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Chapter Title: On the Evolution of U.S. Foreign-Exchange-Market Intervention: Thesis, Theory, and Institutions

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On the Evolution of US Foreign-Exchange-Market Intervention

Thesis, Theory, and Institutions

1.1 Introduction

Today, most of the advanced economies—Australia, Canada, Japan, the euro area, Sweden, the United Kingdom, and the United States—allow market forces to determine their exchange rates. Policymakers in these economies understand that if they want to focus their monetary policies on independently determined domestic objectives—low inflation and growth at potential—and to continue to enjoy the substantial benefit of free cross-border financial flows, they must allow their exchange rates to float.

Nevertheless, these same monetary authorities recognize that, from time to time, the normally smooth operation of foreign-exchange markets can become impaired, and they maintain the capacity to influence key nominal exchange rates. Usually, they do so through official purchases or sales of foreign exchange. The effectiveness, the limitations, and the costs of these policies, however, have been and remain the subject of debate. Over the last twenty years or so, reflecting the modern tenor of this debate, the monetary authorities in most of the large advanced economies have come to regard foreign-exchange-market intervention as a tool that they should deploy sparingly, if at all.

This has not always been the prevailing view. Throughout most of the twentieth century, monetary authorities considered exchange-rate stability an important, if not the sole, objective of monetary policy. Even after the adoption of generalized floating in 1973, policymakers hoped that foreign-exchange-market intervention offered a means of influencing exchange rates independent of their monetary policies. Traditional instruments of monetary policy, they believed, could focus on price stability or growth at poten-

tial, while intervention could influence the path of key exchange rates. This view was never constant, and it seldom went unchallenged.

This book explores the evolution of exchange-market policy—primarily foreign-exchange intervention—in the United States. It is fundamentally a study of institutional learning and adaptation as the monetary-policy regime changed following the collapse of the classical gold standard. As such, this study explains the economic developments, the political environment, and the bureaucratic issues that nurtured those changes. Although we reference many of the econometric studies of foreign-exchange-market intervention, ours is not a survey of the voluminous literature.[1] While we introduce some empirical analysis, ours is primarily a historical narrative.

We observe this evolutionary process primarily through the lens of Federal Reserve documents and a unique data set consisting of all official US foreign-exchange transactions executed through the foreign exchange desk at the Federal Reserve Bank of New York between 1961 and 1997. Although we discuss operations of the US Treasury, particularly as they dovetail with the Federal Reserve's policies, we lacked detailed documentation of Treasury attitudes about intervention. Hence the scope of our analysis is somewhat restricted to the Federal Reserve. We also refer to other advanced countries in our narrative, but again, we only consider them insofar as they relate to US policies. For the most part, we do not discuss how foreign governments formulated policies in an open economy.

This introductory chapter starts with an overview of the major theme of this book: Attitudes about foreign-exchange intervention and monetary policy have changed over the decades and have come to embrace a monetary policy focused on price stability, freely floating exchange rates, and global openness. It then discusses the economics of exchange-market intervention, offers a brief interpretation of existing empirical research, and provides an overview of the institutional arrangements for intervention in the United States. In subsequent chapters, our historical narrative explores all of the topics in much greater detail. The final section of this introduction offers a road map to the subsequent chapters.

1.2 Monetary-Policy Evolution and the Development of Foreign-Exchange-Market Intervention

The same evolutionary process that forged modern views about monetary policy has shaped contemporary attitudes about foreign-exchange-market intervention. Over the past century, monetary authorities have grappled with the basic problem of having more economic policy objectives than independent instruments with which to attain them. Standard monetary-policy tools, which alter bank reserves and interest rates, cannot continuously maintain fixed exchange rates and independent domestic policy objectives unless a monetary authority also restricts financial flows. This is the

well-known trilemma of international finance.[2] Modern foreign-exchange intervention resulted from attempts to find an additional instrument with which to affect exchange rates while allowing monetary authorities to set independent domestic inflation objectives without sacrificing the gains from unfettered cross-border financial flows. Intervention was an attempt to skirt the trilemma.

By the end of the twentieth century, monetary authorities saw a credible commitment to price stability as the key contribution that central banks can make in maintaining economic growth at potential—or along a full-employment path of output—and in fostering exchange-rate stability.[3] In this view, an activist intervention policy is worse than superfluous. To be effective monetary policy must be credible, and foreign-exchange intervention—even interventions that leave the money stock unaltered—can threaten that credibility. This is especially true for a central bank, like the Federal Reserve, that operates without a legislative mandate for price stability and is subservient in its intervention operations to fiscal authorities (Broaddus and Goodfriend 1996).

Intervention—the key focus of this book—refers to official purchases and sales of foreign exchange that monetary officials undertake to influence exchange rates. This definition describes intervention in terms of a type of transaction and a motive guiding that transaction. The distinction among various types of transactions is important because countries have many policy levers affecting the exchange value of their currencies. This broader set of operations constitutes exchange-rate policy, of which intervention is a subset, and it includes other things such as commercial policies, restraints of financial flows, or even monetary-policy actions targeted at exchange rates. An understanding of the motive for buying and selling foreign exchange is also a necessary component of the definition of intervention because governments often transact in foreign-exchange markets for purposes other than altering their exchange rates. Central banks sometimes buy or sell foreign exchange to manage the currency composition of their reserve portfolios or to undertake transactions for customers, such as their own fiscal authorities and other monetary authorities, or even to conduct domestically focused monetary policy. While these transactions may well affect exchange rates, this is not their purpose, and hence, they do not constitute intervention.[4]

Intervention, and exchange-rate policies more broadly, derive from a desire to limit exchange-rate variability—a policy objective that the classical gold standard most completely reached. Under the classical gold standard (1880–1914) countries did not maintain domestic monetary-policy objectives as such; they effectively focused on preserving fixed exchange rates. Countries set an official price of gold and promised to buy and sell unlimited quantities of gold to maintain that price. They also allowed individuals to freely import and export gold. Exchange-rate parities were derivatives of official gold prices and were contained within gold export and import points,

which the cost of arbitrage in gold determined. Forms of money other than gold coins, such as bank notes and national currencies, circulated but were ultimately convertible into gold. With these arrangements, the gold standard limited monetary authorities' abilities to undertake discretionary policy actions and anchored expectations about the long-run internal and external values of money. The classical gold standard solved the trilemma at the expense of domestic monetary-policy independence.

The gold standard, however, did not completely eliminate discretionary monetary-policy actions to protect the domestic economy and banking sector from disruptive gold flows.[5] The ideal view of quick and automatic gold-standard adjustment rests on a frictionless world, but real and financial frictions did exist and encouraged discretionary governmental actions.[6] Central banks, of course, could operate with some latitude within the gold points. They could, for example, alter the ratio of gold reserves to currency or change their discount rates. If, however, a substantial amount of gold flowed in or out of a country, pushing its exchange rate to one or the other gold point, central banks were generally expected to reinforce the domestic monetary effects of these gold flows through their discount-rate policies. Many monetary authorities did not conform to these so-called rules of the game. If the ratio of their gold reserves to currency remained sufficiently high, they could either not act at the gold point or attempt to offset the effects of gold flows on their monetary bases. Some countries resorted to gold devices—policies that effectively altered the gold points—such as artificial impediments to the export or import of gold. Some central banks even acquired foreign-exchange reserves and intervened both to smooth exchange-rate fluctuations and to keep exchange rates within the gold points. These operations at the gold points served to soften the trilemma's constraints. Still, maintaining the official gold price and fixed exchange rates with free cross-border financial flows was sacrosanct.

The classical gold standard collapsed at the onset of World War I, along with the view that monetary policy should focus on maintaining a fixed exchange rate to the near-complete exclusion of domestic-policy objectives. To be sure, the gold-exchange standard (1925–1931) remained a strong commitment to fixed exchange rates, but not one for which countries would long sacrifice internal economic conditions. When necessary, countries sterilized gold flows, devalued their currencies, and erected trade barriers and capital controls. Countries also intervened in foreign-currency markets. They were trying to escape the strictures of the trilemma.

The Great Depression saw the collapse of the gold-exchange standard as countries focused monetary policy on domestic objectives. Still, exchange-rate stability remained a desirable objective. The United Kingdom established the Exchange Equalisation Account (1932) and the United States followed with its own Exchange Stabilization Fund (1934). Both funds sought to promote exchange-rate stability through interventions in the gold

and foreign-exchange markets, while monetary and fiscal policies pursued macroeconomic objectives. The Tripartite Agreement of 1936 introduced a degree of international cooperation into attempts at exchange-rate management, which would persist thereafter. The funds and the agreement sought to offer policymakers an additional means to meet their expanding set of objectives.

The disconnection between discretionary monetary policy and adherence to rigidly fixed exchange rates, which grew as the classical gold standard collapsed, progressed through the Bretton Woods era. The Federal Reserve System—the dominant central bank under Bretton Woods—focused monetary policy almost exclusively on domestic economic objectives, notably full employment or growth at potential. Other countries bore the burden of intervening to defend their currencies. Constraints on financial flows often proliferated. By 1960, the fundamental weakness of the Bretton Woods system, which Triffin's paradox described, began to appear. The US Treasury's Exchange Stabilization Fund (ESF) and the Federal Reserve System adopted myriad stopgap mechanisms, notably temporary facilities offering cover for foreign central banks' dollar exposures and funding for deficit countries' interventions. These mechanisms lengthened the Bretton Woods system's tenure, but offered no solution to the trilemma. Bretton Woods collapsed because neither the Federal Reserve nor other central banks would indefinitely subvert domestic economic conditions to the rigors of maintaining fixed exchange rates. Generalized floating began in 1973.

Although Bretton Woods imposed few, if any, constraints on US monetary policy, the Federal Reserve failed to maintain price stability after 1965. By the late 1970s, inflation in the United States reached double-digit levels through a combination of bad economic theory, a blinkered focus on full employment, poor measurement, and at times political pressure. People no longer believed that the Federal Reserve would continue to accept the real output and employment costs of eliminating inflation. Inflation expectations became imbedded in economic decisions with adverse consequences for potential growth. The near crisis atmosphere that emerged in the late 1970s prompted a dramatic change in monetary policy under Chairman Paul Volcker. The Federal Reserve, thereafter, embarked on a long process of rebuilding its credibility. Monetary policy increasingly focused on an inflation objective, and the Federal Open Market Committee (FOMC) eventually accepted that low and stable inflation expectations were necessary for maintaining the economy's growth at potential.

A similar learning process occurred with respect to foreign-exchange operations after the collapse of Bretton Woods. Monetary authorities reluctantly accepted floating exchange rates, and, despite their desire for a greater degree of policy independence, they initially feared giving exchange rates free reign. Policymakers believed that foreign-exchange-market inefficiencies created unnecessary volatility and caused rates to deviate from fundamental values.

Intervention—particularly on the part of the United States—was necessary to provide guidance and to calm market disorder. Moreover, the early-on, predominant explanation for the effectiveness of sterilized intervention—the portfolio-balance channel—supported exchange-market activism by suggesting that intervention solved the instrument-versus-objectives problem. In this view, monetary policy could focus on domestic objectives, and intervention could manage exchange rates. Intervention offered a solution to the trilemma.

Views about exchange-market efficiency changed more slowly than attitudes about effectiveness of intervention. By the early 1980s, policymakers in the United States were questioning whether sterilized intervention did indeed provide a means of systematically affecting exchange rates independent of monetary policy. Reflecting this uncertainty, the United States, from 1981 through 1985, adopted a minimalist approach to exchange-market operations, but as the dollar dramatically appreciated under a mix of tight monetary and loose fiscal policies and seemed to overshoot a value consistent with fundamentals, pressure for intervention reemerged. The Plaza and Louvre Accords were attempts to reemphasize exchange rates as objectives of policy. Unfortunately, by then the now prevailing view of intervention—that it signaled future monetary-policy changes—left advocates of coordinated exchange-market operations short one policy instrument.

That intervention did not solve the trilemma was one thing; that it made the situation even worse was something altogether intolerable. In the late 1980s and early 1990s, as the FOMC worked to strengthen its policy credibility, the thrust of foreign-exchange intervention—now usually undertaken at the Treasury's behest—often conflicted with the motivation for monetary policy. The FOMC believed that such interventions created uncertainty about its commitment to price stability. Moreover, the committee feared that the related institutional connections between the US Treasury and the Federal Reserve—chiefly swap lines and warehousing privileges—also threatened the Federal Reserve's independence and, therefore, its credibility. These concerns—not questions about intervention's effectiveness—curtailed the operations. By the late 1990s, central banks in the advanced economies accepted that a commitment of price stability also removed uncertainty about monetary policy as a source of volatility in foreign-exchange markets. Most large developed economies ended their activist approach to intervention. The large developed economies solved the trilemma in favor of monetary policy independence, floating exchange rates, and free cross-border financial flows.

Nevertheless, the large developed economies have not completely forsaken foreign exchange-market intervention. While policymakers now generally view foreign-exchange markets as highly efficient, they still see the potential for occasional bouts of disorder. One might dismiss intervention as an

independent instrument with which to routinely—or frequently—manage exchange rates, but one cannot deny that intervention sometimes affects exchange rates.

1.3 Intervention as Distinct from Monetary Policy

Economists have offered two broad channels through which intervention, as distinct from monetary policy, might affect exchange rates. Each channel has different implications for what intervention might achieve and how it should be conducted. To understand these channels, one must first understand the important distinction between sterilized and nonsterilized intervention, since only the former could possibly give monetary authorities an additional instrument with which to pursue an exchange-rate objective independent of their monetary policy.

When a central bank buys or sells foreign exchange, it typically makes or accepts payment in domestic currency by crediting or debiting the reserve accounts of the appropriate commercial banks. Except for the instruments involved, the mechanics of the transactions are similar to those of an open-market operation, and like an open-market operation, foreign-exchange interventions have the potential to drain or add bank reserves.

Central banks in large developed economies typically offset, or sterilize, any unwanted impacts from their foreign-exchange interventions on bank reserves (see Lecourt and Raymond 2006; Neely 2001, 2007). They can do so through offsetting open-market operations. Any central bank that conducts its monetary policy through an interest-rate or reserve-aggregate target—as many usually do—will automatically offset all transactions, including foreign-exchange interventions, that threaten the attainment of its operating objective.

Sterilization prevents foreign-exchange transactions from interfering with the domestic objectives of monetary policy. The potential for conflict between the two depends on the nature of the underlying disturbance to the exchange market. In general, only if the underlying disturbance is domestic in origin and monetary in nature, will pursuing an exchange-rate objective through nonsterilized intervention *not* conflict with a central bank's inflation objective. A central bank, for example, whose currency appreciates in the face of a domestic deflation, can prevent both a deflation and a currency appreciation through faster money growth produced either by nonsterilized intervention or traditional monetary policy. If the underlying shock is either foreign or real in nature, a nonsterilized intervention will inevitably interfere with a central bank's inflation objective (Craig and Humpage 2003; Bordo and Schwartz 1989).[7]

Sterilization is also important in countries whose central banks are independent, but whose fiscal authorities maintain primary responsibility for

intervention, because in the absence of sterilization, the fiscal authorities would maintain some direct control over monetary policy. In Japan, for example, the Ministry of Finance maintains authority for foreign-exchange intervention, and the otherwise independent Bank of Japan acts as its agent. A similar relationship exists in the United States where the US Treasury and the Federal Reserve share responsibility for intervention. If these central banks did not routinely sterilize foreign-exchange operations, their independence and the credibility of their monetary policies might come under question. A loss of credibility could increase the speed with which monetary impulses translate into inflation and adversely skew any short-term inflation-output tradeoff.

To be sure, central banks sometimes factor nominal exchange-rate objectives into their monetary-policy decisions. The Federal Reserve, for example, has occasionally altered its federal-funds-rate target while undertaking compatible foreign-exchange operations. One might expect that implementing the appropriate monetary-policy change through the purchase or sale of foreign currency could have a bigger impact on the exchange rate than implementing the move through open-market operations in government securities, and thereby justify official nonsterilized foreign-exchange operations. Bonser-Neal, Roley, and Sellon (1998) and Humpage (1999) show that US interventions undertaken in conjunction with changes in the federal funds rate have no apparent effect on exchange rates; both studies attribute observed exchange-rate responses solely to the federal funds rate.[8]

Under the best of circumstances, nonsterilized interventions seem redundant to conventional open-market operations.[9] Under the worst of circumstances, nonsterilized interventions can conflict with domestic monetary policy objectives. Sterilized intervention, on the other hand, holds open the prospect of providing central banks with the means of affecting exchange rates independent of their domestic monetary policy objectives. How sterilized intervention might actually do this has been the focus of research over at least the last thirty-five years.

1.4 Theoretical Underpinnings

The asset-market approach to exchange-rate determination provides a useful framework for conceptualizing the channels through which sterilized intervention might influence exchange rates (see Dominguez 1992; Aguilar and Nydahl 2000). The asset-market approach, which emphasizes the importance of expectations, describes current exchange rates in terms of existing fundamentals and expectations about their future paths. Within this framework, sterilized intervention can affect current exchange rates if it alters fundamental determinants of exchange rates (other than the monetary base), if it affects expectations about these fundamentals, or even if it impacts expectations that are unrelated to fundamentals.

1.4.1 Portfolio-Balance Channel

Although sterilized intervention has no effect on the monetary base, sterilization alters the currency composition of publicly held government securities. The associated rebalancing of private-sector portfolios, however, offers central banks a potential channel through which to routinely and fundamentally affect exchange rates without interfering with their domestic monetary-policy objectives. Economists refer to this as the portfolio-balance channel.

The very act of sterilizing an intervention increases outstanding government securities denominated in the currency that central banks are selling relative to government securities denominated in the currency that central banks are buying. If risk-averse asset holders view securities in different currency denominations as imperfect substitutes, they will only hold the relatively more abundant asset in their portfolios if the expected rate of return on that asset compensates them for the perceived risk of doing so.[10] Their initial reluctance to hold the relatively more abundant security forces a spot depreciation of the currency that central banks are selling relative to the currency that they are buying. The spot depreciation relative to the exchange rate's longer-term expected value then raises the anticipated rate of return on the now more-abundant securities, and compensates asset holders for the perceived increase in risk.[11]

Unfortunately, most empirical studies find the relevant elasticities to be either statistically insignificant or quantitatively negligible (Edison 1993). Central banks also do not put much stock in the portfolio-balance channel (Neely 2007, 11). Dominguez and Frankel (1993a) is a notable, often-cited exception to the standard conclusion; they find a statistically and economically significant relationship. The reason offered for the absence of a portfolio effect is that the typical intervention transaction is miniscule relative to the stock of outstanding government assets.

If, however, US intervention did operate through a portfolio-balance channel, then intervention should exert a fairly robust influence on exchange rates. A number of papers find some connection between intervention and uncovered interest parity, but the relationship is not very robust across either time periods or currencies, suggesting that the finding does not stem from a portfolio-balance effect (see, e.g., Humpage and Osterberg 1992).

Recently, proponents of the microstructure approach to exchange-rate determination have renewed interest in the portfolio-balance approach (Evans and Lyons 2001; Lyons 2001). These models focus on the role of foreign-exchange dealers who, as market makers, stand ready to buy and sell foreign exchange. These same dealers typically do not hold sizable open positions in a foreign currency, especially overnight (Cheung and Chinn 2001). They will try to distribute their unwanted currency holdings among other dealers and eventually among their commercial customers. Since different currencies are not perfect substitutes in the dealers' portfolio, this inventory-

adjustment process resembles a portfolio-balance-like mechanism at the microlevel. Evans and Lyons (2001, 2005) claim evidence of both temporary (dealer to dealer inventory reshuffling) and permanent (dealer to customer) portfolio-balance effects. The permanent component of this model, however, is at odds with the macroliterature. The microstructure model measures only currency flows in the foreign-exchange market. It does not account for the fact that the sterilization process leaves the total amount of bank reserves for each currency unchanged, while changing the relative stock of domestic- and foreign-currency-denominated government securities in the hands of the public.

1.4.2 Expectations Channel

Exchange markets are highly efficient processors of information, but not perfectly so. If information is costly, at any point in time, market participants either will not have complete information or will not fully understand its implications. In such cases, market exchange rates cannot continuously reflect all available information.

The volume of foreign-exchange trading, estimated at approximately $4 trillion equivalent per day, seems large relative to the volume of cross-border commercial transactions (BIS 2010). Approximately 80 percent of trades occur among traditional market-making dealers or between these dealers and other financial customers, rather than between dealers and nonfinancial customers (BIS 2010). Much of this seemingly excessive dealer trading undoubtedly results from heterogeneous information among market participants and is vital to price discovery.

Survey evidence does indeed suggest that access to private information differentiates market participants (Cheung and Chinn 2001). Large foreign-exchange players have better information derived from a broader customer base and market network, which gives them a keener insight about order flow and the activities of other trading banks. In such a market, exchange rates perform a dual role of describing the terms of trade and of transferring this information. In markets characterized by information asymmetries, however, nonfundamental forces like bandwagon effects, overreaction to news, technical trading, and excessive speculation may affect short-term exchange-rate dynamics. Any trader whom others suspect of having superior information, including a monetary authority, could affect price if market participants observed his or her trades.

Research into foreign exchange market intervention then is largely predicated on the assumption that monetary authorities possess a significant informational advantage over other market participants, and that intervention can serve as a conduit for transferring that information. Is this a reasonable assumption for any player—let alone a central bank—in a highly efficient market? If so, is this advantage routine or episodic?

Mussa (1981) suggested that central banks might signal future, unan-

ticipated changes in monetary policy through their sterilized interventions, with sales or purchases of foreign exchange implying, respectively, domestic monetary tightening or ease. Such trades would have direct implications for future fundamentals, and forward-looking traders would immediately adjust their spot exchange-rate quotations. Mussa suggested that such signals could be particularly potent—more so than a mere announcement of monetary-policy intentions—because the intervention gives monetary authorities open positions (i.e., exposures) in foreign currencies that would result in losses if they failed to validate their signal. Reeves (1997) formalized Mussa's approach and demonstrated that if the signal is not fully credible, or if the market does not use all available information, then the response of the exchange rate to intervention will be muted. In Reeves's model, the amount of intervention influences the market's response.

When Mussa proposed this signaling effect, the Federal Reserve—and other central banks—had lost much of their integrity for price stability. If, however, central banks are credible, signaling future monetary policy through intervention would seem unnecessary. Markets can easily anticipate the future monetary policies of credible central banks. Carlson, McIntire, and Thomson (1995) showed that federal-funds futures anticipated monetary-policy changes fairly accurately within a two-month horizon, while Fatum and Hutchison (1999) found that intervention added noise to the federal-funds-futures market. These findings suggest that a credible central bank simply may not routinely have private information even about its own future monetary policies.[12]

Even central banks with private information about monetary policy are not likely to actively employ intervention as a signal. For one thing, when a central bank eventually validates its signals, the interventions are no longer sterilized. Consequently, such intervention does not ultimately provide central banks with an independent influence over exchange rates and, as we explained above, it can interfere with monetary-policy credibility.[13] Moreover, most large central banks do not intervene for profit, and although central banks do not like to sustain huge losses on their foreign-exchange portfolios, the fear of losses does not strongly motivate their near-term actions. Finally, as noted above, in countries like Japan and the United States where intervention falls under the purview of the fiscal authorities, central banks could lose their independence if they altered monetary policy in response to the interventions of the fiscal authorities.

Intervention, of course, may offer a *passive* signal of future monetary policy; that is, purchases and sales of foreign exchange may simply be correlated with a future easing or tightening in monetary policy, with no signal intended. In this case, one might find episodic evidence of signaling. Specifically, when the original shock to the exchange market resulted from an excessive easing or tightening in monetary policy, intervention might predict future policy corrections. One would then only find a consistent correlation

between intervention and future changes in monetary policy if the underlying shock to the exchange rate was persistently associated with domestic monetary policies. If the underlying shock to the exchange market was not of that type, one might not find evidence of signaling. Kaminsky and Lewis (1996), who investigate the signaling hypothesis, find that when consistent monetary policy supports intervention, exchange rates tend to respond in the expected direction, but when inconsistent monetary policy accompanies intervention, exchange rates tend to move in the opposite direction.

The connection between intervention and compatible monetary policy highlights the essential ambiguity in the monetary-policy signaling story: If intervention only works when it is consistent with imminent monetary-policy changes, that implies that prior and current monetary policy created the exchange-rate disturbance in the first place. Why then intervene? Why not just alter monetary policy? The usefulness would seem to depend on central-bank credibility. This narrow interpretation of signaling seems passé.

Monetary authorities often claim to intervene when they view current exchange rates as being inconsistent with market fundamentals defined more broadly than monetary-policy variables. They have large research staffs that gather and interpret statistics on current economic conditions. If central banks have useful private information about market fundamentals, providing that information to the market through intervention can alter market expectations. Bhattacharya and Weller (1997) and Vitale (1999) present theoretical models in which central banks maintain an informational advantage and disseminate their information to the market. Popper and Montgomery (2001) provide a particularly interesting model in which a central bank aggregates the private information of individual traders and disseminates this information through intervention. Central banks typically maintain an ongoing informational relationship with a select group of major banks (domestic and foreign) and use these banks as counterparties for their foreign exchange transactions.[14] In exchange for their exclusivity, these dealers provide the central banks with interpretations of general market conditions, perceived reasons for market movements, and order flows. If monetary authorities routinely have better broad-based information than other market participants, as Popper and Montgomery (2001) argue, then their interventions should accurately predict future exchange-rate movements; that is, researchers should be able to uncover a statistically valid relationship between the two.

1.4.3 Coordination

In extreme cases of information imperfections, when a substantial portion of market participants base trades on extrapolations of past exchange-rate movements, exchange rates might remain misaligned vis-à-vis their fundamentals, even if the more-informed private traders believed that the cur-

rent exchange rate is inappropriate in terms of economic fundamentals.[15] As Reitz and Taylor (2008, 57–59) explain, if the exchange rate has moved beyond a range consistent with market fundamentals, those traders who base their trades on fundamental analysis may have suffered recent losses and drained their liquidity. If so, they may have lost confidence in their judgment as well as their credibility with their managers. This can deter them from trading on fundamentals, even though each knows that if they acted in concert, the exchange rate would return to a level consistent with market fundamentals. The misalignment persists.

In such a situation, a central bank could intervene openly and offer a coordinating signal to those traders who react to fundamentals. This signal bolsters those traders' confidence about their exchange-rate expectations and encourages them to take positions in the market. Monetary authorities need not have better information than the private sector to provide a coordination role, but they must be able to take a long-term position without fear of incurring temporary losses (Reitz and Taylor 2008, 58). As noted, central banks do not intervene for profits.

The coordination channel is distinct from the expectation channel because it does not require that the central bank necessarily have better information than the market. It does, like the signaling channel, seem to require that the monetary authorities lack credibility. A credible central bank could simply announce that the exchange rate is misaligned, and get a reaction from the market. A central bank lacking credibility may need to "put its money where its mouth is" (Reitz and Taylor 2008, 59).

1.5 Does Intervention Work?

Over the years, empirical research on the effectiveness of sterilized intervention has grown sharply. The myriad studies are almost all empirical, and they incorporate a broad range of experimental strategies and techniques. The results clearly demonstrate a high frequency—daily or intradaily—connection between foreign-exchange-market intervention and exchange rates. The results, however, are often not robust across currencies, time periods, and empirical techniques. Intervention often seems more like a hit-or-miss proposition than a sure thing.[16]

Even though most empirical studies do not provide a fully articulated theoretical model of intervention, economists typically interpret the results from such studies as evidence of a broad expectation or a coordination channel. We do not know much about the duration of these effects, but given the near martingale nature of exchange-rate changes, it seems reasonable to interpret them as highly persistent, if not permanent. A successful sterilized intervention would seem to set an exchange rate off along an alternative path, but one that is still consistent with preexisting, unaltered fundamentals.

The lack of robustness in the empirical literature suggests that if intervention does indeed operate through a general expectations channel, monetary authorities do not always possess an information advantage over the market. Large interventions, especially those undertaken in concert with other central banks, seem more likely to affect exchange rates in the desired direction than small, unilateral operations.[17] From an expectations perspective, large interventions may demonstrate a higher conviction on the part of the monetary authorities, in the same manner that a speculator who is very certain about his or her private information will take a larger position in the market. Coordinated interventions suggest that more than one monetary authority share a particular view about the market.[18]

Somewhat more controversial is the relative importance of secrecy to an intervention's effectiveness. Prior to the late 1970s, the Federal Reserve usually operated covertly. Thereafter, the Federal Reserve usually operated openly. Given that intervention often operates through an expectations channel, secrecy may seem counterproductive, but Bhattacharya and Weller (1997) and Vitale (1999) present theoretical models in which secrecy contributes to an intervention's success. Dominguez and Frankel (1993a), Hung (1997), Chiu (2003), and Beine and Bernal (2007) also discuss various reasons for maintaining secrecy.

In the end, however, if sterilized intervention does not affect market fundamentals, it does not afford monetary authorities a means of routinely guiding their exchange rates along a path that they determine independent of their monetary policies. It can instead conflict with monetary policy. That, we argue, is why the Federal Reserve stopped intervening.

1.6 The Mechanics of US Intervention

In the United States, both the Treasury and the Federal Reserve System have separate legal authority for intervention, but the Gold Reserve Act of 1934 made the Treasury first among equals in this arrangement. The Treasury and the Federal Reserve have always coordinated their operations and, depending on their exact nature, have often acted in close concert. Since 1980, for example, each agency has usually financed an equal share of every intervention operation. The Federal Reserve Bank of New York executes all foreign exchange transactions for the accounts of both the Federal Reserve and the Treasury.

At various times over the years, each agency has lobbied the other for or against initiating an intervention, depending on its individual assessment of the operation's overall appropriateness and its likelihood for success. At times, the Treasury has basically delegated intervention operations completely to the Federal Reserve, and at other times the Treasury has closely monitored and controlled minor details of the operations (Task Force 1990c, Paper no. 6, 12). In any event, the Treasury and the Federal Reserve have

always ironed out differences over the operating strategies and the best techniques to follow (Task Force 1990c, Paper no. 6, 14). The Federal Reserve, however, has never intervened for its own account without the Treasury's authorization, but the Treasury, presumably, cannot direct the Federal Reserve to intervene for its own account against the latter's will. Still, the Federal Reserve has at times unwillingly participated in Treasury-initiated interventions because appearing not to cooperate in a legitimate policy action of the administration would raise market uncertainty and could sabotage the operation's chances for success. Congress has repeatedly cautioned that the Federal Reserve should conform to the Treasury's foreign financial policies (Task Force 1990c, Paper no. 6). By the mid-1990s, however, the Federal Open Market Committee (FOMC) stopped intervening with the tacit approval of the Treasury because it feared that intervention—especially when directed by the Treasury—threatened its independence and weakened the credibility of US monetary policy.

1.6.1 Exchange Stabilization Fund

The Treasury conducts intervention through the Exchange Stabilization Fund (ESF), which Congress established at the urging of the Roosevelt administration under the Gold Act of 1934 (see chapter 3).[19] The ESF's primary objective was to stabilize the exchange value of the dollar by buying or selling foreign currencies and gold. In addition to foreign-exchange intervention, the ESF has provided temporary stabilization loans to select developing countries. Most of these have been Latin American countries, with Mexico being the most persistent recipient. While these operations conform broadly to the ESF's directive of stabilizing dollar exchange rates—many of these countries pegged their currencies to the dollar—the recipients need not use these funds directly in their exchange markets. Some, for example, have dressed up their foreign exchange reserves on reporting dates. Consequently, the loans often have a distinct foreign-aid and foreign-policy flavor.[20]

Congress initially capitalized the fund with $2.0 billion acquired from the devaluation of the dollar against gold, but later used $1.8 billion of the ESF's funds to make an initial quota payment to the International Monetary Fund (IMF). Besides its initial capitalization, Congress allowed the ESF to retain all of the earnings from its operations and to remain outside of the annual appropriations process. Doing so guarded the agency's secrecy, a precious commodity when attempting to stabilize exchange rates. In a similar vein, Congress gave the secretary of the Treasury—who ultimately reports to the US president—exclusive control over ESF operations. The secretary's decisions are final and not subject to the review of any other officer of the US government.[21] Responding quickly is also essential for successful foreign-exchange operations.

Still the ESF's ability to expand its balance sheet is fairly inelastic. Its capacity to acquire foreign exchange through intervention or to extend

loans is limited by the amount of dollar denominated assets in its portfolio. Absent a congressional appropriation, the ESF can acquire additional dollars through two mechanisms: First, the fund can monetize special drawing rights (SDRs) with the Federal Reserve System. With the authorization of the Treasury secretary, the ESF creates "SDR certificates," a liability on its balance sheet, and sells them to the Federal Reserve, which is legally obliged to accept them. The ESF can also obtain dollars by warehousing foreign exchange with the Federal Reserve. Warehousing is a currency swap in which the Federal Reserve buys foreign currency from the ESF in a spot transaction and immediately sells it back—typically for delivery within twelve months—in a forward transaction. At times, the Treasury has also augmented the ESF's foreign-currency reserves directly by issuing foreign-currency-denominated securities—Roosa and Carter bonds. The Treasury can also draw on the US quota with the International Monetary Fund (IMF) and turn the proceeds over to the ESF. Still, the ESF's balance sheet is inelastic. The need to quickly augment the ESF's resources in the early 1960s was a key reason that the Federal Reserve decided to participate in US foreign exchange operations, as chapter 4 explains.

1.6.2 The Federal Reserve System

The FOMC has derived its legal authority for intervention from various sections of the Federal Reserve Act (see chapter 4). Under this authority, Federal Reserve banks—chiefly the Federal Reserve Bank of New York—first undertook some limited exchange-market operations during World War I and extended stabilization credits to European central banks in the mid-1920s (see chapter 2). These operations were controversial, and Congress amended the Federal Reserve Act in 1933 to prevent Federal Reserve banks from operating without the Board of Governors' direct oversight (Task Force 1990a, Paper no. 2, 2). After a long hiatus, the Federal Reserve reestablished its own portfolio of foreign-exchange in 1962 and began intervening to forestall gold losses and to stabilize the dollar. The Federal Reserve remained a fairly active participant in the foreign-exchange market from 1962 through the mid-1990s. Since 1995, it has intervened on only three occasions, but it maintains a portfolio of foreign exchange for that purpose. Although some FOMC participants argued that the Federal Reserve lacked clear legal authority for intervention after 1933, Congress has never attempted to prevent the Federal Reserve's activities in the foreign-exchange market. The FOMC, moreover, interprets Congress's passage of the Monetary Control Act of 1980, which expanded the Federal Reserve's authority for investing its foreign-exchange portfolio, as tacit congressional recognition of the FOMC's authority for foreign-exchange operations.

Within the Federal Reserve System, the FOMC maintains authority over intervention operations because intervention involves a type of open-market transaction. A subcommittee consisting of the chairman and vice-chairman

of the FOMC, the vice-chairman of the Board of Governors, and one other member of the Board of Governors, whom the chairman appoints and who has responsibility for international matters, is accountable for intervention decisions when the full FOMC is not immediately available to render vital judgments.

The FOMC's guidelines for intervention operations consist of three documents. The first, *Authorization for Foreign Currency Operations*, sanctions the desk's purchases of foreign exchange, permits holding of specific foreign-currency balances, and establishes overall limits on the Federal Reserve's net-open position—its foreign-exchange exposure. The second, *Foreign Currency Directive*, focuses more on the objectives of intervention and on the manner in which the desk at the Federal Reserve Bank of New York should undertake foreign-exchange transactions. Finally, the *Procedural Instructions* clarify the relationship among the FOMC, the Foreign Exchange Subcommittee, and the manager of the desk at the Federal Reserve Bank of New York. From time to time, the FOMC established informal agreements, such as limits on the amounts of intervention the desk can take in specific currencies.

The Federal Reserve—in stark contrast to the ESF—finances its purchases of foreign exchange by creating reserves. Consequently, its capacity to acquire foreign exchange is ultimately limited only by the FOMC's willingness to acquire foreign-exchange risk. The Federal Reserve finances sales of foreign exchange either from its portfolio of foreign exchange assets or via its capacity to borrow or buy foreign exchange from other central banks or from the US Treasury. As noted, the Federal Reserve undertakes intervention "in close and continuous consultation and cooperation with the United States Treasury" (Task Force 1990c, Paper no. 6, 1).

The United States also closely coordinates its intervention operations with foreign central banks. In the broad sense, this means that the United States seeks permission to buy and sell a particular foreign currency from the issuing central bank. More narrowly, however, the United States and the relevant foreign central bank have often operated in concert, both to signal agreement with the operation's objectives and to increase the amount of intervention.

The oft-stated objective of US foreign exchange operations is to counter disorderly market conditions—a very amorphous concept. Greene (1984c, 12–13) described the desk's perception of market disorder:

> In making judgments about conditions in the exchange market and the need for orderly market intervention, US authorities considered many dimensions of trading. They evaluated the variability of the exchange rate itself as indicated, for example, by the magnitude and speed of rate changes within a day, day to day, cumulatively over several days or longer, and relative to perceived or known changes in the underlying economic fundamentals. They also evaluated market participants' perceptions of

> the risk of dealing as indicated, for instance, by the width of bid-asked spreads, the existence of large gaps between successive rate quotations, or an unwillingness on the part of market professionals to take currency into position even temporarily, and thereby cushion the impact on the market of their customers' currency needs.

Ultimately, however, market disorder was largely in the eyes of the beholder (see chapters 5 and 6).

1.6.3 Swap Lines

Both the US Treasury and the Federal Reserve have from time to time set up swap lines either as a means of acquiring foreign exchange or as a method of supplying dollar reserves temporarily to a foreign government or central bank in need of dollars. In a swap, the United States and a foreign government exchange currencies spot and simultaneously reverse the transaction at a known forward exchange rate on a specific date in the future. The Federal Reserve maintained an extensive network of swap lines during the 1960s and 1970s and commonly relied on them for intervention purposes. Use of swap lines to finance intervention dropped off by the early 1980s, but the Federal Reserve resurrected an extensive swap network during the Great Recession as a mean of providing dollar liquidity to foreign central banks, which offered it to commercial banks in their jurisdictions (see epilogue). The Federal Reserve continues to maintain liquidity swap lines with the Bank of Canada, Bank of England, the European Central Bank, the Bank of Japan, and the Swiss National Bank. In addition, the Federal Reserve maintains two swap lines with the Bank of Canada and the Bank of Mexico as part of the North American Free Trade Agreement (NAFTA).

As noted, warehousing refers to a swap transaction between the US Treasury and the Federal Reserve System in which the Federal Reserve temporarily acquires foreign exchange from the Treasury and the Treasury acquires dollars from the Federal Reserve. Once the loan is extended, the Federal Reserve has absolutely no control over how the Treasury uses the funds. Warehousing is controversial because it resembles a temporary collateralized loan from the Federal Reserve to the ESF, outside of the congressional appropriations process (see chapters 5 and 6). FOMC members have worried that such loans could impede the Federal Reserve's independence and its monetary policy credibility.

1.6.4 Investments and Profits

Prior to 1980, the United States did not hold large balances of foreign exchange. Moreover, its foreign-exchange liabilities (swap drawings, Roosa and Carter bonds, or IMF drawings) exceeded its foreign-exchange assets, giving the Federal Reserve a small negative net-open position. The decision in the early 1980s to expand its portfolio and to hold an open position in

foreign exchange stemmed from concerns that foreign governments could place conditions on the Federal Reserve's ability to borrow foreign exchange and that these conditions could delay or otherwise hamper US intervention operations (see chapter 5). After 1980, the Federal Reserve acquired a substantial net-open position in foreign exchange and a corresponding exposure to exchange-rate-revaluation risk. At the end of 2010, US monetary authorities held nearly $52 billion equivalent in foreign-exchange reserves split equally between the Federal Reserve System's and the US Treasury's accounts. Each portfolio contains slightly more euro assets (55 percent) than yen assets (45 percent).

Outside of small working balances, the United States currently holds its foreign exchange in highly liquid and safe interest-earning assets. Prior to 1980, the desk invested its foreign exchange holdings in deposit accounts with foreign central banks, some of which could not legally pay interest on the balances, or with the Bank for International Settlements (BIS). When interest was available, the underlying rates were generally administered rates—discount or other policy rates—or set by swap arrangements. Safe and liquid alternatives were often not available. The Monetary Control Act allowed the Federal Reserve to earn a higher (market-related) rate of return on its balances by investing them in the obligations of foreign governments and official institutions (see Task Force 1990h, Paper no. 8).

The Federal Reserve earns profits and losses on its portfolio—a realized profit or loss when the desk sells foreign exchange from the portfolio and an unrealized profit or loss each month when it marks the portfolio to market. When the Federal Reserve buys or sells foreign exchange, whether for its own account or for the ESF's account, it books the transactions at current exchange rates. Foreign-currency-denominated interest receipts on the account are treated similarly. Over time, the Federal Reserve books increments to the portfolio at different exchange rates. When it calculates the profit or loss associated with a subsequent foreign exchange sale, the desk must decide which of the exchange rates used to book the foreign-exchange acquisitions is the appropriate base for the transaction. The choice can make a substantial difference to the profit calculation when exchange rates fluctuate day to day.

The Federal Reserve resolves this problem by using a weighted-average exchange rate based on the entire portfolio. This rate equals the cumulative book value in a particular foreign currency divided by its cumulative book value in dollars. Realized profits compare the exchange rate at which currency is sold to this weighted-average rate. The Fed also calculates the valuation, or unrealized profits, on the entire portfolio using an end-of-month exchange rate and compares this valuation with the aforementioned weighted average. Essentially, this reveals the profits from selling off the entire portfolio at a particular time. On this basis, the Federal Reserve has generally profited (realized and unrealized) from intervention, but not

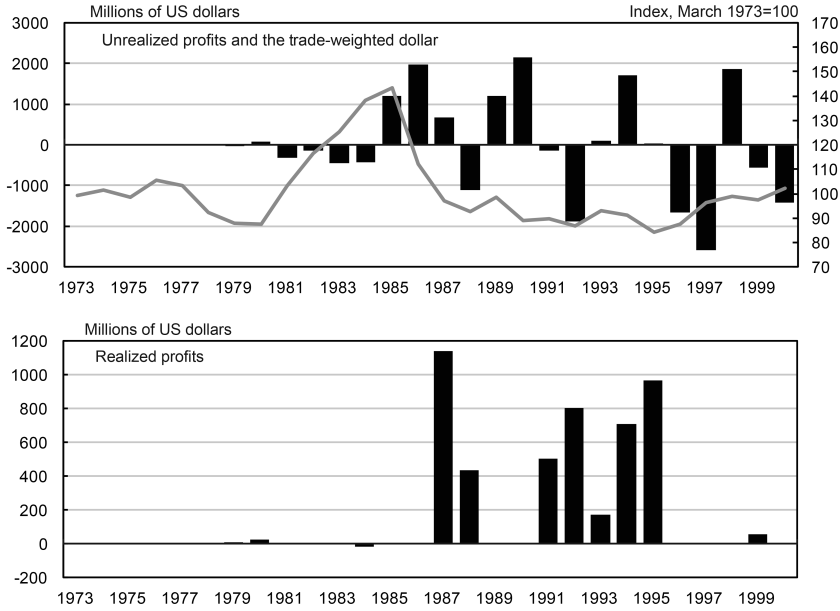

Fig. 1.1 US intervention profits, 1979–2000

Note: No data available on realize profit or loss for 1982 and 1983. Data are from the Federal Reserve.

always. Between 1979 and 1997, the years for which data are readily available, these profits were small, but their year-to-year variance has been large (see figure 1.1).[22]

During the Bretton Woods era, 1962 through 1971, exchange rates did not change much, the gold price remained fixed, and many of the mechanisms used for interventions—swap lines and Roosa bonds—contained protections against exchange-rate changes. Interest-rate differentials were largely inconsequential to profit calculations. Consequently, the United States' relatively small exposures did not generate large profits or losses (Task Force 1990e, Paper no. 10, 14–19).

The closing of the gold window on 15 August 1971 meant that the United States could not sell gold to meet outstanding foreign-currency obligations, and had to look for an alternative means of repaying the debt. The United States had nearly $5 billion in outstanding obligations, primarily in Swiss francs, British pounds, Belgian francs, and German marks. Estimates of the profit or loss associated with repayment range widely from a loss of about $2 1/2 billion to a small gain, depending on the counterfactual assumptions that one makes about the Treasury's ability to sell gold (Task Force 1990e, Paper no. 10, 24–27).

While the Federal Reserve, out of its fiduciary responsibility to Congress

and the American people, hopes to avoid losses on its foreign-exchange portfolio, a desire for profits has never motivated US intervention operations. As noted, the desk intervenes to calm market disorder. In holding a net open position in foreign exchange, however, the Federal Reserve and the US Treasury are acting much like speculators, and they earn profits or incur losses at the expense of the private sector. If, for example, the Federal Reserve acquires Japanese yen through its market interventions, and the yen subsequently appreciates against the dollar, the Federal Reserve's net worth rises while the private sector's net worth falls relative to what it would have been in the absence of the intervention (Task Force 1990e, Paper no. 10, 6–7).

Friedman (1953) suggested that profits contained information about the effectiveness of official interventions. Destabilizing foreign-exchange speculators necessarily incur losses that quickly drive them from the market.[23] Only stabilizing speculators remain in the market. He warned, however, that central banks do not face hard budget constraints and, therefore, could undertake more persistent unprofitable and destabilizing transactions. Subsequent work, however, indicated that Friedman's correspondence between profitable and stabilizing speculation need not hold, especially if the underlying equilibrium exchange rate is not constant. Profitable intervention can sometimes be destabilizing, and unprofitable intervention can sometimes be stabilizing (Task Force 1990e, Paper no. 10, 2). Consequently, one cannot infer much about the ability of central banks to stabilize exchange rates from the profitability of the foreign-exchange operations.

Perhaps the most interesting way to think about central-bank profits, particular valuation gains or losses, is in terms of their connection to profits or losses generated in the private market. A substantial number of studies, for example, have found that fairly simple technical trading rules—including ex ante rules, as in Neely, Weller, and Ditmar (1997)—generate profits that are difficult to explain in terms of standard risk measures.[24] Recent surveys suggest that technical trading rules seem to account for a large segment of foreign-exchange trading.

Quite a few studies have shown that technical trading rules generate excess returns during periods of central-bank intervention (LeBaron 1999). This seems especially likely if central banks adopt a "leaning-against-the-wind" intervention strategy. If central banks slow, but do not reverse, exchange-rate movements, they will inevitably sustain valuation losses, at least in the short run. By taking a position opposite that of the central bank, technical traders apparently stand to profit. In contrast to these findings, however, many other studies conclude that central banks have earned small profits from their intervention operations since the collapse of Bretton Woods.

Neely (1998) reconciles the technical trading results with the apparent overall profitability of intervention by showing that intervention profits occur over a longer time horizon than technical trading profits. In the short run, intervention often generates losses, a point that Goodhart and Hesse

(1993) also illustrate. Hence, it is possible that technical traders profit against central banks in the short run while central banks profit in the long term. This raises questions about the effect that sustained intervention might have on the functioning of private foreign-exchange markets.[25]

1.7 Road Map

This chapter has presented background material on foreign-exchange intervention and on the US institutional framework for that intervention. The remainder of this book explains how theories of intervention and institutional arrangements evolved in the United States, primarily during the twentieth century. The key concern is how these developments interacted with monetary policy.

As chapter 2 explains, precedents for modern foreign-exchange-market operations are found in European experience with the classical gold standard, but they quickly grew and developed after World War I as countries first attempted to return to the gold standard and then reacted to the Great Depression. European central banks under the classical gold standard often bent the "rules of the game" through discount policies and gold devices. These were early exchange-market operations. Some European central banks held foreign-exchange reserves and stabilized their exchange rates within the gold points through intervention. Chapter 2 illustrates early uses of secrecy, sterilization, and forward transactions—all of which become important characteristics of modern interventions. The chapter also discusses the establishment of the British Exchange Equalisation Account, which directly intervened in the foreign-exchange market.

American antecedents also aided the development of foreign-exchange operations in the United States. Chapter 2 explains the rise of private firms that specialized in the spatial and temporal arbitrage of sterling bills and related instruments. The Second Bank of the United States under Nicholas Biddle extended these operations, buying and selling foreign exchange to stabilize exchange rates and to insulate the domestic economy from external shocks. Biddle conducted foreign-exchange-market intervention, or at least a prototype of it. The Civil War saw the issuance of greenbacks and floating exchange rates. After the war, the Treasury contracted the money supply to return to the gold standard and avoided exchange-market operations until World War I. Both the issuance of greenbacks and the return to the gold standard were decisions on how to deal with the trilemma.

In 1914, Congress established the Federal Reserve System and gave it powers consistent with foreign-exchange operations. World War I turned the potential for such operations into an actuality. As chapter 2 shows, by the end of the war, the machinery for future exchange-market operations was clearly in place. With the war as a precedent, the Federal Reserve Bank of New York participated in a number of stabilization programs for other

countries and engaged in several direct foreign-exchange-market interventions during the 1920s and early 1930s. As the chapter also illustrates, these operations saw the beginnings of central-bank cooperation in gold and foreign-exchange operations, which would become the hallmark of Bretton Woods and, later, the Plaza and Louvre accords. The object of most of the activities in the 1920s and 1930s was to preserve the gold standard—a pillar of monetary stability and a solution to the trilemma.

Chapter 3 introduces the US Exchange Stabilization Fund, chronicling its establishment, structure, and operations from its inception through 1961. In the depth of the Great Depression, Britain devalued the pound and established the Exchange Equalisation Account. President Roosevelt saw the Exchange Equalisation Account as a protectionist device, and as a countermove, he devalued the dollar and established the Exchange Stabilization Fund in January 1934. The Exchange Stabilization Fund (ESF), which is the primary vehicle for foreign-exchange-market intervention in the United States, has a structure conducive to intervention, but one that is unlike most other government agencies: It is under exclusive control of the US Secretary of the Treasury and has always been self-financing, meaning it is outside of the congressional appropriations process.

The ESF first intervened in dollars and gold against French francs, British pounds, Belgian francs, and Netherlands guilders. Chapter 3 details these early operations. Information about many of the transactions during the 1930s, including data on their dollar amounts come from William Brown's (1942) rare, unpublished manuscript. In addition, chapter 3 draws on newly available material from the Morgenthau Diaries to construct the narrative.

In 1936, Britain, France, and the United States signed the Tripartite Agreement—a cooperative effort to stabilize exchange rates through intervention in gold and foreign exchange. (Belgium, the Netherlands, and Switzerland also accepted the principles of the Tripartite Agreement.) The Tripartite Agreement enabled France to devalue the franc without foreign offsets and reestablished mechanisms for gold settlements. (Belgium also soon devalued.) Intervention in currency and gold—mostly the latter—occurred through 1939 with the objective of stabilizing exchange rates. While the Tripartite intervention between 1934 and the outbreak of World War II may have helped stabilize short-term exchange-rate movements, it did not address the fundamental misalignment among key currencies. The Tripartite Agreement did not solve the trilemma. World War II, with its exchange controls and disruptions, ended the Great Depression and the problems that it posed for exchange markets in the 1930s.

Because the ESF holds substantial assets, is self-financing, and is solely under the direction of the Treasury, it can also undertake myriad operations only tangentially related to its original objective. Chapter 3 explains three such operations of the ESF. First, the ESF has often made loans to developing countries, especially Mexico and other Latin American nations. Second,

under the Silver Purchase Act of 1934, the ESF purchased silver and lifted its price. It, therefore, intervened in the silver market. Third, the ESF had authority to invest in government securities, and therefore could support the market and potentially interfere with monetary policy.

Chapter 4 discusses US foreign-exchange operations during the Bretton Woods era. Bretton Woods—established in 1944—became fully functional in 1958 when key European countries made their currencies convertible for current-account transactions. By 1961, however, the total external dollar liabilities of the United States exceeded the US gold stock, implying that the United States could not fulfill its commitment to exchange dollars for gold at $35 per ounce. This development encouraged central banks to convert unwanted dollars for gold, heightened uncertainty about the exchange rates, and fostered speculation. A rising US inflation rate in the late 1960s and early 1970s only aggravated the situation.

To protect the US gold stock and to neutralize speculative activities, the US Treasury began intervening in 1961. The Federal Reserve System joined a year later after a debate about its legal authority to do so. As illustrated in chapter 4, the Treasury and Federal Reserve cooperated closely, but a clear division of labor emerged. The Federal Reserve formed the first line of defense primarily through its reciprocal currency arrangements or swap lines—a key focus of the chapter. The swap lines provided the central banks of surplus countries with cover for their temporary acquisitions of unwanted dollars and offered the central banks of deficit countries dollar liquidity to defend their pegs. The US Treasury, with its clearer authority for intervention, focused on longer-term operations. If, for example, market conditions prevented the desk from acquiring enough foreign exchange to reverse a swap drawing, the Treasury could acquire the necessary foreign exchange by issuing foreign-currency-denominated securities, drawing foreign exchange from the IMF, or selling gold.

United States foreign-exchange-market operations from 1961 through 1973 may have successfully delayed the disintegration of the Bretton Woods system, but by allowing monetary authorities to postpone more fundamental and necessary adjustments, they only delayed the inevitable. Bretton Woods ultimately failed because countries would not subvert their domestic economic objectives to the maintenance of fixed exchange rates. Floating rates offered a viable solution to the trilemma.

Still, monetary authorities would not allow exchange rates free reign, as chapter 5 explains. During the early float period (1973–1981), policymakers viewed exchange markets as inherently prone to bouts of disorder in which information imperfections caused exchange rates to deviate from their fundamental values, fostered excessive volatility, and encouraged destabilizing speculation. Many thought that intervention was necessary to maintain order. United States policymakers, however, never clearly articulated

the transmission mechanism through which intervention worked. Early on, economists viewed intervention as affecting exchange rates through a portfolio-balance mechanism. Oddly, the foreign exchange desk at the Federal Reserve Bank of New York did not seem to espouse this view. They described intervention as having a vague "psychological" impact on exchange markets, which came about because the desk demonstrated concern for the dollar.

Between 1973 and 1981, as chapter 5 details, the desk operated on both sides of the market. Typically, the desk sold foreign exchange to bolster the dollar. Because these operations were usually financed through swap drawing, the desk then quickly looked for opportunities to buy back the dollars and to repay the swaps. In 1977, the dollar began to depreciate sharply as confidence in the United States' willingness to deal decisively with inflation was rapidly evaporating. Over the next two years, US intervention operations increased in amount, frequency, and openness.

The record of US operations between 1973 and 1981 was at best equivocal. During nearly every operation, the dollar continued to depreciate, although intervention often seemed to moderate the pace. Only after the United States changed monetary policy on 6 October 1979 and convinced markets that it would pursue disinflation despite a recession and rising unemployment, did the dollar start to strengthen. Intervention's lackluster record during the early float led the Reagan administration to adopt a minimalist approach in 1981.

By the late 1970s, foreign central banks, impatient with the US response to inflation, threatened to attach conditions to continued swap drawings. In response, as chapter 5 explains, the FOMC began to acquire a portfolio of foreign-exchange reserves. Drawing on the swap lines to finance intervention soon ended. In contrast, the Federal Reserve's swap lines with the US Treasury—its warehousing facility—continued and grew. Chapter 5 also looks backward to explain the evolution of warehousing.

Chapter 6 discusses intervention during the Volcker and Greenspan eras. By the early 1980s, most economists concluded that intervention did not work through a portfolio-balance channel. The Jurgensen Report (1983)—a multinational pronouncement about intervention's effectiveness—suggested that if intervention were to be effective, monetary policy had to support it. This implied that intervention did not provide a means of affecting exchange rates independent of monetary policy. Intervention could not solve the trilemma.

The dollar appreciated sharply on both a nominal and a real basis between 1980 and early 1985 under tight monetary and loose fiscal policies. Facing pressure from myriad directions, the administration abandoned its minimalist strategy. Coordinated interventions, highlighted by the Plaza and Louvre accords, followed. Many believe this period offers clear support for

concerted foreign-exchange intervention and macroeconomic policy coordination, but our narrative and statistical evidence in chapter 6 are less supportive.

A lack of unequivocal statistical support for intervention was never key to its demise. The FOMC stopped intervening primarily because FOMC participants believed that intervention, and the institutional arrangements associated with it, undermined their ability to establish and to maintain a credible commitment to price stability. As chapter 6 explains, the FOMC's objections were threefold. First, while legally independent, the Federal Reserve had little choice but to participate with the Treasury in major foreign-exchange operations. This undermined the Federal Reserve's independence. Second, FOMC participants—recalling the Jurgensen Report—feared that if markets interpreted sterilized intervention as a signal of future monetary-policy changes, intervention created uncertainty about the FOMC's commitment to price stability. Third, losses on its now substantial portfolio of foreign exchange and large commitments to warehouse funds for the Treasury could result in congressional actions to limit the Federal Reserve's independence.

Our conclusion, chapter 7, summarizes our main argument: Official attitudes about intervention and monetary policy evolved in tandem. Frequent intervention ended because it did not offer monetary authorities an independent instrument with which to pursue an additional policy goal. Intervention did not solve the trilemma. Instead, intervention and its associated institutions weakened the Federal Reserve's credibility for price stability.

The United States essentially stopped intervening by the mid-1990s, but US policymakers never dismissed intervention as completely ineffectual. Since then, the Federal Reserve has intervened on three occasions: on 17 June 1997, the Federal Reserve purchased $833 million worth of Japanese yen in concert with the Japanese Ministry of Finance; on 22 September 2000, the Federal Reserve bought $1.3 billion equivalent euros in concert with the European Central Bank, and on 17 March 2011, the United States intervened in concert with the Japanese Ministry of Finance and other governments to buy yen following Japan's earthquake and tsunami. Our epilogue briefly discusses modern intervention operations in Japan, Switzerland, China, and among the many emerging market and developing countries. We also explain the use of swap lines during the recent financial crisis.