Capital-Goods Prices and Investment, 1870–1950

WILLIAM J. COLLINS AND JEFFREY G. WILLIAMSON

The relative price of capital goods, an important component of the user cost of capital, has rarely been incorporated into comparative studies of long-run capital accumulation. This article constructs and explores a data set for capital-goods and equipment prices covering the 1870–1950 period for 11 OECD countries. We document substantial differences across countries in the relative prices of capital goods, but also find convergence in those prices over time. Finally, we show that relative capital-goods prices are strongly negatively correlated with investment rates.

The conventional wisdom is that global financial markets were as well integrated in the 1890s as in the 1990s but that it took several postwar decades to regenerate the connections that existed before 1914. This view has emerged from a variety of tests for world financial capital-market integration, ranging from the correlation of saving and investment aggregates to the dispersion of security prices and real interest rates.[1] The ultimate importance of these connections has been justified in terms of the growth of nations and income convergence, and so, when growth equations are applied to historical cross-sections from the Atlantic economy, measures of financial saving capacity and access to foreign capital are often included.[2] However, financial capital-market integration cannot speak to the issue of investment and growth without making an explicit connection with the cost of capital goods.

More specifically, per capita income growth depends to a large extent upon capital accumulation, accumulation depends upon investment, and the investment decision hinges on a comparison of capital's user cost with its marginal product. Ignoring tax implications, the stripped down version of the user cost of capital can be written as $u = (P_K / P)(r + \delta)$ where r is the real interest rate, P_K the price of capital goods, P is the price of output, and

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William J. Collins is Assistant Professor, Department of Economics, Box 1819-B, Vanderbilt University, Nashville, TN 37235; phone: (615) 322-3428; e-mail: william.collins@vanderbilt.edu. Jeffrey G. Williamson is Laird Bell Professor, Department of Economics, Harvard University, Cambridge, MA 02138; phone: (617) 495-2438; e-mail: jwilliam@kuznets.fas.harvard.edu.

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[1] See Feldstein and Horioka, "Domestic Saving"; Edelstein, *Overseas*; Neal, "Integration"; and Obstfeld and Taylor, "Great Depression."

[2] Prados et al., "De Te Fabula Narratur?"; Obstfelt and Taylor, "Great Depression"; and O'Rourke and Williamson, *Globalization*, chap. 11.

δ the depreciation rate.[3] Therefore, for a given rate of depreciation, the user cost of capital is determined by a combination of conditions in financial capital markets (interest rates) and in physical capital markets (capital-goods prices). Given these connections, it is surprising that the price of capital goods has rarely been incorporated into long-run studies of accumulation, growth, and global capital-market integration.[4]

This could be an omission that matters. First, the relative price of capital goods, and of machinery in particular, has been featured prominently in recent studies of postwar growth, where the view that "low equipment prices operate to promote growth by increasing the quantity of equipment investment" has gained some credence.[5] For example, Carlos Díaz-Alejandro, J. Bradford De Long, and Alan Taylor all argue that Argentina's import-substitution policy in the 1940s and 1950s drove up equipment prices and thereby drove down accumulation and growth rates.[6] Nonetheless, the exploration of Argentina's experience is more the exception than the rule; quantitative studies of pre-1960 growth have been nearly silent on the issue.

Second, the literature on long-run international capital-market integration has focused on financial capital markets, often using the dispersion of interest rates as a measure of the degree of integration.[7] However, the level and trend in the international dispersion of the user cost of capital, which is determined in part by the relative price of capital goods, might have differed from what real interest rates alone suggest. In light of the data we assemble here for the price component of user costs, conventional tales about epochs of integrated and disintegrated capital markets and their contribution to income convergence up to 1914 and divergence in the interwar period might require some revision.

By combining the national accounts' time series for capital-goods prices with data from the Penn World Table (henceforth PWT), this article examines levels and trends in capital-goods prices relative to consumption-goods prices from 1870 to 1950 for 11 countries: nine from the Atlantic economy, plus Australia and Japan.[8] The article, therefore, covers both an early period

[3] To elaborate on the stripped down version, write the user cost of capital as

$$u = (P_K / P)(i + \delta - \Delta P_K / P_K)$$

where, in addition to the notation introduced in the text, i denotes the nominal interest rate. The expression in the text can be derived from this one by assuming that the price of capital goods changes at the same rate as for all goods (the inflation rate). Jorgenson ("Capital Theory") illustrated that the user cost of capital could be characterized as a function of the price of capital goods, the rate of depreciation, the interest rate, and tax policies. The latter can be ignored for most of our period.

[4] There are exceptions that will be noted, Kuznets, "Quantitative Aspects," certainly being one.

[5] The quote is from De Long and Summers, "Equipment," p. 474. See also Jones, "Economic Growth"; Easterly, "How Much Do Distortions"; Lee, "International Trade"; Greenwood and Jovanovic, "Accounting"; and Greenwood, Hercowitz, and Krusell, "Long-Run." See Auerbach et al., "Reassessing" for a comment on the empirical fragility of the link between machinery investment and growth.

[6] Díaz-Alejandro, *Essays*; De Long, "Productivity"; and Taylor, "External Dependence" and "On the Costs."

[7] For example, Obstfeld and Taylor, "Great Depression."

[8] See Summers and Heston, "Penn World Table Mark 5"; and Summers et al., *Penn World Table Mark 5.6*.

of economic globalization (up to World War I) and the subsequent period of international disintegration. By doing so, it provides some historical perspective on the more recent period of globalization. Moreover, by taking a longer view of the growth process than most of the recent literature, the article will make a connection between the economics of accumulation in the prewar period and the relative economic standing of countries in the postwar period.

The article has three main goals. First, it constructs measures of the relative price of capital goods and equipment across countries and over a long period. No other such database extends back to 1870, so the information contained here should be useful for economists and historians interested in the long-run evolution of price structures, capital accumulation, and growth. Second, the article investigates potential explanations for the observed trends over time and for differences across countries in these relative-price series. Third, it estimates the effect of differences in relative capital-goods prices on investment rates. The article concludes with speculation about how the conventional wisdom regarding "world capital-market integration" can be enriched by widening the scope of inquiry to include capital-goods prices.

We find that the international dispersion of relative capital-goods prices has narrowed considerably since 1870, especially for equipment, confirming commodity-price convergence. We also find a downward trend in the relative price of equipment in all countries prior to World War I, a trend which is confounded in the overall capital-goods price indices by a generally upward drift in construction prices. On the basis of the economic histories of Japan and the United States, we argue that the price ratio's decline reflects relatively fast productivity advance in the equipment-producing sector. Furthermore, we argue that cross-country differences in the relative price of capital goods reflected differences in productivity levels and skill endowments, and we find that countries with high overall tariff rates had relatively low capital-goods prices. Finally, we show that countries with relatively high capital-goods prices undertook relatively low rates of investment, implying that such price differences had important growth implications.

THE DATA

Capital-goods price indices underlie the real investment series of all national accounts. Because the overall capital-goods price series combine equipment prices with those of other capital goods, and because the existing literature emphasizes the connection between equipment investment and growth, we have made an effort to extract separate price series for equipment where possible. For comparison, we have also extracted building-construction price series. All together we have price series for Australia,

Canada, Denmark, Finland, Germany, Italy, Japan, Norway, Sweden, Great Britain, and the United States.[9] The Appendix describes the sources and construction of these series. For each country a relative price index is formed by dividing the capital-goods price index by the consumption-goods price index.[10] The resulting series tell us how this relative price has changed over time within each country, but they do not tell us anything about differences in relative prices across countries. For example, we can tell that the price of investment goods relative to consumer goods fell in Japan and rose in the United States from the 1870s to the 1950s, but we cannot tell whether the relative price of capital goods in the United States was high or low compared to that in Japan at any point in time. To do so, we need to establish a cross-country benchmark. The earliest year for which this is possible is 1950, a year for which a purchasing-power parity price level is reported by the PWT for investment and consumption for each country. The benchmark permits a double comparison similar to that made by Charles Jones for the postwar period: we observe whether the price of capital goods relative to the price of consumption goods in a particular country is high or low compared to the same ratio in other countries.[11] Thus, we can say something about the relative cost of capital goods between countries as well as over time.

Unfortunately, the PWT does not provide price series for capital-goods components, and at the same time it is evident that the producer-durables price may differ substantially from the overall capital-goods price. This implies that the 1950 PWT figures for overall investment-goods prices are probably not reliable approximations of equipment or machinery prices. Instead, we take the producer-durables and consumer-goods price data from the United Nations' International Comparison Program for 1980 and extend these prices back to 1950 by using the producer-durables and consumer-goods price indices implicit in the OECD country national accounts.[12]

[9] We would like to include more countries in the sample, but most do not have long and detailed national accounts stretching back to the nineteenth century.

[10] Consumption goods are chosen for the comparison rather than the overall GDP deflator because the investment goods index is included in the GDP deflator. Greenwood, Hercowitz and Krusell, "Long-Run" and Greenwood and Jovanovic, "Accounting" also relate capital goods prices to consumption goods prices. Furthermore, Jones ("Economic Growth," p. 361) shows that the choice does not matter for the 1960–1985 period.

[11] Jones, "Economic Growth."

[12] More specifically, we take the 1980 benchmarks from United Nations (1987), and then we calculate the implicit price deflators from 1950 to 1980 using the nominal and real producers durables investment series in OECD, *National Accounts Statistics 1950–1968* and *National Accounts: Detailed Tables 1964–1981*. We have not tried to establish such benchmark estimates for the building series. Unlike Gordon, *Measurement*, we do not attempt to make quality adjustments to the reported national accounts price series. Based on Gordon's findings, such an adjustment would almost certainly strengthen the findings in this article.

Admittedly, this is not an ideal measure of relative capital-goods prices over time or across countries, as Simon Kuznets pointed out long ago.[13] The national accounts capital-goods price series are often combinations of input prices rather than actual observations of capital-goods prices, as discussed in the Appendix. Consequently, they probably mismeasure productivity advance within the capital-goods sector. Furthermore, the methods of price estimation are not identical across countries, and so we cannot even expect that the biases work the same way and to the same extent in every country. Finally, using a single benchmark to anchor time series running back to 1870 could produce misleading comparisons.[14] The farther we travel from the benchmark, the less certain our estimates become.

Nevertheless, after employing similar national accounts price series almost forty years ago, Robert Gordon observed that "To deny the existence of these differential price trends is to deny the validity of the deflated estimates of the components of GNP on which we all so heavily rely."[15] It is no surprise that historical national accounts data are quite imperfect, and so it is clear that we must proceed with caution. At the same time, it seems foolish to postpone the exploration of potentially important determinants of long-term economic growth simply because the data are not ideal. Until the next round of revision of historical national accounts (and their underlying price series) and the appearance of comprehensive cross-country capital-goods price data for the nineteenth century, the comparisons we make here rely on the best evidence we could assemble.

THE EVOLUTION OF RELATIVE CAPITAL GOODS PRICES, 1870–1950

Table 1 documents the movements in capital-goods prices relative to consumer-goods prices over 80 years, country by country, with each series set equal to 100 in 1900–1904. Panel A reports the quinquennially averaged relative price of all capital goods (equipment and structures) for each country from 1870 to 1950. Panel B reports the relative price of equipment alone for a somewhat smaller sample (data are not available for Australia and Finland). Panel C documents trends in the relative price of building investment for comparison with those in equipment prices.

Panel A reveals that the relative price of capital goods clearly did not trend at the same rate, or even in the same direction, in all countries. Australia, Canada, Denmark, Sweden, and the United States all had a rising relative price up to World War I, but some others, especially Japan, experienced a decline in the relative price of capital goods despite the fact that

[13] Kuznets, "Quantitative Aspects," p. 15.

[14] See Nuxoll, "Differences"; and Dowrick and Quiggin, "True Measures," for considerations of the problems associated with intertemporal and international price data.

[15] Gordon, "Differential Changes," p. 937.

TABLE 1
RELATIVE PRICE OF CAPITAL GOODS, 1870–1950: (1900–1904 = 100)

Year	AUS	CAN	DEN	FIN	GER	ITA	JAP	NOR	SWE	UK	US
					Panel A: Relative Price of All Capital Goods						
1870–74	91.20	86.63	91.18	92.18	116.15	101.53	—	98.28	84.91	106.83	90.00
1875–79	88.69	89.51	87.37	88.35	94.42	104.80	151.42	102.24	89.01	102.73	91.08
1880–84	75.61	91.45	80.69	87.89	86.76	102.02	105.26	92.93	90.71	99.36	93.75
1885–89	70.67	91.98	90.86	99.02	93.47	99.05	126.21	94.46	92.58	96.21	93.89
1890–94	80.16	94.22	92.17	89.39	89.64	95.38	115.46	97.20	90.01	96.73	90.97
1895–99	92.65	99.05	101.12	102.81	95.12	88.09	114.46	98.35	97.37	98.45	96.15
1900–04	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1905–09	95.49	95.14	101.86	98.73	98.05	99.50	91.58	101.61	98.76	96.02	100.65
1910–14	99.14	96.76	104.29	89.75	93.85	93.13	81.09	97.09	99.75	98.38	99.55
1915–19	124.46	—	—	88.06	—	128.66	100.94	131.22	123.06	97.45	106.13
1920–24	125.82	110.86	112.19	102.62	—	105.63	95.73	112.71	116.64	87.89	110.67
1925–29	123.30	100.73	102.03	111.58	100.55	95.43	80.93	84.27	107.65	77.64	106.98
1930–34	114.17	100.44	116.96	110.04	84.53	93.99	78.91	85.50	117.17	78.15	119.76
1935–39	124.38	105.84	114.39	124.52	97.48	88.24	85.08	93.08	121.94	82.83	120.90
1940–44	141.60	110.79	87.84	127.66	—	52.31	—	—	111.60	86.05	122.04
1945–49	164.83	113.21	110.43	137.80	—	78.68	—	122.37	112.39	102.98	120.30
1950	154.37	118.31	124.79	156.17	104.99	92.34	93.84	129.63	109.44	105.99	131.54
					Panel B: Relative Price of Equipment						
1870–74	—	125.83	99.87	—	135.29	104.26	—	116.54	142.44	118.30	114.89
1875–79	—	129.73	80.86	—	89.88	114.41	228.76	119.71	106.73	122.07	105.24
1880–84	—	126.49	78.27	—	84.40	95.15	139.92	102.72	101.29	109.65	99.70
1885–89	—	112.56	81.54	—	79.11	88.30	138.91	103.99	97.58	101.29	95.72
1890–94	—	104.84	84.92	—	88.47	90.22	127.32	98.66	94.20	99.57	89.87
1895–99	—	106.43	94.81	—	91.75	95.88	111.80	99.12	98.89	96.24	95.25
1900–04	—	100.00	100.00	—	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1905–09	—	81.54	97.01	—	93.49	103.67	90.76	94.30	96.79	96.67	95.39

TABLE 1 — continued

Year	AUS	CAN	DEN	FIN	GER	ITA	JAP	NOR	SWE	UK	US
					Panel B: Relative Price of Equipment — continued						
1910–14	—	75.99	94.84	—	86.55	92.17	76.46	89.45	99.45	97.74	97.67
1915–19	—	—	—	—	—	132.56	104.88	112.69	156.14	94.94	106.46
1920–24	—	91.70	124.07	—	—	115.80	64.05	92.73	97.11	75.60	105.20
1925–29	—	75.75	100.37	—	86.36	98.41	51.20	77.61	76.22	70.90	101.65
1930–34	—	74.91	122.59	—	90.44	90.83	56.43	73.21	73.99	69.99	109.79
1935–39	—	83.76	116.06	—	85.57	87.70	61.76	79.12	90.35	82.18	116.20
1940–44	—	86.47	—	—	—	57.63	—	—	88.61	86.66	120.59
1945–49	—	76.40	131.88	—	—	73.18	—	94.49	84.65	96.55	107.01
1950	—	80.69	134.96	—	88.79	82.17	59.85	105.61	86.34	101.09	115.37
					Panel C: Relative Price of Building Investment						
1870–74	—	75.76	86.37	—	105.46	98.20	—	81.88	73.23	99.57	75.45
1875–79	—	78.76	85.04	—	94.17	102.14	107.81	89.90	84.97	97.93	76.72
1880–84	—	82.35	78.22	—	81.09	104.49	82.61	84.39	87.37	96.87	84.77
1885–89	—	86.80	87.66	—	97.11	99.34	107.67	88.30	91.30	96.01	90.41
1890–94	—	91.39	88.75	—	89.52	100.72	100.50	92.92	87.76	96.80	89.65
1895–99	—	96.17	99.62	—	95.48	96.84	113.57	98.35	96.57	99.44	94.50
1900–04	—	100.00	100.00	—	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1905–09	—	102.41	101.21	—	98.15	101.29	95.28	104.28	98.83	94.48	106.65
1910–14	—	107.30	105.18	—	95.44	98.62	86.29	102.53	99.12	99.11	104.11
1915–19	—	—	—	—	—	102.93	94.57	125.30	107.11	107.61	94.18
1920–24	—	118.61	115.36	—	—	103.82	117.86	118.90	135.55	105.04	112.81
1925–29	—	115.71	114.81	—	112.63	98.45	94.90	100.64	151.86	100.85	119.08
1930–34	—	111.98	128.27	—	109.65	98.20	89.70	98.72	170.63	99.36	128.43
1935–39	—	114.34	126.77	—	105.75	85.92	92.51	109.34	161.25	103.68	139.38
1940–44	—	121.61	—	—	—	68.83	—	—	155.83	109.55	142.54
1945–49	—	126.82	138.31	—	—	121.01	—	135.97	157.91	144.02	170.66
1950	—	129.69	141.19	—	117.64	124.80	101.31	145.35	157.26	143.91	176.55

TABLE 1 — continued

Notes: The figures represent the price of capital goods relative to consumption goods in each country. These prices are drawn from each country's national accounts. Each series is scaled to equal 100 in 1900–1904. Due to data limitations, Japan's figure for equipment in the 1950 row is actually for 1952.
Sources: National accounts sources are cited in the Appendix.

a late-nineteenth-century investment demand boom in Japan should have tended, *ceteris paribus*, to increase the relative price of capital goods there. Panel B, however, shows that every country in our sample experienced a decline in the relative price of equipment up to 1914. This ubiquitous downward trend in the relative price of equipment leveled off or reversed itself in most countries during the tumultuous interwar period, Italy being the major exception with a continuing downward drift. Unlike the relative price of equipment, the relative price of building construction rose everywhere during the period under study. This upward trend tends to offset the downward drift of the equipment prices when the series are combined in the overall capital-goods prices index. Consequently, throughout the article, we are careful to distinguish the findings based on the overall capital-goods price series from those based on the equipment price series. The overall capital-goods price sample has the benefit of being larger, but the equipment-price series is more in line with the literature emphasizing the importance of machinery investment to growth.

What can be said about the variance in relative prices across countries at any given point in time? Compared to consumption goods, where were capital goods relatively cheap, and where were they relatively expensive? Ultimately, what were the implications for capital accumulation and growth? Table 2 combines the time-series data for all capital goods and equipment from Table 1 with the cross-national benchmarks for 1950 described previously to provide international relative-price comparisons. All figures in Table 2 are expressed relative to the United States in 1950.

In 1950 only Germany and Finland had lower relative capital-goods prices than the United States (Panel A), and only Canada had lower relative equipment prices (Panel B). Despite its spectacular capital-goods price decline up to World War II, Japan still had a much higher relative price of capital goods than the United States, approximately 75 percent higher. Ignoring international financial capital mobility, Japan would have required a savings rate 75 percent higher than that of the United States to make the same real investment in its productive capacity. Thus, Japan's historically high savings rate has had to compensate for its high relative price of capital goods. Given the large literature concerning Japan's unusually high saving rate, it is surprising that scholars have failed to stress the relative dearness of the capital goods financed with those savings.[16]

[16] Ohkawa and Rosovsky, *Japanese*; and DeBever and Williamson, "Saving."

TABLE 2
RELATIVE CAPITAL-GOODS PRICES 1870–1950: (US = 100 in 1950)

Year	AUS	CAN	DEN	FIN	GER	ITA	JAP	NOR	SWE	UK	US
					Panel A: Relative Price of All Capital Goods						
1870–1974	81.44	84.76	89.82	49.88	94.44	119.00	—	78.54	94.56	125.34	68.42
1875–1979	79.19	87.58	86.08	47.81	76.77	122.86	282.95	81.71	99.13	120.54	69.24
1880–1984	67.51	89.48	79.50	47.56	70.54	119.61	196.69	74.27	101.02	116.59	71.27
1885–1989	63.10	90.00	89.51	53.58	76.00	116.09	235.85	75.50	103.10	112.89	71.38
1890–1994	71.58	92.19	90.80	48.37	72.88	111.82	215.77	77.68	100.24	113.49	69.16
1895–1999	82.73	96.92	99.62	55.63	77.34	103.27	213.89	78.60	108.44	115.52	73.09
1900–1904	89.30	97.85	98.51	54.11	81.32	117.23	186.87	79.92	111.36	117.34	76.02
1905–1909	85.27	93.09	100.40	53.42	79.73	116.65	171.12	81.21	109.99	112.66	76.52
1910–1914	88.53	94.68	102.70	48.56	76.31	109.17	151.53	77.60	111.09	115.44	75.68
1915–1919	111.13	—	—	47.65	—	150.83	188.62	104.90	137.05	114.34	80.67
1920–1924	112.36	108.50	110.50	55.53	—	123.83	178.90	90.08	129.89	103.13	84.13
1925–1929	110.10	98.56	100.50	60.38	81.76	111.88	151.24	67.35	119.88	91.09	81.33
1930–1934	101.95	98.28	115.20	59.54	68.74	110.18	147.45	68.33	130.49	91.70	91.04
1935–1939	111.07	103.60	112.70	67.38	79.26	103.44	158.98	74.40	135.80	97.19	91.91
1940–1944	126.44	108.40	86.54	69.08	—	61.33	—	—	124.28	100.96	92.77
1945–1949	147.18	110.80	108.80	74.56	—	92.24	—	97.80	125.16	120.83	91.45
1950	137.80	115.80	122.90	84.50	85.37	108.30	175.30	103.60	121.90	124.40	100.00
					Panel B: Relative Price of Equipment						
1870–1974	—	119.40	133.20	—	184.50	286.90	—	137.70	242.20	178.90	99.58
1875–1979	—	123.10	107.90	—	122.60	314.80	717.20	141.40	181.50	184.60	91.23
1880–1984	—	120.00	104.40	—	115.10	261.90	438.70	121.40	172.20	165.80	86.41
1885–1989	—	106.80	108.80	—	107.90	243.00	435.50	122.90	165.90	153.20	82.96
1890–1994	—	99.48	113.30	—	120.60	248.30	399.10	116.60	160.20	150.60	77.90
1895–1999	—	101.00	126.50	—	125.10	263.80	350.50	117.10	168.10	145.60	82.56
1900–1904	—	94.88	133.40	—	136.30	275.20	313.50	118.10	170.00	151.20	86.68
1905–1909	—	77.36	129.40	—	127.50	285.30	284.50	111.40	164.60	146.20	82.60

TABLE 2 — continued

Year	AUS	CAN	DEN	FIN	GER	ITA	JAP	NOR	SWE	UK	US
					Panel B: Relative Price of Equipment — continued						
1910–1914	—	72.09	126.50	—	118.01	253.65	239.69	105.68	169.08	147.83	84.65
1915–1919	—	—	—	—	—	364.76	328.83	133.14	265.46	143.59	92.28
1920–1924	—	87.01	165.50	—	—	318.67	200.82	109.55	165.10	114.35	91.19
1925–1929	—	71.88	133.90	—	117.75	270.78	160.53	91.69	129.59	107.23	88.11
1930–1934	—	71.08	163.53	—	123.31	249.94	176.88	86.48	125.80	105.86	95.16
1935–1939	—	79.47	154.83	—	116.67	241.35	193.63	93.47	153.60	124.28	100.71
1940–1944	—	82.04	—	—	—	158.61	—	—	150.66	131.07	104.52
1945–1949	—	72.49	175.91	—	—	201.38	—	111.63	143.92	146.03	92.75
1950	—	76.56	180.02	—	121.06	226.12	189.81	124.77	146.79	152.88	100.00

Notes: The figures show the relative price of capital goods in each country compared to the relative price of capital goods in the United States in 1950. The movement of each series over time is determined by the price series of that country's national accounts. Internationally comparable price data from the Penn World Table are used to benchmark these national-account series relative to the United States in 1950 for Panel A. The Penn World Table does not include separate price information for equipment, however. So, the 1950 figures in Panel B are derived using the benchmark for producers durables and consumption prices from the 1980 report of the United Nations' International Comparison Program in combination with the OECD national accounts in current and constant prices from 1980 back to 1950. Due to data limitations, Japan's reported figure for 1950 is actually calculated for 1952 (relative to the United States in 1950). Sweden did not participate in the ICP in 1980, and so its 1950 relative price of equipment is estimated by multiplying Norway's figure by the ratio of the relative price of investment goods in Sweden and Norway in 1950 (reported in Panel A).
Sources: Summers et al., *Penn World Table*; United Nations, *World Comparisons*; and OECD, *National Accounts* (1970 and 1983). National accounts sources are cited in the Appendix.

Over the 80 years as a whole, Australia, Canada, Denmark, Italy, Japan, Sweden, and the United Kingdom all appear to have had relatively expensive capital goods, implying a relatively disadvantageous price structure for capital accumulation. Japan, Sweden, and the United Kingdom carried the heaviest burdens. Finland, Germany, Norway, and the United States all appear to have had relatively cheap capital goods, implying a favorable price structure for capital accumulation. The impact of these differences in price structure on rates of capital accumulation will be explored later, but this is a good time to remind the reader that it is the *relative* price of capital goods we are describing; consequently, differences in consumption-goods prices may matter as much as differences in capital-goods prices in explaining cross-country differences in the ratio.

The relative price of equipment declined in each of the nine sampled countries up to World War I, but the decline was much steeper in some than others; those with very expensive equipment relative to consumer goods in the 1870s experienced the steepest relative price declines up to World War I. As a result, the between-country spread in relative prices just prior to World War I was far smaller than in the late 1870s. At the extremes of the distribution, in the 1870s the relative prices of equipment in Japan and Italy were 7.9 and 3.5 times that of the United States, but by World War I those ratios had fallen to 2.8 and 3.0. The convergence phenomenon is illustrated in Figures 1A and 1B where the change in the relative price of capital goods or equipment for each country over ten- to 15-year periods is graphed against the level of the price at the beginning of the period. This beta-convergence may have been driven by trade's equalization of prices across countries, by simple mean reversion from times of unusually high or low relative prices, by the convergence of productivity levels or skill endowments across the countries in the sample, or by some combination of all three.[17]

For the full distribution of relative prices, Table 3 reports the coefficient of variation from 1875 to 1990. Clearly, there has been sigma-convergence for capital-goods prices in the OECD for more than a century. Even when Japan is excluded from the sample, the dispersion of both relative capital-goods prices and relative equipment prices were about half as large in 1950 as in 1870, and the epochs of big decline in the dispersion of capital-goods prices were 1885–1895, 1945–1950, and 1965–1985.[18] During the two

[17] Beta convergence occurs when places with relatively high initial values of some variable tend to have relatively small increases in that variable over time. Sigma convergence occurs when the dispersion of a variable's values across countries falls over time. We borrow the terms from the empirical growth literature (Barro and Sala-i-Martin, *Economic Growth*).

[18] The magnitude of the relative price change in Japan tends to dominate the change in the overall dispersion, and so we calculate the dispersion statistics both with and without Japan. Either way, there is clear evidence of a decline in price dispersion over the past century.

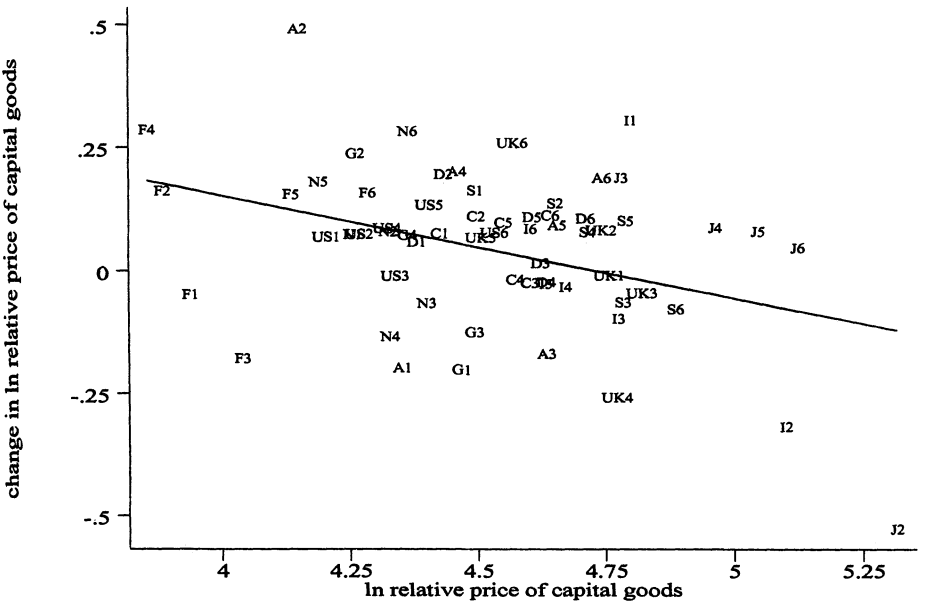

FIGURE 1A
CHANGE IN THE RELATIVE PRICE OF CAPITAL GOODS AND INITIAL PRICE

Notes: Each country's name is abbreviated with its first letter, except for the United States, "US," and the United Kingdom, "UK." The number in parenthesis after each country abbreviation in the figure denotes one of the following time periods: 1) 1870–1885, 2) 1885–1900, 3) 1900–1913, 4) 1913–1929, 5) 1929–1939, 6) 1939–1950. Not all countries have data available at the beginning of every period. The x-axis measures the price level at the beginning of the period, whereas the y-axis measures the percentage change in the price level over the period. The OLS regression line fitted through these points has the slope = −0.21 (*t*-statistic = 3.15).
Sources: See the Appendix.

world wars, when international commodity markets disintegrated, the capital-goods price dispersion figures rose in six out of eight cases in Table 3 (four columns and two wars), the puzzling exception being for equipment between 1940 and 1945. Between 1910 and 1915 the equipment-price dispersion rose from 0.44 to 0.54 and the capital-goods price dispersion rose from 0.29 to 0.31 before jumping to 0.43 in 1917. During World War II, the dispersion measure for relative capital-goods prices rose from 0.25 to 0.43 between 1940 and 1945.[19] Thus, the 1910–1950 period of war, autarky, and de-globalization slowed down the process of price convergence, but the convergence trend resumed strongly after 1960.

For the sake of comparison, it is worth noting what happened to the international dispersion of real interest rates, the other component of the user cost

[19] These comparisons are inexact because some countries leave the sample during the wars. However, we constructed coefficient of variation time series for samples that always exclude those countries and found that the rise in the dispersion is not merely the result of changes in sample composition.

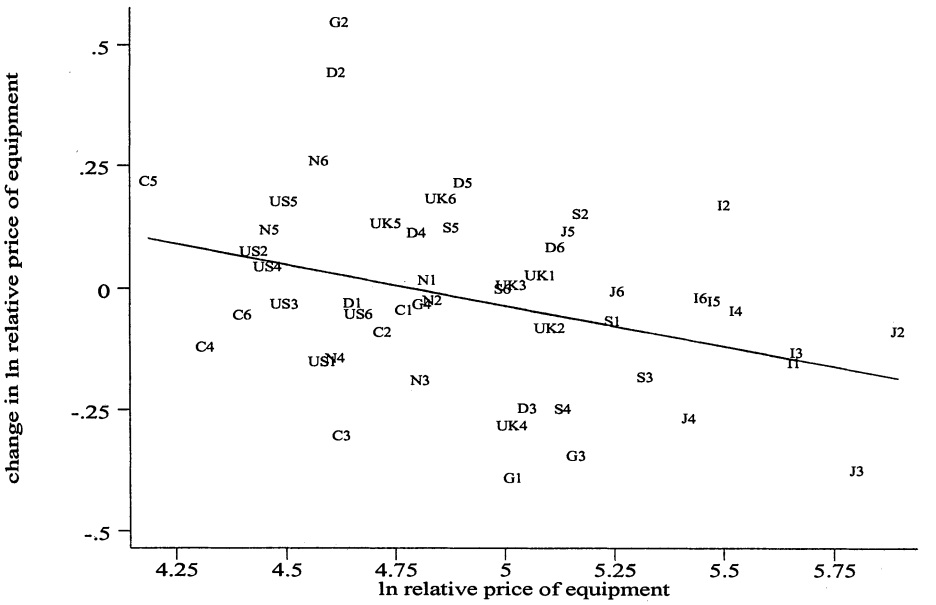

FIGURE 1B
CHANGE IN THE RELATIVE PRICE OF EQUIPMENT AND INITIAL PRICE

Notes: The x-axis measures the price level at the beginning of the period, whereas the y-axis measures the percentage change in the price level over the period. Periods are the same as in the notes to Figure 1A. The OLS regression line fitted through these points has the slope = −0.17 (*t*-statistic = 2.64).
Sources: See the Appendix.

of capital. Maurice Obstfeld and Taylor observe that the dispersion of real interest rates for ten countries fell slightly between 1885 and 1914, jumped upward during World War I, declined somewhat during the 1920s before rising again in 1930s and reaching a peak in the mid-1940s.[20] From that peak, the dispersion declined until 1960, and despite the much ballyhooed financial globalization since then, the dispersion of real rates had not changed by much up to the mid-1990s. Ultimately, by this measure, international financial markets appear to have been as well integrated in the early 1900s as they are now. In contrast, our evidence on relative capital-goods prices suggests that the dispersion of relative capital-goods prices was substantially narrower in the 1980s than at the beginning of the 1900s. Thus, compared with the 1880s, capital markets were probably far better integrated in the 1980s than the financial evidence alone suggests.

EXPLAINING THE RELATIVE PRICE OF CAPITAL GOODS

In a world of perfectly integrated commodity markets where all goods are tradable and transportation costs are zero, the relative price of capital goods

[20] Obstfeld and Taylor, "Great Depression."

TABLE 3
COEFFICIENT OF VARIATION (CV) OF THE RELATIVE PRICE OF CAPITAL GOODS
1875–1950

	Capital Goods Full Sample		Capital Goods w/o Japan		Equipment Full Sample		Equipment w/o Japan	
	CV	*N*	CV	*N*	CV	*N*	CV	*N*
1875	0.60	11	0.26	10	0.88	9	0.45	8
1880	0.35	11	0.26	10	0.56	9	0.35	8
1885	0.45	11	0.35	10	0.52	9	0.36	8
1890	0.41	11	0.22	10	0.56	9	0.33	8
1895	0.46	11	0.19	10	0.56	9	0.37	8
1900	0.33	11	0.21	10	0.43	9	0.37	8
1905	0.30	11	0.19	10	0.48	9	0.40	8
1910	0.29	11	0.21	10	0.44	9	0.42	8
1915	0.31	9	0.23	8	0.54	7	0.52	6
1920	0.31	9	0.23	8	0.40	7	0.43	6
1925	0.25	11	0.21	10	0.45	9	0.48	8
1930	0.27	11	0.25	10	0.38	9	0.40	8
1935	0.23	11	0.20	10	0.36	9	0.38	8
1940	0.25	9	0.17	8	0.32	6	0.36	5
1945	0.43	8	0.43	7	0.24	5	0.24	5
1950	0.21	11	0.15	10	0.31	8	0.31	8
1955	0.20	11	0.16	10	—		—	
1960	0.22	11	0.16	10	—		—	
1965	0.17	11	0.16	10	—		—	
1970	0.12	11	0.12	10	—		—	
1975	0.13	11	0.13	10	—		—	
1980	0.11	11	0.11	10	0.19	9	0.18	8
1985	0.09	11	0.09	10	—		—	
1990	0.10	11	0.10	10	—		—	

Notes: *N* equals the number of countries with available price observations. The full sample includes Australia, Canada, Denmark, Finland, Germany, Italy, Japan, Norway, Sweden, the United Kingdom, and the United States. Equipment-price series for Australia and Finland are not available for the 1870 to 1950 period, and internationally comparable equipment prices are not available for Sweden and Australia in 1980.

Sources: See the notes and sources of Table 2. Data for 1950–1990 are from Summers et al., *Penn World Table*; and OECD, *National Accounts*.

should be identical across countries, and every country's time series of relative prices should follow the same trend. Tables 1 and 2 show quite clearly that this was not the case prior to 1950. Still, the patterns in Tables 1 and 2 can be understood by considering the implications of departures from perfect commodity-market integration and complete tradability.

First, even though machines and consumer goods may be tradable, transport costs and tariffs will cause relative machinery prices to diverge across countries according to international differences in productivity (a Ricardian model) or skill endowments (a Heckscher-Ohlin model).[21] Given that tech-

[21] See Floud, *British*, pp. 68–119, for a discussion of the international trade of machine tools in the late nineteenth century, and see Svennilson, *Growth*, for discussion of such trade in the early twentieth century.

nology is more advanced in high-income countries, and given that machine design and production are relatively skill-intensive activities, high-income countries should exhibit lower relative prices for machinery in the presence of imperfectly integrated global commodity markets. Figures 2A and 2B graph each country's relative price against its income per capita at the beginning of ten- to 15-year periods. Figure 2A finds no correlation between initial levels of GDP per capita and relative capital-goods prices, although if observations are excluded so that Figure 2A's sample is identical to that in Figure 2B, a relatively weak negative correlation emerges. Figure 2B, on the other hand, clearly shows that at times and in places where GDP per capita was higher, the relative price of machinery was substantially lower. We will discuss some potential explanations of these findings in the next section, but for now, we simply note that the negative correlation for machinery prices is in accord with findings for the postwar period.[22]

Second, Bela Balassa has shown that the prices of nontraded goods and services tend to be higher in countries with relatively high incomes.[23] Balassa's finding is relevant in the context of this article because the capital-goods aggregate includes items that are traded (such as machines) as well as ones that are not (such as buildings, roads, irrigation, and other forms of construction). When traded and nontraded capital goods are combined in a single capital-goods price measure, they tend to offset one another because equipment prices are likely to be relatively low in places where nontradeable prices are likely to be relatively high. It is not too surprising, therefore, that Figure 2A finds little correlation between income and overall capital-goods prices even when Figure 2B finds a strong negative correlation between income and relative prices for machines.

Third, different rates of sectoral-productivity advance will drive changes in the relative prices of the goods those sectors produce. For example, in an economy where productivity advance is fastest in machines, slowest in building, and in-between in consumer goods, we would predict a downward trend in the price of machines relative to consumer goods, an upward trend in the price of building, and an indeterminate trend in the relative price of all capital goods. Table 1 suggests that there was a downward trend in relative machinery prices prior to World War I, although during and after the war price trends varied considerably in the presence of intense macroeconomic shocks and with the disintegration of international commodity markets. If sectoral rates of productivity advance differ across countries, if the barriers to trade change, or if the nature of the goods themselves change (for example, their tradability), then countries and epochs may experience very different trends in the relative price of capital goods and equipment.

[22] Jones, "Economic Growth."

[23] Balassa, "Purchasing Power Parity Doctrine."

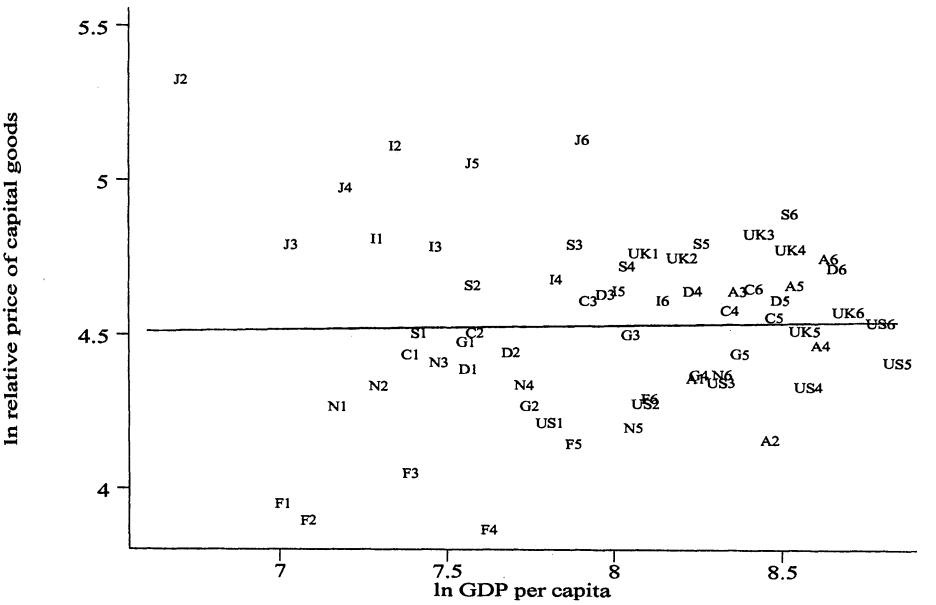

FIGURE 2A
RELATIVE PRICE OF CAPITAL GOODS AND GDP PER CAPITA

Notes: Graphed figures are for the levels at the beginning of each period. Periods are the same as in the notes to Figure 1A. Not all countries have data available at the beginning of every period. The OLS regression line fitted through these points has slope = 0.016 (t-statistic = 0.23).
Sources: See the Appendix.

A full explanation of international differences in relative capital-goods prices and their trends is beyond the bounds of this article. We can, however, see how the concepts in the previous paragraphs are manifested in the histories of the United States and Japan. We have chosen these case studies for two reasons. First, their economic histories include fairly well-documented narratives regarding capital-goods prices, capital accumulation, international trade, and income growth. Second, these two countries followed very different growth paths over the 80 years after 1870, and so they represent a vast range of experience. The United States started and ended the period as a world leader in income per capita and with relatively low equipment prices. Japan started the period with low income per capita and high equipment prices but experienced the biggest equipment-price decline and the fastest rate of income per capita growth. We conclude the section with an econometric investigation of the international differences in capital-goods prices.

United States

Different rates of productivity advance across sectors have been central to discussions of the trend in capital-goods prices in the United States, and

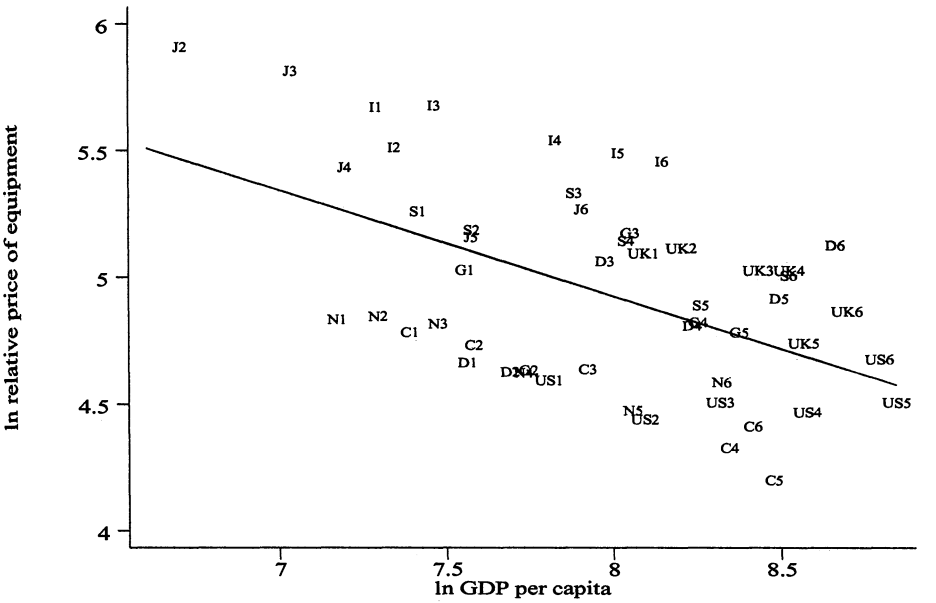

FIGURE 2B
RELATIVE PRICE OF EQUIPMENT AND GDP PER CAPITA

Notes: Graphed figures are for the levels at the beginning of each period. Periods are the same as in the notes to Figure 1A. Not all countries have data available at the beginning of every period. The OLS regression line fitted through these points as the slope = −0.42 (*t*-statistic = 4.3).
Sources: See the Appendix.

economic historians have always argued that the rate of productivity advance in the producer durables sector was relatively fast.[24] For example, in studies of nineteenth-century capital accumulation, Jeffrey Williamson argued that structures and infrastructure were labor-intensive, nontradable goods undergoing slow rates of productivity growth, but that equipment was a skill-intensive, tradable capital good undergoing fast rates of productivity growth.[25] These assertions appear to match up reasonably well with the U.S. evidence in Table 1 where the relative price of equipment is reported to have held steady even as the relative price of construction and all capital goods rose over the 80 years prior to 1950. Productivity advance in the machine sector might not have outpaced that in the consumption-goods sector in the United States, but it certainly did keep up, whereas productivity advance in structures and other capital goods seems to have lagged behind.

Economic historians have also argued that international differences in capital-goods prices, and in machinery prices in particular, might be a reflec-

[24] Rosenberg, "Technological Change," "Capital Goods," and "Direction"; David, *Technical Choice*; and Williamson, "Inequality."
[25] Williamson, "Watersheds" and "Inequality."

tion of differences in skill endowments.[26] Where labor was relatively cheap and skills relatively expensive, the relative price of machinery should have been high unless, of course, international goods markets were perfectly integrated. Conversely, where skills were cheap, the relative price of machines should have been low. Over time, this line of argument offers a reason to expect a fall in the relative price of equipment as development tends to raise skill endowments. The United States has always been relatively well endowed with skilled labor, and the comparative advantage in machines suggested by Table 2 is consistent with this perspective.

Williamson also argued that part of the decline in the U.S. relative price of capital goods between the 1840s and the 1870s was due to the Civil War tariffs, which raised the price of manufactured consumer goods relative to investment goods. The interests of southern agricultural exporters, who opposed tariffs, and northern manufacturers, who sought protection, conflicted throughout the antebellum period. Not surprisingly, with the secession and eventual defeat of the South, the balance of political power swung in favor of the northern interests which, through protection, succeeded in raising the price of manufactured consumption imports. Initially, this policy was motivated by Civil War finance, but it stuck after the war, thus making for a more permanent fall in the price of investment goods relative to manufactured consumption goods. Canada, another New World country with relatively low capital-goods prices, protected its manufacturing sector too, especially after 1878 when Conservatives came to power with an explicitly protectionist platform.[27] During a period when capital goods were less tradable, this late-nineteenth-century move towards protection in North America lowered the relative price of investment goods and fostered industrial-based accumulation.

It may appear that the Argentine experience in the 1940s and 1950s is inconsistent with the American tariff experience in the 1860s, the former contributing to higher relative capital-goods prices and the latter to lower relative prices. The key to resolving this apparent inconsistency is that U.S. capital goods in the 1860s were mainly nontradable structures and homemade machines, whereas Argentine capital goods in the 1950s were largely imported machines.[28] Consequently, while the U.S. Civil War tariff served to raise the relative price of manufactured consumption goods by more than that of (then mostly nontradable) investment goods, the protectionist Argentine regime—which gave lowest priority to the import of capital goods when

[26] Rosenberg, "Anglo-American"; and Brito and Williamson, "Skilled Labor."

[27] See O'Rourke and Williamson, *Globalization*, for a more detailed discussion of the political economy of trade policy in the New World and Europe in the late nineteenth century.

[28] In 1913 equipment made up only 21 percent of manufactured exports from the United Kingdom, United States, France, and Germany to Argentina; by 1950, that percentage had risen to 51 percent (Svennilson, *Growth*, p. 296).

allocating scarce foreign exchange (a populist move which secured support from urban workers)—served to raise the relative price of (then mostly tradable) investment goods. Thus, tariffs can have different effects on the relative price of capital goods in different times and places. Williamson's position on the price effect of the Civil War tariffs has been challenged recently by De Long and Douglas Irwin.[29] Later, we will offer some new econometric evidence on the connection between tariffs and capital-goods prices in the pre-1950 period to assess Williamson's hypothesis.

Japan

The U.S. historiography on machine prices stresses skill endowments and productivity advance, whereas the historiography for Japan stresses international trade and wartime shortages. One of the outstanding characteristics of Table 2 is the high relative price of capital goods in Japan, especially in the 1870s and 1880s and especially for machinery. The small size of the domestic machine-tool industry at the time of the Meiji Restoration, and its evolution thereafter, is discussed at length by Toshiaki Chokki.[30] Imported machines were crucial to the establishment of Japanese arsenals in the 1870s, and, as Kozo Yamamura has pointed out, the subsequent process of military modernization appears to have provided an important impetus to the development of domestic machine production.[31]

During World War I domestic production of machinery expanded rapidly to fill the growing demand which could not be satisfied by imports from Britain, the United States, or Germany. Tables 1 and 2 show that the relative price of capital goods rose substantially in Japan during these years ,reflecting the increase in domestic demand coupled with an inelastic supply of machine imports during the war. Imports bounced back after the war, however, and the relative price of capital goods resumed its long-run fall. The invasion of Manchuria in 1931 and the years of war that followed again cut off foreign supplies of machinery, and this is reflected in the rise of the relative price of machinery. These temporary shocks drove the expansion and evolution of the domestic capital-goods industry, and in doing so, may have contributed to the long-run permanent decline in Japanese capital-goods prices.

This feedback from the demand to the supply side of the capital-goods market has been most clearly articulated by Nathan Rosenberg. Although he did not discuss Japan specifically, he argued more generally that "with the growth in the demand for machinery the capital-goods industry became gradually more and more highly specialized and subdivided in order to

[29] De Long, "Trade Policy"; and Irwin, "Tariffs."
[30] Chokki, "History."
[31] Yamamura, "Success."

undertake the production of machines, the cost of producing machines was thereby sharply reduced. . . ."[32] Presumably, Rosenberg's view is more likely to hold when machinery is closer to being nontradable or when there are interruptions in the flow of imports to a relatively high-price country. Of course, Rosenberg's focus was on *absolute* capital-goods prices, whereas this article's focus is on what we think is more relevant for investment, *relative* prices, and it is possible that scale and market size were even more important for consumption goods than investment goods.

In sum, the Japanese case suggests that countries will be reliant on international trade for machinery and equipment in early stages of development, although a domestic capital-goods industry may eventually emerge and grow along with the domestic economy. By implication, countries without strong domestic capital-goods industries should witness a rise in the relative price of (tradable) capital goods at times when the flow of imports is interrupted. The effect of such interruptions when nontradable capital-goods prices are taken into account is, however, less clear. This historical narrative matches the trends in Table 2 well. Japan started with a very high relative price of machinery, but it declined substantially as international transport costs fell, trade expanded, and a competitive domestic machine industry developed.

The Econometrics

We explore the capital-goods price data econometrically in Table 4 by regressing the relative capital-goods price (or equipment price) on the log of initial GDP per capita, the log of total GDP, and a measure of tariff rates (tariff revenue divided by value of imports).[33] Each observation in the regression represents a particular country at the beginning of one of the following six periods: 1870–1885, 1885–1900, 1900–1913, 1913–1929, 1929–1939, and 1939–1950. Across columns, the sample size changes depending on the availability of tariff data.

The regressions highlight three key relationships. First, consistent with the raw data graphed in Figure 2B, GDP per capita was negatively related to the relative price of capital goods, especially equipment. This finding is consistent with our discussion of unbalanced factor productivity growth as well as with the hypothesis that countries with relatively high incomes and relatively abundant skills will be characterized by relatively cheap capital goods. The GDP per capita variable also has a big economic impact. For example, according to the coefficient on income per capita in column 2, at the turn of the century nearly 60 percent of the gap between the United States and the

[32] Rosenberg, "Capital Goods," p. 223.

[33] The results are similar if we use the log of the relative price measure as the dependent variable. We have chosen not to use the log here so that the results of this exercise dovetail with those in the next section where the connection between investment and relative prices is assessed.

TABLE 4
CORRELATES OF THE RELATIVE PRICE OF CAPITAL GOODS, 1870–1950

	Capital Goods			Equipment		
	(1)	(2)	(3)	(4)	(5)	(6)
ln GDP per capita	−16.00	−28.58	−11.04	−108.95	−138.51	−152.60
	(1.24)	(2.46)	(0.88)	(4.68)	(5.97)	(5.45)
ln total GDP	—	9.26	3.28	—	19.93	27.70
		(3.30)	(1.31)		(3.71)	(4.77)
Tariff	—	—	−70.80	—	—	−342.97
			(2.04)			(4.65)
1885–1900	15.72	12.71	4.15	14.53	8.82	−9.37
	(1.01)	(0.98)	(0.35)	(0.47)	(0.36)	(0.50)
1900–1913	19.33	15.50	12.70	58.69	52.46	31.51
	(1.76)	(1.54)	(1.47)	(1.89)	(2.10)	(1.40)
1913–1929	18.89	14.24	5.53	49.89	42.60	22.82
	(1.40)	(1.23)	(0.54)	(1.66)	(1.63)	(0.98)
1929–1939	23.83	18.39	6.32	56.35	48.25	33.21
	(1.58)	(1.44)	(0.52)	(1.76)	(1.65)	(1.34)
1939–1950	36.42	31.65	20.28	87.18	80.71	76.98
	(2.17)	(2.22)	(1.61)	(2.61)	(2.68)	(2.94)
Constant	205.41	213.38	152.05	975.24	1004.27	1092.72
	(2.10)	(2.67)	(1.83)	(5.45)	(6.43)	(6.11)
Observations	64	64	52	52	52	46
R^2	0.1	0.27	0.17	0.43	0.57	0.59
Summary Statistics: Mean and Standard Deviation (in parentheses)						
Relative price	96.96	96.96	95.94	152.46	152.46	141.17
	(29.08)	(29.08)	(19.98)	(67.26)	(67.26)	(56.03)
ln GDP per capita	7.97	7.97	8.09	7.96	7.96	8.04
	(0.51)	(0.51)	(0.45)	(0.50)	(0.50)	(0.45)
ln total GDP	—	10.36	10.48	—	10.64	10.57
		(1.54)	(1.53)		(1.52)	(1.59)
Tariff	—	—	0.13	—	—	0.12
			(0.08)			(0.07)

Notes: The dependent variable is the relative price of capital goods or equipment at the beginning of the relevant period. GDP per capita, total GDP, and the tariff rate also pertain to the beginning of the period. The omitted category for the time indicator variables is 1870 to 1885. For the regressions, robust standard errors are used to calculate the *t*-statistics reported in parentheses.
Sources: See Table 2 and the Appendix for the relative price sources. Initial GDP per capita and total GDP are from Maddison, *Monitoring*. The tariff data are those underlying Collins, O'Rourke, and Williamson, "Were Trade and Factor Mobility."

average relative capital-goods price for the rest of our OECD sample can be accounted for by the relatively high level of GDP per capita in the United States[34] Alternatively, according to the coefficient on income per capita in column 5, about 74 percent of the turn-of-the-century gap between Japan and the average relative price of equipment for the rest of our OECD sample can be accounted for by Japan's relatively low level of GDP per capita.

[34] Specifically, we calculate $[(\beta_X)(X_{U.S.} - X_{AVG.})] / (Y_{U.S.} - Y_{AVG.})$, where β is the coefficient estimate on ln GDP per capita in Table 4, X is ln GDP per capita, and Y is the relative price of capital goods. The average (*AVG.*) is calculated for the non-United States around 1900.

Second, columns 2 and 5 show that for a given level of GDP per capita, the overall size of the domestic economy is positively correlated with relative capital-goods prices, a finding contrary to our expectations based on Rosenberg's work. Third, higher tariffs are associated with *lower* relative capital-goods prices, a finding which supports Williamson's interpretation of the connection between tariffs and capital-goods prices in the pre-1950 period.[35] The coefficient in column 3 implies that approximately 39 percent of the turn-of-the-century gap between the average relative price of capital goods in the United States and that in the in the rest of the sample countries can be accounted for by the relatively high U.S. tariff.[36] Similarly, the coefficient in column 6 implies that nearly 65 percent of the U.S. advantage in the relative price of equipment is accounted for by the relatively high tariff. Thus, to the extent that tariffs distorted prices prior to 1950 in this sample, they apparently did so in a way that favored capital goods relative to consumer goods, a finding that might help explain the positive correlation between growth and tariffs uncovered by Paul Bairoch and Kevin O'Rourke for the late nineteenth century, a correlation which is negative for the late twentieth century.[37]

CAPITAL-GOODS PRICES AND INVESTMENT BEHAVIOR

As noted in the introduction, the relative price of capital goods has been featured prominently in a number of recent cross-section studies of late-twentieth-century economic growth. Jones, for example, uses data underlying the PWT to argue that "an increase in the relative price of machinery reduces capital accumulation and therefore reduces the growth rate of the economy."[38] But have capital-goods prices always had this influence on investment and growth, or is it only a late-twentieth-century phenomenon? Is the influence strong enough that it belongs near center stage as we search for an explanation of the historical patterns of capital accumulation that underpin current differences in GDP per capita?

Following Jones and Diego Restuccia and Carlos Urrutia, we offer an empirical assessment of the link between capital-goods prices and invest-

[35] For the equipment price data, the coefficient on the tariff variable remains negative and statistically significant even when the United States (a high tariff, low P_K/P_C country) is omitted from the regression. For the all capital goods price data, the coefficient becomes positive but statistically insignificant when the United States is omitted.

[36] Note this figure is not directly comparable to the figure reported in the previous paragraph regarding the influence of GDP per capita. Both the sample and the specification change when moving from column 2 to column 3.

[37] Bairoch "European"; and O'Rourke, "Tariffs."

[38] Jones, "Economic Growth," p. 372.

ment rates in Table 5.[39] We use the investment rates rather than the change in capital stock (a truer measure of capital accumulation) because capital stock estimates are not as widely available as investment estimates. For the moment, we treat the capital-goods price as an exogenous variable. Each observation in the regression represents a particular country's experience over one of the six periods defined earlier.[40] The investment share in GDP is regressed on the log of GDP per capita, the relative price of capital goods (or machinery) at the beginning of each period, and the real interest rate on long-term financial assets at the beginning of each period.[41] We also include time-period indicators in case period-specific circumstances affected both investment rates and capital-goods prices simultaneously, although the coefficients and statistical significance of the price variables are similar if we do not. Across columns, the sample size changes depending on the availability of price and interest-rate data.

We find that the correlation between investment rates and capital-goods or equipment prices is in all cases negative and statistically significant, even after controlling for differences in levels of GDP per capita. According to Table 5, column 1, a one-standard-deviation increase in the relative price of capital goods is associated with a decline in the investment share of about 3.6 percentage points (an elasticity of −0.68). According to column 2, a one-standard-deviation increase in the relative price of equipment is associated with a decline in the (total) investment share of 3.4 percentage points (an elasticity of −0.46). For the sake of perspective, if the United States had had a relative price of capital goods equal to the average of other countries in 1870 (not including Japan), the regression suggests that the U.S. investment share would have been about 2.4 percentage points lower than it actually was between 1870 and 1885. Previous studies of international income convergence have found that the U.S. growth rate outpaced the predictions of long-run convergence regressions.[42] In other words, the United States was a high-income country, which continued to grow quickly relative to the

[39] Restuccia and Urrutia, "Public Policy." The constant price investment and GDP series from each country are used to form a series representing the constant price investment share over time, and then internationally comparable figures for investment and GDP from the PWT for 1950 are used to benchmark each country's constant price investment share in that year. On the basis of standard growth theory, Restuccia and Urrutia argue that internationally comparable prices should be used when comparing investment shares across countries. For the sake of comparison, earlier versions of this paper included estimates using current price investment rates, and qualitatively similar results emerged.

[40] For most countries we have year-to-year measures for growth, investment and capital goods prices, but we have chosen not to use that year-to-year variation in a time-series analysis because in many cases the national accounts (at some level) must interpolate between benchmark dates to create these series and therefore the year-to-year variation may not be informative. We believe that the historical national accounts are most useful for comparisons over longer periods of time.

[41] The real interest rate figures are derived from unpublished data supplied by Michael Bordo and Alan Taylor. Of course, cross-country comparisons of such rates are necessarily inexact.

[42] Wright, "Origins"; and Williamson, "Globalization."

TABLE 5
INVESTMENT SHARES AND CAPITAL GOODS PRICES, 1870–1950

	(1)	(2)	(3)	(4)	(5)	(6)
Capital-goods price	−0.001233 (6.03)	—	−0.001844 (3.59)	—	−0.001802 (3.50)	—
Equipment price	—	−0.0005184 (3.20)	—	−0.0005361 (2.27)	—	−0.0005272 (2.32)
ln GDP per capita	0.005147 (0.30)	−0.02384 (0.73)	0.008906 (0.33)	−0.03812 (0.83)	0.009494 (0.36)	−0.03695 (0.83)
Real interest rate	—	—	−0.1646 (0.59)	−0.1232 (0.30)	—	—
1885–1900	0.02192 (0.92)	0.01199 (0.42)	0.02703 (0.77)	0.02209 (0.49)	0.02504 (0.76)	0.02101 (0.51)
1900–1913	0.03312 (1.43)	0.04463 (1.43)	0.04637 (1.33)	0.05548 (1.11)	0.04293 (1.32)	0.05301 (1.17)
1913–1929	0.01549 (0.66)	0.01676 (0.55)	0.01204 (0.34)	0.03060 (0.61)	0.01410 (0.43)	0.03041 (0.64)
1929–1939	0.003668 (0.14)	0.003372 (0.10)	0.005974 (0.13)	0.02644 (0.40)	−0.003933 (0.11)	0.01962 (0.36)
1939–1950	0.03948 (1.27)	0.04272 (0.95)	0.01957 (0.39)	0.03590 (0.53)	0.02832 (0.64)	0.04352 (0.69)
Constant	0.2373 (1.79)	0.4194 (1.59)	0.2707 (1.21)	0.5316 (1.48)	0.2555 (1.16)	0.5162 (1.48)
Observations	63	51	43	37	43	37
R^2	0.36	0.23	0.33	0.17	0.32	0.16
	Summary Statistics: Mean and Standard Deviation (in parentheses)					
Investment rate	0.1773 (0.0615)	0.1703 (0.0657)	0.1774 (0.0658)	0.1736 (0.0693)	0.1774 (0.0658)	0.1736 (0.0693)
Capital-goods price	97.26 (29.22)	153.05 (67.79)	96.05 (20.91)	140.62 (56.13)	96.05 (20.91)	140.62 (56.13)
ln GDP per capita	7.96 (0.52)	7.95 (0.50)	8.10 (0.45)	8.04 (0.46)	8.10 (0.45)	8.04 (0.46)
Interest rate	—	—	0.0471 (0.0512)	0.0460 (0.0497)	—	—

Notes: The dependent variable is the average gross investment share in GDP over the period valued at constant prices. The omitted category for the time period indicators is 1870 to 1885. The constant price investment series are calculated by taking the ratio of each country's constant price investment and GDP series, and then benchmarking this series to that implied by the Penn World Table in 1950. For the regressions, *t*-statistics are in parentheses based on robust standard errors. Columns 5 and 6 are specified like columns 1 and 2 respectively, but they exclude the observations missing from columns 3 and 4 for the sake of comparison.
Sources: See the Appendix.

rest of the world despite the implications of neoclassical growth models. Table 5 identifies one part of the explanation: the United States was favored by low relative capital-goods prices throughout the period under consideration.

Consider another case: Europe's golden era of growth over the quarter century after 1950. This was an era of spectacular catch-up on the United States, and it apparently took place *in spite of* relatively expensive capital

goods and machinery.[43] Table 2 shows that in 1950, as Europe was poised to launch its great American catch-up, the relative price of machines was substantially higher there than in the United States. These countries (and Japan) successfully converged on U.S. income levels despite their disadvantageous price structure, but they had to pay for it with higher savings rates.

Columns 3 and 4 add the real interest rate at each period's beginning to the regressions. This changes the sample composition considerably because interest-rate data are not available for every country. The real-interest-rate variable is negatively related to the investment rate, but the coefficient estimate is very imprecise. This imprecision might be due to demand-side forces that tend to raise investment and interest rates simultaneously or to problems with the international comparability of the interest rates, or both. Also, while using the interest rate at the period's beginning might help avoid the demand-driven bias discussed previously, the fact that real interest rates can change rather quickly might make the beginning-of-period interest rate an unreliable proxy for the full period's financial cost of capital. The specifications of columns 5 and 6 are similar to those of columns 1 and 2, but their samples are trimmed to match those of columns 3 and 4 for the sake of comparison. The coefficient estimates on the price variables are similar across the columns.

Because the relative price of capital goods is not exogenously determined and might be measured with error, this kind of estimation procedure might not offer a clean identification of the effect of capital-goods prices on investment. For example, forces which shift the demand curve for investment goods to the right will simultaneously raise the price of capital goods and quantity of investment undertaken, and this will tend to generate a (spurious) positive relationship between investment rates and relative capital-goods prices. We mitigate this bias in two ways: first, the period-specific dummies should help control for any demand-driven positive bias associated with global investment booms and busts; second, by relying on prices prevailing at the beginning of the period, rather than an average over the period, we mute demand-driven run-ups in the price within each country over any period. Furthermore, including GDP per capita in the regression should mitigate any bias associated with the relationship between level of development, capital-goods prices, and investment rates.[44] Finally, including country-specific fixed effects in addition to the period effects does not eliminate the negative correlation between the price of capital goods and the investment share of GDP (results not shown). In other words, this appears to be a fairly robust empirical link.

[43] See Crafts and Toniolo, *Economic Growth*, on Europe's postwar growth.

[44] It turns out that omitting the GDP per capita variable from the regressions reported in Table 5 has little effect on the coefficient estimates for capital-goods prices.

Going one step further, however, we borrow from the regressions specified in Table 4 (where relative capital-goods prices are the dependent variable) to construct two-stage least squares estimates of the connection between capital-goods prices and investment. This approach, in which the first stage is similar to that run in Table 4 and the second stage is similar to that in columns 1 and 2 of Table 5, should help circumvent two potential sources of bias: the endogeneity we have already discussed, as well as measurement error in the price variables. Essentially, the total GDP and the tariff variables serve as instruments for the capital-goods price variable. The two-stage least square estimate for the effect of the relative price of capital goods on investment is −0.003317 (t-statistic equals 3.01) and for the effect of the relative price of machinery is −0.0005371 (t-statistic equals 1.87). Both estimates are at least as strong (in magnitude) as those obtained from ordinary least squares, though the standard errors are somewhat larger.[45]

CONCLUSIONS AND ADDITIONAL QUESTIONS

This article develops a data set that documents the relative price of capital goods in 11 countries from 1870 and 1950. Although it must be viewed as only a start on a long-term assessment, some stylized facts seem to be robust. First, different countries experienced different trends in the relative price of capital goods. Some, such as Japan, underwent a spectacular decline in the aggregate capital-goods price from 1870 to 1914, while others, such as those in Scandinavia, underwent a rise. However, and second, the relative price of equipment fell everywhere up to 1914, an event in accordance with the view that productivity growth was relatively fast in the producer-goods sector. Third, there was substantial variance in the level of the relative capital-goods prices across countries. Some, such as Japan and Italy, were disadvantaged by relatively expensive capital goods, and thus needed higher savings rates to achieve the same accumulation rates as their competitors. Others, such as Canada and the United States, were favored by relatively cheap capital goods, and thus, compared with their competitors, could achieve the same accumulation performance with lower savings rates. Fourth, the dispersion of relative prices narrowed considerably over time.

With these new data in hand, the remainder of the article pursues two questions. First, how can we explain international differences in capital-goods price levels and trends? We argue that differences in relative prices across countries have persisted even during periods of globalization because many capital goods are nontradable, and even for the tradable goods, both

[45] The tariff measure is not available for the full sample, so the ordinary least squares estimates that are relevant for the sake of comparison are not those in Table 5. Rather, using the same sample as in the two-stage regressions, the ordinary least squares coefficients would be: −0.001869 for capital-goods prices and −0.0005195 for machinery prices.

natural and political barriers to trade have always existed. Given barriers to trade and nontradable goods, international price differences arise naturally from international differences in productivity and skill endowments. These hypotheses are consistent with the strong negative correlation we find between income per capita and equipment prices. Drawing on economic historians' qualitative knowledge of U.S. sectoral productivity trends, we also argue that differential rates of productivity advance across sectors can generate the observed trends in relative prices of equipment, buildings, and overall capital goods.

Second, we ask whether the relative price of capital goods had a significant impact on investment. Evidently, the answer is yes: at times and in places where capital goods were relatively expensive, investment rates were relatively low. This finding confirms that the connection between investment rates and investment-goods prices identified by Jones and Restuccia and Urrutia for the post-1960 period existed in the pre-1950 period as well. The impact of capital-goods prices is statistically significant and economically powerful. Moreover, this negative correlation is fairly robust from an econometric standpoint.

We conclude with some speculations about the evolution of a global capital market. We have shown that capital *goods* markets were far better integrated in the 1980s than they were in the 1880s, at least if one accepts price dispersion as a measure of integration. In contrast, many observers have argued that *financial* capital markets were as well integrated a century ago as now. Thus, the time path of the capital-goods price dispersion has been quite different from that of financial variables. Presumably, we care about capital-market integration because it can have an impact on accumulation performance and the global distribution of the capital stock. The results of this article suggest that studies of international capital-market integration must take account of more than just the financial side of those markets because in both theory and history the prices of the capital goods themselves play an important role in determining investment rates and growth performance.

Appendix: Capital-Goods Price and Investment Data, 1870–1950

This appendix discusses the assembly of the capital-goods price indices, and it documents the sources of the price and investment series for each country in our sample. In order to move between nominal and real figures for investment, national accountants must have an investment-goods price series. However, it is rather rare for actual capital-goods prices to be used in the construction of the price indices, especially historical national accounts. It is much more common for the prices to be estimated on the basis of input prices, for example by simply combining engineering wages with steel prices for machin-

ery, or by combining wages and material costs for building-construction indices, and so on for other subcomponents of investment. The "all capital goods" price index then amounts to a combination of the indices for all the underlying subcomponents.

The most glaring problem with such a method is that productivity improvements in the capital-goods sector are almost surely mismeasured, especially in the equipment price series. Unfortunately, as Charles Feinstein notes ". . . the exceptionally heterogeneous nature of most of the output of the engineering industry makes it extremely difficult to obtain continuous price series."[46]

What are the implications of such issues for this study? First, regarding the trend of capital goods prices: in this article we are always looking at relative prices, and it is likely that the consumption-price indices also suffer from inadequate allowance for productivity gains. Nonetheless, if the omitted productivity gains bias the equipment series upward more severely than they do the consumption-price series, then the relative price of equipment would fall more in reality than in the national accounts series. The relative price of building (where productivity advance is relatively slow), on the other hand, probably would rise more in reality than in the national-accounts series. Thus, the potential biases in the equipment and building series would tend to work against one another in the "all capital goods" series, but the degree (or direction) of bias could change over time as the relative importance of the various subcomponents of capital goods changes. These are exceptionally difficult issues facing historical national accountants, and unfortunately there is not much we can do in this article to resolve them, though the problems ought to be kept in mind when interpreting the series.

Second, regarding cross-country comparisons: even if we suppose that the 1950 benchmarks are appropriate, the biases discussed in the previous paragraph will probably operate to different extents in different countries. The estimation methods differ somewhat from place to place, the nature of the underlying input-price data probably differ from place to place, and the relative importance of different kinds of investment in the overall price series must differ from place to place as well. Consequently, there is a fairly large margin of error in the cross-country comparisons, especially as we travel farther from the benchmarks. Again, short of re-creating national accounts series for each country on a consistent basis (which is impossible given the available raw data), there is not much we can do to improve the estimated series. When those price estimates are used in the investment regressions, however, there is something we can do to attempt to circumvent the problems associated with measurement error, and this motivated our use of an instrumental variables approach to estimation.

Regarding the investment regressions: if there is measurement error in the price series, then there is measurement error in the investment series which are based on those price estimates. Consequently, a regression of investment rates on capital-goods prices will tend to be biased. A standard econometric method for circumventing such bias is through an instrumental variable approach to estimation. We provide such an estimate in the text, and we get results that are similar to those from an OLS regression, though with somewhat larger standard errors.

The remainder of the appendix cites the national accounts sources for the series we have used in this article.

AUSTRALIA

Price Index for Capital Goods:

1870–1939: N. Butlin, *Australian Domestic Product*, p. 33.

1939–1950: M. Butlin, "Preliminary Annual Database." The series is for private non-

[46] Feinstein, "National Statistics," p. 263.

dwelling investment.
Price Indices for Machinery and Equipment and Building:
Not available.
Price Index for Consumption Goods:
1870–1950: Mitchell, *International Historical Statistics: Africa.* We use a consumer-price index because we have not found one for the consumption-goods component of GDP.
Current Price Value of Investment:
1870–1939: N. Butlin, *Australian Domestic Product*, pp. 6–7.
1940–1950: Mitchell, *International Historical Statistics: Africa,* pp. 1017–18.
Current Price Value of GDP:
1870–1939: N. Butlin, *Australian Domestic Product*, pp. 6–7.
1940–1950: Mitchell, *International Historical Statistics: Africa,* pp. 1017–18.
Constant Price Value of Investment:
1870–1939, 1949–1950: Mitchell, *International Historical Statistics: Africa,* pp. 1017–18.
1939–1949: M. Butlin "Preliminary Annual Database."
Constant Price of GDP:
1870–1939, 1949–1950: Mitchell, *International Historical Statistics: Africa,* pp. 1017–18.
1939–1949: M. Butlin (1977).

CANADA

Price Index for Capital Goods:
1870–1929: Data for roughly every ten years are from Firestone, "Canada's Economic Development," p. 178. Missing data (except 1916–1919 which are left blank) are interpolated.
1929–1950: Urquhart, *Historical Statistics of Canada*, p. 305.
Price Index for Machinery and Equipment:
1870–1929: Derived from Firestone, "Canada's Economic Development," pp. 100–01. The 1880 figure is calculated using an unpublished draft of the aforementioned paper by Firestone. Missing data (except 1916–1919) are interpolated.
1929–1950: Leacy, *Historical Statistics of Canada*, series K160-171.
Price Index for Building:
1870–1929: Derived from construction index in Firestone, "Canada's Economic Development," pp. 100–01). The 1880 figure is calculated using an unpublished draft of the aforementioned paper by Firestone.
1929–1950: Leacy, *Historical Statistics of Canada*, series K160-171.
Price Index for Consumption Goods:
1870–1929: Firestone, "Canada's Economic Development," p. 178). Missing data (except 1916–1919) are interpolated.
1929–1950: Urquhart, *Historical Statistics of Canada*, p. 305.
Current Price Value of Investment:
1870–1900: Investment shares are from Kuznets ("Quantitative Aspects"), who based figures on Firestone ("Canada's Economic Development") for 1870, 1890, and 1900. Missing data are interpolated.
1901–1930: Leacy, *Historical Statistics of Canada*, series F179-182. Leacy provides quinquennial sums. Investment shares are calculated for five year periods by dividing by the quinquennial sum of GNP.

1930–1950: Mitchell, *International Historical Statistics: The Americas*, pp. 750, 754.
Current Price Value of GNP:
1901–1930: Derived from Altman, "Revised Real Canadian GNP Estimates."
1930–1950: Mitchell, *International Historical Statistics: The Americas*, pp. 750, 754.
Constant Price Value of Investment:
1870–1929: Firestone, "Canada's Economic Development," p. 275. We use the series for gross investment in new residential and nonresidential construction and new machinery and equipment.
1929–1950: Mitchell, *International Historical Statistics: The Americas*, pp. 750, 754.
Constant Price Value of GNP:
1870–1929: Firestone, "Canada's Economic Development," p. 275).
1929–1950: Mitchell, *International Historical Statistics: The Americas*, pp. 750, 754.

DENMARK

Price Index for Capital Goods:
1870–1950: Derived from current and constant price investment series in Hansen, *Økonimisk vækst.*
Price Index for Machinery and Equipment:
1870–1950: Derived from Bjerke, "National Product."
Price Index for Building:
1870–1950: Derived from Bjerke, " National Product."
Price Index for Consumption Goods:
1870–1950: Derived from Hansen, *Økonimisk vækst.*
Current and Constant Price Value of Investment:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 890, 893, 899.
Current and Constant Price Value of GDP:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 890, 893, 899.

FINLAND

Price Index for Capital Goods:
1870–1950: Derived from current and constant price investment series in Hjerppe, *Finnish Economy*, pp. 201–04, 211–13.
Price Indices for Machinery and Equipment and Building:
Not available.
Price Index for Consumption Goods:
1870–1950: Derived from Hjerppe, *Finnish Economy*, pp. 201–04, 211–13. We use the series for private consumption.
Current and Constant Price Value of Investment:
1870–1950: Hjerppe, *Finnish Economy*, pp. 201–04, 211–13).
Current and Constant Price Value of GDP:
1870–1950: Hjerppe, *Finnish Economy*, pp. 201–04, 211–13).

GERMANY

Price Index for Capital Goods:
1870–1950: Hoffmann, *Das Wachstum*, pp. 598–600.

Price Index for Machinery and Equipment:
1870–1950: Index for agricultural machinery from Hoffmann, *Das Wachstum*, pp. 569–70.
Price Index for Building:
1870–1950: Hoffmann, *Das Wachstum*, pp. 569–70.
Price Index for Consumption Goods:
1870–1950: Hoffmann, *Das Wachstum*, pp. 598–600.
Current and Constant Price Value of Investment:
1870–1950: Series for net investment from Hoffmann, *Das Wachstum*, pp. 825–28.
Current and Constant Price Value of GDP:
1870–1950: Series for net national product from Hoffmann, *Das Wachstum*, pp. 825–28.

ITALY

Price Index for Capital Goods:
1870–1950: Ercolani, "Documentazione statistica," pp. 434–35.
Price Index for Machinery and Equipment:
1870–1950: Vitali, "La stima," pp. 511–12.
Price Index for Building:
1870–1950: Vitali, "La stima," pp. 499–502.
Price Index for Consumption Goods:
1870–1950: Ercolani, "Documentazione statistica," pp. 434–35.
Current and Constant Price Value of Investment:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 891, 895, 901.
Current and Constant Price Value of GDP:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 891, 895, 901.

JAPAN

Price Index for Capital Goods:
1870–1940: Ohkawa et al., *Estimates*, volume 8, p. 134.
1952: Ohkawa et al., *Patterns*, p. 389.
Price Index for Machinery and Equipment:
1870–1950: Ohkawa et al., *Estimates*, volume 8, p. 161–62.
Price Index for Building:
1870–1940: Ohkawa et al., *Estimates*, volume 8, p. 158–59.
1952: We formed a link using capital goods price index.
Price Index for Consumption Goods:
1870–1940: Ohkawa et al., *Estimates*, volume 6, p. 106.
1952: Ohkawa et al., *Patterns*, p. 389.
Current and Constant Price Value of Investment:
1870–1950: Mitchell, *International Historical Statistics, Africa*, pp. 1002–08.
Current and Constant Price Value of GDP:
1870–1950: Mitchell, *International Historical Statistics, Africa*, pp. 1002–08.

NORWAY

Price Index for Capital Goods:
1870–1930: Bjerke, *Langtidslinger I Norsk Økonomi*, pp. 142, 148–51.

1930–1950: Aukrust, *Nasjonalregnskap*, pp. 316–17.
Price Index for Machinery and Equipment:
1870–1930: Bjerke, *Langtidslinger I Norsk Økonomi*, pp. 142, 148–51.
1930–1950: Aukrust, *Nasjonalregnskap*, pp. 318–19.
Price Index for Building:
1870–1930: Bjerke, *Langtidslinger I Norsk Økonomi*, pp. 142, 148–51.
1930–1948: Aukrust, *Nasjonalregnskap*, pp. 318–19. We linked to 1950 using the capital-goods price index.
Price Index for Consumption Goods:
1870–1900: Private consumption goods prices from Bjerke, *Langtidslinger I Norsk Økonomi*, p. 142.
1900–1930: Cost of living series underlying Williamson, "Globalization."
1930–1950: Private consumption goods prices from Aukrust, *Nasjonalregnskap*, pp. 316–17.
Current and Constant Price Value of Investment:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 891, 896, 902.
Current and Constant Price Value of GDP:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 891, 896, 902.

SWEDEN

Price Index for Capital Goods:
1870–1950: Derived from Johansson, *Gross Domestic Product*, pp. 134–37.
Price Index for Machinery and Equipment:
1870–1950: Derived from Johansson, *Gross Domestic Product*, pp. 134–37.
Price Index for Building:
1870–1950: Derived from Johansson, *Gross Domestic Product*, pp. 134–37.
Price Index for Consumption Goods:
1870–1950: Derived from Johansson, *Gross Domestic Product*, pp. 122–29.
Current and Constant Price Value of Investment:
1870–1950: Johansson, *Gross Domestic Product*, pp. 134–37.
Current and Constant Price Value of GDP:
1870–1950: Johansson, *Gross Domestic Product*, pp. 150–53.

UNITED KINGDOM

Price Index for Capital Goods:
1870–1920: Feinstein, "National Statistics," pp. 470–71.
1920–1950: Feinstein, *National Income*, table 61.
Price Index for Machinery and Equipment:
1870–1920: Feinstein, "National Statistics," pp. 470–71.
1920–1950: Feinstein, *National Income*, table 63).
Price Index for Building:
1870–1920: Feinstein, "National Statistics," pp. 470–71.
1920–1950: Feinstein, *National Income*, table 63).
Price Index for Consumption Goods:
1870–1950: Feinstein, *National Income*, table 61).
Current and Constant Price Value of Investment:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 891, 897, 905.
Current and Constant Price Value of GDP:
1870–1950: Mitchell, *International Historical Statistics: Europe*, pp. 891, 897, 905.

UNITED STATES

Price Index for Capital Goods:
1870–1950: Derived from Kuznets, *Capital*, pp. 572–74. All data here are reported as five-year moving averages.
Price Index for Machinery and Equipment:
1870–1950: Derived from gross producers' durables figures in Kuznets, *Capital*, pp. 596–97.
Price Index for Building:
1870–1950: Derived from nonfarm residential figures in Kuznets, *Capital*, pp. 576–79.
Price Index for Consumption Goods:
1870–1950: Derived from Kuznets, *Capital*, pp. 561–64.
Current and Constant Price Value of Investment:
1870–1950: Kuznets, *Capital*, p. 572.
Current and Constant Price Value of GDP:
1870–1950: Kuznets, *Capital*, p. 561.

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