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Capital Imports and the Jacksonian Economy: A New View of the Balance of Payments

Trevor J. O. Dick and John E. Floyd*

This paper offers a new intrepretation of United States balance of payments adjustment in the bimetallic period from 1820 to 1860 during which President Jackson vetoed the charter renewal of the Second Bank of the United States—an event destined to spark controversy over the macroeconomic interpretation of the period. Raising of the gold–silver price ratio in 1834 and the discovery of gold in the 1850s confirmed a United States commitment to the gold standard. Accordingly, new explanations of the period focussed on international factors, and many authors tried to make sense of the facts using price–specie–flow theory. Weaknesses in this view were noted long before any more satisfying alternative explanation emerged.

In this paper, a portfolio theory of adjustment is outlined that highlights the significance of the substantial international capital flows witnessed during the antebellum period. This interpretation is shown to be more consistent with the evidence than the more traditional price–specie–flow mechanism, and serves to underline the importance of international capital mobility to the mechanism of balance of payments adjustment. The United States price level was affected by United States and/or British banking events only to the small extent that these may have determined the world money stock and world price level. Inflows and outflows of specie were not the cause of changes in the United States price level, but instead, the result of changes in the United States excess demand for money, in turn, the result of major changes in real economic activities in the United States relative to the rest–of–the–world that contributed to the changes in relative price levels. A similar rationale explains the behavior of the British price level.

1. Introduction

Antebellum United States history belongs with a number of examples of nineteenth century settlement and growth in hitherto less populated parts of the world receiving immigrants and capital from Europe. This process was accompanied by an unprecedented development of international markets in goods and assets. Before World War I, Canada, the United States, Australia and Argentina in particular all enjoyed substantial net capital inflows under fixed

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exchange rate regimes that implied a monetary commitment to either silver or gold or both. International markets operated not only to deliver the gains from comparative advantage in goods and services trade, but also to facilitate a redistribution of world savings from surplus to deficit countries to yield the gains from comparative advantage in investment opportunities.

In this paper we examine the pre-Civil War consequences of capital inflow into the United States. Between 1820 and 1840 about 20% of domestic investment was financed by foreign savings (Davis and Cull, 1994, p. 3) even though the domestic savings rate grew along with investment.[1] Net capital inflows into the United States were at an all time high in the early part of the period, and accounted for the major part of British capital exports (Imlah 1958).

The macroeconomic history of the period has been variously interpreted. The United States banking system underwent major changes during this time, and early commentators pointed to the demise of the Second Bank of the United States as the principal source of inflation and depression (Atack and Passell 1994, chap. 4). Later when the importance of international considerations was recognized, the discussion invoked price-specie-flow as the principal mechanism of adjustment (Temin 1969, 1974). The only alternative explanation yet to appear anticipates a monetary approach to the balance of payments (Williamson 1964).

The importance of price-specie-flow in contexts where the balance of payments includes capital as well as trade flows has not been well understood. Recent studies have shown that the presence of international capital mobility fundamentally alters the nature of the adjustment process (Dick and Floyd 1992, Dick, Floyd and Pope 1996). Previous attempts to patch up the price-specie-flow story to accommodate capital flows have been ad hoc in the mistaken belief that only a minor amendment was needed with no major qualitative change in the theory. In this paper, we show that incorporating a portfolio equilibrium in integrated world markets for capital assets is a major qualitative change in theory and also best explains the antebellum process of adjustment.

The paper is organized in five main sections: (1) an overview of antebellum macroeconomic history, (2) a summary of past macroeconomic explanations of the period, (3) an outline of the portfolio approach to balance of payments adjustment under capital mobility, (4) a discussion of the empirical evidence supporting this portfolio approach, and (5) our conclusions reinterpreting antebellum macroeconomic history.

[1] External finance accounted for only 3% of domestic investment by the 1850s. But it should be made clear that net inflows of capital into the United States are not inconsistent with simultaneous growth in the domestic savings rate. Whatever the growth of domestic savings and investment rates may have been and however we may wish to account for them, it was apparently the case that the flow of domestic savings before the Civil War was not sufficient to meet the flow investment demand (Davis and Gallman 1994; Davis and Cull 1994, pp. 68–78).

2. Antebellum Macroeconomic History

The period is noted both for its great political changes and for its dramatic economic fluctuations. Peter Temin

Although much has been written about the severity of economic fluctuations and their explanation, the antebellum era was also a time of remarkable economic progress (Smith and Cole 1935; North 1961). Population doubled between 1820 and 1840, and nearly doubled again by 1860. Major canal investment, particularly in the north, took place before 1850 and railroad mileage increased 10-fold between 1840 and 1860 (Wicker 1960; Cranmer 1960). Interregional specialization and trade arose on the basis of northeastern manufacturing, western agriculture and southern cotton (North 1961). Fluctuations notwithstanding, it is clear that major immigration and settlement took place. The investment rate rose from 6–7% to about 12% between the 1800–40 and 1850–60 periods (Davis and Gallman 1994). The foreign funds that helped to support this growth went into the financial and transportation infrastructure. In 1838, for example, banks absorbed 31%, canals 35%, and railroads 25% of these funds, with states and cities acting as the guarantors. Total foreign indebtedness increased about 10-fold between 1820 and 1860, the bulk of it accumulating before 1840 (Davis and Cull 1994, p. 12). The balance of payments shows that net inflows occurred in two major episodes, in the 1830s and in the late 1840s to early 1850s.

The financial system that facilitated this growth consisted of state banks created by state legislatures that operated as regular commercial banks and the Second Bank of the United States which was a commercial bank that had the Federal government as its most important customer. The Second Bank, chartered in 1816, was conservative in its policies like the First Bank before it, acting as a sort of bankers' bank and fiscal agent for the government. As a center of control over the banking system closely linked to government, it is not surprising that it came under attack. When President Jackson, elected in 1828, decided to veto in 1832 a bill to renew the charter of the Second Bank due to expire in 1836, the growth of ordinary commercial banks exploded (Rockoff 1974, 1975). Many states passed laws that permitted free entry into the banking business without much attention to the type of security required against default. Apart from the implications these changes may have had for business fluctuations, there were long run costs associated with the reluctance of people to substitute paper for specie during the unbridled growth of free banks after 1836 (Engerman 1970). Jackson himself declared in 1836 (the Specie Circular) that the government would henceforward accept only specie in payment for land (Timberlake 1960a). Although banks issued notes and accepted deposits, these were not considered legal tender until 1862 (Officer 1996, p. 26). Only gold and silver coin were legal tender and banks were required to redeem their liabilities in this medium. The money supply, however, is usually defined in this period as the net obligations (notes and deposits) of banks to the public plus specie held by the public.[2]

To meet international obligations the government inherited the commitment made earlier by Hamilton to a bimetallic standard. The market ratio of gold to silver fluctuated around 15:1, an official ratio that Jackson raised to 16:1 in 1834. The United States was effectively on a silver standard before 1834 and a gold standard thereafter. Silver half-dollars circulated from early in the century and gold dollars were not actually minted till 1849 (Officer 1996, p. 56). The true mint parity before 1834 shows a minor amount of fluctuation produced by movements in the market prices of silver and gold. The parity of $4.86 to the pound sterling was established by the legislation of 1834. This dollar price of the pound defines the American exchange rate henceforward. Gold discovery in California in the early 1850s reinforced the operation of Gresham's Law strengthening the country's de facto gold standard. (Berry 1984; Laughlin 1896, pp. 26ff.; Friedman 1992, chap. 6; Greenfield and Rockoff 1995).

Public finance over the 1820–60 period began with the substantial retirement of Federal debt. By 1835 the federal debt was virtually zero. Revenues from tariffs and land sales appear to have contributed to this. One might have expected the crowding in of private investment, but according to James and Sylla (1980, pp. 268–272), the domestic money and financial markets were too undeveloped before 1835 for there to have been any noticeable effect apart from a generally deflationary impact.[3] Most states also had little debt in 1820, and the reputation of the Federal government on debt repayment wore off on the states making state debt an attractive holding in private portfolios including those of investors abroad. As a result, much of the retired Federal debt was replaced with state debt that became the channel for foreign loans to finance canal investment. The situation changed after 1836, however, when the Federal government began to run deficits. Treasury Notes that served as both bank reserves and currency were first issued in 1837 and not retired until after 1845. Divorcing itself from the banking system, the government instituted an Independent Treasury to be a safe depository of all government monies. This idea had a somewhat erratic history, but finally took hold in 1846 (Timberlake 1960b).

The cyclical pattern during the period is well known with two principal episodes of collapse in 1837 and 1857 (Smith and Cole 1935; Matthews 1954; Hughes and Rosenberg 1960; Temin 1969, 1974, 1975; Calomiris 1991). A major observation about these crises relevant to the adjustment process we wish to explore is that they were not solely American crises. England also experienced crises at about the same time—somewhat before the American crisis in 1837 and somewhat after the American crisis in 1857 (Gayer, Rostow and Schwartz

[2] Some reporting irregularities occurred in the late 1830s when private free banks arose in reaction to the demise of the Second Bank. Since private banks were not required to report their assets and liabilities, deposits and currency may be underestimated for some years (Warburton 1949, p. 77).

[3] Domestic financial markets, however, did improve before the Civil War (Bodenhorn 1992).

1953, vol. 1; Hughes 1960; Temin 1974). Whatever the state of undevelopment of domestic financial capital markets, it would appear that the international market was well developed and provided a transmission mechanism for the propagation of shocks. Explaining these cycles turns out to be intimately related to understanding the mechanism of balance of payments adjustment.

3. Explaining Antebellum Macroeconomic Adjustment: Domestic vs. International Factors

Jackson's attack on the Second Bank, the Bank War, was cited [by many] as the ultimate cause of the contraction of 1834 and the inflation of 1835 and 1836. Hugh Rockoff

The aggregate price level in the United States was determined by the price-specie-flow mechanism, operating in more or less textbook fashion. Peter Temin

The traditional picture of the period is well summarized by Temin (1968, 1969) in his introduction and by Rockoff (1971). The First (1791–1811) and Second (1816–32) Banks of the United States operated as bankers' banks and served as fiscal agents of the United States government. This is alleged to have conferred a monopoly in domestic exchange repugnant to Jeffersonian democratic ideals. The movement against this monopoly, with which Jackson's veto of the Second Bank seemed to many to harmonize, has also been traditionally regarded as a movement against sound banking. Inflation and ensuing depression is blamed on this decision. Implicit in this view is the contention that these banks could have effectively controlled the monetary base, and therefore, the money supply. Most fundamentally, this story assumes simply that domestic money determined domestic prices, and that the Second Bank of the United States had the ability to control the money supply. Added to this, the Specie Circular of 1836 is alleged to have helped precipitate the crisis by forcing the banks to meet heavy demands for specie. While this type of explanation may have accorded well with controversies of the time, it lacked any consistent recognition of the linkages among prices, the supply of specie and activities in the international capital market.

A European contribution to the traditional picture that the banking system was responsible in a major way for the history of cycles and the balance of payments in this period is provided by Lévy-Leboyer (1964, 1982). European banks, the Bank of England in particular, were instrumental in organizing trade credit for the expanding international trade of the period. Had the Bank of England not adopted a more passive stance in 1832 by abandoning the so-called "Palmer rule," Lévy-Leboyer believes the 1830s cycle could have been moderated. While it is true that the Bank of England was a bankers' bank, a lender of last resort, it is also true that a commitment to the gold standard, especially after 1844, limited the ability of the bank to "lean against the wind." Matthews (1982) criticizes Lévy-Leboyer for making too sharp a distinction between the Bank of England and other banks, and believes the Bank of

England policies displayed greater continuity over time than found in the Lévy-Leboyer picture. Temin (1982) points out that the evidence is not clear that what Lévy-Leboyer choses to describe as excessive British lending in the 1830s was actually under the control of the Bank of England. Temin observes that Lévy-Leboyer talks only of excessive lending and never of the money supply in connection with Bank of England policies, yet Temin too fails to observe that the Bank of England, under the gold standard, did not control the British money supply.

An early attempt at revision was made by Macesich (1960) who viewed the price-specie-flow mechanism as having played a key role in the 1834–1845 period. Capital flows were taken as mainly exogenously determined by external considerations.

> . . . Given the specie standard, we should expect that an inflow of capital and the corresponding increased supply of foreign exchange would drive the exchange rate in the United States to the specie-import point; the inflow of specie would cause the money supply in the United States to rise, and consequent price changes would cause imports to rise and exports to fall. In this way the trade balance would be turned against the United States thus enabling the real transfer of capital to the United States to occur. And, conversely for the period when capital inflows ceased. [Macesich 1960, p. 413]

Williamson (1961) is critical of this approach, largely because it appeared to fail to take any account of changes in income (important to his long swing analysis) on the various elements of the balance of payments. An early embellishment of price-specie-flow was, of course, to elaborate a similar mechansim to incorporate income effects—the so-called "income-specie-flow" mechanism. The full implications of Williamson's work, however, were more fundamental, as will be seen below. Temin (1968) also criticized Macesich's views, largely on the grounds that it was difficult to find evidence after 1835 of the close connection between specie flows and inflation that Macesich hypothesized.

Jeffrey Williamson (1962, 1964), in the context of long swing analysis, appears to have come closer to understanding the balance of payments adjustment mechanism at work that we develop more fully in the present paper. In considering relative fluctuations in capital movements, gold flows, the trade balance, and the current account, Williamson takes a general equilibrium approach according to which excess demand for both goods and real money balances can be offset by an excess supply of securities—a net inflow of foreign capital (p. 163). The novel feature of his analysis is the view that gold flows may have been occurring to satisfy excess demands for real money.

> . . . . the balance of payments components form a part very closely related to the whole of the general equilibrium growth matrix. The flow of gold seems to respond in a functional way to excess demands for money over the long swing in real income: it is fortuituous in the sense that net capital flows are excessive enough to oversatisfy excess demands for real-money balances while, if net capital inflows had not been forthcoming in increasing amounts, severe interference with maxiumum growth performance might have occurred prior to the secular peak.
>
> The period 1842-1861 is the only exception during the nineteenth century to the

> less restrictive hypothesis that gold inflow is positively related to income movements over the long swing. It is not, however, an exception to a model which states that net gold inflows are conditioned by excess demand in the money market. During this time span, for various and complex reasons, net capital movements were not sufficient to finance the usual expanding trade deficit. But this was also a period of unusual domestic gold production, which allowed continued development without enormous needs for foreign capital. The export of gold financed that deficit, yet domestic gold production was still large enough to allow the domestic system sufficient liquidity. An excess supply of money released gold from the domestic system [Williamson 1964, p. 187].

Williamson is faulted by Willett (1968) and by Temin (1968) for not developing these ideas into a more completely specified theory of adjustment as well as for interpreting specie solely as gold when silver also was clearly relevant in the 1830s. These passages are nonetheless highly suggestive for the potential analysis of internal and external forces on domestic prices and output. The general thrust is that capital mobility permits reaping gains from comparative advantage in investment, while gold, wherever it appears under a gold standard, redistributes itself to accommodate the changing demands for real money.

Willett (1968), apart from criticizing Macesich and Williamson for their shortcomings, proposes another alternative explanation that is a variant of the "rules-of-the-game" view. According to Willett, international specie flows provoke attempts on the part of the banking system to sterilize them. This manifests itself in variations in the reciprocal of the reserve ratio—what Willett calls the "expansion ratio." These variations, Willett believes, are linked to financial crises. It is far from clear, however, that the evidence brought to bare on this hypothesis effectively discriminates against alternative explanations.

In a more recent view that also pays attention to international factors, it is observed that in the 1830s, prices rose in both Great Britain and the United States (Temin 1974). The rise in British prices, due to some unspecified "variant of the price-specie-flow mechanism" (p. 212), is alledged to have produced a deficit in the British balance of payments and an outflow of bullion. The rise in prices in the United States is alledged to result from the inflow of funds that accompanied net capital inflow during the prolonged boom in transportation investment. How did the outflow of bullion from the Great Britain arrive in the United States as the classical price-specie-flow mechanism predicted? Evidently it did not move directly, but nonetheless accumulated in the predicted manner. The particular vehicles in this case were the mining of silver in Mexico and opening of the Chinese opium trade. The United States paid for its trade deficit with China in Mexican silver and China bought opium from Great Britain with the same silver. Instead of shipping silver around the world, American merchants sent a bill on London to the Orient and silver remained in the United States, in effect, the result of London lending to the United States. Hence, with some slight complications, the inflow of British capital into the United States brought silver with it and this silver apparently increased American prices.

In the 1850s, however, the process began in the United States with the discovery of gold. This raised prices in the United States, resulting in the substitution of imports for domestic goods and a deteriorating balance of trade. But since capital was being imported from Great Britain at the same time, prices rose more in the United States than in Great Britain, according to Temin. Notwithstanding the earlier reference to a "variant of price-specie-flow" applying to the 1830s situation, Temin now insists the rise in British prices in the 1830s was entirely without bullion inflow, while the rise in British prices in the 1850s was the result of both inflation abroad and the inflow of gold (Temin 1974, p. 214). The forces determining the relative importance of internal and external influences on domestic prices are never explained.

The revisionist view, due to Temin (1968, 1969, 1974), Macesich (1960) and Rockoff (1971), to be sure, recognizes the openness of the American economy, gives much greater importance to international considerations and places less emphasis on domestic banking decisions. Rather than the absence of restraint in the banking system after Jackson's veto, it was an influx of specie that financed the inflow of British capital and overheated the economy thereby producing inflation. At the time, Great Britain was on the gold standard and the United States effectively on silver. According to Temin (1974), the United States price level was determined by price-specie-flow, silver in the 1830s and gold in the 1850s. As in a traditional Humean picture, money still determined prices, but the balance of payments rather than the banking system was responsible. According to price-specie-flow, an improvement in the balance of payments leads to specie inflow, monetary expansion, a rise in domestic relative to foreign prices, and subsequent deterioration in the balance of payments to restore equilibrium in goods markets. But this is apparently not what happened in Great Britain.

It is not surprizing that Temin finds that Humean theory will not encompass all of the facts he observes. Both Taussig (1927) in his later years and his famous student Viner (1924) also find anomalies to the price-specie-flow story. It appears that specie flows were not always as remarkable or well timed as they would have to have been to explain convincingly all relative price movements and balance of payments changes. Williamson (1961, pp. 377, 382) reports a similar finding for the 1827–43 period of United States history, and Matthews (1954, pp. 95–99) recognizes that incomes and prices probably did not play the central role in British balance of payments adjustment that the Currency School of banking attributed to them and attempted to enshrine in the Act of 1844 (Collins 1978). Indeed, even contemporary observers questioned the role of gold discoveries in raising price levels in some countries in the 1850s (Hughes 1960, pp. 14–17).

The reasons why the mixed banking and price-specie-flow picture of price determination offered by Temin and others creates problems for coherent explanation are not hard to find. Since both the United States and Great Britain were on commodity standards, the exchange rate between their currencies was fixed and stable except for the minor variations due to the costs of operating bullion markets (Officer 1983, 1996; Collins 1986, 1988, chap. 5). It follows that neither Great Britain nor the United States ought to have been able to alter independently their domestic money supplies (Timberlake 1961). These latter were determined for both countries by the balance of payments. And if the inflow of capital from Great Britain raised the United States price level, it did so by the influence of that inflow on the prices of nontraded goods in the United States and their importance to the total price level. The influence of capital flows, as Viner (1924) correctly noted, comes from their impact on nontraded goods prices relative to traded goods prices. The similarity between the movements of British and American prices, as presented by Temin, is misleading in this respect since the indices used represent mostly traded goods whose prices ought to have been, and in fact were, largely the same everywhere given open markets. This evidence is a demonstration of the law of one price rather than part of a reason for viewing the nature of price formation in the two countries as fundamentally different. Dornbusch and Frenkel (1984) also recognize the weakness of the price-specie-flow story applied to the 1847 British crisis and note instead the importance of capital flows, though their model differs from ours in the role they assign to interest rate differentials. The anomalies that Temin uncovers disappear when it is recognized, as explained below, that an open economy trading goods and assets in world markets has its price level determined partly by the world price level and partly by what is going on in that country relative to the rest-of-the-world that determines the relative price of its goods in terms of rest-of-world goods. It is clear from the way Rockoff (1971) summarizes what recent research has achieved that a full exploration of the relevant linkages has yet to be made.

While the revisionist attempts have clearly advanced our understanding of the period by recognizing the importance of international considerations, they require a more complete and consistent theory of balance of payments adjustment and of price formation to be completely effective. To test alternative theories of balance of payments adjustment, including price-specie-flow, requires that these theories be properly specified to recognize the essential elements that distinguish them, a task to which we turn in the next section.[4]

[4] The problem of explaining cycles from 1820 to 1860 to which balance of payments adjustment is closely related once drew the comment, "A totally fresh assault upon the problem seems overdue" (Hughes and Rosenberg 1963, p. 493). Despite the work of the intervening years, we believe this statement is almost as valid today as it was when it was written.

4. The Portfolio Theory of Adjustment: The Significance of International Capital Mobility

The role of prices in the adjustment process when capital is internationally mobile is not a simple extension of Hume's original theory, much less an elaboration logically equivalent to the price-specie-flow mechanism. Trevor Dick and John Floyd

The portfolio theory of balance of payments adjustment contains three essential propositions. First, economic agents decide the form in which they hold their wealth and the disposition of the income from that wealth on the basis of rational choice. Second, agents are free to exchange a wide variety of assets in an international market. And third, the markets for goods and assets must be in equilibrium, subject to the usual resource constraints. Our portfolio theory of balance of payments adjustment follows from a rigorous interpretation of the implications of proposition two in terms of propositions one and three.[5]

The proposition that individuals are free to buy and sell a wide range of assets (though not necessarily every asset) across international boundaries constrains the domestic interest rate in relation to interest rates in the rest of the world according to the familiar relationship

$$i = i^* + \rho + E_\pi \tag{1}$$

where i and i^* are the domestic and rest-of-world nominal interest rates, ρ is the risk premium on domestic assets and E_π is the expected rate of change of the nominal exchange rate, with the latter defined as the price of foreign currency in terms of domestic currency. When convertibility into gold is not in doubt, E_π will equal zero. Equation (1) has its counterpart in the relation between the two countries' real interest rates. The two Fisher equations can be written

$$i = r + E_P \tag{2}$$

$$i^* = r^* + E_{P^*} \tag{3}$$

where r and r^* are the domestic and foreign real interest rates and E_P and E_{P^*} are the expected inflation rates. Substitution of these into (1) yields

$$r = r^* + \rho - E_q \tag{4}$$

where E_q is the expected rate of change of the real exchange rate. The real exchange rate is defined as

$$q = \frac{P}{\pi P^*} \tag{5}$$

[5] The development that follows is an extension of that used in the authors' previous studies (Dick and Floyd 1991, 1992, 1993; Dick, Floyd and Pope 1996). The extension recognizes that the domestic (United States) economy might not be "small" in the sense that the term is usually applied.

where P and P^* are the price levels of domestic and foreign output and π is the nominal exchange rate. The real exchange rate is the relative price of domestic output in terms of foreign output. Equations (1) and (4) derive from market efficiency and interest rate parity and appear as Euler equations in intertemporal maximization models.[6] The risk premium ρ would be zero if there were "perfect capital mobility". This would occur where every asset is tradeable internationally and all assets are perfect substitutes in the portfolios of a sufficient number of individuals. The importance of equation (4) lies in its constraining effect on domestic real and monetary equilibrium.

Small open economy analysis proceeds under the assumption that r^* is independent of developments in the domestic economy. In the case at hand, the United States is 20–25% of our rest-of-world aggregate and could conceivably be as much as 10% of the complete rest-of-world aggregate one would construct if the data were available. This raises the question of the potential role of the United States in determining world interest rates. A simple generic model of the equality of world savings and investment yields the following:

$$S(Y\,, r^* + \rho - E_q, \gamma_S\,) + S^*(Y^*\,, r^*, \gamma_S^*\,) = I(Y\,, r^* + \rho - E_q, \gamma_I\,) + I^*(Y^*, r^*, \gamma_I^*\,) \tag{6}$$

where we have substituted in equation (4) to eliminate the domestic interest rate. The functions $S(...)$, $S^*(...)$, $I(...)$ and $I^*(...)$ represent domestic (United States) and rest-of-world real savings and investment. The variables γ_S, γ_I, γ_S^* and γ_I^* denote exogenous shifts in the respective functions. This suggests the following relationship determining the rest-of-world interest rate:

$$r^* = r(\,Y^*, \,Y\,, \,\Omega\,, \,\rho\,, E_q\,) \tag{7}$$

where Ω is an umbrella shift variable that incorporates all of the γ variables. As the domestic economy gets increasingly smaller the effects of Y, ρ, E_q and the γ_S and γ_I components of Ω approach zero and r^* becomes determined entirely in the rest of the world. Even when

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[6] Interest parity implies that

$$i - i^* = \psi + \rho_X$$

where ψ is the forward discount on domestic currency and ρ_X is the premium for political and security-specific risks. Efficient markets implies that

$$\psi = \rho_T + E_\pi$$

where ρ_T is the risk premium on forward domestic currency. These two equations plus the Fisher equations yield (1) and (4) above, with the consolidated risk premium equal to

$$\rho = \rho_X + \rho_T.$$

This relationship is derived many places in the international monetary economics literature (e.g., Obstfeld, 1986; Cumby, 1988).

the domestic economy is of significant size, however, we would be unlikely to see much effect of variations in Y on r^* in the data since the effects of changes in world income $Y + Y^*$ combine a variety of ambiguous effects. A rise in world full-employment income resulting from technological change and expansion of the human and physical capital stock will affect both savings and investment. The effect on the world interest rate will depend on what happens to the marginal productivity of capital and there is little presumption as to the direction of effect. When changes in world income are the result of changes in employment, the relationship between those changes and movements in world interest rates is similarly ambiguous. Income expansion consequent on world monetary shocks will typically be associated with lower world real interest rates—the so-called liquidity effect. Income expansion consequent on improved expectations as to the return on investment (portrayed in (7) as a shift of Ω) will be associated with increases in world interest rates. The net effect will depend on the mix of these two types of shocks.[7] To the extent that domestic full-employment income expansion contributes to world expansion its effects too will also be in either direction.

Turning now to domestic real goods market equilibrium, we begin with the budget constraint

$$Y = X + DSB = C + I + B_T + DSB \tag{8}$$

where Y is domestic real income, X is domestic output, C is real consumption of domestic and foreign goods (on both private and government account), I is real investment of domestic and foreign goods (on both private and government account), B_T is the balance of trade and DSB is the debt service balance (interest and dividends received from foreign residents minus interest and dividends paid to foreign residents). Subtracting $C + I$ from both sides of (8) and noting that domestic savings is the excess of income over consumption we obtain

$$Y - C - I = S - I = B_T + DSB. \tag{9}$$

Since $S - I$ is the net capital outflow and $B_T + DSB$ is the current account balance, equation (9) implies that the capital account deficit must equal the current account surplus. This equation is treated here as an equilibrium condition—for the demand for domestic output to equal the supply, the "desired" or "planned" magnitudes of C, I, Y, B_T, and DSB must satisfy (9).

Equation (9) can now be expanded using the expressions determining domestic savings and investment in equation (6) and giving the balance of trade its standard functional representation as dependent upon domestic and foreign real incomes and the real exchange rate.

$$S(Y, r^* + \rho - E_q, \gamma_S) - I(Y, r^* + \rho - E_q, \gamma_I) = B_T[q, Y, Y^*, \Psi] + DSB \tag{10}$$

[7] In elementary textbook parlance, the liquidity effect results from a rightward shift in the world LM curve while the expectations effect results from a rightward shift of the world IS curve. Changes in the level of world full-employment income appear as rightward shifts of both the IS curve and the vertical line representing full-employment output.

where the function $B_T[...]$ represents the real balance of trade—a rise in domestic income increases imports relative to exports, a rise in foreign income increases exports relative to imports, and a rise in the real exchange rate (i.e., an increase in the relative price of domestic output in terms of foreign output) shifts both domestic and rest of the world demand away from domestic goods towards foreign goods and reduces the balance of trade. Ψ is a shift variable incorporating exogenous shocks. *DSB* is determined, of course, by past capital movements.

Equation (7) can now be substituted into (10) to eliminate r^*, yielding

$$N[\,Y\,,\,Y^*,\Theta\,] = B_T[\,q\,,\,Y\,,\,Y^*,\Psi\,] + DSB \tag{11}$$

where $N[...]$ is the net capital outflow and Θ encompasses all the shift variables affecting it. Either q or Y must continually adjust to maintain equality of aggregate demand and supply of domestic output as expressed by this equation and, alternatively, by equation (9) from which it is derived.

Equation (11) has interesting implications about observed statistical relationships between the real exchange rate and the current account balance in an environment in which the major changes in income do not involve cyclical changes in employment. If the data are generated primarily by shocks to Θ we can expect to observe a negative relationship between the real exchange rate and the current account balance—the real exchange rate has to adjust to drive the current account balance into line with the equilibrium net capital outflow. On the other hand, if the data are generated primarily by shocks to Ψ the current account balance will appear to be insensitive to real exchange rate changes—the real exchange rate has to adjust in this case to prevent the current account from changing. And particular combinations of Θ and Ψ shocks will exist for which a positive relationship between the real exchange rate and current account balance will be observed.[8]

Manipulation of (11) yields the formal determinants of the real exchange rate:

$$q = q(\,Y\,,\,Y^*,\Theta\,,\,\Psi, DSB\,) \tag{12}$$

Using the definition of the real exchange rate in equation (5) this becomes

$$P = q(\,Y\,,\,Y^*,\Theta\,,\Psi\,, DSB\,)\cdot\pi\cdot P^* \tag{13}$$

It is immediately evident that under a commodity standard where π is normalized at unity the relationship between the domestic and rest-of-world price levels can depend on asset market

[8] This makes it clear that information about the sign and magnitude of the partial derivative of $B_T[...]$ with respect to q, commonly known as the Marshall-Lerner condition, cannot be obtained by regressing the current account balance (or the balance of trade) on the real exchange rate and domestic and foreign incomes. A negative value of this partial derivative is necessary for stability of the equilibrium.

conditions only to the extent that the latter have real effects on the levels of output and employment, the level or expected rate of change of the domestic real exchange rate or the risk premium on domestic assets. The domestic and foreign price levels are linked together by real sector equilibrium.

Two conditions are required for world asset equilbrium to hold. One of these has already been defined by equation (4)—relative domestic and foreign interest rates must adjust so that world asset holders in the aggregate have no incentive to reallocate their portfolios among the outstanding stocks of claims to domestic and foreign employed capital. The second condition, taken in context of the issues we are considering, is that the world demand for specie equal the supply. Since the total portfolio consists of specie and non-specie, equality of the demand and supply of specie implies equality of the demand and supply of the aggregate of the remaining assets. Letting G_d, G_f and G be the domestic, foreign and world specie stocks respectively, and denoting the domestic and foreign ratios of money stock to specie by μ and μ^*, we can write

$$\mu G_d = P \cdot L(r^* + \rho - E_q,\, r^*, E_P, Y\,) \tag{14}$$

$$\mu^* G_f = P^* \cdot L^*(r^*\,,\, r^* + \rho - E_q\,, E_{P^*}, Y^*) \tag{15}$$

$$G = G_d + G_f \tag{16}$$

where $L(...)$ and $L^*(...)$ are the domestic and foreign demand functions for money. Using (4), we have expressed the domestic interest rate as $r^* + \rho - E_q$. These three equations can be consolidated into the form

$$G = \frac{P\,L(...)}{\mu} + \frac{P^*\,L^*(...)}{\mu^*} \tag{17}$$

To see the implications of (17) for determining the domestic price level, differentiate it totally and translate the differentials into relative changes as follows:

$$\hat{G} = \alpha\,\hat{P} + \alpha\,\hat{L}(...) - \alpha\,\hat{\mu} + (1-\alpha)\,\hat{P}^* + (1-\alpha)\,\hat{L}^*(...) - (1-\alpha)\,\hat{\mu}^* \tag{17a}$$

where a ˆ over a variable denotes its relative change and α is the share of the world gold stock held in the domestic economy. This implies

$$\hat{P}_w = \alpha\,\hat{P} + (1-\alpha)\,\hat{P}^* = \hat{G} - \alpha\,\hat{L}(...) + \alpha\,\hat{\mu} - (1-\alpha)\,\hat{L}^*(...) + (1-\alpha)\,\hat{\mu}^* \tag{17b}$$

where P_w is the world price level. The rate of change in the rest-of-world price level can therefore be expressed

$$\hat{P}^* = \frac{\hat{G}}{(1-\alpha)} - \hat{L}^*(...) + \hat{\mu}^* - \frac{\alpha}{(1-\alpha)}\,\hat{L}(...) + \frac{\alpha}{(1-\alpha)}\,\hat{\mu} - \frac{\alpha}{(1-\alpha)}\,\hat{P} \tag{17c}$$

As the domestic economy becomes increasingly small, α approaches zero and the rest-of-world (and world) price level becomes independent of developments in the domestic economy. As the domestic economy becomes of significant size domesic variables can influence the domestic price level only insofar as they affect the world demand for specie. Given the world demand for and supply of specie, and hence the world price level, a rise in the domestic price level will require a reduction of the price level in the rest of the world.

In formal terms, the rest-of-world price level can thus be expressed

$$P^* = A(G\,,\, r^*\, Y^*\,,\, \mu^*\,,\, E_{P^*}\,,\, Y,\, \mu\,,\, E_q\,,\, \rho\,,\, E_P,\, P\,) \tag{18}$$

where the influence of all variables other than G, Y^*, r^*, μ^* and E_{P^*} disappears as the domestic economy becomes very small.

Equations (13) and (18) can now be solved simultaneously for the equilibrium values of P and P^* in terms of the world gold stock, domestic and foreign incomes, the domestic and foreign money multipliers and the whole range of expectational and shift parameters appearing in both equations. The essential feature of this equilibrium is that the domestic price level is unaffected by the allocation of the world gold stock between the domestic and rest-of-world economies. Domestic forces affect the domestic price level only to the extent that they affect either the world demand for specie (which can only happen if the country is of significant size) or the equilibrium real exchange rate. The domestic price level is not determined, as the traditional price-specie-flow theory suggests, by changes in the domestic money supply consequent on the inflow of specie in response to balance of payments shocks.

The relationship between the money supply and the price level is the reverse of that postulated by the price-specie-flow theory. The domestic reserve stock is determined by the domestic demand for reserves given in equation (14):

$$G_d = \frac{P \cdot L(\,r^* + \rho - E_q,\, r^*, E_P, Y\,)}{\mu} \tag{14a}$$

Changes in the domestic price level determined by (13) and (18) help determine the size of the desired stock of domestic specie reserves. This stock can be attained by simply trading non-monetary assets for specie in the international market. If the banking system creates, through its domestic loan and discount policies, less money than domestic residents want to hold, domestic residents reestablish portfolio equilibrium by selling non-monetary assets in the world market. As the foreign currency acquired is converted into domestic currency at the banks the domestic banking system is forced to create additional domestic money balances to meet the demand for them and to acquire international reserves in the process. The banking system controls its reserve levels by appropriately adjusting domestic credit policies. It has *no* control over the domestic money supply. The latter always equals whatever domestic residents want to hold. The banks can only control the division of their asset portfolios between domestic loans and discounts and international reserves. The country's stock of international reserves thus depends on the public's desired money holdings, which determine the banking system's note and deposit liabilities, and on the various factors, such as interest rates, that affect the profit maximizing reserve ratios of the commercial banks.[9] [10]

Note that domestic/foreign interest rate differentials play no role in the adjustment process. As can be seen from equations (1) and (4), those differentials depend on the risk premium on domestic assets and the expected rate of change in the real and nominal exchange rates. There is no response of capital flows to independently determined domestic and foreign interest rates as postulated in many price-specie-flow models. Modern asset pricing theory views ρ as determined by the covariance structure of output and asset returns and establishes no presumption that an increase in the supply or demand for money in any given period will affect that covariance structure—the money shock need only be a draw from the random process defining that covariance structure (Merton, 1971; Kouri, 1977; Lucas, 1978, 1982; Stulz, 1984; Pasula, 1992). The domestic price level is thus determined by world monetary conditions and the set of domestic and foreign real factors—technology, savings propensities and the international distribution of investment opportunities—that determine the real exchange rate.

The reserve flow or balance of payments surplus is obtained by differentiating (or differencing) equation (14a) with respect to time.

$$\frac{\dot{G}_d}{P} = \frac{L(\cdots)}{\mu}\,\frac{\dot{P}}{P} + \frac{L_{r^*}}{\mu}\,\dot{r}^* + \frac{L_Y}{\mu}\,\dot{Y} - \frac{L(\cdots)}{\mu}\,\frac{\dot{\mu}}{\mu} \tag{19}$$

[9] In the antebellum United States, the government had no control over the stock of money through its Treasury note issue. The quantity of government notes held depended on the public's and the banking system's demand for them—any excess would be converted into gold. This convertibility enables us to apply our theoretical model without explicitly separating government and private note issue.

[10] Our approach differs from a number of contemporary models of international portfolio equilibrium [See, for example, Dornbusch (1975), Frankel (1983), Branson and Henderson (1985), and Frenkel and Mussa (1985)]. These models formulate issues in terms of a wealth aggregate composed of four assets consisting of domestic money, foreign money, domestic bonds and foreign bonds, where the quantities of all aggregates are defined as their present values. Demand functions for the respective assets are then constructed with interest rates and the aggregate present value of wealth as arguments. Given the exogenously determined (in the short run) supplies of the assets, the system of equations solves for the domestic and foreign interest rates and the portfolio shares. This type of formulation focuses on the effects of changes in government debt and official reserve holdings in a world of Ricardian non-equivalence. It largely ignores international exchange in real capital assets. Our purposes do not require an explicit definition of aggregate wealth. Moreover, by using Temin's money stock estimates, as Friedman and Schwartz (1970, p. 257) point out, we implicitly share Temin's belief that the government functioned much like private agents in it's money holding decisions so that issues of Ricardian equivalence do not arise.

where a $\dot{}$ over a variable denotes its time rate of change and L_{r^*} and L_Y are the partial derivatives of $L(\cdots)$ with respect to r^* and Y. The variables ρ, E_q, and E_p are assumed constant.

The balance of payments surplus can also be expressed in more conventional terms. We can split aggregate real savings in equation (10) into two components: the country's accumulation of international reserves, measured in units of domestic output, and all other accumulations of real assets by domestic residents on both private and public account, denoted by S'.

$$S = \frac{\dot{G}_d}{P} + S' \tag{20}$$

Substitution of this into (10) yields

$$\frac{\dot{G}_d}{P} = B_T[\, q \,,\, Y \,,\, Y^*,\, \Psi \,] + DSB + I - S'. \tag{21}$$

Equation (21) represents the balance of payments surplus as the excess of autonomous receipts over autonomous payments. Nevertheless, as equation (20) indicates, the entire source of variation in the induced net capital flow is S', which varies only as a result of shifts in the rate of growth of desired money holdings, given by the right side of equation (19). The balance of trade and debt service balance are unrelated to factors affecting the real reserve flow for the reasons discussed above.

It is evident from the role played by ρ in the above analysis that the condition for balance of payments equilibrium—and the *process* by which balance of payments adjustments occur—is fundamentally the same whether capital is perfectly or imperfectly mobile internationally. Even if the risk premium varies through time, a change in the surplus or deficit in the balance of payments results from a change in autonomous relative to total saving as a direct consequence of a change in the desired rate of domestic money accumulation and corresponding change in the accumulation of domestic specie reserves. Domestic interest rates will not change unless there is a change in the risk premium. Modern consumption-based asset pricing theory suggests that the difference between domestic and foreign interest rates should depend on the differences between the covariances of domestic and foreign returns on real capital with the marginal utility of consumption.[11]

The novelty of the portfolio theory is perhaps best understood against the background of the price-specie-flow theory that has for so long held sway as the fundamental theory of balance of payments adjustment.[12] The standard textbook version of the classic adjustment

[11] For a review of this point see Blanchard and Fischer (1989, pp. 510–12). Domestic credit expansion can affect the domestic covariance and risk premium only if it signals a change in the pattern of future variations in domestic output and asset returns.

[12] The classical price-specie-flow theory has a long history dating back at least to Hume (Hume, 1752, pp. 330–41 and 343–5). For a useful historical survey, see Viner (1937, chapters 6 and 7).

mechanism equates the international specie flow to the balance of trade, sometimes including long-term capital flows as an exogenous additive item. When gold flows occur, the quantity of money and price level fall in the country losing gold and increase in the recipient country, thereby making the goods of the deficit country relatively more attractive. This process leads to an adjustment of the balance of trade until the gold flow is eliminated. In more sophisticated discussions of the adjustment mechanism, short-term capital flows are incorporated as a response to international interest rate differentials. An outflow of gold and the resultant tightening of domestic money causes the interest rate to rise relative to the interest rate abroad. This attracts capital, moderating the gold loss and smoothing out the adjustment process. More theoretically sophisticated treatments also allow for the effects on the balance of trade of small movements of the exchange rate between the gold export and import points and of spending effects that are negative in the country losing gold and positive in the country accumulating it.

The classical view can be represented formally in terms of the equation

$$\frac{\dot{G}_d}{P} = B_T[\,q\,,\,Y\,,\,Y^*\,\Psi\,] + DSB + N_L + N_S[\,r - r^*\,] \tag{22}$$

where N_L is the exogenous net inflow of long-term capital and $N_S[\,r - r^*\,]$ is the net inflow of short-term capital, expressed as an increasing function of the differential of domestic over foreign real interest rates.

In essence, equation (22) is simply (21) with the constraint imposed that

$$I - S' = N_L + N_S[\,r - r^*\,]. \tag{23}$$

Equation (22) then takes the place of (4). The domestic interest rate and price level are determined by (10) and (14a) (without the substitutions of (4) that eliminated r) and the resulting values of P and r plug into (22) to determine the specie flow. This specie flow then affects the stock of reserves G_d, eventually causing balance of trade and price level adjustments that reduce the size of the specie flow. Long-run equilibrium occurs when the specie flow is zero.

Equation (4) connects the domestic and foreign interest rates on the basis of risk adjusted arbitrage in an open international capital market. Equation (22) imposes a relationship between the interest rate differential and the magnitude of the autonomous international flow of short-term capital. In the classical system, the domestic interest rate is determined by domestic real and monetary conditions. A capital flow is then generated by the interest differential leading, along with the balance of trade surplus or deficit, to reserve flows and consequent adjustments in the domestic money supply until a new domestic equilibrium is established consistent with a zero gold flow. This process of reestablishing balance of payments equilibrium involves temporary changes in prices, incomes, and the balance of trade. In contrast, domestic interest rates are determined in the portfolio theory by the condition that, given free international trade in assets, asset prices must adjust at every point in time until the aggregate stocks of domestic and foreign assets are willingly held by world asset holders. Domestic residents then adjust their money holdings to the desired level by exchanging money and assets with foreign residents at this equilibrium vector of world interest rates and the associated equilibrium levels of domestic income and prices.

5. The Empirical Evidence

> *The combined balance on current and capital accounts and not merely the first component was critical for the smooth operation of the gold standard system.* Barry Eichengreen

The core of our empirical testing is the attempt to assess the relative support offered by the data to the portfolio theory viz-a-viz the price-specie-flow mechanism. Preliminary to the main tests, we begin with an examination of the relationship between the real net capital inflow and the real exchange rate and relative non-traded goods prices in the United States vs. the rest of the world. Then after presenting incidental estimates of the demand functions for real money balances and the real reserve stock we test the alternative theories of balance of payments adjustment in several steps. First, starting from the perspective of the specie-flow theory we conduct tests of cross-equation restrictions implied by the two theories of balance of payments adjustment within a seemingly unrelated regressions framework. The the reserve flow equation suggested by portfolio theory is then estimated and its standard error compared to the reserve flow equation under the price-specie-flow theory. This leads, finally, to a set of non-nested hypotheses tests.

The real net capital inflow plus debt service balance together with the movements of the real exchange rate and relative United States/Rest-of-World non-traded goods prices are shown in Figure 1 (see page 38). Apart from trends, there is a general correspondence between the relative price level variables and the real net capital inflow plus debt service balance. As indicated in the theoretical analysis above and demonstrated in Figure 2 (see page 39) there is no reason why we should at all times and places expect to observe a negative relationship between the real exchange rate and the current account surplus less debt service balance (or, correspondingly, a positive relationship between the real exchange rate and the net capital inflow plus debt service balance). The line CB in Figure 2 shows the effect of a change in the real exchange rate on the balance of trade in goods and services excluding the services of capital. Shifts in income, technology and tastes (captured by Ψ in equation (10)) shift this curve. The vertical line SI shows the level of the net capital outflow minus the debt service balance. This line shifts in response to changes in income and taste and technology factors affecting desired domestic savings and investment. Clearly, if there have been substantial shifts during the data period in the factors affecting savings and investment and no shifts in the exogenous shocks to exports and imports the data points will trace out the line CB.

A negative relationship between the real exchange rate and the trade balance excluding the services of capital (and positive relationship between the real exchange rate and the real net capital inflow plus debt service balance) will be present. On the other hand, if there have been major shifts in the forces determining exports and imports and no shifts in the exogenous determinants of domestic savings and investment, the data points will trace out the vertical line SI and no relationship between the net capital inflow plus debt service and the real exchange rate will be present. Since any combination of these exogenous technological and income expansion effects on savings and investment and exports and imports is possible there is no reason why we might not observe a relationship in either direction between the real exchange rate and the net capital inflow plus debt service balance.

These arguments explain why the absence of a significant relationship between the real exchange rate and real net capital inflow plus debt service balance in column (1) of Table 1A (see page 40) should not be surprising. The addition of the domestic and foreign real income variables to the regression shown in column (2) removes the influence of real income shocks to the curves in Figure 2 (see page 39) and we end up with a positive relationship between the real exchange rate and the net capital inflow. All this tells us is that the factors not appearing in the equation that shifted SI have been more important in the data than those shifting CB.[13] The addition of the terms of trade variable in column (3) improves the fit while leaving everything else much the same. That there are many forces affecting the real exchange rate not captured by the real income variables and the terms of trade is evident from the low Durbin-Watson statistic. Column (4) presents the reverse regression to that in column (2). This regression yields an acceptable Durbin-Watson statistic, suggesting that the left-out variables are better correlated with the real exchange rate than with the real net capital inflow.

Table 1B (see page 41) presents the same regressions except that United States/Rest-of-World non-traded goods prices are substituted for the real exchange rate. This relative price variable does not do nearly as well as the real exchange rate, though the other variables do about the same except that the coefficient of domestic real income is about twice as large in columns (2) and (3). It should be kept in mind that relative non-traded goods prices is only one component of the real exchange rate, the other being relative traded goods prices. A comparison of the magnitudes and significance of the net capital inflow and relative price coefficients in Table 1B as compared to Table 1A suggests that the traded goods price components of the real exchange rate adjustments that occurred as a result of shifts in the international relative price structure were less destructive of a positive observed relationship to the real net capital inflow than the non-traded goods price components. There were

[13] In our Canadian study (Dick and Floyd, 1991, 1992) the effect of the settlement of the western prairies on investment and the movement of capital into the country was so predominant that we obtained a positive sign in the counterpart equation to that in column (1).

evidently significant world-wide movements in the relative prices of traded vs. non-traded goods. Alternatively, of course, the different results in Table 1B may be due to our inability to adequately divide the price indexes into their traded and non-traded goods components and may thus reflect poor data.

Estimates of the demand function for money for the period are presented in Tables 2A (see page 42) and 2B (see page 43). In the former table we use the British open market discount rate as the short-term interest rate; in the latter we use a constructed United States short-term interest rate. The results are similar except that the British open market discount rate has a higher coefficient and gives a somewhat better fit. Adding a long-term interest rate does not improve matters in either case. Trend must be added to the usual specification of real income and interest rates on the right-hand side to obtain an acceptable coefficient for the interest rate variable, and this is possible only when we use the British short-term interest rate.[14] It turns out that adding the real net capital inflow to the regression improves the fit, eliminates the first-order serial correlation in the residuals and increases the statistical significance of the United States short-term interest rate variable, though it reduces the significance of the British short-term interest rate variable. This suggests that factors associated with the net capital inflow must have shifted the demand function for money. The residuals from regression (2) of Table 2A are plotted against the real net capital inflow in the top panel of Figure 3 (see page 44). The correspondence is remarkable. In the bottom panel of Figure 3 we plot the ratio of the banking system's note and deposit liabilities to its specie reserves. It is evident that periods of generally low capital inflow were periods when the equilibrium real money stock was low and the banks' reserve ratios were high after correcting for the effects of changes in the level of real income. Although further work needs to be done it appears that, as Sushka (1976) has shown, the demand for money, and the demand for specie, behaved differently after the Second Bank ceased operation as the federal bank. Periods of high confidence were periods in which capital flowed in, asset holders held relatively large money holdings and banks kept relatively low reserve ratios. In periods of low confidence, the opposite occurred. Another possibility is that the response of the demand for money to interest rates was much greater after 1835 than before that year, as Sushka's work suggests, and that appropriate dummy variables for the constant term and interest rate to incorporate this hypothesis would eliminate the significance of the real net capital flow variable in explaining the regression residuals. But regressions including these dummy variables (not shown) yield insignificant coefficients for both the dummy and interest rate variables.

The real reserve stock demand regressions are presented in Table 3 (see page 45). Here we pursue the idea that a coherent relationship should be found between interest rates and income and the demand for the stock of specie similar to the demand function for money. To the extent that the money multiplier is included on the right-hand side the interest rate

[14] Much poorer results are obtained when we use the logarithms of the real money stock and real income variables.

and income variables represent determinants of the quantity of money demanded in the same way as in conventional demand functions for money. It is evident from Table 3 that the fit is generally much better than that for the demand for money. In regression (2), for example, real income and the interest rate variables are significant with the correct signs, but the residuals continue to indicate misspecification. The addition of trend improves things substantially. Curiously, the money multiplier variable is insignificant with the wrong sign. One interpretation of these results is that specie is the real 'money' in the economy during this period.

Table 4 (see page 46) contains regressions of the real reserve flow into the United States on the set of determining variables postulated by the price-specie-flow theory as well as regressions explaining movements of the real trade account balance.

$$T_B = \alpha_0 + \alpha_1 q + \alpha_2 Y + \alpha_3 Y^* + \alpha_4 L_C + \alpha_5 N_E + u_t \tag{24}$$

$$\mathbf{G_d} = \beta_0 + \beta_1 q + \beta_2 Y + \beta_3 Y^* + \beta_4 L_C + \beta_5 (r_t - r^*_{t-1}) + \beta_6 N_E + v_t \tag{25}$$

where T_B is the real balance of trade in goods and services excluding the services of capital, $\mathbf{G_d}$ is the discrete first difference of G_d deflated by P_{t-1}, N_E is the real debt service balance, L_C is a proxy for real long-term net capital inflow, and u_t and v_t are $i.i.d.$ error terms with mean zero and constant variance. As specified in equation (22), the specie flow theory postulates that the real balance of payments surplus (real reserve flow) is the sum of several independent balance of payments components—the trade balance, which is determined by relative prices and real income as in (22) augmented by the transfer effect on domestic spending of the net capital flow plus debt service, the debt service balance, the exogenously determined real long-term net capital inflow and the short-term real net capital inflow which is a function of the differential between domestic and foreign interest rates. We use the real value of land sales, real investment in canals, and railroad mileage as proxies for the long-term capital inflow. Because the trade balance is an additive component of the balance of payments surplus, both it and the balance of payments surplus should respond identically to changes in relative prices and income—that is, the coefficients of the relative price variable and the respective real income variables should be the same in the real reserve flow regression as in the real trade balance regression. To test this proposition we fit the two equations jointly using the seemingly unrelated regressions technique. The results are presented in columns (3) and (4). The differences between OLS and SUR in this case are minor and incidental to our purposes.[15] The null hypotheses that the coefficients of the real exchange rate, domestic real income and rest-of-world real income are respectively the same in the two equations is rejected at the 1% level with an F(3,63) value of 6.47. If the portfolio theory were true all the variables in the

[15] The coefficients of the variables and standard error of the regression are the same in (1) and (3) because both equations have the same right-hand-side variables. It turns out that the correlation between the residuals of equations (1) and (2) is so small that there is also little difference in the coefficients and standard error of regression of (4) as compared to (2).

real reserve flow regression other than the constant term should be zero. The null hypothesis that these coefficients together are zero cannot be rejected at the 5% level—the P-value for the test is 0.075. This gives little support for the specie-flow theory, however, because the relative price and income coefficients (the latter of which are statistically significant) and two of the three long-term capital coefficients have the wrong signs.

The portfolio theory predicts that the real inflow of specie reserves should depend on the change in the demand for specie by the United States banking system and non-bank public, as indicated in equation (19). Converting (19) into an equation useful for estimation purposes yields (26):

$$\mathbf{G_d} = \gamma_0 \,+\, \gamma_1[g_d\,\tilde{P}] \,+\, \gamma_2[g_d\,(r^*_t - r^*_{t-1})] \,+\, \gamma_3[g_d\,\tilde{Y}] \,+\, \gamma_4[g_d\,\tilde{\mu}] \,+\, \gamma_5[g_d\,\tilde{N}_E] \,+\, w_t \qquad (26)$$

where g_d is $G_{d(t-1)}$ deflated by P_{t-1}, a ˜ over a variable denotes the relative first difference change of that variable and

$$\gamma_0 = 0$$

$$\gamma_1 = 1$$

$$\gamma_2 = \frac{1\,\partial L}{L\,\partial r^*} < 0$$

$$\gamma_3 = \frac{Y\,\partial L}{L\,\partial Y} > 0$$

$$\gamma_4 = \frac{\mu\,\partial L}{L\,\partial \mu} < 0$$

$$\gamma_5 = \frac{N_E\,\partial L}{L\,\partial N_E}$$

and w_t is an *i.i.d.* error term with zero mean and constant variance. Note that γ_2 is the interest semi-elasticity of demand for money and the other γ coefficients, with exception of the constant term γ_0, are elasticities of demand for money with respect to the relevant variables.[16]

The least-squares fit of (26) is given in column (1) of Table 5 (see page 47). The interest rate variables have the correct signs but both are statistically insignificant. United States real income and the money multiplier are significant with the right signs. Contrary to expectations based on money demand theory, as reflected in our derivation of (26) from (19), the coefficient of the price level variable is significantly different from unity (t = 2.07). When in column

[16] Our derivation yields a value of γ_4 equal to minus unity. We must recognize, however, that shifts of the demand function for money (not incorporated in our exogenous variables) will often be correlated with shifts in banks' desired reserve ratios, so departures of the coefficient from minus unity should not be surprising.

(2) the coefficient of the price variable is constrained to be unity, the long-term interest rate coefficient is statistically significant and larger in magnitude. As in earlier work (Dick and Floyd 1991, 1992), and following equation (26), including the debt service balance in column (3) also substantially improves the fit, but the difference from unity of the coefficient of the price level variable remains statistically significant (t = 1.74). When we further constrain the coefficient of the price variable to be unity in column (4), the results of column (3) hardly change.[17] Overall, the standard errors of these portfolio theory regressions are one-half to two-thirds the standard errors of the comparable specie-flow regression, lending strong support to the portfolio theory as compared to the specie-flow alternative.

Further strong evidence of support for the portfolio theory and lack of support for the price-specie-flow mechanism is obtained from a number of non-nested hypotheses tests, the results of which are shown in Table 6 (see page 48) . First, all the regressors in regression (2) in Table 4 (see page 46) are added to regression (3) in Table 5 (see page 47) and F-tests of the significance of the two sets of regressors in the expanded equation are conducted. The null hypothesis that the portfolio theory variables contribute nothing to explaining the dependent variable is rejected with a value of $F(6,25)$ of 24.5 and an infinitesimal P-value. The null hypothesis that the specie-flow variables contribute nothing to the explanation of the real reserve flow cannot be rejected—the $F(8,25)$ statistic is 0.80 and the P-value is 0.61. Next, J-tests are performed by including the fitted values for each equation as regressors in the other equation (Davidson and McKinnon 1981). The fitted value from the portfolio regression is statistically significant in the specie-flow regression with a t-statistic of 12.6 while the fitted value from the specie-flow regression is statistically insignificant in the portfolio theory regression with a t-statistic of 0.61. The F-tests enable us to evaluate each theory's prediction that the means of the coefficients of the other theory's regressors are zero while the J-tests enable an evaluation of whether the conditional variance of the dependent variable can be reduced by the predictions from the other theory's regressors. Finally, complete parameter encompassing tests are conducted to evaluate whether each theory's predictions about the other theory's coefficients and contribution to reducing the conditional variance of the dependent variable are jointly consistent with the data (Mizon and Richard 1986). Here, the specie-flow theory predictions regarding the parameters of the portfolio theory are rejected with an $F(6,31)$ statistic of 4.42 and a P-value of 0.002. The portfolio theory predictions regarding the parameters of the specie-flow theory are not rejected—$F(8,33)$ is 0.84 and the P-value is 0.57. These non-nested hypotheses tests strongly support the portfolio theory and do not support the specie-flow theory.

To the extent that the United States economy is sizable relative to the rest of the world

[17] The debt service balance can be formally incorporated into the model in three possible ways: as an argument in the demand function for money, as a determinant of μ and/or as a component of income not properly measured by Y. The sign of this variable will depend on what was happening during the time-period of estimation.

there is the possibility that the price variable in regressions (1) and (3) might be correlated with the error terms in those equations. Increases in demand for money growth, for example, will increase reserves above the level predicted by the included right-hand side variables, increasing the error term. It will also increase world demand for money growth and thereby lower the rate of growth of the price level in the world as a whole and, hence, in the United States. This will bias the coefficient of the price variable upward. The results in regression (4) are unaffected by the possible simultaneity bias because the offending coefficient is constrained to equal unity.[18]

6. Conclusion

> *Given a nation which is on the gold or a bimetallic standard dominated by gold, there is reason to suppose that the rate of change in the money stock over the domestic long swing will be controlled partially by conditions in the balance of payments and the flow of specie.* Jeffrey Williamson

We conclude by confirming that part of the revisionist reinterpretation of antebellum monetary history that rejects the events-of-banking-history explanation of the courses of prices and output in the United States after 1820. Given the commitment to a metallic standard, and therefore to fixed exchange rates, by the United States and her principal trading partners, neither the Bank of the United States, the United States Treasury, nor the Bank of England, nor any collection of banks in either country exercised any important control over domestic money supplies, but only over the composition of monetary bases in their respective countries. At the same time, the presence of international capital mobility made a critical difference to the balance of payments adjustments that ensued from the international behavior of investors and banks, and from discoveries of gold. These adjustments cannot be properly explained by any version of the price-specie-flow theory of adjustment.

The evidence presented here suggests instead that portfolios were adjusted at home and abroad to accommodate the specie requirements of wealth holders who reacted to developing trade and investment flows that accompanied the growth of the international economy and to the changing world supplies of gold and silver. In both the United States and Great Britain, the price level was a consequence of each country's real exchange rate and the world demand for money and supply of specie and was not determined by the size of the domestic stock of specie, over which neither country's government or banking system had any control. The distribution of specie was determined by their relative demands for money, in turn a consequence of their relative pace of investment and growth of income. Changes in the balance of trade occurred only to maintain equilibrium in output markets and were subservient to the process of portfolio adjustment. The mining of silver in Mexico, the opening of the opium

[18] Attempts at instrumental variable estimation have thus far been unsuccessful due to lack of an appropriate instrument for our price level variable.

trade, and the discovery of gold in California, events that have figured importantly in previous accounts of how the United States economy worked, were of importance only to the extent that they affected world economic conditions.

Data Appendix

The data required for this study are time series (1820-60) of the basic macroeconomic variables including population, measures of nominal and real output, prices, long- and short-term interest rates, the balance of payments and its components, money and international reserves, and exchange rates for the United States and a relevant subset of countries representing the rest of the world. In this study, the rest-of-the-world includes Great Britain, France, Germany and Sweden. Because the period has attracted research attention in the past, considerable data has already been accumulated by other scholars, and one must choose among competing alternatives whose relative quality is still disputed (Bairoch 1976; Maddison 1995). In other cases, where series are yet to be devised, proxies for early output and price index measurements are reasonably inferred from the available series in order to implement the model.

POPULATION: Population statistics were used to construct weights to build rest-of-the-world aggregates of prices and output. These data were readily available over the entire period for the United States, Great Britain, France, Germany and Sweden from Mitchell (1962, 1992, 1993).

NOMINAL AND REAL OUTPUT: The annual series estimated for the United States by Berry (1988) for both nominal and real values and the accompanying deflator are used. These are the only annual estimates for the period available and rely on interpolation of census benchmarks with concensus patterns of a wide variety of annual real, monetary and financial series. While these benchmarks and patterns yield results broadly consistent with the work of Kuznets (1952, 1961), Gallman (1966, 1972, 1992), Engerman and Gallman (1983), David (1965), and Weiss (1994), they offer no definitive resolution of the controversies among these researchers and eschew the belief of Calomiris and Hanes (1994) that "it is impossible to construct an adequately consistent series for real GNP" (p. 414). Although these annual estimates rest on a statistical rather than an economic model, they happily avoid direct inferences that might be made from such economic theories as the quantity theory of money that would render the resulting series inappropriate for the econometric estimation of money demand required by the present study. It is, of course, still possible to make casual inferences such as the possible correlations between stock and bond yields and more general economic activity observed by Sylla, Wilson and Jones (1994), but this does not suggest the use of such correlations as a basis for the generation of new data for econometric use for similar reasons.

A rest-of-the-world aggregate for output was constructed using population weights for 1850 applied to goss domestic product data for Great Britain (.27), France (.35), Germany (.35) and Sweden (.03). For aggregation purposes, each series was converted to an index with base 1850 and the weights applied to the indexes. The deflators were treated the same way.

Although some of these countries were on a bimetallic standard over much of the period, the dominant housekeeping role played by France in this system resulted in virtually fixed exchange rates for our period (Flandreau 1996). It was unnecessary, therefore, to introduce exchange rates into the aggregation procedures. For Great Britain, real gross domestic product estimates from 1830 made by Deane (1968) are adjusted from an 1841 base using the revised estimates of industrial output made by Crafts and Harley (1992). Since there are no GDP estimates prior to 1830 (Harley 1982; Crafts 1980, 1995), the Crafts-Harley series was used to project GDP back to 1820. For GDP in nominal terms, we infer the use of a deflator such as the general level of British prices estimated by Kuznets (1930). For France, we use the nominal and real GDP estimated by Toutain (1987) and the associated deflator for the entire period. For Germany, we use the data by Hoffmann (1965) from 1850, and project backwards to 1820 with Prussian data using benchmarks summarized in Fremdling (1995) and Maddison (1995) interpolated by the output of Prussian coal (Spree 1978). For deflators, we use wholesale prices before 1850 (Jacobs and Richter 1935), and Hoffmann (1965) after 1850. For Sweden, our period predates formal GDP estimation. Following Jonung (1976), we assume mainly extensive growth before 1860 and project real GDP backward from an 1861 benchmark (Krantz 1988) provided by the start of official statistics using population, and infer nominal values using an index of general prices (Amark 1921).

Prices: Apart from the price levels associated with the GDP estimation, we require a measure of the distinction between movements of traded and non-traded goods' prices in the United States and in the rest of the world. For the United States, the benchmarks and weights provided by David and Solar (1977) for the key subindexes of food and clothing (traded goods), fuel and light, and rent (non-traded goods) were interpolated using the annual Vermont series for these components constructed by Adams (1944). For the rest-of-the-world, non-traded goods prices were based on a representative sample of these goods in Great Britain, France, Germany, and Sweden. For Great Britain, we used fuel and light price indexes from Phelps Brown and Hopkins (1981). For France, we used coal price indexes from Kuznets (1930). For Germany, we used coal and brick price indexes from Jacobs and Richter (1935), and for Sweden, we used indexes of coal, brick, roofing and nail prices from Jorberg (1972). In general, construction material prices were taken as proxies for rental costs. As in the case of rest-of-the-world output, all indexes were based to 1850 and aggregated using population weights assuming fixed exchange rates throughout.

Interest Rates: For the United States, long term interest rates are represented by a New England municipal bond rate (Homer and Sylla 1991), and an implicit interest rate on foreign debt estimated by North (1960). Inasmuch as international capital was highly mobile over the period, the British consol rate is another proxy (Homer and Sylla 1991). Short term United States market rates begin only in the 1830s (Homer and Sylla 1991) and were associated with textile financing (Davis 1960, 1963). A short term commercial paper rate was spliced over the first half of the 1830s with yields on earning assets for Pennsylvania constructed from 1820 by Bodenhorn and Rockoff (1992). For the rest-of-the-world, we assume British rates are appropriate in this period and use the consol rate for long term and the open market discount rate for the short term (Homer and Sylla 1991).

Money and International Reserves: For the United States, we use the sum of net bank obligations and specie outside banks calculated by Temin (1969) and reported in Friedman and Schwartz (1970). The underlying specie estimates are a residual obtained by subtracting state bank and Bank of the United States holdings from his reconstructed total specie estimates. These latter estimates are designed to take account of the output of domestic gold mines as well as net specie inflows. In these calculations, there is little disagreement over the size of bank holdings of specie, while the total specie in the United States rises more steeply in the 1850s than the published series of the Comptroller of the Currency. The resulting money stock estimates are approximately in line with the estimates of Macesich (1984). Somewhat more conservative total specie estimates for the 1850s are provided by Friedman and Schwartz (1970). Missing values for 1851, 1859, and 1860 in the Temin money stock series were interpolated using Friedman and Schwartz (1970). For international reserves, we use the total specie stock reconstructed by Temin (1969). The annual flow of international reserves is simply the first difference of this stock. There are few estimates of the world stock of specie before 1850, but it is possible to exploit an 1885 estimate (Soetbeer 1886) in combination with gold and silver production data (Laughlin 1896; Vilar 1976) to provide an approximate series.

Balance of Payments: The primary source of balance of payments statistics in this period is North (1960). From this source we derive net capital inflow (long and short term) by the indirect method as the negative of the current account balance. The current account balance, for our purposes, consists of the trade account balance (trade in goods and services and invisibles) plus the debt service balance (interest and dividends received on foreign investments less interest and dividends paid out on investments made by foreigners). For this purpose, specie flows are excluded from current account trade flows. Independent direct estimates of long term capital inflow (Wilkins 1989) for benchmark years correspond well with the negative of North's current balance that includes specie flows, making it possible to infer that his specie flows correspond roughly to short term capital inflows. Some useful proxies employed in this study and assumed to be correlated with these flows include land sales (Williamson 1964), canal investment (Cranmer 1960) and railroad mileage (Wicker 1960).

Exchange Rates: The United States was on a bimetallic standard over the whole period making a small change in the mint ratio in 1834. Minor restrictions in bank payments also occurred in 1837 and in 1857. Great Britain was on the gold standard from 1821 when she resumed specie payments at the parity prevailing before the Napleonic Wars. France was on a bimetallic standard. Germany was on a silver standard. Sweden returned to a silver standard in 1834 following a period of inconvertibility from 1809 (Bordo and Schwartz 1996; Flandreau 1996; Officer 1996). Except for Sweden, as Flandreau has shown, there were no significant departures from fixed exchange rates among the currencies of these countries over the period considered. Changes in the price of silver in Sweden, and therefore in the gold-silver price ratio, are recorded in Jorberg (1972). Except for Sweden, actual exchange rates, as explained above, were not therefore required in this study.

References

Adams, T. M. (1944) *Prices Paid by Vermont Farmers for Goods and Services and Received by Them for Farm Products, 1790–1940; Wages of Vermont Farm Labor, 1780–1940.* Vermont Agricultural Experiment Station Bulletin 507. Burlington VT: Free Press.

Amark, Karl. (1921) "En svensk prishistorisk studie." *Ekonomisk Tidskrift* 23:1–24.

Atack, Jeremy, and Peter Passell. (1994) *A New View of American History from Colonial Times to 1940.* 2d ed. New York: Norton.

Bairoch, Paul. (1976) "Europe's Gross National Product: 1800–1975." *Journal of European Economic History* 2:273–340.

Berry, Thomas Senior. (1984) *Early California: Gold, Prices, Trade.* Bostwick Paper No. 4. Richmond, Va.: Bostwick Press.

——. (1988) *Production and Population Since 1789: Revised GNP Series in Constant Dollars.* Bostwick Paper No. 6. Richmond VA: The Bostwick Press.

Blanchard, Olivier Jean and Stanley Fisher. (1989) *Lectures on Macroeconomics.* Cambridge: MIT Press.

Bodenhorn, Howard, and Hugh Rockoff. (1992) "Regional Interest Rates in Antebellum America" Eds Claudia Goldin and Hugh Rockoff. In *Strategic Factors in Nineteenth Century American Economic History*, 159–187. NBER Conference Report. Chicago: University of Chicago Press.

Bodenhorn, Howard. (1992) "Capital Mobility and Financial Integration in Antebellum America." *Journal of Economic History* 52:585–610.

Bordo, Michael D. and Anna J. Schwartz. (1996) "The Operation of the Specie Standard" Eds. Jorge Braga de Macedo, Barry Eichengreen, and Jaime Reis. In *Currency Convertibility The Gold Standard and Beyond*, 11–83. New York: Routledge.

Branson, William H. and Dale Henderson. (1985) "The Specification and Influence of Asset Markets," Eds. R. W. Jones, and Peter B. Kenen. In *Handbook of International Economics*, Vol II, 749–895. Amsterdam: North Holland.

Calomiris, Charles W. (1991) "The Panic of 1857: Origins, Transmission, and Containment." *Journal of Economic History* 51:807–834.

Calomiris, Charles W. and Christopher, Hanes. (1994) "Consistent Output Series for the Antebellum and Postbellum Periods: Issues and Preliminary Results." *Journal of Economic History* 54:409–422.

Collins, Michael. (1978) "Monetary Policy and the Supply of Trade Credit, 1830–1844." *Economica* 45:379–89.

——. (1988) *Money and Banking in the U. K.: A History*. London: Croom Helm.

——. (1986) "Sterling Exchange Rates 1847–80." *Journal of European Economic History* 15:511–33.

Crafts, N. F. R. (1980) "National Income Estimates and the British Standard of Living Debate: A Reappraisal of 1801–1831." *Explorations in Economic History* 17:176–88.

——. (1995) "Recent Research on the National Accounts of the UK, 1700–1939." *Scandinavian Economic History Review* 43:17–29.

Crafts, N. F. R., and C. K. Harley. (1992) "Output Growth and the British Industrial Revolution: A Restatement of the Crafts-Harley View." *Economic History Review* 45, no. 4:703–30.

Cranmer, H. Jerome. (1960) "Canal Investment, 1815–1860" In *Trends in the American Economy in the Nineteenth Century*. 547–570. NBER Studies in Income and Wealth, vol. 24. Princeton: Princeton University Press.

Cumby, R. (1988) "Is it Risk? Explaining the Deviations from Covered Interest Parity" *Journal of Monetary Economics* 22:279–299.

David, Paul A. (1967) "The Growth of Real Product in the United States Before 1840: New Evidence, Controlled Conjectures." *Journal of Economic History* 30: 151–197.

David, Paul A., and Peter Solar. (1977) "A Bicentenary Contribution to the History of the Cost of Living in America." *Research in Economic History* 2:1–80.

Davidson, R., and J. G. MacKinnon. (1981) "Several Tests for Model Specification in the Presence of Alternative Hypotheses." *Econometrica* 49:781–93.

Davis, Lance E. (1960) "The New England Textile Mills and the Capital Markets: A Study of Industrial Borrowing 1840–1860." *Journal of Economic History* 20:1–30.

——. (1963) "Capital Immobilities and Finance Capitalism: A Study of Economic Evolution in the United States, 1820–1920." *Explorations in Entrepreneurial History* 1:88–105.

Davis, Lance E., and Robert J. Cull. (1994) *International Capital Markets and American Economic Growth 1820–1914*. New York: Cambridge University Press.

Davis, Lance E., and Robert Gallman. (1994) “Savings, Investment, and Economic Growth: The United States in the Nineteenth Century” Eds John James and Mark Thomas. In *Capitalism in Context*, 202–229. Chicago: University of Chicago Press.

Deane, Phyllis. (1968) “New Estimates of Gross National Product for the United Kingdom 1830–1914.” *Review of Income and Wealth* 14:95–112.

Dick, T. J. O., J. E. Floyd, and D. Pope. (1996) “Balance of Payments Adjustment Under the Gold Standard Policies: Canada and Australia Compared” Eds T. Bayoumi, B. Eichengreen, and M. Taylor. In *Modern Perspectives on the Gold Standard.* New York: Cambridge University Press.

Dick, Trevor J. O., and J. E. Floyd. (1993) “Canada and the Gold Standard, 1871–1914: A Durable Monetary Regime.” Eds Michael D. Bordo and Forrest Capie. In *Monetary Regimes in Transition*, 173–200. Studies in Monetary and Financial History. New York: Cambridge University Press.

——. (1992) *Canada and the Gold Standard: 1871–1913.* Cambridge: Cambridge University Press.

——. (1991) “Balance of Payments Adjustment Under the International Gold Standard: Canada, 1871–1913.” *Explorations in Economic History* 28:209–38.

Dornbusch, R. (1975) “A Portfolio Balance Model of the Open Economy.” *Journal of Monetary Economics* 1:3–20.

Dornbusch, R., and J. A. Frenkel. (1984) “The Gold Standard Crisis of 1847.” *Journal of International Economics* 16:1–27.

Engerman, Stanley L. (1970) “A Note on the Economic Consequences of the Second Bank of the United States.” *Journal of Political Economy* 78:725–728.

Engerman, Stanley L. and Robert E. Gallman. (1983) “U. S. Economic Growth, 1783–1860.” *Research in Economic History* 8:1–46.

Flandreau, Marc. (1996) “The French Crime of 1873: An Essay on the Emergence of the International Gold Standard, 1870–1880.” *Journal of Economic History* 56:862–897.

Frankel, Jeffrey. (1983) “Monetary and Portfolio Balance Models of Exchange Rate Determination,” Eds. J. Bhandari and B. Putnam. In *Economic Interdependence and Flexible Exchange Rates*, 84–115. Cambridge: MIT Press.

Frenkel, J. A. and Michael Mussa. (1985) “Asset Markets, Exchange Rates, and the Balance of Payments,” Eds. Jones, R. W. and Peter B. Kenen. In *Handbook of International Economics*, Vol II, 679–747. Amsterdam: North Holland.

Fremdling, Rainer. (1995) "German National Accounts for the 19th and Early 20th Century." *Scandinavian Economic History Review* 43:77–100.

Friedman, Milton. (1992) *Money Mischief: Episodes in Monetary History*. New York: Harcourt Brace Jovanovich.

Friedman, Milton and A. J. Schwartz (1970) *Monetary Statistics of the United States, Estimates, Source, Methods*. NBER Studies in Business Cycles, vol. 20. New York: Columbia University Press.

Gallman, Robert E. (1966) "Gross National Product in the United States, 1834–1909." In *Output, Employment and Productivity in the United States After 1800*, 3–90. NBER Studies in Income and Wealth, vol. 30. New York: Columbia University Press.

——. (1972) "The Pace and Pattern of American Economic Growth." Eds. Lance E. Davis, et al. In *American Economic Growth*, 15–60. New York: Harper and Row.

——. (1992) "American Economic Growth Before the Civil War: The Testimony of the Capital Stock Estimates." Eds Robert E. Gallman and John Joseph Wallis. In *American Economic Growth and Standards of Living Before the Civil War*, 70–120. NBER Conference Report. Chicago: University of Chicago Press.

Gayer, A. D., W. W. Rostow, and A. J. Schwartz. (1953) *The Growth and Fluctuation of the British Economy 1790–1850*, vol 1. Oxford: Clarendon Press.

Greenfield, Robert L., and Hugh Rockoff. (1995) "Gresham's Law in Nineteenth-Century America." *Journal of Money Credit and Banking* 27:1086–98.

Harley, C. Knick. (1982) "British Industrialization Before 1841: Evidence of Slower Growth During the Industrial Revolution." *Journal of Economic History* 42:267–89.

Hoffmann, W. G. (1965) *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19. Jahrunderts*. New York: Springer–Verlag.

Homer, Sidney, and Richard Sylla. (1991) *A History of Interest Rates*. 3rd. ed. New Brunswick: Rutgers University Press.

Huffman, Wallace E., and James R. Lothian. (1980) "Money in the United Kingdom, 1833–80." *Journal of Money, Credit, and Banking* 12:155–74.

Hughes, J. R. T. (1960) *Fluctuations in Trade, Industry and Finance*. Oxford: Oxford University Press.

Hughes, J. R. T., and N. Rosenberg. (1963) "The United States Business Cycle Before 1860: Some Problems of Interpretation." *Economic History Review* 15: 476–493.

Hume, David (1752) "Of the Balance of Trade," *Essays, Moral, Political and Literary, Vol 1*, London: Longmans Green, 1898, 330-41, 343-5.

Imlah, Albert H. (1958) *Economic Elements in the Pax Britannica, Studies in British Foreign Trade in the Nineteenth Century.* New York: Russell and Russell.

Jacobs, A. and H. Richter (1935) *Die Grosshandelspreise in Deutschland von 1792 bis 1934.* Berlin: Hanseatische Verlagsanstalt Hamburg.

James, John A., and Richard E. Sylla. (1980) "The Changing Nature of American Public debt 1690–1835." In *La Dette Publique aux XVIII^e et XIX^e Siècles Son Developpement sur le Plan Local, Regional et National*, 243–272. Credit Communal de Belgique.

Jonung, Lars. (1976) "Money and Prices in Sweden 1732–1972." *Scandinavian Journal of Economics* 78:40–58.

Jorberg, L. (1972) *A history of prices in Sweden*, 2 vols. Lund: Gleerup.

Kouri, Penti J. K. (1977) "International Investment and Interest Rate Linkages Under Flexible Exchange Rates," Ed. R. Z. Aliber. In *The Political Economy of Monetary Reform*, 74–96. London: Macmillan.

Krantz, Olle. (1988) "New Estimates of Swedish Historical GDP Since the Beginning of the Nineteenth Century." *Review of Income and Wealth* 34:165–81.

Kuznets, Simon. (1930) *Secular Movements in Production and Prices.* New York: Houghton Miffin.

——. (1952) "National Income Estimates for the United States Prior to 1870." *Journal of Economic History* 12:115–30.

——. (1961) *Capital in the American Economy.* Princeton: Princeton University Press.

Laughlin, J. Lawrence. (1896) *The History of Bimetallism in the United States.* New York: Appleton.

Lévy–Leboyer, M. (1964) *Les Banques Européennes et L'Industrialisation Internationale dans la première moitié du XIX^e siècle* Paris: Presses Universitaires de France.

——. (1982) "Central banking and foreign trade: the Anglo-American cycle in the 1830s," Eds. C. P. Kindleberger and J.–P. Laffargue. In *Financial crises, theory, history and policy*, 66–116. Cambridge: Cambridge University Press.

Lucas, Robert E., Jr. (1978) "Asset Prices in an Exchange Economy." *Econometrica* 46:1426–1445.

Lucas, R. E. Jr. (1982) "Interest Rates and Currency Prices in a Two Country World." *Journal of Monetary Economics* 10:335–60.

Macesich, George. (1960) "Sources of Monetary Disturbances in the U. S. 1834–1845." *Journal of Economic History* 20:407–34.

——. (1984) "The Issues of Monetary Reform: Private Monetary Arrangements and Constitutional Constraints." Chapter 7 in his *The Politics of Monetarism Its Historical and Institutional Development*. Totowa: Rowman and Allanheld.

Maddison, Angus. (1995) *Monitoring the World Economy 1820–1992*. Paris: OECD.

Matthews, R. C. O. (1954) *A Study in Trade-Cycle History, Economic Fluctuations in Great Britain 1833–1842*. Cambridge: Cambridge University Press.

——. (1982) "Comment" Eds. C. P. Kindleberger and J.–P. Laffargue. In *Financial crises, theory, history and policy*, 110–113. Cambridge: Cambridge University Press.

Merton, Robert C. (1971) "Optimum Consumption and Portfolio Rules in a Continuous-Time Model." *Journal of Economic Theory* 3:373–413.

Mitchell, B. R. (1962) *Abstract of British Historical Statistics*. Cambridge: Cambridge University Press.

——. (1992) *International Historical Statistics. Europe 1750-1988*, 3rd. ed. New York: Stockton Press.

——. (1993) *International Historical Statistics. The Americas. 1750–1988*, 2nd. ed. New York: Stockton Press.

Mizon, G. E. and J. F. Richard. (1986) "The Encompassing Principle and its Application to Non-nested Hypotheses." *Econometrica* 54:657–78.

North, Douglass C. (1961) *The Economic Growth of the United States 1790–1860*. Englewood Cliffs: Prentice Hall.

——. (1960) "The United States Balance of Payments, 1790–1860." In *Trends in the American Economy in the Nineteenth Century*, 573–627. NBER Studies in income and Wealth, vol 24. Princeton: Princeton University Press.

Obstfeld, Maurice. (1986) "Capital Mobility in the World Economy: Theory and Measurement," *Carnegie-Rochester Conference Series on Public Policy* 24:55–104.

Officer, L. H. (1983) "Dollar-Sterling Mint Parity and Exchange Rates, 1791-1834." *Journal of Economic History* 43:579–616.

——. (1996) *Between the dollar-sterling gold points. Exchange rates, parity, and market behavior*. Cambridge: University Press.

Pasula, Kit. (1992) The Balance of Payments, The Balance of Trade, and Monetary Independence Under Bretton Woods: Perspectives from Stochastic, Maximizing Models, Unpublished Ph.D. dissertation. Toronto: University of Toronto.

Phelps Brown, Henry, and Sheila V. Hopkins. (1981) *A Perspective of Wages and Prices.* London: Metheun.

Rockoff, Hugh. (1971) "Money, Prices and Banks in the Jacksonian Era." Eds Robert Fogel and S. L. Engerman. In *The Reinterpretation of American Economic History*, 448–67. New York: Harper and Row.

——. (1975) "Varieties of Banking and Regional Economic Development in the United States, 1840-1860." *Journal of Economic History* 35:160–181.

——. (1974) "The Free Banking Era A Reexamination." *Journal of Money Credit and Banking* 6:141–167.

Sushka, M. E. (1976) "The Antebellum Money Market and the Economic Impact of the Bank War," *Journal of Economic History* 34:809–35.

Smith , W. B. and A. H. Cole. (1935) *Fluctuations in American Business 1790–1860.* Cambridge: Harvard University Press.

Soetbeer, Ad. (1886) *Materials toward the Elucidation of the Economic Conditions affecting Precious Metals.* 2nd ed. Trans. F. W. Taussig [1887] Ed Edward Atkinson. In *Bimetallism in Europe*, 57–280. United States Senate, 50 Congress, 1st Session, Ex Doc. No. 34. Washington: Government Printing Office.

Spree, R. (1978) *Die Wachstumszyklen der Deutschen Wirtschaft von 1840 Bis 1880.* Berlin: Duncker and Humblot.

Stulz, Rene. (1984) "Currency Preferences, Purchasing Power Risks, and the Determination of Exchange Rates in an Optimizing Model." *Journal of Money, Credit and Banking* 16:302–16.

Sylla, Richard, Jack W. Wilson, and Charles P. Jones. (1994) "U. S. Financial Markets and Long-Term Economic Growth, 1790–1989." Eds. Thomas Weiss and Donald Schaefer. In *American Economic Development in Historical Perspective*, 28–52. Stanford CA: Stanford University Press.

Taussig, Frank W. (1927) *International Trade.* New York: Macmillan.

Temin, Peter. (1975) "The Panic of 1857." *Intermountain Economic Review* 6:1–12.

——. (1974) "The Anglo-American Business Cycle, 1820–60." *Economic History Review* 27:207–21.

——. (1969) *The Jacksonian Economy.* New York: Norton.

——. (1968) “The Economic Consequences of the Bank War.” *Journal of Political Economy* 76:257–274.

——. (1982) “Comment” Eds. C. P. Kindleberger and J.–P. Laffargue. In *Financial crises, theory, history and policy*, 113–116. Cambridge: Cambridge University Press.

Timberlake, Richard E. (1960a) “The Specie Circular and Distribution of the Surplus.” *Journal of Political Economy* 68:109–117.

——. (1960b) “The Independent Treasury and Monetary Policy before the Civil War.” *Southern Economic Journal* 27:92–103.

——. (1961) “The Specie Standard and Central Banking in the United States Before 1860.” *Journal of Economic History* 21:318–341.

Toutain, Jean-Claude. (1987) “Le Produit Intérieur Brut de la France de 1789 à 1982.” *Économies et Sociétés, Cahiers de l’I.S.M.E.A., Serie Historie quantitative de l’Économie française.*

Vilar, Pierre. (1976)[1969] *A History of Gold and Money 1450–1920.* Trans. Judith White. London [Barcelona]: NLB [Ediciones Ariel].

Viner, Jacob. (1924) *Canada’s Balance of International Indebtedness 1900–1913.* Cambridge, Mass.: Harvard University Press.

——. (1937) *Studies in the Theory of International Trade.* New York: Harper and Brothers.

Warburton, Clark. (1949) “The Secular Trend in Monetary Velocity.” *Quarterly Journal of Economics* 63:68–91.

Weiss, Thomas. (1994) “Economic Growth Before 1860: Revised Conjectures.” Eds Thomas Weiss and Donald Schaefer. In *American Economic Development in Historical Perspective*, 11–27. Stanford CA: Stanford University Press.

——. (1992) “U.S. Labor Force Estimates and Economic Growth, 1860–1860.” Eds Robert E. Gallman and John Joseph Wallis. In *American Economic Growth and Standards of Living Before the Civil War*, 19–78. NBER Conference Report. Chicago: University of Chicago Press.

Wicker, E. R. (1960) “Railroad Investment Before the Civil War.” In *Trends in the American Economy in the Nineteenth Century*, 503–545. NBER Studies in Income and Wealth, vol. 24. Princeton: Princeton University Press.

Wilkins, Mira. (1989) *The History of Foreign Investment in the United States to 1914.* Cambridge: Harvard University Press.

Willett, Thomas D. (1968) "International specie flows and American monetary stability, 1834–1860." *Journal of Economic History* 28: 28–50.

Williamson, J. G. (1961) "International Trade and U. S. Economic Development 1827–1843." *Journal of Economic History* 21:372–83.

——. (1962) "The Long Swing: Comparisons and Interactions Between British and American Balance of Payments, 1820–1913." *Journal of Economic History* 22:21–46.

——. (1964) *American Growth and the Balance of Payments 1820–1913.* Chapel Hill: University of North Carolina Press.

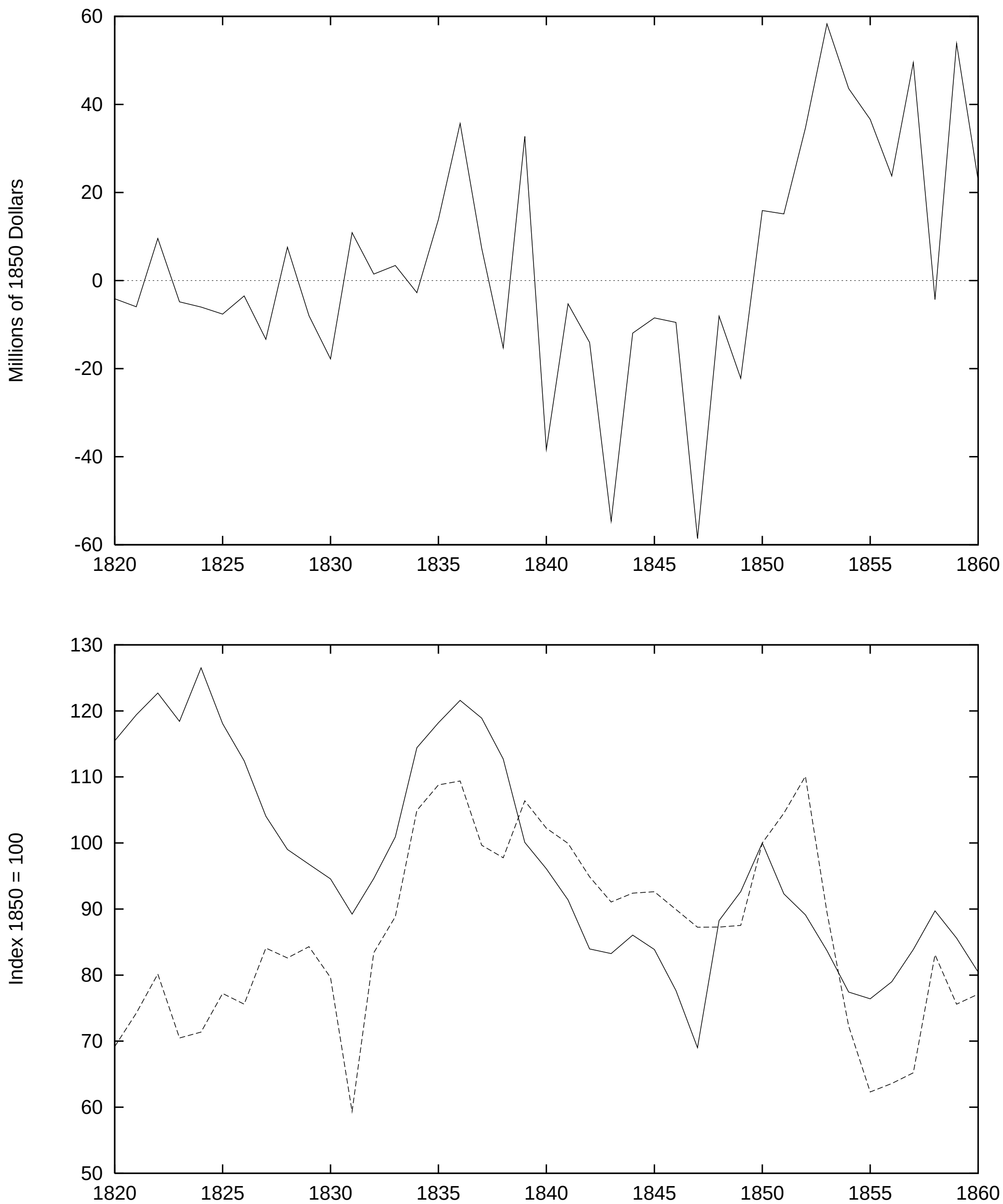

Figure 1: Real net capital inflow plus debt service balance (*top panel*); U.S. Real Exchange Rate (*solid line—bottom panel*) and Ratio of U.S. to Rest-of-World non-traded goods prices (*dotted line—bottom panel*). Source: See Data Appendix.

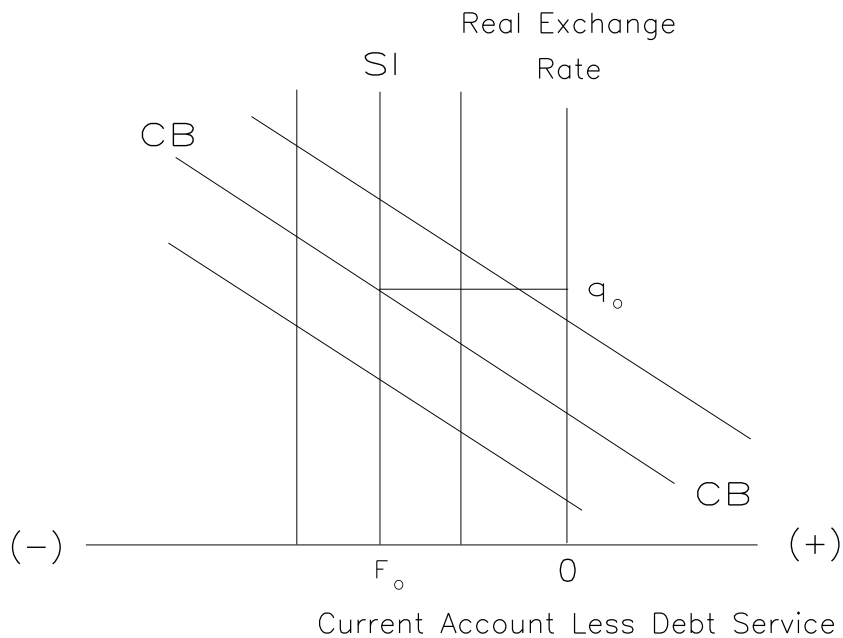

Figure 2: Determinants of the equilibrium real net capital inflow plus debt service balance (= minus the current account less debt service) and the equilibrium real exchange rate.

Table 1A: Real Exchange Rate and Real Net Capital Inflows plus Debt Service
United States, 1820-1860

	Real Exchange Rate			Real Net Cap. Inflow + Debt Serv.
	(1)	(2)	(3)	(4)
Constant	97.3	78.2	67.2	-48.14
	(39.2)	(5.30)	(5.09)	(-1.24)
Real Net Capital Inflow + Debt Service Balance	-0.035	0.29	0.20	
	(-0.36)	(4.50)	(3.12)	
U.S. Real Income		-0.86	-0.77	1.80
		(-5.64)	(-5.69)	(6.00)
Rest of World Real Income		0.96	0.72	-2.33
		(3.20)	(2.68)	(-4.13)
Real Exchange Rate				1.20
				(4.50)
Terms of Trade			0.26	
			(3.58)	
Observations	41	41	41	41
R-Square	0.003	0.71	0.78	0.57
Standard Error	15.75	8.75	7.62	16.50
Durbin-Watson	.19	0.69	0.92	1.89

NOTES:

Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

Table 1B: Real Exchange Rate and Real Net Capital Inflows plus Debt Service
United States, 1820-1860

	Non-traded Goods Prices United States / Rest of World			Real Net Cap. Inflow + Debt Serv.
	(1)	(2)	(3)	(4)
Constant	86.5	-0.20	-9.33	69.0
	(39.2)	(-0.01)	(0.49)	(1.98)
Real Net Capital Inflow + Debt Service Balance	-0.066	0.09	0.006	
	(-0.77)	(1.02)	(0.07)	
U.S. Real Income		-0.87	-0.79	1.42
		(-4.36)	(-4.08)	(3.52)
Rest of World Real Income		1.79	1.59	-2.34
		(4.59)	(4.13)	(-2.77)
Non-traded Goods Prices U.S. / Rest of World				0.31
				(1.02)
Terms of Trade			0.22	
			(2.07)	
Observations	41	41	41	41
R-Square	0.015	0.37	0.44	0.36
Standard Error	13.96	11.44	10.96	26.69
Durbin-Watson	.44	0.76	0.74	1.53

NOTES:

Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

Table 2A: Demand for Money Regressions: United States, 1820-1860

	Dependent Variable: Real Money Supply				
	(1)	(2)	(3)	(4)	(5)
Constant	-62.28 (-2.17)	-204.5 (-1.51)	-58.6 (-2.15)	-56.1 (-2.19)	-14.9 (-0.09)
U. S. Real Income	0.17 (23.2)	0.178 (16.8)	0.25 (6.77)	0.16 (25.5)	0.25 (6.14)
U. K. Open Market Discount Rate	-7.26 (-1.11)	-11.4 (-1.50)	-13.4 (-1.98)	-9.03 (-1.55)	-12.6 (-1.73)
U.K. Consol Rate		41.7 (1.07)			-12.7 (-0.27)
Trend			-7.24 (-2.29)		-7.88 (-1.99)
U. S. Net Capital Inflow				1.19 (3.35)	
Observations	41	41	41	41	41
R-Squared	0.93	0.936	0.942	0.95	.94
Standard Error	46.42	46.32	44.01	41.22	44.58
Durbin-Watson	1.02	1.10	1.49	1.82	1.53

NOTES:

Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

Table 2B: Demand for Money Regressions: United States, 1820-1860

	Dependent Variable: Real Money Supply				
	(1)	(2)	(3)	(4)	(5)
Constant	-80.43	-117.9	-97.4	-57.9	-48.2
	(-3.91)	(-0.89)	(-4.14)	(-3.24)	(-0.29)
U. S. Real Income	0.17	0.172	0.22	0.17	0.24
	(21.6)	(17.0)	(6.01)	(26.3)	(5.48)
U. S. Short-term Interest Rate	-1.58	-1.51	-0.52	-6.08	-0.20
	(-0.66)	(-0.62)	(-0.21)	(-2.71)	(-0.08)
U.K. Consol Rate		9.88			-40.9
		(0.29)			(-0.89)
Trend			-4.56		-7.18
			(-1.43)		(-1.66)
U. S. Net Capital Inflow				1.62	
				(4.29)	
Observations	41	41	41	41	41
R-Squared	0.933	0.933	0.936	0.955	.938
Standard Error	46.89	47.47	46.26	38.83	46.39
Durbin-Watson	1.07	1.10	1.43	2.24	1.55

NOTES:

Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

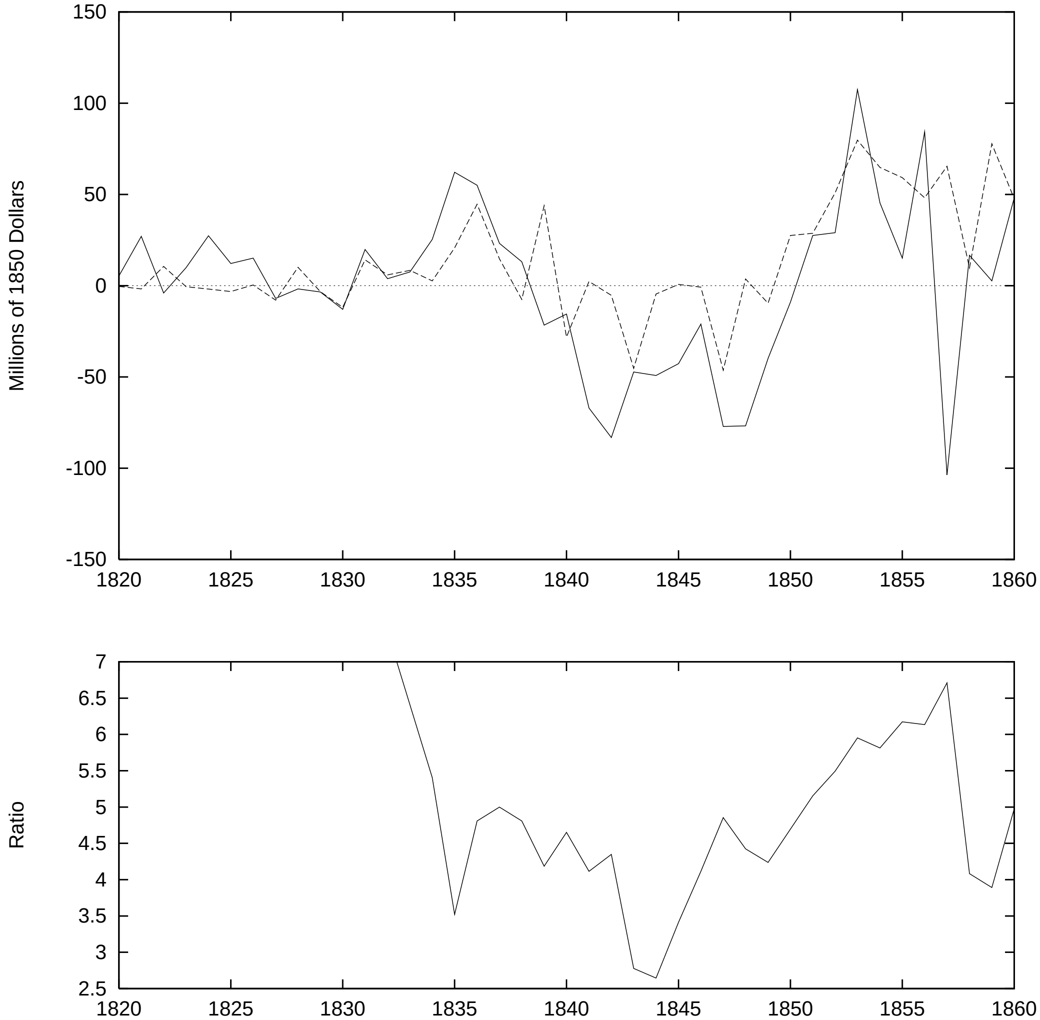

Figure 3: Residuals from demand for money regression in column (2) of Table 2a (*top panel—solid line*) and real net capital inflow (*top panel—dotted line*); banking system's ratio of notes and deposits to specie reserves *bottom panel*). Source: See Data Appendix.

Table 3: Demand for Reserve Stock Regressions: United States, 1820-1860

	Dependent Variable: Real Stock of Reserves				
	(1)	(2)	(3)	(4)	(5)
Constant	-104.11	-401.5	-98.0	-113.9	-74.4
	(-4.41)	(-3.96)	(-5.91)	(-1.16)	(-2.14)
U. S. Real Income	0.124	0.141	0.27	0.26	0.26
	(20.8)	(18.0)	(11.74)	(10.4)	(11.19)
U. K. Open Market Discount Rate	-2.96	-11.63	-13.3	-13.54	-13.5
	(-0.55)	(-2.05)	(-3.24)	(-3.04)	(-3.26)
U.K. Consol Rate		87.3		4.63	
		(3.00)		(0.16)	
Trend			-12.20	-11.96	-12.17
			(-6.37)	(-4.97)	(-6.32)
Money Multiplier					6.17
					(0.77)
Observations	41	41	41	41	41
R-Squared	0.92	0.936	0.961	0.96	0.94
Standard Error	38.15	34.67	26.70	27.06	26.85
Durbin-Watson	0.55	0.78	1.62	1.60	1.57

NOTES:

Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

Table 4: Real Reserve Flow Regressions—Price-Specie-Flow Theory
United States, 1821-1860

	Real Trade Account Balance	Real Reserve Flow	SUR[1] Trade Bal.	SUR[1] Res. Flow
	(1)	(2)	(3)	(4)
Constant	12.6	5.08	12.6	4.61
	(0.25)	(0.05)	(0.28)	(0.05)
Real Exchange Rate	-0.70	0.65	-0.70	0.65
	(-2.45)	(1.36)	(-2.74)	(1.55)
Domestic Real Income	-1.25	2.46	-1.25	2.46
	(-2.12)	(2.54)	(-2.37)	(2.88)
Rest of World Real Income	2.02	-2.76	2.02	-2.76
	(2.86)	(-2.30)	(3.20)	(-2.60)
Real Long-term Net Capital Inflow	-0.002	-0.001	-0.002	-0.001
Proxy 1: Land Sales	(-2.69)	(-0.796)	(-3.01)	(-0.90)
Real Long-term Net Capital Inflow	-0.763	0.31	-0.763	0.31
Proxy 2: Canal Investment	(-0.63)	(0.16)	(-0.71)	(0.18)
Real Long-term Net Capital Inflow	-0.0007	-0.002	-0.0007	-0.003
Proxy 3: Railroad Mileage	(-0.615)	(-1.14)	(-0.69)	(-1.30)
Long-term Interest Rate Differential		9.09		9.00
		(1.23)		(1.38)
Net Repatriated Earnings	1.05	0.686	1.05	0.681
	(0.64)	(0.256)	(0.72)	(0.289)
Observations	40	40	40	40
R-Square	0.62	0.28	0.62	0.28
Standard Error	18.32	29.584	18.32	29.585
Durbin-Watson	2.09	2.42	2.09	2.42

NOTES:

1. Regressions obtained using the seemingly unrelated regression technique.
2. Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

Table 5: Real Reserve Flow Regressions—Portfolio Theory: United States, 1821-1860

	Dependent Variable: Real Reserve Flow			
	(1)	(2)	(3)	(4)
Constant	3.51	3.70	0.935	0.917
	(0.92)	(0.93)	(0.401)	(0.38)
Price Level Variable	-0.72	1.0	0.79	1.0
	(-0.86)		(0.15)	
Interest Rate Variable —Short-Term	-0.02	-0.02	-0.0001	-0.0006
	(-1.16)	(-1.28)	(-0.01)	(-0.065)
Interest Rate Variable —Long-Term	-0.09	-0.46	-0.47	-0.675
	(-0.32)	(-2.02)	(-2.58)	(-4.79)
U.S. Real Income Variable	1.24	1.08	0.81	0.707
	(3.08)	(2.60)	(3.22)	(2.79)
Money Multiplier Variable	-0.49	-0.44	-0.62	-0.60
	(-3.25)	(-2.84)	(-6.59)	(-6.23)
Debt Service Variable			0.40	0.42
			(7.67)	7.94
Observations	40	40	40	40
R-Squared	0.63	0.58	0.87	0.85
Standard Error	20.12	21.03	12.25	12.63
Durbin-Watson	1.95	2.24	2.13	2.37

NOTES:

Figures in brackets are t-ratios.

SOURCES: See Data Appendix.

Table 6: Non-nested Tests: Price-specie-flow vs. Portfolio Theory

Test	Null Hypothesis of No Effect: Portfolio Variables in P-S-F Theory (1)	Null Hypothesis of No Effect: P-S-F Variables in Portfolio Theory (2)
F	F(6,25) = 24.5 (Reject)	F(8,25) = 0.80 (Accept)
J	t(1) = 12.6 (Reject)	t(1) = 0.61 (Accept)
CPE	F(6,31) = 4.42 (Reject)	F(8,33) = 0.57 (Accept)

NOTES:

Rejecting a null of no effect (column (1)) means that the portfolio variables added to the P-S-F theory lend no support to the P-S-F theory because these added variables have an effect that the P-S-F predicts they won't have. Corresponding P-values are tiny for rejections.

Accepting a null of no effect (column (2)) means that the P-S-F variables added to the portfolio theory lend support to the portfolio theory because these added variables have the zero effect that the portfolio theory predicts they will have.

SOURCES: See text.