Machinery prices during the second Industrial revolution.

*An international comparison of capital goods, 1850 – 1939.*

**Abstract**

Machinery prices are a crucial part of the history of catching up, technological progress and the industrial revolution diffusion. However, the efforts to obtain an international price for capital goods have been scattered and the majority of the works dealing with this phenomena had a national scope mainly . In this paper, the authors have done an effort to homogenise the different national machinery prices available for the period 1850 – 1939, considering three European countries (Great Britain, Sweden and Germany) and five American countries (USA, Argentina, Chile, Brazil and Mexico). The research value of these countries is the mix between producers and buyers, allowing us to understand the cost to implement new technologies in the core economies and the periphery.

The paper is also related to the discussion whether prices of comparable *tradables* differ between countries. The findings suggest that they may do so and over periods extending over more than a decade. The textbook case does not allow such slow adjustments of prices in tradable goods. However, friction is a phenomenon of real life and in an economic context this does mean that adjustments to change take time. With technological change production functions change and prices do not adapt immediately into an international equilibrium. Summing up, this paper will contribute with empiric results to the debate on the technological diffusion in the so called “Second industrial revolution” period.

**Keywords**: Machinery prices, second industrial revolution, Technological diffusion

**Introduction**

The debate on the origins of the industrial revolution is more alive than ever. A series of paper by Robert Allen have spread the idea that the IR is linked to factor prices in energy and the high cost of labor force in Great Britain was a strong incentive to invest in labour-saving machinery (R. Allen, 2001; R. C. Allen, 2009b, 2009a, 2012a, 2012b, 2015). These ideas has been contested with the apparition of detailed wages series for the construction sector in the period 1650 – 1780 by Judy Stephenson, among others (Stephenson, 2018, 2019) . Surprisingly, in this debate the role of machinery prices appears to be absent and inputs regarding this production factor could shed light in the real ratio between energy and labour costs.

Currently, the available machinery price series for United Kingdom and USA have remarkable flaws. In the case of UK, the most important producer during the studied period, the price index is mainly a proxy obtained from iron prices with an arbitrary adjustment of technological change. In USA, the equipment price index has been done by Lipzey and it has export price approach to measure the price of capital goods.

This article is a novel approach to the debate in the period immediately after the classical *first industrial revolution*. One of the reasons that machinery prices are explicitly absent from the debate regarding factor cost of energy and labour is the difficulty to find reliable series on capital goods costs. If it’s difficult to find machinery prices series for the period 1940-1980, this task become extremely challenging for former periods. For this reason, we would like to contribute to the debate on the causes and spread of mechanization centring our effort in the period 1850 – 1939, standardizing the available national series on machinery prices and complementing them with novel data. Our new resulting series have observations from three European countries (Great Britain, Sweden and Germany) and five American countries (USA, Argentina, Chile, Brazil and Mexico). The research value of these countries is the mix between producers and buyers, allowing us to understand the cost to implement new technologies in the core economies and the periphery.

The section two of this article has a literature review on machinery prices and technological diffusion. Section three discuss the data available, the main flaws of them and the methodology utilized in this article to achieve a series standardization. Section five presents the main results and section six concludes.

**Literature review**

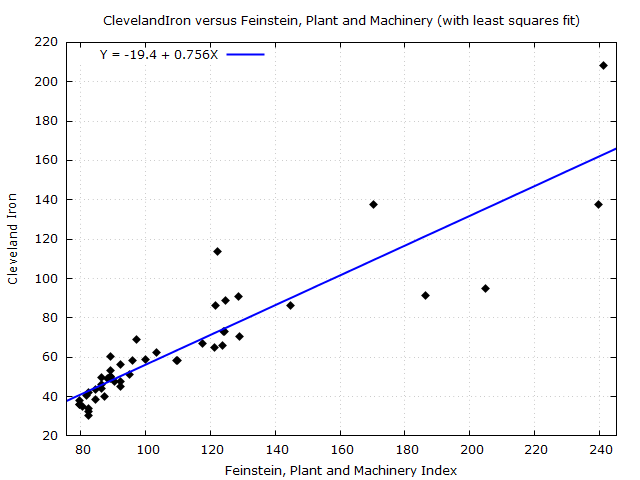
There has been several studies dealing with machinery and equipment in UK highlighting the dissertation by Floud (1976). In the case of Sweden, there are works worth to mention, such as "Priser och marknadskrafter i Sverige 1885-1969: en prishistorisk studie" (Ljungberg, 1990). The figures presented in these books are relevant for our research, but do not resolve the main questions that we have proposed. Therefore, machinery prices have been analysed from tangential perspectives, and not as playing a key role; the technological changes that occurred in the past centuries (XIX and XX) are so huge that we have to continue re-estimating relative prices of capital goods. This problem is even bigger if we want to elaborate long run series and to compare the prices of a good in the 1870’s with that of a "similar" item in the 1930’s.

Current debates in computers and software prices are dealing with similar problems. Several attempts have been made to understand the role of technology and relative prices changes in historical perspective (Collins and Williamson, 2001), but the majority of these works are estimations based on proxies of capital prices such as interest rates or import/export figures. In Collins and Williamson (2001), as example, M&E price indexes are proxies of investment figures, which do not take into account the enormous differences within the several Non-residential investment items.

Technological changes in the machinery & tool industry have been so incredible in the last two hundred years that the use of almost same indexes for the period 1850 - 1913 could be considered a noticeable mistake. However, as we will see in this section, the construction of M&E indexes taking into account quality changes are absent. If we observe the last developments in economic history research, it could be possible to sort the literature on M&E prices among Technological change studies, historical national accounts and industrial revolution debate.

Allen (2012); Albers (2002) observed in a comparative framework and analysing a national experience respectively, the influence of machinery in economic growth and how the available horsepower in the economy could impulse productivity and the transition from organic to mineral fuels. If the studies of such people as Abramovitz and Solow are even approximately correct with respect to orders of magnitude, then the contribution of technological change to rising per capita incomes absolutely dwarfs the contribution from a rising but qualitatively unchanging stock of capital "Several studies have collected data on prices paid by buyers, but few of these series refer to capital goods. While a seller can provide price information on a given model of a complicated piece of machinery over a period of time, most buyers purchase capital goods only occasionally and thus cannot provide a continuous price series.

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Articles on international prices: Collins and Williamson (2001) introduced a new perspective in the long run relation between machinery prices and investment. In their article, funded in a data base of machinery exports and imports prices, they argue that a constant reduction in the price of capital goods was the main cause behind the investment rates in developed countries (Collins & Williamson, 2001; Gómez-Galvarriato & J.G., 2009). The main problem of this article is the absence of an explanation on the kind of capital goods and the extreme aggregation of the different kind of equipment, limiting the explanatory capacity of the price on the investment trends.

**Data reconstruction and methodology**

A fundamental problem for the construction of any volume series is to take account of quality change. In modern national accounts hedonic price indices have been suggested, but not generally applied, in order to take account of quality change in particular considering ICT. Figure 1 illustrates the effect on price deflators when Statistics Sweden introduced such hedonic indices in the 1990s and early 2000s.[[1]](#footnote-3)

***Figure 2.* The effect of hedonic deflators in Swedish national accounts**

**(1995=100), 1970-2005**



*Note:* Source KLEMS (2008); SIC 30 is Office, accounting and computing machinery, SIC 31 Electrical machinery and apparatus, and SIC 32 Radio, television and communication equipment

A hedonic price index estimates, in a regression, *the price of a commodity as a function of some of its properties*. Hence, the rising efficiency of a mobile phone or computer implies a declining price even if the price tag would be the same. Stable or declining prices despite improved efficiency are, of course, not a new phenomenon in the third industrial revolution but have gone along with technical change through history. However, hedonic indices are rarely applied on historical price development and given the requirement of large amounts of data this is understandable. Regressions are however not the only tool for taking account of efficiency or, more generally, quality change in price series. The matching or splicing method, will do much the same if carefully conducted. The advantage is that it is possible to apply even with a low number of observations, as is often the case with historical price data. A condition is, however, that there are continuous observations and that the diversified products share at least one observation.

Say, if we take into account prices for steamship A over year 1 to 4, and for steamship B from year 4 to 8. The common observation in year 4 can then be used to extrapolate A forwards with B to year 8, or the other way, extrapolate B backwards with A to year 1. In principle this method can be used also if observations for one model of a product type is more scattered but there are several models with observations that together cover all years. This matching or splicing method has been applied in the construction of price indices for a wide range of machinery in Britain, Sweden and Germany. In addition, the hedonic method has been used for the construction of the price indices of electrical motors, for which the data were particularly feasible. The data have been compiled from manufacturers’ sales records, price lists, mostly from archival sources, as well as records on acquisitions. References are given below in connection with the presentation of the different price indices.

***Steamships***

Efforts to construct a price index for ships, since the rise of modern shipbuilding in Britain, have been pursued along several lines. One has been to construct a ship price index from the input side, weighing together factor and intermediate costs (Maywald 1956; Feinstein 1988; and for the Netherlands, Albers 1996). Feinstein (1988 p.334ff) presents an impressive estimate for the period 1850-1920, on the basis of index series for wages and materials, and adjusting for quality change, which is assumed non-existent before 1870 and thereafter progressing stepwise at an increasing rate. This assumption is, however, not fortunate since a major technical change considered the improved efficiency of engines and, according to Harley (1972: 218, 240), coal consumption of marine steam engines was reduced by a good half 1855-1870, and at a slower rate 1870-1890. Today the most used ship price index is the one construed by Feinstein (1988). [[2]](#footnote-4)

Another line has estimated the average price per gross register ton, (Cairncross 1953, p. 127; Slaven 1980; Craig 1981). Cairncross' index, ranging 1870-1913, was actually a linking of different methods, the first one-third being average values. From the early 1880s Cairncross used quotations of the Kellock shipbrokers, which from 1898 onwards are published as the famous Fairplay quotation of a 7500 dwt steamer. Pollard and Robertson (1979) also use the Kellock/Fairplay quotation, but only for the years 1898-1913. This series is then extrapolated backwards to 1883 by means of a GDP-deflator, but adjusting for "greater fluctuations in the price of ships than in the economy as a whole" (p. 187). Harley (1972), in a way similar to the Kellock/Fairplay quotation, presents price series of a particular specification for the period 1856-1890. One series is for a sailing ship and another for a steamer of 2,000 gross tons and capable of 10 knots, based on the records of the shipbuilder Stephen and Sons. By taking a ship of a particular kind and tonnage, and “of plain specification” (as stated by Fairplay) quality change should in principle be accounted for, at least for shorter periods. The 35 years covered by Harley seems a bit long, and the change from iron to steel hulls, mostly taking place in the 1880s, would be hidden by taking gross tons instead of the carrying tonnage, which increased with steel. However, Harley partly avoids the shortcoming of the long period by use of a hedonic model. Hence, only a few of the more than 500 steamers built or offered by Stephen were of the stated specification, but their prices and properties are used for the simulation of a price series. In effect the result is the same as when the price of a Volvo Amazon is extrapolated with an index based on the later models, and used to show the development of Volvo car prices. To accomplish a British steamship price index, it seems therefore attractive to link together Harley’s series in 1890 with the Kellock/Fairplay quotation, which was continued for greater vessels into the post-WWII period, but here stops in 1940.

The adequacy of the Fairplay quotation can, however, be questioned. In 1933 Mr A L Ayre, a British shipbuilder, criticised the journal's quotation, and emphasized: *"It can never be a sound method of comparing* ***values*** *of ships, however much it may be used by the lesser experienced to compare prices."* It is conceded, by the journal, that while the January quotation of 1933 was about £32,000, actually at the same time, the price offered for such a ship ranged between £62,350, for "very plain job", and £74,850, for "good specification." (Fairplay 1933, p. 532)

It seems that the Fairplay quotation also in the 1920s was far too low. Thus in 1925, the quotation was only at half the level of a tender of the Hamburger shipyard Blohm+Voss, precisely for a cargo steamer of 7500 DWT of "einfacher Bauart." The same German ship, but fitted with diesel engines and electrical deck machinery, would add about 25 per cent to the price (Blohm+Voss). The Swedish shipyard Kockums in 1925 and 1926 built motorships of the same size about 65 per cent above the Fairplay quotation, yet below the German offers. Competition was hard and Kockums suffered a loss on these ships, a loss that matched most of the differential to the German offer (Kockums). If the error of the Fairplay quotation were constant, it would not be a problem to use it for extrapolation from a reasonable benchmark. However, a comparison with similar cargo ships built in 1899-1901 by Denny at the Clyde, and Blohm+Voss shows that these were about a fourth higher per gross register ton than the Fairplay quotation (Lyon 1975; Blohm + Voss). This is broadly in line with a contemporary assessment by German scholars, that German yards could build fast liners cheaper than anyone, even if the British still were the most competitive on cargo steamers (Schwarz and von Halle, 1902, II:276ff). In 1911-1914, prices at Blohm+Voss was about a third higher and prices at Lindholmen, which at the time was the biggest Swedish shipyard, a fourth above the Fairplay quotation. According to these comparisons, a shift might have occurred in the Fairplay quotation between 1914 and 1933, and the British ship price index here presented should, in particular for the interwar period, be taken as provisional. Nevertheless, the behaviour of the index looks quite reasonable in comparison with the Swedish ship price index, not only in the nineteenth century but notably in the first decades of the twentieth and in the interwar period (see figures 2-3). From the aforementioned comparison of levels and an inspection of the curves, it seems reasonable that these three shipbuilding nations were at about the same level in the first decade of the twentieth century, or say 1901-1907.[[3]](#footnote-5)

***Figure 3. Price indices for ships (1901/1907=100), 1850-1914***



Sources: see the text



[Figures 2 and 3 about here]

In figure 2, the similarity after 1870 between the “British” (linked Harley and Fairplay index) and the Feinstein index is striking. One should recall that they are constructed with quite different methods and this must be seen as a corroboration of the pattern. However, the neglect, by Feinstein, of quality change before 1870 is demonstrated by a lower level and no decline over the preceding decades, while Harley’s capture of the rapid technical development is reflected in the fall of the “British” through the 1860s.

The Swedish and German indices, also shown in figures 2-3, are constructed with the matching method on the basis of shipbuilders’ records, with descriptions of the ships and prices. The Swedish index up to 1888 is based on the deliveries of two yards on the Baltic, Bergsund and Motala, aimed for coastal shipping . From 1888 it is based on the deliveries of Kockums in the south, though still largely producing for a segmented market even if many orders were sold abroad. In the early twentieth century Swedish shipbuilders were in the front of the transition to motorships and tankshipping.[[4]](#footnote-6) In Germany, modern shipbuilding took off in the last quarter of the 19th century. The present German index is construed, along the matching method, from the records of Blohm+Voss, a leading shipbuilder in Hamburg. Unfortunately, it has not been possible to start earlier than 1889, although already some years before large, ocean going ships were built at this yard. And the hand written book on deliveries ends with 1914 whereafter only scattered records could be found.[[5]](#footnote-7) The lower level of German ship prices before 1900 is reasonable given the lower costs and, as will be seen below, in comparison with locomotive prices. After the turn of the century both German and Swedish ship prices broadly follow the British. After WWI Sweden seems to have been price leading which is consistent with the rapid technical change, both of their ships and production methods.

***Locomotives***

The price indices for locomotives, presented here, are based on records of renewals and of manufacturers output and constructed according to the matching method. The British index ranges 1860-1940 and is up to 1917 based on overlapping data on the acquisitions of several railway companies.[[6]](#footnote-8) From 1915 the sales of a major producer, NBL, has been used.

For Sweden and Germany official statistics on renewals of public railways have been used (BiSOS:La; Statistik des deutschen Reichs). These include specifications which allow a reasonable identification of locomotive models and prices that can be matched. These data on renewals run 1856-1920 for Sweden, began for Germany in 1880 with retrospective data back to 1855 but was ended in 1897. A continuation (linked in 1895) of the index is built on the sales records of close to 6000 locomotives, delivered by Krauss & Company in Munich from 1887-1925.[[7]](#footnote-9)

Until the 1860s both Swedish and German state railways acquired British made locomotives, though in the second half of the 1860s all three countries seem to have been on the same level. This assessment is based on a comparison of comparable engines and in the index series Britain and Germany have 1875=100 with Sweden slightly above at 102. Then prices diverged, as can be seen in figure 4. The German prices, displaying a distinct cyclical pattern, fell much deeper than the British in the 1880s, approached the British in the early 1890s but then continued along a falling trend while the British rose until 1907. The German decline after 1875 is arresting, yet was over the period 1870-1896 not as steep as in the British steamship prices (for a comparative view of the trends in machinery prices, see appendix table 1). The Swedish prices diverged upwards and stayed remarkably high until the early twentieth century. This divergence came before the rise of tariffs and was obviously due to a policy of the state railways only to buy Swedish. The fall of prices after the turn of the century is connected with a big acquisition of American locomotives (Klemming 1906), and also coincides with a general fall of prices of Swedish engineering products (Ljungberg 1990).[[8]](#footnote-10)

[Figure 4 about here]



***Electrical motors***

Electrical motors were for the second industrial revolution what steam engines had been for the first, and computers for the third. Electrical motors and dynamos were manufactured by the British firm Greenwood and Batley already in the early 1880s, but more frequent production began in 1894. The specifications in the sales records were important both for producers and customers, and could be used for the calculation of a hedonic price. Hedonic indices have been constructed also for Germany, although based on price lists, with quotations more sticky than the actual transactions prices of sales books, (see appendix for a description). For Sweden the matching method has been used based on both price lists and acquisition records of the Kockums shipyard (Ljungberg 1990).

Prices of electrical motors fell sharply in their first decade but the decline came to a halt already around 1905.[[9]](#footnote-11) Figure 5 gives an overview: while the movements were similar the levels differ remarkably, but as explained in the appendix, the difference between the British and the German-Swedish motors is adjusted for. It seems that the more standardized production of the German electrical industry from early on had an advantage over the customized British production. The Swedes were close to the frontier in electrical technology and the price levels of electrical motors in 1906-1907 may give an indication: setting Britain at 100, Germany would come at 70 and Sweden at 90. In the 1920s Sweden forged ahead while Britain improved compared with Germany, and in 1929-1930 the levels were, with 100 for Britain, 83 for Germany and 66 for Sweden.

[Figure 5 about here]



***Other British machinery***

For some other machinery, it has been possible to construct price indices for Britain, but not for other countries. Figure 6 thus shows British price indices for machine tools, agricultural ploughs, and steam engines. While machine tools end in 1915, the other indices continue until 1940 and 1934, respectively. Machine tools are based on sales records of Greenwood and Batley,[[10]](#footnote-12) ploughs and steam engines each are composed of several models as presented in the catalogues of Ransomes & Sims with successors, and also Biddel & Balk’s (1857-1863). Ploughs were for long only horse drawn but from 1919 tractor ploughs were marketed by Ransomes and make out a half of the index. Since the tractor ploughs declined 1.7 per cent annually 1919-1938, compared to -0.3 per cent for the horse drawn, the weighting is important and may not truly represent the output of the industry. The steam engines were of different kinds, portable or stationary and traction, each offered in makes with different effects, usually 8 to 20 horse powers. From the catalogues the engines seem to have changed very little, and Ransomes boosted their reliability with reference to their very long-term service. Price changes were similar across models and the technical change, tracked in marine engines by Harley (1972. Thus, neither ploughs nor steam engines in the second half of the nineteenth century reflected the price development typical of innovations, still seen in the machine tools.

[Figure 6 about here]



*Sources: see text.*

***Figure 3. Price indices for ships (1901/1907=100), 1900-1940***

*Sources: see text.*

***Figure 4. Price indices for steam locomotives (British 1875=100), 1855-1914***

*Sources:* see text.

***Figure 5. Prices of electrical motors in Britain, Germany and Sweden (Britain 1906/07=100), 1893-1938***

*Sources: see appendix.*

***Figure 6. Prices of other British machinery (1901/07=100), 1853-1940***

*Sources:* see text.

**Appendix**

***Table A1. Average annual percentage rate of change of price indices (fitted trend)***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Steamships | | | | | Locomotives | | | |
|  | Feinst 1 | Feinst 2 | GB | DE | SE | Feinst 3 | GB | DE | SE |
| 1860-1870 | -0.55 | 0.21 | -2.62 |  | -1.00 | -0.04 | 0.23 | -0.80 | -0,75 |
| 1870-1896 | -3.56 | -2.95 | -3.56 |  | -1.74 | -0.88 | -0.98 | -1.53 | -0,24 |
| 1896-1914 | 0.00 | 0.84 | 0.06 | 0.64 | -0.29 | 0.95 | -0.33 | -0.30 | -0,65 |
| 1860-1914 | -1.78 | -1.78 | -2.03 |  | -1.09 | 0.22 | -0.32 | -0.72 | -0,38 |
|  |  |  |  |  |  |  |  |  |  |
|  | Great Britain | | | | |  |  |  |  |
|  | Feinst 4 | M.Tools | Steam E. | Ploughs | |  |  |  |  |
| 1860-1870 | 0.43 | -0.82 | -0.68 | 0.73 | |  |  |  |  |
| 1870-1896 | -1.56 | -1.71 | -0.32 | 0.14 | |  |  |  |  |
| 1896-1914 | 0.55 | -0.09 | 0.40 | 0.47 | |  |  |  |  |
| 1860-1914 | -0.39 | -0.94 | 0.04 | 0.39 | |  |  |  |  |
| 1920-1940 |  |  | -3.71 | -0.43 | |  |  |  |  |
|  |  |  |  |  | |  |  |  |  |
|  | Electrical motors | | |  | |  |  |  |  |
|  | G.B | DE | SE |  | |  |  |  |  |
| 1896-1914 | -6.85 | -6.17 | -3.86 |  | |  |  |  |  |
| 1920-31 | -10.20 | -9.41 | -7.27 |  | |  |  |  |  |
| 1930-38 |  | -1.56 | -1.56 |  | |  |  |  |  |

*Note:* Feinst 1 is the ship price index in Feinstein (1988), table 15.12 col. 5/6; Feinst 2 is the implicit deflator for GDFCF of Ships, appendix tables III/X; Feinst 3 is the implicit deflator for GDFCF of Rolling stock and vehicles (ibid.); Feinst 4 is ditto for GDFCF of Machinery, Plant & Equipment (ibid.). Feinstein’s price indices are constructed from the input side: “For the price index there still appears to be nothing better available than the standard index based on movements in the price of iron and steel and in engineering wages.” (Feinstein 1988, p. 294)

***Index calculations for electrical motors***

The price is assumed to have been constant during the whole year, and a function between the technical variables and the price could be estimated for each year. The technical variables hence were assigned specific coefficients by a regression, and then a price for specified models could be simulated for all the years. The regression for each year had the form:

(1) *PRICE = β1 CONSTANT + β2HP + β3SIZE + β4LOG(RPM) + ε*

HP is the effect in horsepowers; SIZE was an internal classification of Greenwood and Batley (though "Size" later became standardized as the height to the axle); and RPM, revolutions per minute, which are converted to logarithms. In a first regression a fitted price was estimated, and the difference between fitted and actual price (the residual) served the omitting of outliers. A probable origin to the occurrence of outliers are motors fitted with extras which have not been specified by the book keeper; or extreme voltage, that, unfortunately, only casually is reported in the sales book. Still there were, on average 53 observations left for each year, 1900-1921, considering the main type of direct current motors. The minimum number of observations was 18 in 1904 and in 1921. In the second regression the independent variables were designed a coefficient for each year. Finally, the specifications of a handful of motors were combined with the coefficients in equations, and the price series were computed. For continuous current motors the proceeding was similar, resulting in estimated prices 1904-1920, though with a gap in 1905. Observations were fewer than for direct current, on average 39 when the year 1905 is excluded, but only for three years less than 22. 1921-1925 are extrapolated with the BEAMA (British Electrical and Allied Manufacturers’ Association) price index for electrical equipment (US Department of Commerce 1928). Finally, 1925-1931 are extrapolated with catalogue prices of Ransomes’s motors as an average of a range of motors of two kinds, for direct and continuous current.

While the British series could be based on transactions, the German series had to be based on list prices which tend to be more sticky. These price lists are from the Siemens central archive, ranging 1894-1907, with gaps but also with annotations about price changes up to December 1908. The AEG central archive has also provided price lists from the period 1912-1938.

The hedonic method for British and German motors made also possible a comparison of price levels with Swedish motors, whose specifications in the years 1906-1907 were inserted into the respective simulation equations why these models served as the basis for the price comparison across countries and time. A constraint on the comparison is that the British motors are not specified whether with "Schleifringsanker" or with "Kurzschlussanker." Both Swedish and German motors are of the former type, but as these were 10-20 percent more expensive than the latter, one may presume that the costly motors made by Greenwood and Batley also were of the "slip ringed" type. Swedish and German prices further consider open motors, and closed motors prevailed in the sales of Greenwood and Batley. An analysis of the AEG 1912 price list, show that open motors were on average 36 percent cheaper than corresponding closed types. As a correction for closed motors, the Greenwood and Batley prices therefore have been multiplied with 0.64 in the comparison.

***Electrical motors***

**International data on machinery prices. The case of Latin America**

The studies on capital formation in the peripheral economies have been growing in the last fivteen years. In the case of Latin America, the works by (Hofman, 2000) and (Ducoing & Tafunell, 2013b; Tafunell, 2013; Tafunell & Ducoing, 2016) have improved our knowledge on the pace and level of fixed investment in the region. One of the main finding in these works, is the great predominance by imported capital goods until the first world war. E.g, in Chile, imported machinery fluctuated between 90 – 95 % during the decade of 1900 – 1910 and these numbers were not reduced significantly until the Second World War (Ducoing & Tafunell, 2013a; Ducoing Ruiz, 2012).

Figure .

Share of machinery and equipment in total exports of the United Kingdom. 1850 - 1936. Current prices.



Source: Annual statement of the trade, several years.

Several price indexes on Machinery. 1850 – 1913.



Sources: (Feinstein, 1988; Floud, 1976)

Methodology

Levels between countries.

Results

Growth rates of machinery price indexes. Selected periods

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | 1850-1940 | 1850-1913 | 1870-1913 |  |
| Feinsten | 0,3 % | -0,38% |  |  |
| Lipzey |  |  |  |  |
| Floud |  |  |  |  |
| Ducoing & Lungberg |  |  |  |  |

**Conclusions and further research**

The current indexes on machinery prices should be updated. The Feinstein index, broadly used to estimate capital stocks and international transmission of technological cost and convergence is no longer suitable to these goals.

In this article, we have proposed an update of the prices of machinery in three European countries plus a new index for machinery equipment and transport in four Latin American countries. One of the main implications of these new indexes is the update of capital stock measures in several countries, and consequently, the total factor productivity (TFP) long run series could be modified with relevant changes.

Three main findings could be extracted from the indexes are the following: in first place, the convergence in machinery prices trends between United Kingdom, Germany and Sweden was constant until the first world war. This finding is relevant to understand the convergence forces behind the globalization period of 1870 – 1913. Second, at least in trends, the famous and controversial debate on the “British relative decline” has a new input. There is not an extremely gap between British machinery & equipment price trend regarding its more relevant European competitor, Germany. In the case of Sweden, the trend is similar and show the features of a catching-up country. Third, the case of Latin American countries and the extremely similarity of trends with core economies it’s a prove of the extremely dependent that were these countries (and probably the whole periphery) in the European and USA technology. The trend in Argentina, Brasil, Chile and Mexico shows that until first World War, the 90-95% of total machinery imports were from United Kingdom, USA and Germany, a result that have been confirmed in other studies (Ducoing & Tafunell, 2013a; Tafunell, 2009).

This article has resolved some important issues on capital goods prices and convergences, but several questions have arisen, such as the quality of the goods, the price in other countries of the periphery and the comparability between different items. Further research should point out these questions.

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1. We leave aside the consequences for the comparability of national accounts over time and across countries. [↑](#footnote-ref-3)
2. There are, however, two ship price indices provided by Feinstein (1988), and it is somewhat puzzling why the quality adjusted price index (cols. 5/6 in table 15.12), does not match the implicit deflator for ships (col. 8 in appendix table III over col. 8 in table X). The former, “explicit index”, declines 1860-1914 with an annual rate of -1.78 % while the annual rate of the latter “implicit index” is -1.03 %. [↑](#footnote-ref-4)
3. Contempory observers held the belief that all shipbuilding outside Britain was heavily subsidized before World War I, but a survey at the turn of the century presented a nuanced picture. In France and Italy subsidies for shipbuilding were substantial. In Germany, the Netherlands, and Scandinavia, however, the principal subsidy was, just as in Britain, for post liners, but not for shipbuilding in general. (Schwarz and von Halle, 1902, I:112 ff). [↑](#footnote-ref-5)
4. The Swedish index continues to 1969 (Ljungberg 1990). For the nineteenth century, however, it is still somewhat provisional and might be revised when we have included the collection of some 300 deliveries 1859-1916 of Lindholmen in Gothenburg. [↑](#footnote-ref-6)
5. One of the authors visited Blohm+Voss in 1995. The book on deliveries 1889-1914 was carefully kept and shown by the CEO. [↑](#footnote-ref-7)
6. The companies are Great Western, North Eastern, Caledonian, the London-Brighton-South-Coast, and the London-South-West, the latter two generously provided by Mr. Anthony Heman from his personal collection. A slight difference in volatility can be distinguished between acquisitions from companies’ own works and from independent manufacturers. [↑](#footnote-ref-8)
7. Quoted in year of order and with a gap during hyperinflation 1921-23. We are grateful to Mr. Helge Hufschläger for being very helpful and allowing us to use the Krauss sales books. [↑](#footnote-ref-9)
8. A comparison, so far not undertaken, with acquisitions of private railway companies might show a pattern closer to the British or German. [↑](#footnote-ref-10)
9. In relative terms, however, electrical equipment continued a long-term decline. Thus electrical equipment in Sweden declined by almost 2 per cent annually 1892-1969, relative to other industrial goods and more than any other group of commodities (Ljungberg 1990). [↑](#footnote-ref-11)
10. By use of the matching method, this index is different from Floud (1976), who calculates average prices of the Greenwood and Batley sales. See Ljungberg (1999) for a discussion. [↑](#footnote-ref-12)