pre-1914 regressions is usually much lower than in the corresponding post-1960 regressions.

Despite reaching broadly similar conclusions, we estimate correlations between saving and investment that are somewhat lower than those Eichengreen (1992a) found. In particular, we find that in comparison to other interwar subsamples, the saving-investment correlation is markedly low during the fleeting years of a revived world gold standard, 1925–1930. The proportions in which this phenomenon should be ascribed to greater exchange rate predictability as opposed to relaxed capital controls is a topic for future research.

Appendix 9.1 Omitted Variables Bias, Alternative Specification, and Parameter Sensitivity

This appendix deals with the sensitivity of the parameter estimates in the paper to the inclusion of gold flows and inventory data, and to the set of countries included in the cross-sectional average.

Gold Flows

We argued in the text that in regressions of investment on saving, figures for the current account should include all data on gold flows. This choice leads to the specification in equation (9.8). Omitting data on total net gold shipments introduces an omitted variables bias into the estimates.

We denoted the true variable of interest, the current account including all gold (expressed as a fraction of GDP or NNP), by CA^O. It is defined as the sum of the nongold current account, CA^{NG}, and net shipments of gold to foreigners, SG:

$$CA^O = CA^{NG} + SG. \tag{A.9.1}$$

The true relation we are interested in estimating is

$$I = \alpha + \beta(I + CA^O) + u. \tag{A.9.2}$$

This expression can be rewritten using equation (A.9.1):

$$\begin{aligned} I &= \alpha + \beta(I + CA^{NG} + SG) + u \\ &= \alpha + \beta(I + CA^{NG}) + \beta SG + u. \end{aligned} \tag{A.9.3}$$

Table A.9.1
Comparison of parameter estimates from regression of I on $(I + CA^{NG} + SG)$ with regression of I on $(I + CA^{NG})$

Sample period	Estimated parameter	With SG	Without SG	Percentage bias†
1885 to 1913	Slope: β	0.55**	0.44*	–19.78
All countries	Adj. R^2	0.30	0.20	–33.56
1919 to 1936	Slope: β	0.95***	0.89***	–7.00
Excl. Den, Fra, Ger, Rus	Adj. R^2	0.74	0.66	–9.98

† Percentage bias is calculated by taking the difference in parameter estimates as a proportion of the correctly specified parameter.
*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

Excluding gold flows from the measured value of the current account introduces a source of bias into the estimation procedure, as regressing I on $I + CA^{NG}$ (and a constant) only omits the third term on the right hand side of equation (A.9.3). The extent of the omitted variables bias is illustrated in the following table.

The table illustrates that the slope coefficient is underestimated by almost 20 percent when the 1885 to 1913 data are used. When data from the interwar period are used, the extent of the understatement of the slope coefficient is reduced, but it still remains important. In both cases the explanatory power of the regression is reduced. These results are in accord with our intuition of the likely impact of including gold flows, as nongold current account balances tend to be negatively correlated in cross-section with net outward shipments of gold.[24] Adding gold flows to the estimated equation thus has the effect of raising the measured correlation between saving and investment, as the table demonstrates.

Inventories

We pointed out in the paper that figures for gross investment should include the value of changes in inventories or stocks. Omitting data on stocks will introduce another source of bias into the estimates.

Suppose that the true variable of interest is total gross investment, I, which is defined as the sum of gross fixed investment, I^F, and changes in inventories or stocks:[25]

$$I = I^F + \Delta Stocks. \tag{A.9.4}$$

Saving is defined residually, as the sum of the current account and gross investment

$$S = CA + I. \tag{A.9.5}$$

Let the level of *fixed* saving, S^F, be defined as the current account plus gross *fixed* investment,

$$S^F = CA + I^F, \tag{A.9.6}$$

such that $S = S^F + \Delta Stocks$. Now suppose that the true relation we are interested in estimating is given by the expression

$$I = \alpha + \beta S + u. \tag{A.9.7}$$

This expression can be rewritten by using equations (A.9.5) and (A.9.6):

$$I^F = \alpha + \beta S^F + (\beta - 1)\Delta Stocks + u. \tag{A.9.8}$$

Excluding inventory data from the measured value of investment introduces a potential source of bias into the estimation procedure, as regressing fixed investment on fixed saving omits the third term on the right-hand side of equation (A.9.8). The extent of the resulting omitted variables bias is illustrated in table A.9.2.

There is a large effect for the 1885–1913 sample. When inventories data are excluded, the slope coefficient is overstated, as is the explanatory power of the regression.

Alternative Regression Specification

An alternative specification, given in equation (9.7), allows for possibly different coefficients on saving and the change in the monetary gold stock. Results from this specification are presented in table A.9.3.

Table A.9.2
Comparison of parameter estimates from regression of I on (S^F + $\Delta Stocks$) with regression of I^F on S^F

Sample period	Estimated parameter	With $\Delta Stocks$	Without $\Delta Stocks$	Percentage bias†
1885 to 1913	Slope: β	0.55**	0.67***	20.92
All countries	Adj. R^2	0.30	0.60	96.41
1919 to 1936	Slope: β	0.95***	0.93***	–2.47
Excl. Den, Fra, Ger, Rus	Adj. R^2	0.74	0.55	–25.19

†Percentage bias is calculated by taking the difference in parameter estimates as a proportion of the correctly specified parameter.
*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

Table A.9.3
Parameter estimates from regression of I on S and ΔMG ($S \equiv I + CA^{NG} + SG + \Delta MG$)

Sample period	Sample size	Coefficient on S: β	Standard error	Coefficient on ΔMG: γ	Standard error	Wald test $\beta = 1$, $\gamma = -1$	Adj. R^2
1880–1913	11	0.42	0.25	8.33	7.48	3.07	0.20
1885–1913	13	0.55**	0.23	0.03	3.78	1.90	0.24
1880–1890	11	0.37	0.23	11.27**	4.66	6.23**	0.45
1891–1901	13	0.61***	0.17	−0.68	1.76	2.72	0.50
1902–1913	13	0.55*	0.27	5.10	5.71	1.59	0.25
1919–1924	10	1.13**	0.44	−4.37	5.55	0.18	0.38
1925–1930	12	0.75**	0.24	−1.37	2.46	1.96	0.63
1931–1936	12	0.94***	0.09	0.34	0.79	1.85	0.91
1937–1939	9	0.94***	0.10	−0.67	0.70	0.36	0.91

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; for 1937–1939 they exclude France, Germany, Italy, and Russia.
*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

We can see from the results in this table that including the monetary gold stock adds little to the previous results. The explanatory power does not change by much, because the coefficient estimates on the change in the monetary gold stock are mostly insignificant, even at the 10 percent level. We can reject the hypothesis that the coefficient on saving equals 1 and the coefficient on changes in the monetary gold stock equals –1 for a single period only: 1880–1890.

Outlier Sensitivity

This section deals with the question of how sensitive the parameter estimates are to outliers. Table A.9.4 presents the results of the regressions for different time periods when one country is dropped from the sample at a time. Using this procedure, the highest and lowest parameter estimates were obtained. For comparison, the full sample estimates of the slope are presented in the final column.

We can see from this table that the parameter estimates are quite sensitive to the sample of countries in the cross-sectional average. The estimated slope coefficient can change by as much as 0.3, and the explanatory power can change by more than 60 percent. For the pre–World War I period, the inclusion of the United States tends to raise the parameter estimates, while Finland tends to lower the estimates. For the post–World War I period, the inclusion of Germany tends to raise the saving-investment correlations, while Australia tends to lower them.[26]

Parameter Estimates: On or Off Gold Standard

Another interesting question to consider is whether being on the gold standard makes a difference to the estimated saving-investment correlation. This question can be addressed by estimating the parameters only for countries that were on the gold standard for the entire sample period, or by using data for the years that a country was on the gold standard.[27] We adopt both approaches here. Table A.9.5 shows the results of estimating the parameters for countries that were on the gold standard, and it shows country averages based on the period for which the country was on the gold standard. For comparison, we include in the final two columns the parameter estimates based on all available data.

We can see from the results presented in this table that including only countries on the gold standard for the entire sample period tends to

Table A.9.4
Maximum and minimum slope estimates from regression of investment on savings

Sample period	Min β parameter	Adj. R^2	Missing country	Max β parameter	Adj. R^2	Missing country	Full sample β
1880–1913	0.38	0.07	SWE	0.50	0.09	FIN	0.45
1885–1913	0.49*	0.23	RUS	0.63**	0.28	FIN	0.55**
1880–1890	0.23	–0.06	USA	0.49	0.18	CAN	0.44
1891–1901	0.53**	0.37	JAP	0.68***	0.57	FIN	0.62***
1902–1913	0.54*	0.18	RUS	0.74*	0.22	FIN	0.60**
1919–1924	0.80**	0.37	NOR	1.14**	0.55	AUS	1.00**
1925–1930	0.55*	0.27	FRA	0.89***	0.94	AUS	0.70***
1931–1936	0.86***	0.87	GER	0.97***	0.92	UK	0.91***
1937–1939	0.87***	0.92	JAP	0.96***	0.95	AUS	0.92***

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

Table A.9.5
Slope estimates from regression of investment on savings for countries on the gold standard and for years on the gold standard

Sample period	Including countries on gold standard		Including years on gold standard		All available data	
	β	Adj. R^2	β	Adj. R^2	β	Adj. R^2
1880–1913	0.46	0.17	0.58**	0.33	0.45	0.16
1885–1913	0.44	0.14	0.57**	0.31	0.55**	0.30
1880–1890	0.44	0.12	0.44	0.13	0.44	0.13
1891–1901	0.52**	0.37	0.66***	0.54	0.62***	0.54
1902–1913	0.63*	0.25	0.63*	0.25	0.60**	0.25
1919–1924	—	—	—	—	1.00**	0.43
1925–1930	0.78**	0.87	0.79***	0.71	0.70***	0.66

Notes: The estimates for countries on the gold standard for 1880–1913, 1885–1913, 1880–1890, and 1891–1901 exclude Italy, Japan, and Russia; the estimates for 1902–1913 exclude Italy; the estimates for 1925–1930 include only Germany, Sweden, the United Kingdom, and the United States. The full sample estimates for 1880–1913 and 1880–1890 exclude Japan and Russia; for 1919–1924 they exclude Denmark, Germany, and Russia; for 1925–1930 they exclude Russia.
*, **, *** indicate significance at the 10 percent, 5 percent, and 1 percent level, respectively.

lower the estimated saving-investment correlation. However, taking the country average for years that a country was on the gold standard tends to raise the estimated correlation as well as the explanatory power of the regression. As noted in the text, this result is difficult to interpret because the timing of gold standard adherence was endogenous for many countries.

Appendix 9.2 Data Sources and Methods

The investment ratios estimated in the paper were calculated by taking current price estimates of gross domestic capital formation (gross fixed investment plus changes in stocks/inventories) as a percentage of gross domestic product at market prices.[28] The estimates of stocks may include changes in the value of livestock.[29] The saving ratio was estimated by adding the investment ratio to the current account to GDP or NNP ratio, measured in current prices. The saving ratio is thus defined residually, and hence incorporates all measurement error from both investment and the current account.

Australia

GDP

GDP data from 1861–1900 are from N. G. Butlin 1962, 6, table 1, col. 2, market prices, calendar years, millions of pounds. GDP data from 1900 to 1944 are from M. W. Butlin 1977, 78–79, table IV.1, col. 11, current prices, millions of (Australian) dollars. Data are for financial years (July 1 to June 30), 1900/1901 to 1944/1945.

Capital Formation

Capital formation data for 1861–1900 are from N. G. Butlin 1962, 16, table 4, total public and private gross domestic capital formation, market prices, calendar years, thousands of pounds. Capital formation data include changes in stocks. Changes in stocks data for 1861–1900 are from N. G. Butlin 1962, 22, table 7, livestock accumulation, market prices, calendar years, thousands of pounds. N. G. Butlin (1962, 21) argues that "Livestock assets form a large part of the total private Australian assets, and changes in livestock assets are very large in relation to total private gross capital formation." N. G. Butlin proposed a measure of domestic capital accumulation equal to capital formation plus changes in livestock. This procedure is used for Australian data prior to 1901.

This inclusion of livestock accumulation estimates in capital formation data is controversial, however. As Boehm (1965, 211) argues, "The alternative sequence warrants close attention in income and growth analyses because the general effects on output and expenditure of changes in livestock are not necessarily comparable with the effects of changes in fixed assets." For Australia, increases in livestock average around 1.07 percent of GDP from 1861 to 1900, and then 0.94 percent from 1900/1901 to 1944/1945.

From the perspective of national accounts classification, the System of National Accounts advocates the classification of livestock accumulation into estimates of changes in stocks. According to the United Nations Statistical Office (1952, 80), the value of the increase in stocks should be classified in the same way as fixed capital formation in the national accounts. The System of National Accounts was adopted by many countries in our dataset and applied retrospectively to historical data. Thus, for the purposes of this chapter, we will follow this procedure and include livestock accumulation in estimates of changes in stocks.

Capital formation data from 1900 to 1944 are from M. W. Butlin 1977, 78–79, table IV.1, private plus public fixed capital formation, current prices, millions of dollars. Data are for financial years (July 1 to June 30), 1900/1901 to 1944/1945. Capital formation data include changes in stocks. Data for changes in stocks from 1900 to 1944 are from M. W. Butlin 1977, 78–79, table IV.1, current prices, millions of dollars. Data are for financial years (July 1 to June 30), 1900/1901 to 1944/1945.

Current Account

Current account data for 1861–1900 are from N. G. Butlin 1962, 444, table 265 for current account balance, in millions of pounds. (The number in Butlin's table is defined as an excess of debits, so that number with its sign reversed is used for the current account balance—that is, a positive number implies surplus.) Current account data for 1900–1944 are from M. W. Butlin 1977, 108–109, table IV.17 for data on exports, imports, and net property income paid overseas (cols. 1, 2, and 4 respectively). Data are in current prices, millions of dollars. Data are for financial years (July 1 to June 30), 1900/1901 to 1944/1945. The value of exports less imports less net property income paid overseas gives the current account balance. For the current account data prior to 1901, N. G. Butlin excluded net exports of gold and included gold production, "treating gold production as the proper current account credit of a gold producing country" (Butlin 1962, 435). M. W. Butlin also followed this procedure for data from 1900/1901 to 1944/1945. To arrive at figures for the current account excluding all gold flows, we subtracted gold production from the Butlin current account figures.

Gold

Data on the gross value of gold production from 1861 to 1900 are from N. G. Butlin 1962, 115, table 55. Data on gold production from 1900 to 1945 are from McLean 1968, 83–86, row 2, gold production, millions of pounds. Data from 1901 to 1913 are for calendar years, data from 1914 are for financial years (July to June). Data on net exports of gold coin and bullion from 1861 to 1900 are from N. G. Butlin 1962, data on current account credits for gold and specie exports from 410–411, table 247, line 12, and gold and specie imports are from 413–414, table 248, line 11. Data on net exports of gold coin and bullion from 1901 to 1945 are from the *Official Yearbook of the Commonwealth of Australia* (Australia, Commonwealth Bureau of Census and Statistics, various years), exports of gold bullion and specie less imports of gold bullion and

specie. The *Yearbook* data from 1901 to 1913 are for calendar years, data from 1914 are for financial years. Data from 1901 to 1914 are converted to financial years by averaging with the data from the previous year.

The monetary gold stock includes coin and bullion held by the treasury, mints, banks, and the public. According to the *Statistical Register* of New South Wales (Colony of New South Wales 1876, 255, and 1890, 255), data on gold coin and bullion held by the New South Wales Treasury and mint for 1867–1876 and 1881–1890 suggest that mint holdings of coin are negligible (maximum value of £804). Bullion held at the mint reaches a maximum of £136,904 in 1874. Treasury holdings of bullion and coin are listed as being negligible. Data on bullion in the hands of the public (outside of banks) are not available. The bullion component of the monetary gold stock held by the public and official agencies is therefore ignored in these calculations.

For data on the monetary gold stock of Australia, the flows of gold reported by the three mints (Sydney, Melbourne, and Perth) can be added to provide an estimate of changes in the total coin stock of the country. For New South Wales, data on gold coin in banks of issue and private hands from 1855 to 1890 are taken from the *Statistical Register* of New South Wales (Colony of New South Wales 1890, 234). Data for 1891 to 1899 are taken from the *Annual Report* of the United Kingdom (United Kingdom, Deputy Master of the Mint, various issues). Data for 1900 and 1901 are estimated by adding gold coin issued by the mint less gold coin withdrawn, plus coin imported less coin exported by the Colony of New South Wales, using data from the *Annual Report* (United Kingdom, Deputy Master of the Mint 1901, 138).

For Victoria, there is little data available on the stock of gold coin in banks and private hands. However, the *Annual Report* (United Kingdom, Deputy Master of the Mint 1893, 123; 1899, 123; 1901, 138) gives data on gold coin flows for the colony of Victoria from the opening of the Melbourne mint in 1872. The sum of the data on gold coin issued less coin withdrawn, plus gold coin imported less coin exported from the colony of Victoria gives the change in gold coin in the colony.

For Western Australia, the *Annual Report* (United Kingdom, Deputy Master of the Mint 1901, 138) gives data on gold coin flows for the colony of Western Australia from the opening of the Perth mint in 1899. The sum of the data on gold coin issued less coin withdrawn, plus gold coin imported less coin exported from the colony gives the change in gold coin in Western Australia.