.

Mundell’s model is also the dominant paradigm in policy circles. For instance, most discussions of Economic and Monetary Union in Europe (EMU) are posed within Mundell’s frameworks. Not *all* work on EMU is posed within this framework. For instance, a popular argument for a common currency is that the latter may be preferable if it is associated with enhanced credibility and therefore lower inflation. There may be more diffuse political benefits as well, which are usually not articulated clearly. Economists who view EMU negatively tend to think that any political gains are offset by net economic disadvantages. Still, the point is that the vast majority of the analysis uses the OCA paradigm. No serious analysis on currency unions ignores the idea.

There is no doubt that this is a path-breaking work. There is also no doubt that Mundell deserves full credit for it; Mundell developed the concept alone. He used it

³ Mundell subsequently added another element to the debate with his (1973) paper showing how risk sharing would be affected by different monetary regimes.

immediately with great foresight to clarify thinking on monetary union in Europe, an issue that remains topical some thirty-five years later. The paper itself is a model of clarity. It is also remarkably short for such a powerful idea, and is a nine-page *AER* “communication” (now it would a “shorter paper”) rather than a full-fledged article.⁴

Monetary Dynamics and Mundell’s “Incompatible Trinity”

One of the enduring themes of Mundell’s work has been the importance of monetary dynamics. Indeed, the introduction of dynamic elements is a key reason why his contribution is such a giant step beyond earlier work such as Meade’s (1951) treatise *The Balance of Payments*, which had focused on static real models.

How are external payments imbalances equilibrated? Before Mundell, the primary dynamic mechanism of relevance was the “specie-flow” mechanism, first articulated by Hume some two hundred years earlier. This mechanism was the inflation-inducing international flow of reserves believed to induce the economy automatically to attain steady state external payments equilibrium. Unfortunately, the persisting post-war payments imbalances seemed to be at odds with this machinery. In his (1961a) paper, Mundell showed how the widespread sterilization of reserve flows could be expected to disrupt international adjustment. Sterilization consists of offsetting losses of international reserves with an equivalent expansion of domestic credit, so that any effect of reserve changes on the money supply is neutralized or “sterilized.” The practice was, and remains, ubiquitous.

⁴ Interestingly, it is not even the lead communication. The editors may perhaps be forgiven for its placement, since the lead communication is the well known “The Golden Rule of Accumulation: A Fable for Growthmen” by Mundell’s Columbia colleague Edmund Phelps. It was a good issue for short papers!

Mundell's work started from the observation that international payments imbalances are, by definition, associated with changing stocks of wealth. He then determined the conditions under which the dynamics lead the economy towards the steady state, and compared these circumstances to the classic conditions specified by Hume. Mundell focused on an economy with rigid prices (in contrast to Hume), and found that sterilization could disrupt the automatic adjustment process despite an "income specie-flow" mechanism, analogous to Hume's "price specie-flow" link. Mundell also argued that sterilization could only have a temporary effect, given the finite stocks of central bank credit and reserves. Ever since, the transient effects of sterilization policy have been taken for granted. More importantly, researchers have used Mundell's modeling strategy, which employs dynamic techniques to determine the conditions under which the economy converges to a steady state with classical properties (monetary neutrality in this case). The dynamics are clear but *ad hoc*; a modern exposition would include maximization, Euler equations and laws of motion where Mundell provides derivatives and phase diagrams. But the intuition is similar. And the strategy was sufficiently general to be later developed by Mundell's colleagues and students into the monetary approach to the balance of payments and its brother the monetary approach to the exchange rate (Frenkel and Johnson (1976), Dornbusch (1976), Mussa (1976)).

A different but equally important use of these dynamic principles was Mundell's solution to the "assignment problem." In a dynamic world, it was no longer sufficient to merely count policy targets and instruments as in earlier work by Tinbergen and Meade. In the context of a Keynesian model with imperfect capital mobility, Mundell (1962) showed that a policy-maker with two instruments (monetary and fiscal policy) in a fixed

exchange rate regime can hit two targets (internal and external balance), but only with an appropriate “policy mix”. The economy would dynamically converge only under the assignment of fiscal policy to internal equilibrium, and monetary policy to external equilibrium. This orientation of monetary policy towards the external side of the economy has since developed into one of the most robust features of open economy macroeconomics. It is also a manifestation of Mundell’s (1960) general “principle of effective market classification,” which states that a system works best if variables respond to the markets on which they exert the most direct influence.

Perhaps the most striking result of Mundell’s work on monetary dynamics is his “Incompatible Trinity” (a result intimately related to the Mundell-Fleming model, which is discussed further below). Mundell was the first to exposit the intrinsic incompatibility of a) perfect capital mobility, b) fixed exchange rates, and c) domestic monetary autonomy. A narrow interpretation of this result would be to conclude that external and internal targets would be in conflict – the economy will not stably converge to its long-run equilibrium – unless *external* policy is assigned to the *monetary* authority. But a broader interpretation of this result is appropriate, since Mundell’s principle explicitly delineates the tradeoffs facing central banks in the most sweeping sense. In the presence of mobile capital, monetary policy can either be oriented towards an external goal (such as exchange rate stability) or an internal objective, *but not both*. The result now stands as one of the undisputed foundations of international monetary analysis. Academics take it for granted. Policy-makers ignore it at their peril.

The Mundell-Fleming Model

Mundell (1963a) and Marcus Fleming (1962) both deserve credit for extending the Keynesian “neoclassical synthesis” model of business cycles to an environment with international trade and capital mobility.⁵ The “Mundell-Fleming” model was aptly described a decade ago by Frenkel and Razin (1987) as “the workhorse of traditional open-economy macroeconomics.” It remains so today.

The model is a simple generalization of a closed-economy IS-LM model for a small open economy with perfect capital mobility. This model was developed in the 1930s by John Hicks (1937) in a purely domestic context. It is a model taught in all principles courses, and consists simply of conditions for asset and goods market equilibrium. As such, it is easy to dismiss the model as outdated in the extreme. Domestic and foreign assets are modeled as perfect substitutes. Prices are simply assumed to be rigid; the supply side of the model is left unspecified. There is no explicit optimization and a near-total absence of micro-foundations. Further, the model is wholly static; for instance, wealth and capital accumulation are ignored. All expectations are assumed to be static. Thus, all issues associated with regime credibility are swept away, Ricardian equivalence is assumed irrelevant, and domestic and foreign interest rates must be equal.

These are the sorts of assumptions that make most modern economists extremely uncomfortable, except perhaps in front of a class of sophomores. The model is precisely as *ad hoc* as macroeconomic models of its vintage. This style of formalization has not stood the test of time well.

⁵ Fleming’s independent paper predates Mundell’s paper. It is somewhat less clearly written than Mundell’s paper and treats perfect capital mobility as a limiting case rather than the focus of the paper.

That said, the Mundell-Fleming model has been invaluable. It still serves as the default model for most policy-makers. Further, the predictions of the model are so striking and intuitive that they continue to represent the benchmark against which the predictions of newer models are tested. Any significant deviation of a model's predictions from those of Mundell-Fleming is still examined carefully and suspiciously today.

The conclusions of the model are many, strong and arresting. The money supply is endogenous when the exchange rate is fixed. Attempts to pursue independent monetary policy carry the seeds of their own destruction, since the central bank is committed to fixing the exchange rate (consistent with the "Incompatible Trinity" discussed above). Any attempt to increase domestic credit and the money supply would lower interest rates, leading to a loss in reserves. The resulting shrinkage of the money supply leads the economy back to its initial equilibrium; the only permanent change is in the balance sheet of the central bank. Quite the reverse is true when one considers the real side of the economy. Shocks there are extraordinarily potent and have standard "Keynesian Cross" multipliers. There is no "crowding out" since interest rates are fixed by international capital flows.

By way of contrast, when the exchange rate is floating, fiscal policy is ineffective in changing the level of economic activity. Debt-financed expansionary fiscal policy would raise interest rates, attract foreign capital, and lead to both a nominal and real appreciation of the currency. This in turn would lead to a deterioration of the trade balance, offsetting the initial fiscal stimulus. Thus there is pure crowding out; real disturbances change only the composition of output, not its level. Instead, real shocks

(including commercial policy and exogenous trade shocks as in the “Dutch Disease”), affect only the level of the real exchange rate and the trade balance. Monetary policy, by contrast has a potent real effect, at least while prices remain fixed. The central bank regains the ability to pursue domestic monetary policy by relinquishing control of the exchange rate, which becomes endogenous. A monetary expansion implies lower interest rates that lead to a capital outflow, resulting in a depreciation. This improvement in domestic competitiveness leads to an improvement in the balance of trade and higher output.

The model also allows one insight into the relative merits of alternative exchange rate regimes. Optimal stabilization of the economy dictates that the exchange rate regime should depend on the sources of the shocks. A country which faces mostly monetary shocks should thus fix its exchange rate. And sterilization policy is ineffective under all exchange rate regimes.

As noted above, taking floating exchange rates seriously would have seemed a matter of only academic (i.e., trivial) interest when the work was done in the early 1960s. The same could be said of capital mobility in an era when virtually all OECD countries (and all developing countries) placed severe restrictions on the ability to trade assets or foreign exchange freely across international borders. In this context, Mundell took full advantage of some of the many advantages to being Canadian. Canada had removed all exchange and capital controls in 1951, the first country to give up the “transition period” excuse after controls were imposed during WWII. The Canadian dollar had also floated with minimal intervention since 1950. The mostly happy experience with floating deteriorated when tight monetary policy was maintained through the 1958-1960

recession. High Canadian interest rates resulted in high unemployment (which the central bank insisted was “structural”), an appreciated currency and a current account deficit. James Coyne, the governor of the Bank of Canada, was forced to resign in 1961, to the general applause of Canadian academic economists. The subsequent fixing of the exchange rate combined with a fiscal expansion resulted in steady growth for the remainder of the 1960s. A little knowledge of the Mundell-Fleming model might have saved Coyne his job (not to mention those of many Canadians)! Since then, this sequence of events has occurred in a number of different countries, though it is typically the finance minister that resigns after a fixed exchange rate has been abandoned for a float. To ignore the basic tenets of the model can be hazardous for one’s career.

How Has the Work Fared?

Mundell’s original paper (1963a) has a number of obvious shortcomings (which it shares with Fleming’s work). Capital mobility is perfect, implying that assets denominated in different currencies are perfect substitutes. It is a static model without forward-looking behavior. Current account and wealth dynamics are ignored, as are any dynamics associated with fiscal imbalances. Thus, the model displays striking – and implausibly strong – short-run non-neutralities without clear dynamics linking the business cycle frequency to a long-run equilibrium. Perhaps most importantly, the absence of micro-foundations, especially vis-a-vis aggregate supply, makes welfare analysis difficult.

Many of these issues have since been cleared up. Mundell himself dealt with imperfect capital mobility in a celebrated analysis where two large economies interact to

determine the interest rate, rather than taking it as given (as in Mundell-Fleming). In this case, expansionary policy (notably monetary policy) from one country can have a “beggar thy neighbor” effect. This is possible since domestic expansion comes at the expense of the foreign trade balance; one country’s gain comes at the expense of its partners. This provocative result has generated a continuing debate in the literature (e.g., Obstfeld and Rogoff (1995, 1996)).

Dornbusch’s celebrated (1976) article on exchange rate overshooting is an insightful generalization of the Mundell-Fleming model to a world with forward-looking agents equipped with rational expectations. Dornbusch’s model incorporates sluggish price adjustment and the resulting dynamics. This in turn requires a more sophisticated treatment of expectations than Mundell’s assumption of static expectations. But the essence of the model is the Mundell-Fleming model (as seen in Dornbusch’s referral to “long-run Mundell-Fleming equilibrium”). Indeed, Dornbusch’s exposition of his (1976) overshooting model explicitly emphasizes the results that are common to both his forward-looking model and Mundell’s static analysis.

Obstfeld and Rogoff (1995, 1996) add the relevant micro-foundations in a general equilibrium model of two large countries. Their supply side relies on monopolistically competitive firms producing differentiated goods. Capital flows are restricted to a single real bond. Individuals have preferences that depend on consumption, leisure and money services. Prices are predetermined temporarily. Setting this all up requires considerable effort, but does allow them to do rigorous welfare economics. Still, many of their results are quite similar to those of Mundell. For instance, monetary policy can lead to reductions in foreign output as in the Mundell-Fleming model. Obstfeld and Rogoff

characterize this as empirically sensible but misleading in terms of its welfare implications, since their model allows one to show rigorously that the negative real exchange rate effects are diluted by other effects.

While that the Obstfeld-Rogoff work has been very well received, it is probably fair to say that it has not yet displaced the Mundell-Fleming model for the majority of the profession. In any case, it is interesting that Obstfeld and Rogoff are at pains to show how little their work diverges from the predictions of Mundell and Fleming. On the more peripheral issues such as the international transmission of monetary policy, there are occasional divergences. However, differences are rare for the core predictions of the model, such as the Incompatible Trinity or the inefficacy of sterilization policy.

Chari, Kehoe and McGratten (1996) pursue the same topic with calibration methods and complete markets; Kollmann (1996) uses a model with incomplete asset markets; and many other researchers are also involved in the area (e.g., Corsetti and Pesenti (1997); Lane (1999) provides a recent survey). But even young and vigorous researchers are at pains to demonstrate the relatively small differences between their results and those of the “classic Mundell-Fleming-Dornbusch model [which] appears remarkably vital in the policy literature” (in the words of Corsetti and Pesenti). The core of most such efforts remains the Mundell-Fleming model; the newer models are, to some extent, more aesthetically pleasing to economists steeped in modern technique. The small industry of researchers that attempts to derive results and welfare consequences from more rigorous foundations so as to be able to understand and dispute the intuition provided by the Mundell-Fleming model is a great compliment to the creators of the latter.

Consider the classic experiment of an economy with mobile capital and a floating exchange rate, which engages in a monetary expansion. In the Mundell-Fleming setup, the shock unambiguously expands output and hence consumption. Since leisure is ignored and there are no wealth effects (other than monetary changes), the shock expands welfare. Modern researchers are at pains to include the dis-utility of work, the wealth effects of exchange rate changes, and current account dynamics. Using models with imperfect substitutes produced by monopolistic competitors, modern researchers find that monetary expansions have ambiguous effects on economic welfare. Output is coordinated at a higher level of economic activity, reducing monopolistic distortions and raising welfare. But the terms of trade depreciate, reducing welfare. Obstfeld and Rogoff show that small expansionary monetary shocks have qualitatively similar effects on national welfare through their impact on global consumption, no matter where they originate. Conversely without price discrimination, foreign monetary expansion unambiguously raises welfare. Still, the Mundell-Fleming model, where monetary expansion can be a beggar-thy-neighbor policy because domestic expansion displaces foreign aggregate demand, remains the benchmark.

From an empirical perspective, many aspects of the Mundell-Fleming model work poorly, especially in the key area of exchange rate determination. This has been known since at least Meese-Rogoff (1983); I survey this area with Frankel in Frankel and Rose (1995). This is not to say that there is a better alternative. The model is a short-run model; *no* known model predicts exchange rates out-of-sample better than a random walk model, at least for low-inflation OECD exchange rates. This of course has not stopped the use of the model in the simulation of large-scale econometric and simulation models.

Work in this vein is ongoing at institutions such as the Federal Reserve Board, DRI and Brookings.

Other Contributions

Mundell-Tobin Effect

If consumption depends on wealth, then monetary phenomena have an effect on the real economy. Mundell (1963b) argued that inflation could lower the real interest rate permanently as wealth holders rebalance portfolios away from money and reduce consumption. This point was independently made by Tobin (1965) and has come to be known as the “Mundell-Tobin” effect. This well-known non-neutrality demonstrates the breadth of Mundell’s thinking. More generally, it illustrates Mundell’s re-orientation of the profession away from a simple focus on flow equilibrium and towards explicit consideration of stocks and the dynamics that issue from wealth changes.

Interpretation of Factor Price Equalization

Samuelson’s Factor Price Equalization theorem had initially been received as a surprising and counter-intuitive result. In his (1957) paper, Mundell presented an alternative interpretation of the theorem, which is now considered folk-wisdom. The argument is that trade in goods and factor mobility are substitutes for each other. Mobility of factors results in a tendency towards equalization of tradable goods prices even without international trade. Alternatively, barriers to trade in factors stimulate trade in goods, and *vice versa*.

Citations

Mundell continues to earn a good number of citations annually. The table below lists his annual citations in the *SSCI* for the last seven years. Since Mundell's work is sufficiently well known as not to require citation, the actual count grossly underestimates his actual influence. Thus for comparison, I also include citation counts for three previous Nobel laureates whose work is related to Mundell's.

	1998	1997	1996	1995	1994	1993	1992
Mundell	50	41	45	49	42	38	46
Meade	32	38	43	50	51	56	50
Ohlin	42	8	19	13	15	6	12
Tinbergen	41	46	45	60	50	41	48

Taken from the *Social Science Citation Index* CD-ROM.

Summary

Mundell broke new ground with his paper on optimum currency areas and his series on the effects of capital mobility. His work on monetary dynamics in models with classical steady state properties was path-breaking. It characterizes much of the work of his best students, including Dornbusch, Mussa and Frenkel. Indeed, the work and influence of his students – and his students' students – is part of Mundell's legacy. Mundell's emphasis on stripped-down models, which simply convey the essence of interesting problems, has also been enduring. Dornbusch (1980, p.4) describes Mundell as having created "the Volkswagens of the field – easy to drive, reliable, and sleek."

However, Mundell's most important contributions have not, in a narrow sense, been methodological. However insightful his modeling strategy has been, he is appropriately best known for his models and their results, rather than his techniques. His intuition has rarely been overturned, and his research program was prescient in the extreme. He is a classic "academic scribbler" whose innovative ideas hit the profession like a tidal wave, and gradually encroached upon the wider world within his own lifetime.

It is both fitting and appropriate to honor Robert Mundell with a Nobel Memorial Prize in Economics.

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