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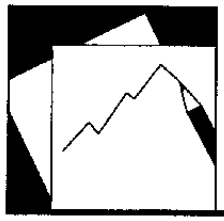

IMF Working Paper

Dual Currency Boards: A Proposal for Currency Stability

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Abstract

This paper shows that extending the convertibility guarantee of the traditional currency board to a second reserve currency brings about an automatic, market-driven change of the peg when the initial reserve currency appreciates beyond a specified level. The "dual" currency board thus maintains the advantages of a hard peg, but avoids the economic difficulties associated with the link to an overvalued reserve currency. As an added benefit, the system has the potential to promote global currency stability, with the reserves of the dual currency board country acting as a buffer stock to the exchange cross-rate of the chosen reserve currencies.

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I. Introduction

Currency boards (CBs) have been successful vehicles for importing monetary stability in a number of countries in the 1990s (see Baliño and Enoch, 1997, for an overview). Much has been made of the virtues of this hardest of pegs (save a currency union): it ensures establishment of low inflation virtually overnight and a significant reduction of currency risk premiums, but allows the CB country to retain its own currency, thereby preserving a degree of national sovereignty (and with it an exit strategy from the arrangement), as well as the ability to collect seigniorage.

Yet the CB arrangement has a number of significant drawbacks, the most important of which may be that it forces the country to choose one particular reserve currency to which to peg. For many countries, especially those in the developing world, a single-currency peg cannot be seen as optimal from the point of view of the theory of optimal currency areas (OCA; see Mundell, 1961). For one, fixing the exchange rate firmly to one reserve currency can impart important costs when the economy is subject to shocks that have a low correlation with shocks in the reserve-currency country. Also, today's diversified trade patterns do not favor hard pegs, as changes in the value of the reserve currency vis-à-vis other main currencies could lead to inappropriate changes in the real effective exchange rate of the CB country.

These drawbacks have most recently been highlighted by the strengthening U.S. dollar, the reserve currency of choice for a number of fixed exchange-rate arrangements. In addition to importing monetary stability, dollar peggers have imported the reserve currency's strength, along with the associated loss of competitiveness vis-à-vis non-U.S. trading partners. In addition, to the extent that the resulting economic difficulties have hurt the credibility of these pegs themselves, higher interest rates and capital flight have compounded the problems.

This paper proposes an enhancement of the CB system that brings about an automatic, market-driven change of peg to a predetermined alternative reserve currency when the initial reserve currency appreciates beyond a certain level, thus avoiding a situation where a country imports an overvalued exchange rate through its peg. In this way, the country benefits from a superior competitive position over the medium term.

The change of peg is made possible (indeed, induced) by extending the promise of convertibility to a second reserve currency; for example, the domestic currency would be convertible into *either* 1 dollar *or* 1 euro. The choice of reserve currency to be received in exchange for the domestic currency would in principle be up to the payee but, to avoid creating a money machine, the convertibility guarantee is made explicitly subject to availability of the currency of choice in the reserves of the CB. If it is not available, convertibility of the domestic currency in the other reserve currency is nevertheless guaranteed. Thus, if the payee wanted 1 dollar in exchange for his unit of domestic currency, but the CB had no dollars, he would receive 1 euro. It is important to note that the non-availability of one of the reserve currencies should not be seen as a "collapse" of the system, and therefore should not weaken its credibility: it is part of its design and is fully foreseen. Convertibility continues to be guaranteed, since the other reserve currency can always be obtained. In fact, the enhanced system may gain credibility compared to the traditional currency board, because it avoids the economic hardship caused by the appreciation of the reserve currency and the associated doubts about the sustainability of the peg.

The modified convertibility guarantee may seem unusual at first glance, and the change of the peg it induces impractical, but the dual-currency board has a famous parallel in history in the gold and silver-based bimetallic monetary system, which prevailed on a near universal scale from the Renaissance until well into the nineteenth century. It is true that bimetallism is sometimes referred to as fundamentally "unstable," and some may claim that it would therefore hardly be an appropriate model for a modern monetary arrangement. It should be kept in mind, however, that the reason for the system's image as unstable was exactly the speed and efficiency with which it induced a change in a country's peg: through Gresham's Law, the "bad money" drove out the "good money".[2] But this feature actually adds to bimetallism's appeal as a model for the dual currency board! The point is that while the workings of both monetary arrangements are closely linked, their aims are radically different. Bimetallism's basic aim was to have coins of both gold and silver circulate side by side in the money supply, while the dual currency board's aim is to allow a quick and efficient change in the peg.

As will be detailed below, the simple modification to the currency board rules leads to particularly beneficial dynamics, the main feature of which is the possibility of a switch in the currency peg. But, in addition to this feature of mainly domestic economic importance, the dual currency board system has another positive effect that concerns global currency stability. It turns out that the stock of reserves of the CB country acts as a buffer stock to the exchange rate between the two reserve currencies, where the "buffered" rate is the one implicit in the fixed rates of exchange between the domestic currency and the two reserve currencies. Thus, the convertibility guarantee of the CB currency into 1 dollar or 1 euro would provide a certain amount of stability to the euro-dollar parity relationship. In a further parallel with the bimetallic system, this stabilizing effect is similar to that which it imposed on the gold-silver price relationship in the nineteenth century (see Oppers, 2000).

The stabilizing effect of one particular CB on the reserve currency cross rate would be limited by the size of its reserves, but if other countries were to adopt CBs with the same implicit cross rate, the stabilizing effect would be enhanced to the extent of their combined total reserves. Moreover, it is shown below that by adding CBs with different implicit cross rates, true "target-zones" of global currency stability could be created, with their boundaries being automatically "defended" by the various buffer stocks made up by the reserves of CB countries.

II. Dual Currency Board Rules

The design of a dual currency board is in principle as straightforward as that of a traditional CB. The only difference is that the dual CB is set up so that convertibility is guaranteed in *either one of two* main currencies, e.g., the domestic currency can be exchanged for either 1 dollar or

[2] Under bimetallism, concurrent circulation of gold and silver coins was rarely achieved, since relatively small changes in the relative price of gold and silver—induced, say, by a change in their relative supply—would induce bimetallic arbitrage that would quickly replace the "good" (appreciating) money with the "bad" (depreciating) money through the operation of Gresham's Law. Thus, countries went through periods when only coins of one metal remained in circulation, punctuated by periodic remintings of the entire money supply, as they saw their pegs change from gold to silver or vice versa (for a description of the workings of the system, see Oppers, 2000).

1 euro.[3] I will call these guaranteed conversion rates the "currency board" rates, which are defined as the number of units of domestic currency that can be converted for a unit of foreign currency.

The choice of currency to be received in return for the domestic currency is in principle up to the payee, but is subject to availability in the CB's reserves. If the foreign currency of choice is not available, the payee nevertheless is guaranteed to receive payment in the other reserve currency. Total reserves (consisting of one or both of the reserve currencies, and valued at the currency board rates) provide full coverage for domestic notes in circulation at all times.

The CB is fully passive, and does not intervene in the market to "defend" the implied reserve currency cross rate. It only buys and sells both reserve currencies (subject to availability) in exchange for domestic notes at the agreed rates upon demand. Thus, while the dual convertibility guarantee in principle creates a fixed relative price between the two reserve currencies in the CB system, one may not be able to obtain this exchange rate at the CB. This would be the case if one of the currencies were not available in its reserves.

III. EFFECTS ON THE CURRENCY BOARD PEG

There is no *a priori* reason to suppose that the reserve-currency price relationship in the market (the "market cross rate") is equal to the fixed currency board cross rate. In fact, one would in general expect both rates to be different, and the response of the CB system to changes in the market cross rate is the source of some interesting and beneficial dynamics. To illustrate these dynamics, the hypothetical example is used of a dual CB arrangement with convertibility of the domestic currency (call it the "ducat") into 1 dollar or 1 euro. As we follow the hypothetical evolution of such a system through 1999 and 2000, with the euro declining through the parity relationship with the dollar, the main features of the dual currency board system are illustrated.

Let us take stock first of the situation in January 1999. At this time, the euro is worth $1.17. With this rate prevailing, the CB cannot obtain or retain any euros, since this currency is undervalued in the domestic monetary system; if the CB had any euros, they would quickly be acquired (at the parity euro-dollar rate specified in the currency board rules) by arbitrageurs, who could make a profit selling them in the market, where they are worth more than one dollar. Similarly, no one would sell euros to the CB; it is much more profitable to sell them in the market.[4] With no euros present in the CB's reserves, the convertibility guarantee is effectively operational only with

[3] The model can easily be extended to incorporate a tri-polar world with the dollar, the euro and the yen, and with other countries operating currency boards at possibly different conversion rates. See below for details.

[4] This suggests a rule for the composition of reserves upon implementation of the dual currency board: only the currency that is overvalued in the CB system should be present in reserves. If any of the undervalued currency were to be present, a run on this part of reserves would ensue and the CB would suffer capital losses as these reserves were sold to the public at less than their market value. The only situation in which both currencies can be present in reserves is that in which the CB is implemented with an implicit cross rate that is exactly equal to that prevailing in the market.

respect to the dollar: anyone converting ducats is able to obtain only dollars from the CB. The ducat has an effective dollar peg.

The dollar appreciates throughout 1999. Initially, this does not have any effect on the CB system. However, upon the breach of dollar-euro parity in early 2000 (to, say, $(1-x)$ dollars per euro), the following arbitrage opportunity arises: buy 1 dollar from the CB for 1 ducat, sell the dollar in the exchange market for $1/(1-x)$ euros; then sell these euros back to the CB for ducats, making a $1/(1-x) - 1 = x/(1-x) > 0$ riskless profit.

As long as this arbitrage process is taking place, market exchange rates will not deviate substantially from the dollar-euro parity relationship: any upward pressure on the value of the dollar releases dollars onto the market from the CB's stock of reserves (in exchange for euros), thereby eliminating any x beyond the margin of profitability of arbitrage. In fact, the CB's foreign exchange reserves act as a buffer stock to dollar-euro parity, providing a stabilizing effect on the cross rate of the two reserve currencies.

Continued downward pressure on the value of the euro will eventually exhaust all dollars from the CB's reserves, at which point only euros remain. The convertibility guarantee then remains effectively operational only with respect to euros and the ducat's peg has switched to the euro. Note that this switch takes place automatically and depends only on the rational actions of currency traders and on the dual-currency convertibility guarantee as described above. In particular, the process does not depend on "intervention" in the currency markets by the currency board authorities. All the authorities do is stand ready to buy dollars and euros in exchange for ducats (to an unlimited extent) and sell them (to the extent that they own them).

It is important to note that the CB does not incur losses (and thus does not see its capital base erode) as a result of the reserve switch. Since its reserves are always valued at the official conversion rates, and the CB buys and sells the two reserve currencies only at these rates, no capital losses are ever recorded in its balance sheet, and there is no fiscal cost to the government associated with the switch. An example makes this clear. Assume the CB starts out with \$10 billion in reserves, valued at 10 billion ducats. As the dollar appreciates beyond the parity relationship with the euro, the CB will see its reserves switched to the euro. As a result of its conversion rules, it will end up holding exactly €10 billion, again valued at 10 billion ducats.[5] Subsequent depreciation of the dollar may cause reserves to switch back to dollars again, of which the CB would end up holding—again—exactly \$10 billion. No capital loss is recorded at any time. It is true that the CB may forego capital *gains* by selling reserves at the official conversion rates to arbitrageurs when the market rate may be higher, but even this may be avoided if the authorities choose to convert their reserve holdings themselves. They would have a particular incentive to this effect if their transaction costs were lower than those of other market participants.

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[5] It is true that upon the dollar's appreciation, the total value of the CB's reserve holdings would be lower *measured in dollars*, but that is not the unit of account of the CB, nor the country's fiscal accounts. But there is a symmetry here as well: when the exchange rate is above 1 dollar per euro, and all reserves are in dollars, their total value in dollars may be \$10 billion, but *measured in euros*, their value would be below €10 billion.

The change of reserves and the change of peg is the dual currency board version of Gresham's Law: "cheap" reserves drive out "expensive" reserves, and the domestic currency is effectively always pegged to and backed by the relatively more depreciated reserve currency. "Relatively more depreciated" in this case is measured by comparing the market exchange rate between the reserve currencies and the cross rate implied by the currency board rates. In the earlier example with the dollar/euro convertibility guarantee, as long as the market exchange rate exceeded 1 dollar per euro, the dollar was the "cheap," or relatively more depreciated currency compared to the currency-board cross rate, and the ducat was pegged to the dollar. As the market exchange rate eventually fell below 1 dollar per euro, the euro became the relatively more depreciated currency, and the ducat switched its peg to the euro.

It is important to note that the CB is not losing reserves as dollars are replaced with euros; there is no "run" on reserves and there is no sense of a collapse of the CB system. As it switches from dollars to euros, the total stock of reserves measured in ducats at the official currency board exchange rates is constant—or, put more accurately, evolves with domestic money demand, which itself should not be affected by the reserve switch (but see the discussion below).

IV. Choosing a Dual Currency Board

Under what circumstances could a country benefit from a dual currency board? Essentially the same arguments come to bear on the choice of this exchange rate arrangement as any other. Eichengreen, Masson, et al. (1998) give a practical guide to the choice of exchange rate regime that is drawn from the theory of optimal currency areas (OCA) and the debates on fixed vs. floating exchange rates and money vs. exchange rate based stabilization. The criteria that are key to the success of the dual currency board are closely linked to those identified by the authors as positively influencing the success of the traditional currency board. These include purely domestic factors, such as low inflation, a high level of reserves, high labor mobility and nominal flexibility, high production and export diversification, and high fiscal policy flexibility and sustainability. Other factors relate to the choice of reserve currency country, including the symmetry of shocks in both countries, and the extent of trade links. It is in these latter criteria that the dual currency board gains an advantage over the traditional arrangement.

The theory of OCA tells us that the closer the trade links between two countries, the greater the benefits of a fixed exchange rate or common currency. The problem is that today's diversified trade patterns make the choice of one specific currency to which to peg less obvious than it may seem at first sight. As Table IV.1 shows, with few exceptions, countries conduct less than half their trade with a major reserve currency center; a proportion less than a quarter is most common. Could countries with such diversified trade patterns, once they have determined that a CB-type hard peg is desirable, benefit from a diversification of their peg along the lines outlined in this paper, to mimic their diversification in trade?

A simple hypothetical example shows that indeed they could. Assume the direction of trade of the CB country from our earlier example is split evenly between the United States and the euro area. Figure IV.1 shows the country's hypothetical REER over the period December 1998 – August 2000, both for the case of a traditional dollar-linked currency board and a dual dollar-euro currency board. Throughout 1999, the dual currency board data are the same as those for the

dollar-based arrangement, as the ducat would have remained effectively pegged to the dollar even under the alternative arrangement; we see that the REER would have risen more than 7 percent over the course of 1999. Starting at the beginning of 2000, however, the ducat would have switched its peg to the euro under the dual currency board system. The figure shows that, as a result, the REER would not only have been prevented from rising a further 6 points in the period to August 2000 (as it would have under the dollar peg), but much of the cumulative appreciation since the end of 1998 would have been reversed. In all, the REER under the dual currency board would have ended up more than 10 points below its level under the dollar peg in August 2000. The consequences for the CB country's economy are significant: under the dual currency board, much of the loss in competitiveness associated with the peg to the appreciating dollar would have been avoided.[6,7]

One may be concerned about the long-run inflationary effect of always being pegged to the more depreciated reserve currency. The inflationary impact of this feature of the dual currency board should not be overestimated, however, as long as care is taken that both reserve currencies chosen as pegs are non-inflationary themselves. The main point to keep in mind is that a "more depreciated" peg does not mean the currency is always depreciating. In fact, it will know periods of depreciation and appreciation as the reserve-currency cross rate moves away from and towards the cross rate implicit in the peg. If the cross rate is mean-reverting (which would be the case if exchange rate movements are governed by some type of long-term PPP and authorities in the reserve currency countries are pursuing similar non-inflationary policies) these movements tend to wash out over time. An historical simulation makes this clear: Figure IV.2 shows the hypothetical exchange rates for the ducat against the dollar and the euro (proxied by the DM at a rate of DM 1.9556 per € prior to 1999) under a dual currency board for the period January 1979 to July 2000. While there are periods of depreciation against both currencies, they are always followed by periods of appreciation, as the dollar-euro rate returns to parity. Periods during which the exchange rate exerts upward and downward pressure on the price level therefore tend to alternate.

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[6] While the dual currency board's effect on the average *level* of the real exchange rate is clearly downward, its effect on the *variability* of the real exchange rate is ambiguous, depending on the trade shares of the various currencies and their covariance against the domestic currency, as well as each other.

[7] One could also envisage a "basket" currency board with the domestic currency backed by a fixed amount of a number of reserve currencies to approximate the direction of trade. While such a system could further enhance stability of the real exchange rate, it would lack the transparency and simplicity of the dual currency board. The value of the domestic currency would no longer have a clear benchmark and the implementation of the convertibility guarantee would be cumbersome, either requiring the public to transact with the CB in a number of different foreign currencies simultaneously (likely involving significant transaction costs) or the CB authorities to actively manage the relative composition of reserves, leaving them exposed to potential trading losses. Also, movements in cross rates may move the basket weights away from the trade weights; it would be unclear how to effectuate any periodic reweightings that may be desirable.

Other economic effects of the dual currency board include an interest rate effect: as the peg switches reserve currencies, interest rates will shift "allegiance" as well. This is of some significance, since the existence of the dual currency board system itself has an effect on relative interest rates in the dollar and euro areas. This can be shown in the formal model in Appendix I by showing it is similar to the familiar interest-rate effect in a target zone (see Krugman, 1991), but it can also be easily grasped by realizing that in the case where the CB's reserves are all held in dollars, anyone holding euros in effect also holds an American call option on the dollar. At any time, they could bring their euro to the CB and demand a ducat, with which they could in turn demand a dollar—in effect, directly exchanging one reserve currency for the other. The "strike price" for this option is the one-to-one implicit cross rate embodied in the currency board rates. The option "premium" takes the form of a relatively lower interest rate on the euro.[8] It follows that the more depreciated reserve currency has the higher interest rate, implying that the CB country's interest rates would always be relatively higher. Note, however, that in practice, this effect may be offset to some extent by a lower risk premium on ducats if the dual currency board avoided the credibility problems that are associated with a peg to an overvalued reserve currency.

V. Choosing Currency Board Conversion Rates

The possibility of a switch in the peg complicates the choice of currency board conversion rates. This choice now involves the determination of a fixed exchange rate against not just one, but two reserve currencies. In addition, this joint determination automatically establishes a fixed cross rate between the two, which should optimally be set at an "equilibrium" rate, i.e., a rate where it is unlikely that either reserve currency is overvalued vis-à-vis the other (or, by implication, vis-a-vis the domestic currency). Since the implicit cross rate determines the timing of the peg switch, setting it at inappropriate level could still cause overvaluation to occur, so that some of the benefits of the dual currency board would be lost. For example, if the CB's conversion rates were set at 1.00 dollars and 1.11 euro, then the switch of the peg from dollar to euro would not occur until the dollar had appreciated to a level that is considered by many to involve considerable overvaluation.

The "equilibrium" argument of the previous paragraph notwithstanding, additional considerations could influence the choice of pegging currencies and conversion rates. It could be imagined, for example, that—for economic or non-economic reasons—the CB country's public considers the euro to be an inferior peg for the ducat. Such sentiments could be reinforced, for example, if there is significant dollarization in the economy, so that the switch to the euro would lead to a depreciation of the ducat vis-à-vis the alternative unit of account in the economy (i.e., the dollar). In this case, the switch to a euro peg could encourage the CB country's residents to exchange their ducat holdings for dollars, so that reserves of the CB would decline and dollarization would increase. The "share" of the economy profiting from the drop in the effective exchange rate of the ducat after a peg switch to the euro would decline. In addition, prices denominated in ducats

[8] While the system is symmetric, holders of dollars do not hold an option to buy euros, since the CB does not own any euros when the ducat is effectively pegged to the dollar. It is as if the option has not been written yet. There is nevertheless a symmetry in the system: when the ducat is effectively pegged to the euro, dollar holders would own a call option on the euro, and the dollar interest rate would be relatively lower.

could quickly rise to match the currency's depreciation vis-à-vis the the dollar unit of account. In this most extreme case, all benefits from the dual currency board could be lost.

To avoid such a situation from occurring, the authorities could choose currency board rates such that the ducat would be pegged to the dollar most of the time, and that only after a sustained appreciation of the dollar a peg switch would occur. If it were clear to the public that the dollar's appreciation was unsustainable and likely to be reversed in the near future (the situation in early 1985 comes to mind), it may be more willing to hold euro-based ducats, which would be expected to appreciate against the dollar. Thus, a flight from the ducat could be avoided, but the country could still be shielded from the most extreme effects of overvaluation. This strategy is reminiscent of that of a bimetallic country such as Britain in the eighteenth century, which chose gold and silver pegs for the pound that ensured that the currency was linked to gold most of the time. Only a large jump in the price of gold would have induced a switch to a silver peg.

Note that the dual currency board system adds a dimension to the "realignment" risk. The CB country may decide that one of the conversion rates is no longer realistic, and realign **only** this rate. For example, if the country had instituted a currency board in January 1999 with an implicit cross rate of $1.25 per euro (say, 1 ducat per euro and 0.8 ducat per dollar), the currency would since that time have been pegged to the euro (the relatively more depreciated currency in the market, when compared to the implicit cross rate). To avoid a strong upward move with the euro when it appreciates, the CB authorities may decide that they will realign the implicit cross rate by revaluing the currency board rate with respect to the dollar only, to, say, 1 ducat per dollar. Since this affects the implicit cross rate of the reserve currencies within the CB system, it may affect their value and rates of interest. The extent to which this happens can be derived from the formal model in Appendix I.

VI. Effects on Global Currency Stability: Target-Zones by Way of Dual-Currency Boards?

While the main result of the modified CB system concerns the CB country itself (i.e., the possibility of a switch in its peg), the global effects are potentially important as well. As was shown above, the foreign reserves of the CB country act as a buffer stock to the cross rate of the two reserve currencies. The price that is "buffered" is the cross rate implied by the currency board rates that are built into the CB system. Note that the CB country's choice of conversion rates therefore takes on global significance in the dual currency board system. The implicit cross rate between the reserve currencies not only determines the point at which the peg switches, but also the rate at which the CB reserves act to stabilize international currency markets.

The stabilizing effect should not be thought of as permanently fixing the reserve-currency cross rate; the reserves of the CB country would be much too small to accomplish this. With typical foreign exchange holdings in the tens of billions of dollars, a medium-sized country controls little more than ½ of 1 percent of U.S. M2. Instead, the CB provides only a limited barrier for the cross rate, which "leans against the wind" of currency movements. This "regulating" barrier can be shown to provide stability to the market cross rate through two effects. First, there is the direct "intervention" effect: when the dollar appreciates to reach parity with the euro, arbitrage will start releasing dollar reserves from the reserves of the CB onto the currency markets, in exchange for a

similar amount of euros. While this switch in reserves is taking place, the euro/dollar rate in the markets is fixed at parity. This first stabilizing effect is limited by the size of the CB's reserves.

There is a second—indirect—effect, however, which is familiar from the target-zone literature. Krugman (1991) showed that in a target zone, rational, forward-looking investors will anticipate the intervention that takes place when authorities defend the edges of a target zone. This anticipation acts to dampen currency movements when the exchange rate gets close to the edge of the target zone band, providing stability to the exchange rate even without actual intervention taking place. A similar effect is operational in the dual currency board system. As the euro/dollar cross rate gets close to the implicit rate in the CB system (say, parity), rational investors will anticipate the arbitrage that would start to take place when the market rate actually hits parity. They foresee that the release of dollars from the CB's reserves will slow any further appreciation of the dollar, thus creating the expectation of a relative euro appreciation compared to the situation where the dual CB system was not operational. This increases the demand for euros and supports the currency's value even before the release of dollars from the CB's reserves gets underway.

There are important differences between the "reflecting" barrier of the target zone and the regulating barrier formed by the cross rate implicit in the dual CB. The main difference stems from the reversibility and symmetry of the system. If dollar reserves "run out" because of sustained upward pressure on the dollar, there is no sense of a collapse of the system. While further dollar appreciation is now no longer prevented, and the cross rate is allowed to rise beyond the parity level, the dual CB is alive and well. The ducat is now linked to the euro, and all of the CB's reserves have been switched to euros. The situation is symmetric to that which prevailed while the euro/dollar cross rate was below parity. In fact, the same—but exactly opposite—stabilizing effects come into play on this side of the euro/dollar parity relationship; in this case, the anticipation of arbitrage taking place in case of *euro* appreciation limits the variability of the market cross rate close to parity.[9]

Another difference with the traditional target-zone has been alluded to previously: the operation of the system is not dependent on the actions of a central bank, but takes place automatically. The reserve switch—i.e., the release of amounts of the appreciating currency onto the currency markets—is the result of an arbitrage opportunity, and is guided by the profit-maximizing behavior of currency traders. This feature of the dual CB ensures that the system is not subject to the type of credibility problems that have plagued target zones. Indeed, the threat of a central bank failing to defend the fixed rate is the likely cause of the failure of empirical studies to find target-zone effects in a variety of monetary arrangements, including the Bretton Woods system and the EMS (see Flood, Rose, and Mathieson, 1991). In contrast, the empirical investigation in Oppers (2000) finds that interest-rate and exchange rate data from the mid-19th century are consistent with target-zone effects operating in the bimetallic system. This suggests such effects could be important in the dual CB system as well.

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[9] The technical side of these differences is explored in detail in Oppers (2000) for the case of 19th century bimetallism; since the dual CB can be modeled analogously (see Appendix I below), the technical results of that paper hold without modification.

In summary, the potential of the dual CB to stabilize global currency relationships is clearly limited by the size of the CB country's reserves, but due to the forward-looking expectations of currency traders (who anticipate the reserve switch) the stabilizing effect of the dual CB system is nevertheless more important than may seem at first sight; it operates even beyond the narrow range over which the reserve switch acts to actually fix the market cross rate. In addition, the stabilizing effect would be further enhanced if other countries joined by establishing CBs with identical implied cross rates. By pooling countries' reserves, coordinated dual currency boards could have a potentially important role in promoting global currency stability.

The stabilizing potential of the CB of the country from our earlier example (call it, country "A") remains one-sided: a market cross rate below parity is only supported from above, and one above parity is supported only from below. Yet the system can be extended to create true dual CB "target zones" if other peripheral countries adopted dual currency boards at slightly different implicit cross rates. If a second country (country "B") were to adopt a CB with conversion rates of 1 domestic currency unit per dollar and 0.9 per euro, for example, its reserves would provide a stabilizing force at the implicit cross rate of 0.9 dollar per euro. At a market rate of, say, 0.95 dollars per euro, B's currency would be effectively pegged to the dollar, with all reserves held in dollars (Table VI.1). But in country A's CB system, the ducat would be fixed to the euro with all reserves denominated in euros. Thus, the "target zone" formed by the implicit currency board rates of these two countries (parity in A, and 0.9 dollars per euro in B) would be "backed up" or "defended" by the buffer stocks that are the reserve stocks of the two countries: a stock of dollars in B that "kicks in" when the dollar appreciates, and a stock of euros in A that does so when the dollar depreciates.[10]

Here is where the analogy with bimetallism is at its most vivid. During the first three quarters of the 19th century, the differing bimetallic ratios in a number of important countries formed a series of bimetallic "stability bands" (Figure VI.1). During periods of comparatively minor shocks to the relative monetary supplies of gold and silver, their price ratio kept relatively constant, partly as a result of target-zone effects that operated around the bimetallic ratios. Larger shocks were absorbed by a quick change of currency in one of the bimetallic countries. France was the pivot of this system, experiencing such a change of currency twice: once in the 1850s, when a decline in the gold price as a result of new discoveries caused its silver coinage to be replaced by gold, and once again in the 1860s, when silver returned to circulation.

The establishment of differing implicit cross rates in two dual CB countries does NOT create an arbitrage opportunity that would make this system collapse immediately (as some may suspect), for a reason similar to that which allowed the different mint ratios to exist alongside each other in the 19th century. It is true that there would be a money machine if the following arbitrage were possible: buy one dollar for 1 ducat at country A's CB, sell this dollar for 1.11 euros at country B's CB, which one could then turn around and sell again at country A's CB for 1.11 ducats,

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[10] In a further extension, the dual CB system could provide global currency stabilizing effects if other countries adopted dual-currency currency boards using dollars and yen or yen and euros. Note however, that because there are only (n-1) independent cross rates, a peripheral country cannot independently choose a yen-euro system of currency-board cross rates if dollar-euro and dollar-yen dual currency boards are already in existence.

ending up with a tidy (and riskless) 11% profit. But note in Table VI.1 that if the market cross rate is such that country A's CB has dollars to sell, country B's CB does not have any euros, so that the money machine breaks down. The table shows that for the whole range of market cross rates, all potential forms of arbitrage between the two banks directly are impossible because one of the banks will in each case not have the currency for sale that is required to make the arbitrage work. The crucial stipulation in the convertibility guarantee is that a particular reserve currency can only be obtained if it is present in the CB's reserves.

VII. Conclusion

The addition of an alternative redemption currency to the convertibility guarantee has a profound effect on the workings of the CB system. It allows the CB country to switch pegs in such a way that the domestic currency is always linked to and backed by the relatively more depreciated reserve currency. It thus avoids importing overvaluation through the CB, which puts the country in a competitively superior position compared to a traditional CB.

As a beneficial side effect, the change in the composition of reserves that occurs when the peg switch takes place provides a stabilizing mechanism for global currency relationships: in effect, the CB reserves act as a buffer stock to the reserve-currency cross rate implied by the conversion rates between the domestic currency and the two reserve currencies.

The peg switch and the change in the composition of CB reserves are market-based and take place automatically. The system does not rely on the actions of the monetary authority beyond exercise of the fundamental convertibility guarantee. Thus, the system does not display the credibility problems that plague "target-zone" systems as a result of the possible failure of the authorities to intervene. The more general credibility problems of the convertibility promise and fixed exchange rate remain, but may be reduced since the risk that the peripheral country will end up being pegged to an overvalued reserve currency is eliminated, so that the economic problems associated with such a situation will be avoided.

One could nevertheless argue that the system's rules are less transparent and its dynamics more complicated than the traditional CB. If its workings are indeed less well understood, the dual CB's credibility could suffer. The experience with bimetallism is encouraging, however. Even though its workings are often a source of confusion today, the dynamics of the bimetallic system were well understood by contemporaries, and as such, the system enjoyed full credibility for centuries.

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APPENDIX I: A MODEL OF A DUAL CURRENCY BOARD

We can model the dual currency board using the log-linear model of the exchange rate originally used by Flood and Garber (1983) and subsequently adopted by the target-zone literature (e.g., in Flood, Rose and Mathieson (1991), Froot and Obstfeld (1991), and Krugman (1991)). Assume, for simplicity, that there are only three "countries" in our world, the United States, the euro area, and the CB country. The United States and the euro area each have their own currency, and the CB country's ducat is fully backed by either dollars or euros.

Thus, we can model the international monetary system by only considering the dollar and euro realms, with

Y_{US}	=	U.S. real output
Y_{EUR}	=	Euro-area real output
Y_{CB}	=	CB country's real output
$M_{\$}$	=	\$ money supply
$M_{€}$	=	€ money supply
$P_{\$}$	=	\$ price level
$P_{€}$	=	€ price level
x	=	dollar - euro exchange rate (\$ per €)
$E_t(dx)/dt$	=	expected change in x
$\bar{x}$	=	implicit cross rate embodied in currency board rates
$i_{\$}$	=	\$ interest rate
$i_{€}$	=	€ interest rate
λ	=	share of CB's reserves held in dollars
$v_{\$}$, $v_{€}$	=	\$ or € money demand shocks

Lowercase denotes natural logs, except for the interest rate.

$$m_{\$} - p_{\$} = a_{\$} + \beta_{\$} y_{\$} + \gamma_{\$} i_{\$} + v_{\$} \quad (1)$$

$$m_{€} - p_{€} = a_{€} + \beta_{€} y_{€} + \gamma_{€} i_{€} + v_{€} \quad (2)$$

$$i_{€} = i_{\$} - E_t(dx)/dt \quad (3)$$

$$p_{\$} = p_{€} + x \quad (4)$$

Equations (1) and (2) are money demand relationships for the dollar and euro realms, while equation (3) indicates that uncovered interest parity holds. Equation (4) assumes PPP.

The dual currency board is incorporated into the model by apportioning the CB country's economy to the dollar and euro realms as follows:

$$y_{\$} = \ln(Y_{US} + \lambda Y_{CB}) \quad (5)$$

$$y_{€} = \ln(Y_{EUR} + (1-\lambda) Y_{CB}) \quad (6)$$

In this setup, $y_{\$}$ and $y_{€}$ represent the proportions of world output that are "covered" by the dollar and euro money supplies. Thus, $y_{\$}$ includes all of Y_{US} and part of Y_{CB}, where the share of Y_{CB} that is apportioned to the dollar area depends on the share of dollars in the CB's reserves.

To summarize the model conveniently, we can combine (1) through (4) to get:

$$x = w + k + \gamma E_t (dx)/dt \qquad (7)$$

where $k = (m_\$ - m_€) - (a_\$ - a_€) - (v_\$ - v_€)$, and $w = \beta_€ \ln(Y_{EUR} + (1-\lambda)Y_{CB}) - \beta_\$ \ln(Y_{US} + \lambda Y_{CB})$. The system knows three basic states. In the first, $\lambda = 1$ and all of the CB's reserves are held in dollars. The exchange rate between the dollar and the euro, x, is above $\bar{x}$, the cross rate implicit in the dual currency board. The ducat is effectively pegged to the dollar. In the second state, $\lambda=0$ and all of the CB's reserves are held in euros; x is below $\bar{x}$ and the ducat is effectively pegged to the euro.

In the intermediate state, λ is between 0 and 1, with dollars and euros both present in the CB's reserves. In this case, the cross rate between the two reserve currencies is momentarily fixed ($x = \bar{x}$), and its instantaneous expected change is zero. Thus, $\bar{x} = w + k$. Any effects on x of changes in fundamentals k are offset by a change in the composition of the CB's reserves; an increase in, say, the dollar money supply would prompt an incipient fall in the value of the dollar, creating an arbitrage opportunity. Arbitrageurs would buy dollars in the exchange market for less than 1 euro, but sell them at the CB (using the ducat as an intermediary) for exactly 1 euro, making a profit. Their actions increase the amount of dollars held by the CB and decrease its holdings of euros. At the same time, the associated demand for dollars and supply of euros generated in the exchange market would tend to push the market exchange rate x towards the implicit cross rate of the dual currency board $\bar{x}$. This type of arbitrage would continue until x was again exactly equal to $\bar{x}$.[11] In the model, an increase in k would spark arbitrage that would cause λ to rise, thereby decreasing $y_€$ and increasing $y_\$$; the resulting fall in w offsets exactly the initial increase in k. On balance, a larger share of world output will be covered by dollars, prices will rise proportionally in the dollar and euro areas, and the market exchange rate between the dollar and the euro will remain unchanged.

If λ is either 0 or 1, this arbitrage mechanism cannot operate and x is free to "float." The existence of the dual currency board still has an effect on x, however, akin to the "target-zone" effect under a target-zone system. In essence, $\bar{x}$ is a regulating barrier for x, whose path is affected by the anticipation of the CB's reserves of dollars (or euros, as the case may be) released onto the market when x reaches $\bar{x}$. The target-zone effects—which influence all variables in the model, including price levels and interest rates—can be easily computed if it is assumed that fundamentals k follow a continuous-time random walk (see Oppers, 2000, for the complete solution to the model applied to the bimetallic system).

[11] Any costs associated with the arbitrage would allow the market cross rate to deviate from the implicit cross rate of the CB by some margin before arbitrage would start taking place. This margin is akin to the "gold points" under a gold standard.

Table IV.1. Selection Developing and Transition Countries: Trade Shares and Openness

	1998 Trade Share with				
	United States	Germany	Japan	Euro Area	1998 Proportion of Trade in GDP [1]
Latin America					
Argentina	14.2	4.3	3.7	20.0	10.2
Brazil	21.7	7.7	5.0	24.8	8.2
Chile	18.8	4.4	8.8	17.9	27.1
Mexico	77.8	2.4	2.6	5.9	25.0
Venezuela	43.0	2.7	2.5	10.8	20.3
Asia					
China, Mainland	17.5	4.3	15.0	11.4	19.6
China, Hong Kong	15.2	3.0	9.0	8.8	124.7
India	14.9	5.8	5.8	19.8	12.4
Indonesia	12.8	4.6	17.3	12.7	71.4
Malaysia	18.1	3.2	12.9	9.0	115.5
Pakistan	15.2	5.2	6.2	16.9	14.6
Philippines	24.8	3.0	16.5	8.9	56.4
Thailand	17.1	3.5	17.2	12.0	49.5
Africa					
Ghana	7.2	5.7	3.0	34.0	29.9
Kenya	5.4	5.1	4.3	17.9	30.5
Morocco	5.1	6.4	2.0	57.1	29.7
Nigeria	25.8	5.1	1.7	29.3	18.9
South Africa	10.5	9.3	6.1	25.6	29.0
Zimbabwe	4.1	3.9	4.5	13.6	47.3
Middle East & Europe					
Egypt	15.7	9.2	4.9	34.2	21.8
Israel	28.9	6.6	3.6	31.3	39.9
Kuwait	24.5	5.7	26.5	20.7	51.3
Saudi Arabia	19.7	3.5	12.1	16.7	34.1
Turkey	8.1	18.0	2.6	42.1	27.2
Central and Eastern Europe					
Czech Republic	2.1	35.0	0.6	54.9	60.9
Estonia	2.9	8.6	0.7	43.3	82.0
Hungary	4.0	34.3	1.8	65.5	60.8
Lithuania	2.9	16.2	1.3	32.7	62.3
Poland	2.3	31.4	0.6	59.2	27.5
Russia	7.8	9.8	2.6	28.1	28.6

Sources: IMF, *World Economic Outlook* Database, *Direction of Trade Statistics*

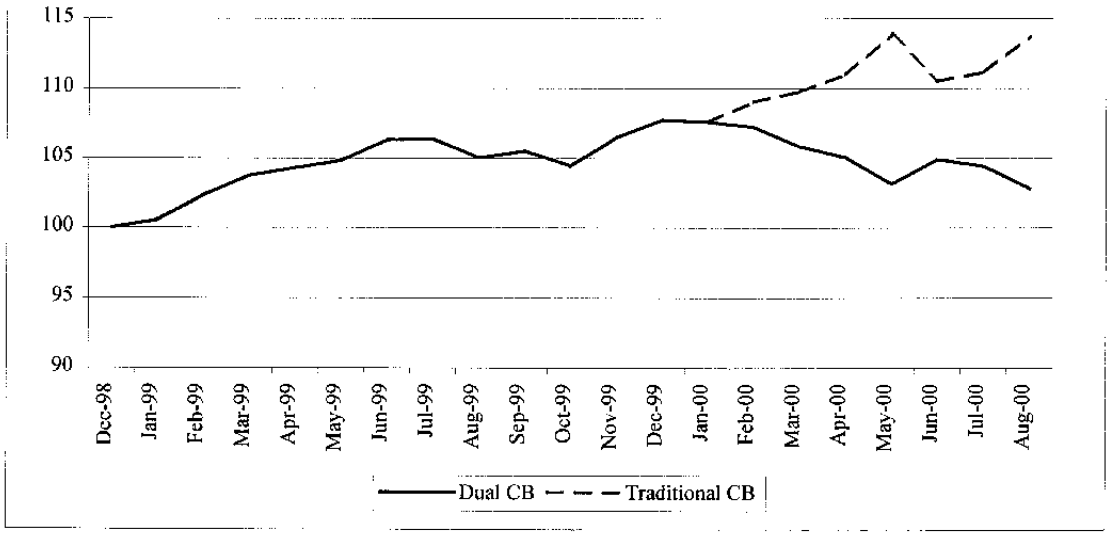
[1]The average of exports and imports in percent of GDP.

Table VI.1. Two dual currency boards with different implicit cross rates

	Market cross rate (dollars per euro)				
	x < 0.9	x = 0.9	0.9 < x < 1	x = 1	x > 1
Country A: CB dollar rate = 1, CB euro rate = 1					
Dollar exchange rate	> 1	> 1	> 1	1	1
Euro exchange rate	1	1	1	1	> 1
Peg	euro	euro	euro	dollar/euro	dollar
Reserves	euro	euro	euro	dollar/euro	dollar
Country B: CB dollar rate = 1, CB euro rate = 0.9					
Dollar exchange rate	> 1	1	1	1	1
Euro exchange rate	0.9	0.9	> 0.9	> 0.9	> 0.9
Peg	euro	dollar/euro	dollar	dollar	dollar
Reserves	euro	dollar/euro	dollar	dollar	dollar

Figure IV.1. REER under hypothetical dual $/€ currency board

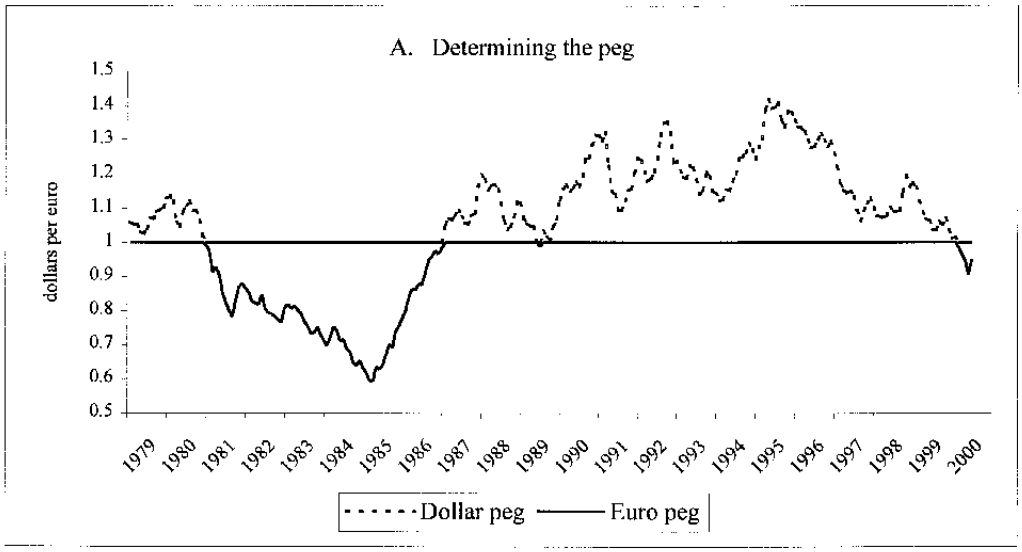
(Index December 1998=100)

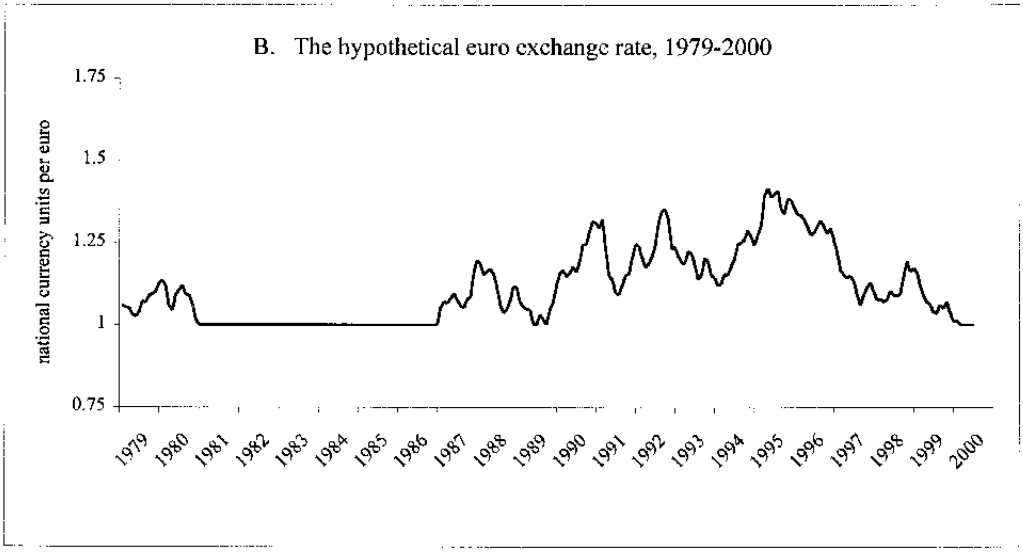


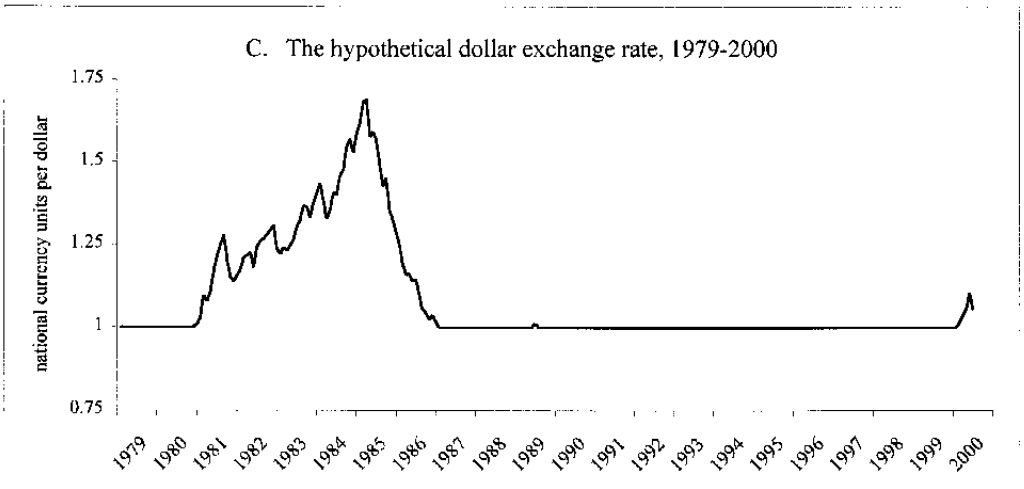
Source: IMF, *International Financial Statistics*; and author's calculations.

Note: Calculations assume:
(i) CB country's trade is divided equally between the United States and the Euro Area;
(ii) CB country's inflation rate of 2% *per annum*.

Figure IV.2. Hypothetical Exchange Rates under a Dual Currency Board, 1979-2000

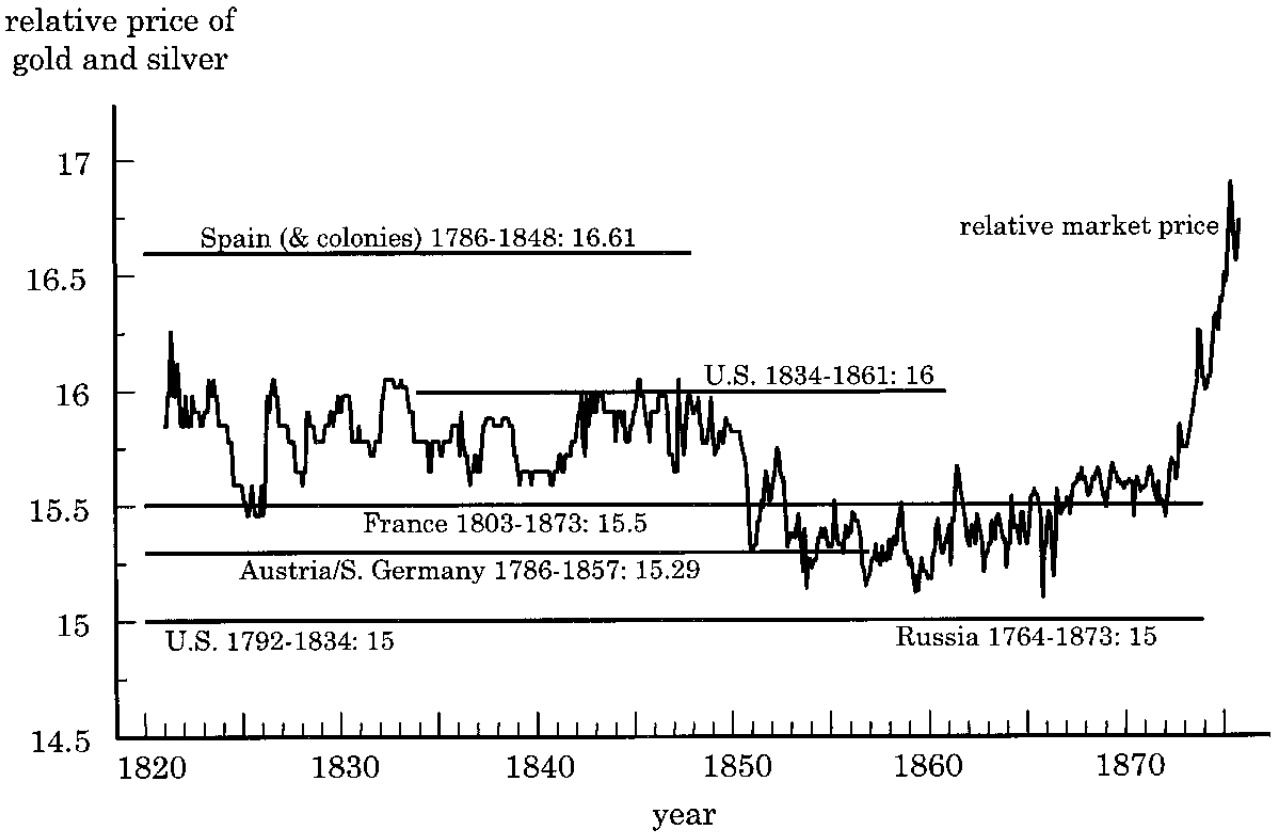






Source: IMF, *International Financial Statistics*; and author's calculations.

Figure VI.1
The Gold-Silver Price Ratio and Bimetallic Ratios in the 19th Century



Sources: Laughlin (1968); *The Course of the Exchange*; *Prijscourant der Effecten.*