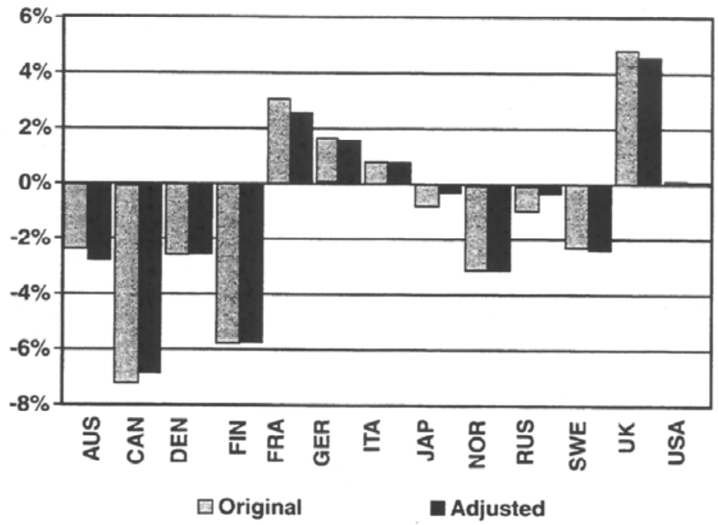

Figure 9.2
Current account with original and gold-adjusted data, 1885–1913, period averages (percentage of GDP)

stock. For example, French gold imports that did not find their way into the measured stock of monetary gold may well have entered private hoards rather than industrial use, and in that form could have been highly substitutable for monetary gold. Our skepticism regarding the adjusted Japanese numbers led us to check all the econometric results reported below for their sensitivity to our adjustment of Japan's customary current account data. That adjustment made no discernible difference to our results.

Table 9.1 shows the effect of adjusting the current account statistics for gold flows for each country. We can see from this table that our treatment of gold provides current account estimates that diverge from the standard historical measures. The mean absolute deviation (MAD) measure presented in the table suggests that for some countries the absolute divergence is frequently large, especially for Denmark, France, Japan, and Russia.

Inventories Data

An analysis of saving and investment flows requires a measure of total gross investment. Gross investment consists of the sum of fixed investment plus changes in stocks or inventories. As Eichengreen (1992a) points out, previous compilations of historical statistics have often

Table 9.1
Effect of gold adjustment on current accounts: Means and standard deviations of original data, gold-adjusted data, and mean absolute difference (expressed as a percentage of GDP)

	Full sample period					1885 to 1913				
	Original CA		Adjusted CA			Original CA		Adjusted CA		
Country	Mean	Std. dev.	Mean	Std. dev.	MAD	Mean	Std. dev.	Mean	Std. dev.	MAD
Australia	−3.9	6.2	−4.2	6.1	0.5	−2.4	6.0	−2.8	6.0	0.5
Canada	−3.5	5.7	−3.4	5.7	0.3	−7.2	3.7	−6.9	3.6	0.4
Denmark	−0.2	4.6	−1.2	2.1	1.2	−2.6	1.5	−2.6	1.4	0.2
Finland	−5.2	5.5	−5.1	5.6	0.2	−5.8	2.5	−5.8	2.5	0.1
France	2.6	3.9	2.6	3.9	0.9	3.1	1.1	2.6	1.2	0.6
Germany	1.2	1.3	1.2	1.3	0.1	1.6	0.7	1.6	0.7	0.1
Italy	−1.3	4.5	−1.3	4.5	0.1	0.8	2.3	0.8	2.3	0.0
Japan	−0.2	3.2	0.1	3.2	0.3	−0.8	3.0	−0.3	2.9	0.5
Norway	−1.7	4.0	−1.7	4.0	0.2	−3.2	2.8	−3.1	2.9	0.2
Russia	−1.0	1.5	−0.4	2.5	1.4	−1.0	1.5	−0.4	2.5	1.4
Sweden	−0.8	3.3	−0.8	3.5	0.3	−2.3	2.1	−2.4	2.1	0.1
U.K.	2.3	3.8	2.3	3.7	0.5	4.8	2.5	4.6	2.6	0.3
U.S.	0.5	1.6	0.5	1.6	0.0	0.1	1.2	0.1	1.2	0.0

Note: The full sample period consists of Australia: 1861–1945; Canada: 1870–1945; Denmark: 1874–1914, 1921–1945; Finland: 1872–1945; France: 1851–1913, 1919–1938; Germany: 1877–1913, 1925–1938; Italy: 1861–1936; Japan: 1885–1944; Norway: 1865–1939; Russia: 1885–1913; Sweden: 1875–1945; United Kingdom: 1869–1945; United States: 1870–1945.

Table 9.2
Estimates of changes in stocks/inventories (as a percentage of GDP), period averages

Country	Sample period	Stocks ratio	Country	Sample period	Stocks ratio
Australia	1861–1945	1.00	Japan	1885–1944	2.79
Canada	1926–1945	0.57	Norway	1900–1939	−0.04
Denmark	—	—	Russia	1885–1913	1.69
Finland	1860–1945	3.74	Sweden	1861–1945	0.03
France[1]	1850–1938	2.08	United Kingdom	1850–1945	0.48
Germany[2]	1872–1938	0.97	United States	1869–1945	2.05
Italy	1861–1945	0.12			

[1] No data for 1914 to 1918.
[2] No data for 1914 to 1924.

ignored the role of inventories in gross investment. We have gathered additional data on inventories, so that the investment numbers for Australia, Canada, Finland, France, Germany, Italy, Japan, Norway, Russia, Sweden, the United Kingdom, and the United States now include estimates of changes in stocks or inventories. The details are discussed in appendix 9.2.[15]

The omission of inventories introduces a source of bias into regression estimates of saving-investment correlations. Table 9.2 shows the magnitude of changes in stocks and inventories for countries with available data. It is evident from the magnitude of the numbers in this table that adjusting for inventory changes may have potentially large effects.[16]

Empirical Analysis

In a world on the gold standard, the two principal outside financial assets are capital and monetary gold. In a closed economy, all saving must flow into one of these two assets. Thus,

$$I = S - \Delta MG. \tag{9.5}$$

Under a gold standard, the Feldstein-Horioka capital immobility hypothesis (in its most extreme form) is that all trade imbalances are financed by international gold flows, rather than by private capital flows (which could involve repayment or political risk). This implies that equation (9.5), which was derived as a closed-economy identity, also applies to open economies when international borrowing and lending are impossible. For example, a country's investment can increase above its saving only if it exports monetary gold abroad or transforms some of its monetary gold into plant and equipment.

Because of the imprecise or inadequate nature of historical national accounts data, historical estimates of saving must be calculated residually as the sum of investment and the current account:

$$S = I + CA. \tag{9.6}$$

Under a gold standard, the appropriate definition of saving recognizes that the current account is equal to net foreign asset accumulation, including monetary gold acquisitions. The typical (post–gold standard) implementation of the Feldstein-Horioka test is a cross-sectional regression of I on S, with both variables defined as ratios to Gross Domestic Product (GDP) or Net National Product (NNP). The more appropriate test under the gold standard is a regression of I on $S - \Delta MG$, according to equation (9.5).

There are thus two ways to implement the Feldstein-Horioka test in a world where gold plays an important monetary role. The first is to run the cross-section regression

$$\frac{I}{Y} = \alpha + \beta\frac{S}{Y} + \gamma\frac{\Delta MG}{Y} + u. \tag{9.7}$$

The Feldstein-Horioka hypothesis is that $\beta = 1$ and $\gamma = -1$. Alternatively, one could impose the constraint that saving and the change in the monetary gold stock have coefficients equal in absolute magnitude but of opposite sign. This procedure leads to the specification

$$\frac{I}{Y} = \alpha + \beta\frac{(S - \Delta MG)}{Y} + u. \tag{9.8}$$

The Feldstein-Horioka hypothesis implies that $\beta = 1$.

Notice that $S - \Delta MG$ is the saving measure one derives by adding to investment the current account inclusive of *all* gold shipments, CA^O, as per Viner's (1924) current account estimates for Canada, described above. Why is Viner's concept, rather than the one used to construct true saving, S, the appropriate one to use on the right hand side of equation (9.8)? Suppose a country imports gold coin to add to its money stock ($\Delta MG > 0$) with true saving, S, unchanged. If investment does not fall by an equal amount, then the country would necessarily be borrowing abroad to maintain an unchanged path of national wealth. If international borrowing and lending are ruled out (as implied by the Feldstein-Horioka hypothesis), however, it follows that increases in national saving (given ΔMG) and decreases in monetary gold holdings (given S) both feed through fully to increased investment.[17]

Our empirical analysis is based on data from thirteen countries: Australia (1861–1945), Canada (1870–1945), Denmark (1874–1914, 1921–1945), Finland (1872–1945), France (1851–1913, 1919–1938), Germany (1877–1913, 1925–1938), Italy (1861–1936), Japan (1885–1944), Norway (1865–1939), Russia (1885–1913), Sweden (1875–1945), the United Kingdom (1869–1945), and the United States (1870–1945). The data sources are described in appendix 9.2. Figure 9.3 presents scatter plots of the average saving and investment rate data for two subperiods, 1885–1913 and 1919–1936. (Rather than giving true saving, S, the horizontal axes in figure 9.3 give the independent variable in equation (9.8).)

Table 9.3 presents the basic Feldstein and Horioka (1980) cross-sectional regression of average investment rates on average saving rates, using the specification of equation (9.8).[18] The estimates of the slope parameter range from just under 0.5 to close to 1. The later samples (after World War I) tend to have stronger correlations and, after 1931, much more explanatory power. (After 1931, the R^2 statistics are above 0.90.) Prior to 1914 the R^2 statistics are much lower than those

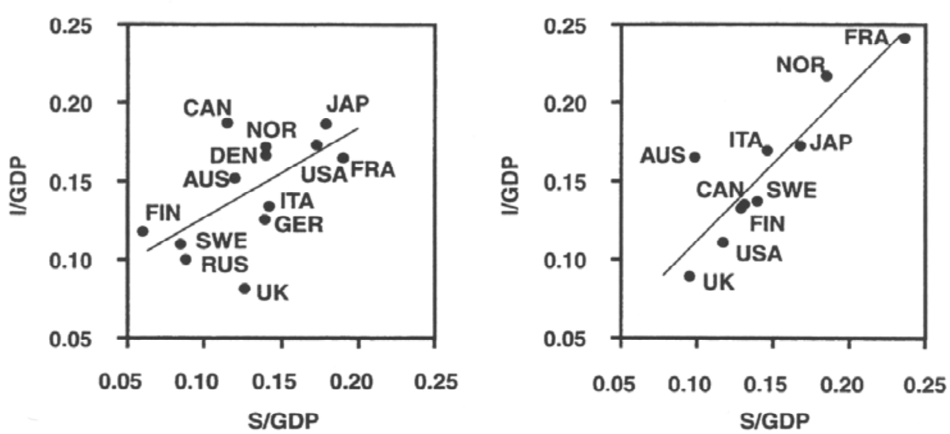

Figure 9.3
Saving and investment rates (expressed as ratios to GDP): 1885–1913 and 1919–1936

Table 9.3
Parameter estimates from regression of investment on savings ($S \equiv I + CA^{NG} + SG - \Delta MG$)

Sample period	Number of countries	Coefficient on S	Standard error	Adj. R^2
1880–1913	11	0.45	0.26	0.16
1885–1913	13	0.55**	0.22	0.30
1880–1890	11	0.44	0.28	0.13
1891–1901	13	0.62***	0.16	0.54
1902–1913	13	0.60**	0.27	0.25
1919–1924	10	1.00**	0.36	0.43
1925–1930	12	0.70***	0.15	0.66
1931–1936	12	0.91***	0.09	0.90
1937–1939	9	0.92***	0.09	0.92

Notes: The estimates for 1880–1913 and 1880–1890 exclude Japan and Russia; for 1919–1924 they exclude Denmark, Germany, and Russia; for 1925–1930 and 1931–1936 they exclude Russia; and for 1937–1939 they exclude France, Germany, Italy, and Russia. *, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

found for industrial countries in the 1960s (usually around 0.90) and even lower than those found for the 1980s (usually around 0.5 to 0.7, depending on the period of estimation).[19]

The results presented in the table suggest that the saving-investment correlation has been lower in periods when the gold standard prevailed. The immediate post–World War I period (1919–1924) and later samples (1931–1936, 1937–1939), periods when many countries were not on strict gold standards, both have higher correlations. These periods also saw rather widespread use of capital controls. Because these controls became much more stringent in the 1930s, they probably are the major explanation for the very high R^2 statistics reported in table 9.3 post 1931.[20]

Even though the R^2 statistics tend to be low before the 1930s, and especially before World War I, the 1891–1901 decade is an exception, with an R^2 not far from those one finds in Organization for Economic Cooperation and Development (OECD) data from the 1980s and 1990s. In addition, the slope coefficient is sometimes significant under the classical gold standard, notably after 1891, when its magnitude is comparable to the estimates from recent OECD data. The results for the late nineteenth century seem even more comparable with those in recent data when one observes that several of the countries in the gold-standard sample could be classified as developing then. Even in post–World War II samples that include the developing countries, the empirical saving-investment link appears weaker prior to the 1982 debt crisis; see Dooley, Frankel, and Mathieson 1987 and Summers 1988.

Having estimated the regression equation, we now turn to tests of some hypotheses. The first question to consider is whether there is sufficient evidence to believe that the coefficient on saving is equal to 1, that is, that saving and investment are perfectly correlated in cross-section. We see from figure 9.4 that the 95 percent confidence intervals for most of the slope estimates are quite wide. Because most of the point estimates are clustered around 0.5, we perform a t test of the hypothesis $\beta = 0.5$ against the alternative $\beta \neq 0.5$. We also perform the one-tailed test of the restriction that $\beta = 1$ against the alternative hypothesis that $\beta < 1$. We present the results of these hypothesis tests in table 9.4. The column labeled *p Value of Test* $\beta = 0.5$ gives the result of the hypothesis test that the coefficient on savings, β, is equal to one-half, against the alternative that β differs from one-half. The p value is the probability of incorrectly rejecting the null hypothesis when it is true, so a low p value implies strong evidence against the null hypothesis that $\beta = 0.5$. We see from this column that we can reject the hypothesis $\beta = 0.5$ only for the last two sub-samples in our data set: 1931–1936 and 1937–1939. The column labeled *p Value of Test* $\beta = 1$ shows we can reject that hypothesis for all sample periods except 1919–1924 and 1931–1939.

To summarize the results of the previous two tables, we do not find strong evidence against the coefficient on saving being equal to 0.5. We have evidence that the coefficient is less than 1 for most periods examined. There is some evidence of a positive relationship between saving

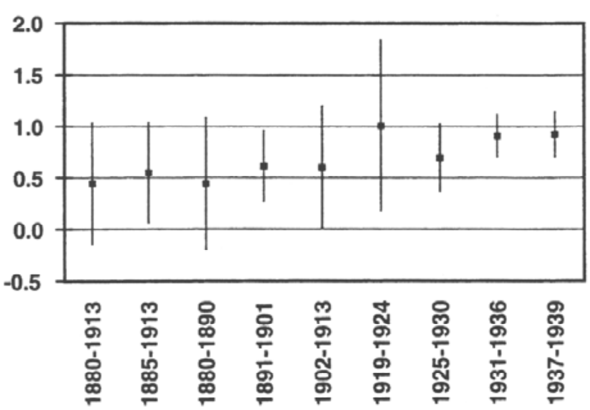

Figure 9.4
Slope estimates (β) and 95-percent confidence intervals

Table 9.4
Hypothesis tests from regression of investment on savings ($S \equiv I + CA^{NG} + SG - \Delta MG$)

Sample period	Coefficient on S	p value of test, $\beta = 0.5$	p value of test, $\beta = 1$
1880–1913	0.45	0.84	0.03
1885–1913	0.55**	0.82	0.03
1880–1890	0.44	0.85	0.04
1891–1901	0.62***	0.48	0.02
1902–1913	0.60**	0.71	0.08
1919–1924	1.00**	0.20	0.50
1925–1930	0.70***	0.21	0.03
1931–1936	0.91***	0.00	0.17
1937–1939	0.92***	0.00	0.22

Notes: The estimates for 1880–1913 and 1880–1890 exclude Japan and Russia; for 1919–1924 they exclude Denmark, Germany, and Russia; for 1925–1930 and 1931–1936 they exclude Russia; and for 1937–1939 they exclude France, Germany, Italy, and Russia. *, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

and investment rates even under the classical gold standard. This last result stands in contrast to Bayoumi (1990), who found no significant cross-sectional relationship between saving and investment for any period from 1880–1913. However, Eichengreen (1992a) reported relatively high estimates of the β coefficient over some sub-samples.[21] The results in tables 9.3 and 9.4 indicate slope coefficients generally lower than those found by Eichengreen but higher and more significant than the ones Bayoumi estimated.

Table 9.5 presents the parameter estimates of Bayoumi (1990) and Eichengreen (1992a) for comparison. Using the same countries and time periods, we estimated the correlations using our gold-adjusted data. For instance, the third column, labeled *Adjusted Bayoumi*, shows the results of the regression using our gold-adjusted data, but with only the eight countries that Bayoumi included in his sample. Similarly, the column labeled *Adjusted Eichengreen* shows the results of the regression using our gold-adjusted data for the nine countries in Eichengreen's sample. The column labeled *Full-Sample Estimates* shows the results from table 9.3, that is, the slope coefficient estimates using the gold adjusted data for all available countries. Bayoumi's conclusions appear to stem mainly from the use of a small sample of countries. Eichengreen's addition of the United States raises the slope coefficients and increases the statistical power available. But our addition of more countries to Eichengreen's sample moderates his findings somewhat.

Table 9.5
Comparison of parameter estimates from Bayoumi, Eichengreen, and gold-adjusted data

Sample period	Bayoumi estimates	Adjusted Bayoumi	Eichengreen estimates	Adjusted Eichengreen	Full-sample estimates
1880–1913	0.29	0.43	0.63*	0.57	0.45
1880–1890	0.48	0.14	0.59*	0.50	0.44
1891–1901	0.69	0.63	0.71***	0.68*	0.62***
1902–1913	−0.10	0.89	0.72	0.86	0.60**
1924–1936	—	0.70**	1.06***	0.76**	0.80***
1925–1930	—	0.56	1.22***	0.55	0.70***

Notes: Bayoumi's sample of countries consisted of Australia, Canada, Denmark, Germany, Italy, Norway, Sweden, and the United Kingdom. Eichengreen added the United States. Our data set adds Finland, France, Japan, and Russia and adjusts for gold flows. The full sample estimates for 1880–1913 and 1880–1890 exclude Japan and Russia; for 1924–1936 they exclude Germany and Russia; for 1925–1930 they exclude Russia.
*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

Table 9.5 suggests that the selection of countries in the cross-sectional average is of key importance. Indeed, this appears to matter as much as the gold adjustment we perform. As we show in appendix 9.1, the parameter estimates are sensitive to the choice of countries in the cross-sectional average. Changing the countries in the sample can alter the estimated slopes by as much as 0.3, and the explanatory power of the investment-on-saving regression can vary by as much as 40 percent. Despite these caveats, the significance of parameter estimates seems fairly robust in the face of single deletions from the sample of countries. Thus, despite the sensitivity of the estimates to outliers, the broad thrust of the full-sample results suggested by the preceding two tables remains valid.

A sample period of particular interest is 1925–1930, during which Britain adhered to the interwar gold standard, and most market economies in the world likewise rejoined the gold standard. Eichengreen (1992a) estimates a highly significant slope coefficient of 1.22 under the resuscitated gold standard that prevailed during the years 1925–1930 (see table 9.5), much higher than those found for the classical, pre-1914 gold standard. On that basis he disputes the theory, advanced by the *Economist* magazine among others (*Economist* 1989), that the greater nominal exchange rate certainty prevailing under gold-standard regimes necessarily leads to greater international capital mobility and thereby to lower saving-investment coefficients.

Table 9.5 shows, however, that for Eichengreen's original sample of nine countries, our adjusted data lead to a statistically insignificant slope coefficient of only 0.55, which is quite comparable to those one finds for pre-1914 data.[22] In our fully-sized sample the estimated slope is somewhat higher, at 0.70, and is significantly different from zero at the 1 percent level. Nonetheless, our estimated slope for 1925–1930 seems markedly lower than those we estimate for any other subperiod of the interwar span (see table 9.4).

Thus, there is indeed some evidence that the interwar gold standard made a difference for the cross-country saving-investment relationship. Exchange rate volatility could be only a minimal part of the reason, however. The restored interwar gold standard was accompanied by a general relaxation of exchange controls, which may well have had a much greater impact on capital mobility than the nominal exchange rate regime.

If the cross-sectional averages used in the saving-investment regression correspond to the years when each country was on the gold standard, then the estimated correlations actually are higher.[23] However one cannot conclude from this result that gold standard adherence resulted in a tighter saving-investment link. Countries may have been more likely to be on gold in periods when their current accounts were near balance.

Conclusions

In this chapter we have presented revised estimates of saving and investment for thirteen countries over the period from 1850 to 1945. We have constructed a measure of the current account that treats gold flows on a consistent basis across countries, and also adjusted investment data to account for changes in inventories.

Our methodology for removing monetary gold flows from current account data led naturally to a gold standard version of the Feldstein-Horioka (1980) hypothesis on capital mobility. Our regression results are in broad agreement with Eichengreen (1992a), who found a significantly positive cross-sectional correlation between saving and investment even during some periods when the gold standard prevailed. Despite the high level of capital mobility that prevailed under the gold standard, it seems that average national saving and domestic investment rates were cross-sectionally correlated, contrary to the Feldstein-Horioka hypothesis. Nonetheless, the explanatory power of the