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Conference Item [eg. keynote lecture, etc.]

Winning the war, losing the peace? A comparative study of labour productivity in British and West German industry, 1936-1968

By NIKITA BOS and TAMÁS VONYÓ*

There has been disagreement on the popular notion of Britain's relative economic decline vis-à-vis West Germany after 1950. While German scholars emphasised the role of the post-war output gap in German super-growth, the recent British literature crystallized around the manufacturing failure hypothesis of Broadberry and Crafts. This paper offers a comprehensive reassessment of the relative productivity performance of British and West German industry both before the outbreak of World War II and in the early post-war period. The war had an enormous impact on the Anglo-German productivity race. Relative to the UK, industrial value added per hour worked in West Germany had declined by a quarter between 1936 and 1951. In the 1950s, German super-growth can be explained entirely by this war-induced productivity gap. Britain's relative decline in this period cannot be attributed to British manufacturing failure. If at any time during the post-war Golden Age, such failure can be observed in the 1960s.

The notion of relative economic decline has long pervaded British historiography, to the extent that Tomlinson called this strand of the literature 'declinism'.[1] The growth record of the United Kingdom during the post-war Golden Age has been studied most frequently in a West German comparison. GDP per capita increased by 2.4 per cent annually in Britain and by 5 per cent in the Federal Republic.[2] Labour productivity grew at average rates of 3 per cent and 5.2 per cent respectively.[3] The inability of British industry to achieve anything close to German super-growth in the 1950s and its worsening market position in the face of resurgent German exports was often linked to Olsonian arguments about the punishment of wartime victors with the legacy of bad institutions inherited from the interwar period.[4] More recently, the mainstream interpretation of Britain's relative economic decline has crystallized around the Broadberry-Crafts view and, at its core, the manufacturing failure hypothesis: British industry failed in large scale operations, Fordist technology, and Chandlerian forms of corporate organization.[5]

Clearly, the United Kingdom was bound to achieve more modest growth rates in industrial productivity, as she was closer to the productivity frontier after the war. However, annual growth rates were still substantially lower than what should have been feasible based on the convergence hypothesis.[6] We argue that another factor was also in action making British productivity growth look inevitably inferior in a West German comparison. German scholars put great emphasis on the war-induced gap between actual and potential output and argued that it was the chief catalyst of the *Wirtschaftswunder*.[7]

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[1] Tomlinson, 'Inventing decline', p. 731.

[2] Data from Conference Board: http://www.conference-board.org/data/economydatabase

[3] O'Mahony, *Britain's productivity'*, p. 5.

[4] Olson, *Rise and decline*; Elbaum and Lazonick, 'Decline'; Kirby, 'Institutional Rigidities'

[5] Broadberry, *Productivity race*; idem, 'Manufacturing'; Broadberry and Crafts, 'UK productivity'; Idem, 'British economic policy'; Broadberry and O'Mahony, 'Britain's productivity gap'; Crafts, 'Deindustrialisation'

[6] Crafts, 'Never had it so good'; Bean and Crafts, 'British economic growth'

[7] The reconstruction thesis is attributed to Jánossy, 'Economic miracle'. On its implication for West German economic growth in the 1950s, see Abelshauser, *Deutsche Wirtschaftsgeschichte*, and Eichengreen and Ritschl, 'Understanding', among others.

The so called reconstruction thesis was confirmed econometrically in cross-country investigations.[8] In our reassessment, we aim to quantify both factors, catch-up and reconstruction growth, and discuss their contribution to the relative decline of British industry during the Golden Age.

This approach requires additional data that go beyond the currently available time-series evidence on productivity growth. We need to know both how far West Germany lagged behind Britain in industrial labour productivity at the start of the Golden Age and how large an impact World War II made on the productivity race between the two economies. In a comparative framework, the reconstruction thesis dictates that under normal peacetime conditions, West German industry was bound to restore the productivity level it had attained relative to its British counterpart. As long as this wasn't achieved, German super-growth cannot be attributed to manufacturing failure in the United Kingdom. To quantify this process we construct two methodologically consistent labour-productivity benchmarks for the industrial sector in West Germany and Britain for the mid-1930s and the early 1950s.

Our 1951 benchmark is the first direct comparison of industrial labour productivity between the two economies at the start of the Golden Age. All existing estimates have been derived by extrapolation from distant benchmarks using time-series data, which do not take account of inter-temporal changes in relative prices and product weights. As for the mid 1930s, the currently available benchmarks all report relative levels of labour productivity for Britain and Germany within their interwar borders, and thus are not directly comparable with post-war productivity data. We report a substantially revised benchmark for 1935/6, drawing on the work of Fremdling and associates but assuring territorial and methodological consistency with our 1951 benchmark.[9] We use a consistent industry classification.

Perhaps the weakest point of most scholarly contributions to the manufacturing failure hypothesis has been the absence of a clear definition of failure, or at least its meaning in a theoretical framework. We argue that the concept of growth failure is difficult to interpret at the macro level; it needs to be specific to particular industries where particular technologies or modes of labour organisation need to be adopted to improve productivity. This implies that we can only provide for an adequate account of relative British manufacturing performance at the industry level. To serve this purpose, our benchmarks are significantly more disaggregated than all previous estimates. A richer dataset also allows us to better test for the existing explanations of German super-growth after 1950.

The rest of the paper is structured as follows. Section I briefly explains the methodology used to construct industry-of-origin benchmarks. Section II presents our new labour-productivity benchmark for 1951. Section III reports the revised estimates for 1935/6 and discusses the implications of our data for cross-war comparisons. In Section IV, we use decomposition analysis to determine the industry-origins of the reversal of fortunes in the Anglo-German productivity race across World War II. Section V combines our benchmarks with time-series data to account for the role of the war-induced productivity gap in German super-growth. We show that Britain's relative decline in the 1950s cannot be attributed to British manufacturing failure. If at any time during the post-war Golden Age, such failure can be observed in the 1960s, particularly in large scale industry. Section VI discusses the potential explanations for the latter, focussing on access to long-term credit and human capital endowments. Section VII concludes.

[8] See Dumke, 'Reassessing', and Vonyo, 'Post-war reconstruction'.
[9] Frendling et al., 'British'

I. Methodology

Our study follows the industry-of-origin approach that uses unit values to convert values of output into a common currency. Unit value ratios are the most appropriate indicator for price comparisons in manufacturing.[10] Purchasing Power Parities (PPPs), as computed by the International Comparison Program (ICOP), are designed for expenditure comparisons and lead to biased estimates in productivity benchmarks. PPPs include relative transport and distribution margins, and foreign prices, and are usually expressed at market prices. Market prices, in turn, are influenced by the level of value-added taxes and excise duties, which are difficult to subtract from the sales price. Another advantage of the unit-value method is that production censuses also provide data on sectors that produce mainly intermediate inputs. Pig iron, basic chemicals, or paper pulp are rarely sold for final consumption. They are used as intermediate inputs in the production of other manufactures. If we used expenditure prices to construct our benchmarks, these sectors would be insufficiently covered. Unit values are obtained by dividing the ex-factory sales value *(v)*, i.e. total turnover, by the corresponding quantity *(q)*, or volume of output, for each industry *i*.

$$uv_i = \frac{v_i}{q_i} \qquad [1]$$

The unit value represents the average price for a product, or a group of similar products, averaged throughout the year and over all firms. A comparison of unit values provides the basis of the industry-of-origin purchasing power parities (industry PPPs), which we use to compare the value of output per worker and per hour worked in West Germany and Britain both in 1935/6 and in 1951.[11]

$$UVR_i^{BA} = \frac{uv_i^B}{uv_i^A} \qquad [2]$$

The unit value ratio (UVR) of the two countries represents the relative producer price of each matched product. By aggregating these UVRs, we can derive a conversion factor for gross output and value added in a given industry branch. In some cases, the coverage ratio, i.e. the value ratio of matched products to total output, is relatively low. This makes it hard to assume that the UVR is representative for the respective industry branch. Therefore, UVRs are weighted according to their share in gross value-added generated in a given industry to construct an overall industry PPP. These industry PPPs are then aggregated, weighted by their share in manufacturing value-added, to obtain a conversion factor for total manufacturing. In the following formula, *i* denotes a matched product in industry *j*, whereas w_{ij} is the share of product *i* in the gross output of industry *j*.

$$GOPPP_j^{BA} = \sum_{i=1}^{Ij,GO} w_{ij} UVR_{ij}^{BA} \qquad [3]$$

There are alternative techniques to weight industry branches and then industries within total manufacturing. By using the weights of the base country (A), we obtain the Laspeyres gross-output PPP.

[10] See B. Van Ark, 'Comparative levels', pp. 343-74.

[11] The name PPP can be slightly misleading, since the actual term is not real purchasing power parity. It is the weighted average of unite value ratios, which are relative producer prices. However, the term PPP has been used in the existing literature and thus will be adhered to in this paper.

$$GOPPP_j^{BA(A)} = \sum_{i=1}^{I_{j,GO}} w_{ij}^{A(A)} UVR_{ij}^{BA} \quad [4]$$

By contrast, the Paasche PPP is obtained when using the weights of the country in the numerator.

$$GOPPP_j^{BA(B)} = \sum_{i=1}^{I_{j,GO}} w_{ij}^{A(B)} UVR_{ij}^{BA} \quad [5]$$

In general, we expect Laspeyres PPPs to be higher than Paasche PPPs because of the negative correlation between prices and quantities on the same market. The quantity weights of the other country (B) are, thus, relatively large. In the Laspereys PPP, the valuation of gross output at foreign quantities tends to inflate its aggregate value. This is known as the 'Gerschenkron effect', named after Alexander Gerschenkron who first described it in detail.[12] The conversion factor is most commonly obtained by taking the geometric average of the Paasche and Laspeyres PPPs, known as the Fisher PPP. The Fisher index has several favourable properties. The most important for our study is that it satisfies the country reversal test, thus changing the denominator and numerator does not alter our results.[13]

In the existing literature on the period we study, most labour-productivity benchmarks have been constructed on the basis of measuring labour input by employment. However, due to large differences in the length of the working week and the number of vacation days, real hours worked in a man-year vary significantly between countries. Therefore, a comparison based on man hours worked is preferred whenever reliable data are available. In our investigation, we report benchmarks both based on man-year and man-hour worked, but our analysis in Sections IV and V will focus on the latter.

Output-based productivity comparisons are subject to distortions caused by quality differences, as UVRs are computed using sheer quantities. However, it has been argued that in the early post-war period, this problem was not as severe as it is today.[14] Broadberry and Crafts demonstrated that the productivity performance of Britain relative to the United States in 1948 appears to have been remarkably similar whether the comparison is based on net output converted by relative unit value ratios or on a physical-output benchmark, as in the seminal work of Frankel.[15] Quality differences are more important in consumer durables or engineering products than in intermediates such as steel, cement, paper, or timber.[16]

II. A new labour-productivity benchmark for British and West German industry in 1951

The data necessary for the construction of our labour-productivity benchmark for 1951 are drawn from the official production censuses of Britain and Germany. For the United Kingdom, detailed figures on both output and labour input are presented in *The Report on the Census of Production for 1951*, published by the Board of Trade. For West Germany, we derived our data from two different series in the annual industry statistics published by the Federal Statistical Office.[17] The industry classification system in

[12] Gerschenkron, *Economic backwardness.*
[13] Van Ark, 'Comparative levels', p. 30.
[14] Broadberry and Fremdling, 'Comparative productivity', p. 408.
[15] Broadberry and Crafts, 'Explaining', pp. 376-7; see also Frankel, 'Anglo-American productivity differences'.
[16] Van Ark, *International Comparison*
[17] *Industrie der Bundesrepublik Deutschland*, Reihe 4, Die industrielle Produktion 1950/55 (1956). *Industrie der Bundesrepublik Deutschland*, Reihe 4: Sonderveröffentlichungen, No. 11. (1956). The German sources provide information on gross output

Britain lists 24 main industries, which are subdivided into 148 branches. The West German nomenclature is based on five core industry groups broken down into 44 industries, which are split up into branches in some cases. We harmonised these classifications at the level of 24 industries, which cover most of, although not the entire, industrial sector. Table A1 in the appendix provides a detailed account of our reclassification work. Since the British census reported data at a much more disaggregated level, our classification system followed the West German nomenclature as much as possible.

Following the classification system used in German industry statistics is not only a choice of convenience. It resembles closely the United Nations International Standard Industrial Classification (ISIC), which has been widely used in the literature. Even more importantly, it is the most appropriate classification to apply when constructing industry-of-origin benchmarks. To accept the matched products within an industry to be representative of the industry output, we need to assume that the branches of the respective industry operate with the same production function. The British industry classification groups industry branches together which use the same type of input materials but at different levels of processing. This is hugely problematic for the above assumption as industries producing intermediary products, like iron and steel, or timber, are typically capital intensive, whereas the engineering branches, or light manufacturing substitute skilled labour for capital – and thus achieve significantly lower levels of labour productivity. By contrast, the German nomenclature groups industries into one class which operate at the same level of the vertical production chain.

All previous benchmarks comparing British and German industrial labour productivity in the mid twentieth century have been constructed on the bases or raw employment data. In order to provide for an appropriate measure of labour productivity, employment levels need to be adjusted for differences between the two countries in average working hours. As we will see, there was substantial deviation between British and West German manufacturing in this regard in the early 1950s, which yield significantly different estimates for relative productivity levels depending on which definition of labour input we use. O'Mahony has constructed estimates at the industry level for several countries on average annual hours worked by all engaged personnel.[18]

To construct our benchmark, we matched in total 186 products or product groups. The matching of products was difficult in several instances. Commodities under the same label are often not homogenous, while similar products are frequently attributed different names in the production statistics of the two countries. Furthermore, the West German and the British census did not use the same measurements, and so the British data had to be converted into metric units. In certain cases, the matching of products was made impossible as the units of measurement were incomparable. Whereas German industry statistics almost always specify the volume of production in tons, the British census often reports the number of products instead. Without reliable data on average product weights in the respective industries, it is impossible to convert volume into quantities, or vice versa. This problem was particularly severe in the

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only. Net production value, i.e. value-added, is reported for 1950 in Fachserie D, Reiche 4 (1965). We use the value added/gross output ratio of 1950 to calculate value added from gross output in 1951.

[18] O'Mahony, *Britain's Productivity Performance*, Table C, p. 102. The industry classification reflects a higher level of aggregation than our benchmark. However, we could match our 24 industries to 18 industry groups reported by O'Mahony. We assumed that standard working hours were uniform across branches of any given industry.

engineering sector, where the matched product groups often included several products measured in incomparable units. To solve this problem, we draw information from British trade statistics. This procedure is described in more detailed in the appendix, in Table A2.

Another problem is that certain products were only manufactured in one country and, therefore, could not be matched. Data on production was not reported for reasons of confidentiality in the German industry statistics in minute industries that incorporated a very small number of firms. Finally, in food products, beverages and tobacco, the German statistics do not provide disaggregate information on output before 1953. Thus, we calculated the unit values for these products based on the 1953 production statistics and extrapolated back to 1951, using export prices drawn from the foreign trade statistics.[19]

We omitted two industries, where a labour-productivity comparison in the early 1950s would not have made practical sense. Aircraft manufacturing was shut down in West Germany after World War II, in accord with the Potsdam Agreement, and was only re-established after 1955, when the Federal Republic had joined NATO. In 1951, only 188 employees were engaged in the aircraft industry, carrying out repairs on existing civilian airplanes.[20] The building of sea-going vessels was also severely restricted until the lifting of the occupation statutes in 1951, so that product composition in shipbuilding was also markedly different that it had been before the war, or what it was in the United Kingdom.[21]

The final challenge we faced was that the widespread price controls that remained in place all over Europe until the early 1950s could affect input and output prices very differently in the two countries. These price movements caused sharp deviations in the ratio of value-added to gross output between West Germany and Britain in several branches of light manufacturing, leading to unrealistic productivity estimates. To overcome this problem, since we could not adjust for price distortions for the products we matched, we had to assume that the value-added to gross output ratio in textiles and the leather industry remained constant between 1935/6 and 1951 in both countries. Appendix Tables A2 and A3 provide more detail on the production censuses and the adjustments we have made.

Table 1 below presents the number of matched products, the coverage ratios and the Fisher PPPs for the 24 industries and for industry as a whole. The 186 matched products or product groups cover 26 per cent of British industry and 33 per cent of West German industry. The coverage ratio varies significantly across industries, which reflects the aforementioned difficulties in the matching of products. However, having a low number of product matches does not necessarily lead to weak results. In certain industries, one product can cover a very large part of total output. For example, in hard-coal mining, the coverage ratio is very high, even though there is only one matched product.

Table 1 about here

The Fisher PPP for total manufacturing is relatively close to the official exchange rate, which was 11.67 Deutschmark (DM) to the pound in 1951. However, for several industries, the industry-specific PPP deviates strongly from the exchange rate. Such discrepancies occur because the exchange rate fails to take account of the fact that the purchasing power of a currency will normally vary between different products.

[19] *Statistisches Jahrbuch 1953*, pp. 311-4; *Aussenhandel der Bundesrepublik Deutschland*, Teil 1: Zusammenfassende Übersichten. Jahrgang 1955, Jahresheft (1956)., p. 4.
[20] Gareau, 'Industrial disarmament', p. 522; Statistisches Bundesamt, *Die Industrie der Bundesrepublik Deutschland*, Reihe 4: Sonderveröffentlichungen, No. 11 (1956), p. 6.
[21] Gareau, 'Industrial disarmament', p. 522.

This problem was severe in the early 1950s, still marked by quantity controls and other trade restrictions under a fixed exchange rate regime. We used the PPPs reported in Table 1 to convert gross output and value added per employee and per man-hour worked in West German industry from DM to Sterling. Table 2 reports our estimates for labour productivity in West Germany relative to the United Kingdom.

Table 2 about here

In terms of gross output per person employed, Germany was lagging almost twenty per cent behind Britain at the aggregate level. In value added per man-hour worked, the German performance was somewhat better at 85 per cent of the British level. However, we can observe large differences across industries. Generally, Britain's productivity lead was larger in terms of output per hour than in terms of output per worker because the German workforce worked significantly longer hours. This phenomenon can be explained by the fact that West German manufacturers reported a high number of hours in overtime in the early 1950s. Schudlich showed that, on average, two hours extra were added to the working week in manufacturing, and in the engineering industries the numbers were even higher.[22] In the remainder of this section, we discuss the estimates for value-added per hour worked.

British firms achieved higher levels of labour productivity then their German counterparts in the majority of industries, but their lead was especially striking in fabricated metal products, building materials, beverages and tobacco manufactures. Germany was lagging behind the most in the tobacco industry, where her productivity was less than one-sixth of the British level. This massive gap reflects two factors. First, variation in excise duties on tobacco products between the two countries distorts price comparisons in a way that we cannot fully take into account. Second, the industry is composed of two branches: the manufacturing of cigarettes is highly capital intensive and thus features high levels of labour productivity, whereas the production of cigars relies heavily on skilled labour and hence generates considerably less output per worker. Whereas cigarettes represented the overwhelmingly dominant component in Britain, cigars still had a large share in the German tobacco industry in the early 1950s.

Thanks to a long-established superiority in steel making and the major steel-processing industries, Germany retained her productivity lead in iron and steel, and stayed very close to British productivity levels in the metal processing sector, except electrical engineering. In chemicals, Germany also preserved a small productivity lead. It is interesting to see that German manufacturers also outperformed their British rivals in textiles, the glass, timber and paper industries, where they had never been particularly competitive. Under the Nazi war economy, light manufacturing was deprived of labour, which pushed up the capital-labour ratio and urged firms operating in these industries to economize on labour. This forced wartime rationalization combined with the post-currency reform consumer boom that emerged in the second half of 1948 placed these industries into a favourable position in terms of labour productivity. In food products, the large German productivity advantage offset a similar British lead in beverages. Both are to a large extent the outcome of discrepancies in product composition, meaning that industry branches with different levels of labour productivity had markedly different weights in the two countries.

Table 3 summarises the alternative estimates in the existing literature for comparative labour-productivity levels of West Germany and the United Kingdom in manufacturing and in the economy as a

[22] Schudlich, *Abkehr*, pp. 158-67.

whole for 1950. As we have explained in the Introduction, all previous estimates were derived by extrapolation from distant benchmark years. Each of these benchmarks is sufficiently far away in time for the time-series projections to generate biased estimates for the early 1950s. Relative prices may change over time and thereby render distant industry PPPs obsolete. To account for the substantial difference between the rate of productivity growth in British and West German industry between 1950 and 1951, we used time-series evidence to project backward by one year from our 1951 benchmark.[23] This makes our estimate directly comparable with the other sources.

Table 3 about here

The aggregate productivity gap we report can be defended in two ways. First, Germany always demonstrated higher productivity relative to other advanced nations, and especially the United Kingdom, in manufacturing than in agriculture or services. Data from the Conference Board on GDP per capita and GDP per man hour worked indicate that the West German economy was one-third less productive than its British counterpart in 1951.[24] Our benchmark suggests a notably smaller gap in industry, but one large enough to support the above pattern for the economy as a whole. Second, our estimates are directly derived from current-price data on industrial production in 1951, and thus are unaffected by distortions that arise from changing relative prices in time-series extrapolations.

Our estimate is relatively close to those derived by backward projection from future benchmarks. There is a substantially bigger gap between our figure and that of Broadberry, which was constructed by forward projection from a 1935 benchmark and which measures gross output per person employed. Using the same specification, our benchmark for 1951 becomes 82, which is twelve per cent below the level Broadberry has estimated for one year earlier. This finding shows that changes in relative prices and the shifting weights of different industries were much more significant across the 1940s than during the post-war Golden Age that have been characterised with unprecedented macroeconomic stability. We return to this issue in Section IV, which compares the two benchmarks presented in this paper.

III. A revised labour-productivity benchmark for British and West German industry in 1936

Fremdling, de Jong and Timmer constructed an industry-of-origins benchmark for value added per worker in German and British manufacturing for the mid 1930s.[25] They used data from the 1935 industry census for the United Kingdom and the archival records of the census of German industry carried out in 1936 and published in 1939 by the Imperial Office for the Economic Planning of Warfare. Albeit certainly the most meticulous study on the subject to date, the estimates Fremdling and associates provide are inappropriate for our investigation for three reasons. One, they cover the German Reich within its interwar borders, and thus cannot be directly compared with our 1951 benchmark. Second, the industry classification does not match the post-war West German nomenclature that we have used. Third, productivity estimates were not adjusted for differences in hours worked between the two countries.

[23] See footnotes 28-31.
[24] http://www.conference-board.org/data/economydatabase
[25] Fremdling, de Jong, and Timmer, 'British and German manufacturing'

In a comparative study of East and West German industrial labour productivity, Sleifer computed values for gross output, value added, employment, and labour productivity for all industries reported in the 1936 German industry census according to post-war borders. In the majority of industries, productivity levels were higher in the western part that in the eastern part of the Reich, but the regional productivity gaps differed across industries substantially.[26] The author has kindly granted us access to his complete dataset. We used the product matches of Fremdling *et al.*, and combined this with the specific West German output and employment data reported in the Sleifer dataset. Following this approach, we could calculate new industry PPPs, as explained in Section II, and thus generated a revised labour-productivity benchmark for West Germany and Britain. Since the product matches are derived from the census that covered the whole of Germany, we had to assume that the value of products in East and West Germany did not differ significantly.

In total, we used 229 product matches from Fremdling *et al.* and were able to match 57 separate industries. Table A4 in the appendix provides detailed information on the classification of industries. We subsequently grouped these industries together to correspond to our 1951 benchmark.[27] In the process, we have excluded the aircraft industry and shipbuilding, as they do not appear in the 1951 benchmark for reasons explained in the previous section. Table 4 shows the number of matched products, the coverage ratio and the Fisher PPPs for all 24 industries and for total industry.

Table 4 about here

To account for differences in average hours worked, standard weekly hours were derived from the ILO Yearbook and the British Labour Statistics for the United Kingdom, and from the statistical yearbook of the German Reich.[28] For both countries, we adjusted for the number of sick days and holidays, for which data are available from Huberman and Minns.[29] The only simplifying assumption we had to make is that average annual hours per worker within individual industries did not differ across regions of the German Reich, since we do not have regionally disaggregated data on working hours.

Our revised labour-productivity estimates for 1935/6 are reported in Table 5. West Germany had a twelve per cent lead over Britain in terms of gross industrial value added per hour worked. The German superiority was most striking in the metallurgical industries, electrical engineering, timber and woodworking. As in 1951, West German manufacturers performed most poorly in tobacco and beverages. As we have explained before, the German tobacco industry was dominated by cigar manufacturing that employed little capital and relied heavily on the use of skilled labour, whereas cigarettes were already the main item in the product mix in the United Kingdom during the 1930s. The contrasting gaps in beverages and food products can likewise be attributed to structural differences.

Table 5 about here

[26] Sleifer, 'Separated unity'

[27] We added coal mining to the revised benchmark, but did not include coke and coal distillation for which we have no sufficient data for West Germany in 1951.

[28] ILO, *Year Book of Labour Statistics*, p. 44; Department of Employment and Productivity, *British Labour Statistics*, pp. 96-97, 104-107; *Statistisches Jahrbuch 1939/1940*, p. 384. British industry was operating on a six-day workweek. In Germany, there were some variations, so we adjusted for daily hours from *Wirtschaft und Statistik*, vol. 18, 5 (1938), p.187.

[29] Huberman and Minns, 'Times they are not changing', pp. 546-68.

When we compare our revised benchmark with the estimates of Fremdling *et al.*, a few findings stand out. For most industries, we report higher levels of labour productivity for West German relative to Britain. This can be explained by the higher productivity levels in West German industry as compared to the whole German Reich. Sleifer found that East Germany was at 88.9 per cent of the West German productivity level in manufacturing.[30] Since industrial valued added for West Germany makes up roughly two-thirds of German industrial output in 1936, we can expect a small difference between the benchmark for West Germany and the whole of Germany. At the industry level, more substantial differences emerge. In textiles, the original benchmark for the German Reich was 96.7 per cent of the British level in terms of value added per worker. We find that West Germany was nine per cent more productive in this specification than the United Kingdom.

According to our estimates, the engineering sector reported a West German productivity lead of twenty per cent in terms of value added per worker. Fremdling *et al.* report a smaller gap of 12.3 per cent. This difference can be explained by the fact that West Germany was 12.6 per cent more productive than East Germany in this sector.[31] Engineering also presents a powerful example for how important it is to disaggregate further than previous studies have done. We find that in the whole sector West Germany commanded a 22 per cent lead in value added per man-hour worked over Britain. However, this average figure disguises substantial differences at the industry level. The gap was 45 per cent in electrical engineering, but only five per cent in optical and precision instruments.

IV. The economic consequences of the war

Having constructed two methodologically consistent benchmarks for British and West German industry in the mid-1930s and 1951, we can assess the consequences of World War II for the Anglo-German productivity race. An important added value of our work is that it does not rely on time-series extrapolations, which has been a major caveat of previous studies. In fact, our two benchmarks can be used precisely to demonstrate how much distortion time-series projections introduce. Distortions can be very substantial in a period characterised by marked structural shifts between and within industry groups and equally significant changes in relative prices. Generally, direct benchmark comparisons and time-series extrapolations should arrive at similar estimates at the aggregate level where inter-temporal shifts tend to balance out. We expect to find much larger differences for disaggregated comparisons.

To test this hypothesis, we apply historical time-series data on net industrial production and employment statistics used in previous research to determine relative labour-productivity levels in British and West German industry in 1951. We derive these alternative estimates by extrapolation from our revised 1935/6 benchmark. The British data are from Feinstein.[32] Times-series on industrial value-added for West Germany are reported in official industry statistics.[33] The number of employees is obtained from the sources we referred to earlier.[34] Since we rely on the Feinstein estimates, we do not adjust for working hours in this exercise. Also, we recalculated our benchmarks according to the 7 major industry groups

[30] Sleifer, *Planning Ahead*, p. 78
[31] Sleifer, 'Separated unity' [database]
[32] Feinstein, *Statistical Tables*, p. 111, 129.
[33] *Industrie der Bundesrepublik Deutschland*, Sonderveröffentlichungen, No. 8 (1956), p. 17.
[34] *Industrie der Bundesrepublik Deutschland*, Sonderveröffentlichungen, No. 11 (1956), p. 5; Sleifer, 'Separated unity' [database].

used by Feinstein and aggregated the data from the other sources up to this level. Table 6 reports output, employment, and productivity growth between 1936 and 1951 for both countries.

Table 6 about here

Manufacturing value-added grew much faster in Britain than it had in West Germany, where the impact of war-induced dislocation was more extensive and more prolonged. In both countries, the major war industries, chemicals and engineering, recorded the most impressive growth rates. Metallurgy in Germany could not surpass the 1936 production level until 1951, which is not surprising given the severe output targets and dismantlement policy prevailing in this industry until the late 1940s.[35] Interestingly, the mining sector expanded faster in Germany than in Britain, which was primarily the product of Allied efforts to boost coal extraction in the Ruhr from the early days of the occupation by expanding employment even at the cost of declining productivity.[36] In the United Kingdom, despite demobilisation, employment growth remained strong in heavy industry. It was much more modest in light manufacturing and the food industries, which thus reported the highest growth rates in labour productivity.

The productivity figures reported in Table 6 are used in the next step to estimate relative levels of labour productivity in 1951 by extrapolation from the 1935/6 benchmark. Table 7 compares the thus derived productivity gaps to the ones determined by our new post-war benchmark. As expected, the two procedures yield very similar results for total manufacturing. A residual of 1.27 per cent is well within the margin of error. However, time-series extrapolations introduce vastly larger distortions at the disaggregate level. With the exception of metal manufacturing, we obtain double-digit percentage differences between the alternative estimates. West Germany remained much more productive relative to Britain after the war in chemicals and light manufacturing, but performed much worse than predicted by time-series projections in mining and the engineering industries. This finding confirms yet again that our new 1951 benchmark makes an important addition to the currently available quantitative evidence.

Table 7 about here

Our benchmarks are also superior in quality to all previously published estimates because they are much more disaggregated. Arguably the greatest merit of disaggregated productivity comparisons is that they allow us to measure the contribution of individual industries to and the role of structural effects in the growth performance of different economies. Decomposition techniques are frequently used in disaggregated growth accounts to exploit the richness of data in order to gain a better understanding of the aggregate growth processes. The exact specification below is derived from the recent work of Timmer and associates.[37] We modified their model, in order to make it applicable to cross-sectional examination, but this does not alter the mathematics. Aggregate nominal value added (Y) is defined as the sum of nominal value-added (Z) over all industries (j).

$$P^Y Y = \sum_j P_j^Z Z_j \qquad [6]$$

[35] On Allied industry plans and reparations policy in West Germany, see Plumpe, 'Reparationsleistungen', pp. 31-46.
[36] See Abeshauser, *Wirtschaftsgeschichte*, pp. 36-43.
[37] Timmer et al., *Economic Growth*, pp. 153-154. The authors applied the above model to decompose GDP growth.

Labour-productivity in a given industry (j) is, in turn, computed as gross value-added in the respective industry divided by the number of labour hours (L).

$$z_j = Z_j / L_j \quad [7]$$

Aggregate labour productivity is defined as a weighted average of labour-productivity levels in all industries, where the weights represent the share of industry (j) in gross value-added.

$$Y/L = \sum_j v^Y_{Z.j} z_j \quad [8]$$

In a comparative framework, the aggregate labour-productivity ratio between two countries can be decomposed into a set of industry contributions, where the industry-specific benchmarks are weighted by the average of their value-added shares between the two countries, and a residual.

$$\frac{Y/L_A}{Y/L_B} = \sum_j v^Y_{Z.j} z_j + \left(\sum_j \Delta \ln L_j \bar{v}^Y_{Z.j} - \Delta \ln L \right) = \sum_j v^Y_{Z.j} z_j + R \quad [9]$$

The residual, which in disaggregated growth accounts is referred to as the reallocation effect, measures the contribution of differences between the two countries in the composition of their labour input to the aggregate labour-productivity ratio. It is positive whenever industries with above-average levels of labour productivity have a larger weight in the country of the numerator (A).

Table 8 about here

Table 8 reports the decomposition result for our two benchmarks for industrial value added per hour worked. The numbers confirm that neither the gaps between the two countries in total industrial labour productivity nor the shifting of their relative positions between the mid-1930s and the early 1950s can be explained by structural differences. Individual industry contributions would have produced very similar results had the two economies exhibited exactly the same industry weights in total manufacturing. British industry had a small structural advantage in both periods, meaning that its productivity level relative to Germany would have been slightly smaller both in 1936 and 1951 based on the individual industry contributions alone. However, this advantage amounted to only a few percentage points, and it is thus of no importance.

Figure 1 about here

Figure 1 depicts the contributions of individual industries to the aggregate labour-productivity gap between West Germany and the United Kingdom on a horizontal bar chart. The bars represent the percentage point deviation of the productivity levels attained in each industry in West Germany from the corresponding British levels, weighted by the average share of the respective industries in total industrial value-added between the two countries. The diagram confirms that Britain had managed to establish a lead in almost all industries by 1951, even in sectors where Germany was clearly superior before World War II. We can observe major shifts in the relative importance of the different industries in explaining the reversal of fortunes in the Anglo-German productivity race. The main reason for Germany's falling

behind was clearly the sharp deterioration of her position in the principle war industries: metallurgy and metal products, machine tools and transport vehicles, electrical engineering and chemicals. In iron and steel, chemicals, and textiles, Germany managed to preserve some of her vast superiority, but even here, British industry had closed most of the gap. Germany's relative position had improved across the war only in the glass industry, paper and board, and in food products.

As noted in the previous sections, the tobacco industry is a special case. The already sizeable British productivity lead in the 1930s increased after the war because the technological shift from cigar to cigarette production explained in the previous sections was faster than in Germany. The mass demand for cigarettes born out of wartime experience all over Europe also meant that both the actual volume and the price of tobacco products relative to other manufactures had increased substantially across the war. The average share of tobacco products in total industrial value-added between the two countries jumped from a mere 2.6 per cent in 1935/6 to 8.4 per cent in 1951. Figure 1 shows that over half of the aggregate German productivity lag in 1951 was the contribution of this relatively small industry. In fact, with the exclusion of tobacco manufactures, labour-productivity in West German relative to British industry would increase from 85 per cent to 93 per cent. This finding provides a perfect example for how helpful decomposition techniques are in explaining aggregate growth processes or, in our case, comparative industrial performance.

V. Post-war reconstruction and Britain's relative decline

Having established the relative productivity levels for British and West German industry both before and shortly after World War II enables us to account for convergence and reconstruction growth in the comparative development of industrial labour productivity during the Golden Age. As we have argued, Britain's relative decline was unavoidable to the extent to which it was due to Germany's larger potential for catch up and to re-establish the productivity lead she had attained before the war.

We use existing time-series evidence to extrapolate our new 1951 benchmark forward to 1968. In this way, we can observe approximately when Germany managed to surpass the British productivity level in a given industry and when she recovered, if at all, to the relative position she had established in the mid-1930s. This exercise requires annual growth rates of gross-value added per man-hour worked at the industry level. For Germany this data can be directly acquired from a collection published by the Federal Statistical Office on long-run time series.[38] The index numbers have been constructed on 1962 as the base year, and thus it required an additional source to establish industry shares in 1962 gross value-added for the purpose of our reclassification.[39] As for Britain, an industrial index of production is reported in the *Annual Abstract of Statistics*.[40] We built a consistent 1951-68 index-number series by using 1958 weights. Employment figures and index numbers on hours worked are drawn from the *British Labour Statistics, Historical Abstract 1868-1968*.[41] Using these data, we could construct an index on value-added per hour worked for every year from 1951 to 1968.

[38] Statistisches Bundesamt, *Lange Reihen*, pp. 74-75.
[39] Fachserie D, Reihe 2 (1975), p. 7.
[40] Central Statistical Office, *Annual Abstract of Statistics* (1958, 1960, 1966, and 1976).
[41] Department of Employment and Productivity, *British Labour Statistics*, Tables 25-26, and Table 138.

For the United Kingdom, index numbers on valued-added in constant prices for total industry are reported annually from 1948 onward online by the Office for National Statistics.[42] However, this source was not sufficiently disaggregated for our purposes. We have managed to disaggregate our series into 18 industry groups that are closely matching the industry classification of our benchmark. We only needed to average up a few industries, especially under food and tobacco and the miscellaneous group, to make our 1951 benchmark perfectly compatible with the time series.

Table 9 about here

The results of our computations are reported in Table 9. At the aggregate level and in almost all industries, German manufacturers caught up with their British rivals in labour productivity by the late 1950s. The shaded figures represent the point in time when West Germany had overtaken the United Kingdom in a given industry. The bordered rubrics indicate industries where the German lead was already established in 1951. Although our cross section is far too small for us to apply sophisticated econometric techniques, even a quick glance over the table reveals a clear pattern of convergence. In coal mining, the engineering industries, and leather goods, where the initial productivity gap was smaller than for industry as a whole, West Germany had overtaken Britain in the first half of the 1950s. By contrast, in food and tobacco, china and earthenware, and in the miscellaneous industries (which include rubber and asbestos, jewellery, musical and sports equipment among others), German manufactures only managed to erased the relatively large initial gaps towards the end of the decade.

In two industries, namely building materials and fabricated metal products, where labour productivity in German industry in 1951 only attained 67 per cent and 45 per cent of the British level respectively, the British productivity lead survived until the end of the Golden Age. In the former, productivity growth was particularly sluggish in West Germany during the 1960s. From the perspective of our motivation, the most important finding is that while Germany had overtaken the United Kingdom in industrial labour productivity in the late 1950s, it was not before 1961 that West German manufacturers managed to re-establish the relative productivity position they had attained by the mid-1930s. At the aggregate level, Britain's relative decline in industrial productivity in the course of the German *Wirtschaftswunder* can be entirely attributed to the post-war reconstruction dynamic.

Our disaggregated figures enable us to test this postulation in a cross section of industries. The scatter diagram in Figure 2 plots the projected levels of labour productivity in West Germany in 1961 relative to Britain against the benchmark estimates for 1935/6. We can observe a very strong positive relationship for most industries, with only three outliers. Germany reported very low relative productivity levels in fabricated metal products, where she actually commanded a respectable lead in the 1930s. The main reason for this shift is most likely the changing composition of the product mix. In the interwar statistics, small firearms, hand grenades, and simple tools used for military consumption were all included under this industry. The production of armaments was shut down by the Allies after 1945 and was only re-allowed following the German accession to NATO in 1955 – most notably after the Sputnik shock in 1957. Consequently, until the late 1950s, the industry operated without the relatively large-scale and highly capital-intensive plants that used to supply these products in 1936.

[42] http://www.statistics.gov.uk/statbase

Figure 2 about here

By contrast, in the leather and glass industries, West Germany recorded much higher levels of labour productivity relative to Britain in the post-war period than in 1936. Depressed consumer demand during the 1930s together with the prioritisation of first public works and later war preparations implied that light manufacturing received very little investment. This changed markedly thanks to the consumer boom of the early post-war decades. These industries became increasingly capital intensive particularly from the late 1950s onward. West Germany was entering an extended period of critical labour shortage, with the unemployment rate averaging 1 per cent between 1959 and 1972. Under these conditions, the industries that typically paid the lowest wages had to keep increasing output with declining employment. This called for the substitution of capital for skilled labour, which was in particularly short supply as the number of industrial apprentices began to plummet already in 1956.[43] In the early 1960s, the number of manual workers also began to decline sharply in textiles, the timber industry and woodworking, yielding higher levels of capital intensity and, thus of labour productivity.

For all 18 industry groups, we obtain the coefficient 0.41 for the correlation between the 1935/6 benchmark and the projected levels for 1961, significant at the ten per cent level. If we eliminate the three clear outliers from the sample, the coefficient jumps to 0.64 and turns significant at the one per cent level. Given the small number of observations, this is a statistically very robust finding, which confirms the argument that West German super-growth until the early 1960s was driven by post-war reconstruction. If in any period during the Golden Age, British industry was failing in comparison with Germany in the 1960s, not in the 1950s. At the aggregate level, the growth of value added per hour worked was still more than 1 percentage point faster in West Germany than in the United Kingdom after 1961. Moreover, the growth pattern emerging at the disaggregate level confirms a central component of the manufacturing failure hypothesis, namely that British industry performed particularly poorly in large scale operations, characterised by highly capital-intensive American style mass production. In this aspect, Broadberry and Crafts were undoubtedly right, even if their timing was not precisely accurate.

Table 9 demonstrates that by 1968 the West German productivity lead over Britain was indeed overwhelming in the branches of large-scale industry, such as coal mining, iron and steel, non-ferrous metals, chemicals and textiles. By contrast, British manufacturers were performing relatively well in industries that traditionally included a vast army of highly specialised small and medium-sized firms, mechanical engineering and metal products, china and earthenware, or clothing and footwear. In electrical engineering and transport vehicles, labour productivity levels in Britain fell behind more substantially, but were still not worse compared to the respective West German levels than they had been in the mid-1930s. Mechanical engineering was the only industry where the United Kingdom was even narrowing the productivity gap after 1962. At first, this may be striking as West German engineering firms were fiercely competitive and had been forcing their British rivals out of world markets since the early 1950s.

German historiography provides ample material to unravel this paradox. In the post-war reconstruction phase, West German engineering firms had no incentive either on the supply or on the demand side to strive for technical innovation. First, large efficiency gains could be achieved through a more efficient allocation of available factor endowments and through the elimination of stringent market

[43] Hoffmann, *Geschichte*, p. 67.

regulations and state-sponsored monopolies that characterised the economy of Nazi Germany. Therefore, manufacturers had no reason to increase their production costs by boosting their R&D expenditure and hence becoming less competitive in the short run.

Second, after two decades of depressed consumption, the war-torn German society had an insatiable thirst for traditional manufacturing goods, particularly consumer durables. In 1950, three out of four households had coal heating and only 7 per cent of them were equipped with an electrical stove. By 1958, only every fifth family owned a refrigerator, and there was also substantial pent-up demand for simple household appliances as well as furniture and textile products.[44] The life of the average working class family during the 1950s did not, in any way, mirror a matured consumer society.[45] The restocking of industrial plants in countries plundered under German occupation during the war meant that the engineering industries could also thrive on external markets by effectively producing at the technological level of the 1930s. In heavy equipment, firms were still exporting old coal furnaces and steam-powered locomotives; the darling of the automobile industry remained the Volkswagen 'Beetle'.

Finally, in metal products, mechanical and precision engineering, production scale was generally insufficient for standardised mass production.[46] In these strongly export-oriented industries, Germany had long specialised in skilled-labour intensive, high value-added differentiated quality products, which were flexibly designed to customer needs.[47] Firms continued to concentrate on product rather than process innovation. Since quality engineering goods sold under the lucrative 'Made in Germany' label faced highly income elastic demand in both domestic and international markets, their producers managed to maintain high profitability without having to make significant real efficiency gains.[48]

The factor that slowed down the growth of labour productivity in mechanical engineering in the 1960s, in particular, was a significant shift in the product mix. The most highly capital intensive branch of this industry was steel constructions, i.e. heavy equipment. The 1958 coal crises marked the transition of European fuel consumption from coal to hydrocarbons. This development was detrimental for heavy equipment manufacturers in West Germany as it depressed demand for several of their key products, such as coal furnaces, railway locomotives and rolling stock, and coal mining equipment. As the most capital intensive and thus most productive segment of mechanical engineering was shrinking throughout the 1960s, labour-productivity growth for the industry as a whole was bound to slow down.

VI. The causes for British failure in large-scale industry

Transforming factory industry in Europe from a traditionally craft based, medium scale and skilled-labour intensive system into the large-scale, highly capital intensive mode of serial production assigned an instrumental role to factor markets. Manufacturing firms had to raise a lot of capital, especially as their existing plants and machinery park often had to be replaced in order to adopt the new technological paradigm. Therefore, differences in the institutional environment that conditioned access to long-term credit for industrial investment and which made incentives for labour-saving investment powerful enough

[44] Weimer, *Deutsche Wirtschaftsgeschichte*, p. 116.
[45] Wildt, 'Privater Konsum', p. 280.
[46] Radkau, 'Wirtschaftswunder', pp. 130-131.
[47] Berghoff, 'The end of family business', p. 276.
[48] Ambrosius, 'Wirtschaftlicher Strukturwandlung', pp. 118-119.

were reflected in the relative productivity performance of different economies. Not surprisingly, both the British and German literature placed heavy emphasis on such differences. Bad institutional legacies, such as the prevalence of entrenched trade unions, the high share of public ownership in large-scale industry, weak competition rules, and inappropriate macro-economic policies have all been blamed for the sluggish adaptation to fast-changing market conditions in British industry.[49] According to Crafts, the post-war settlement inhibited productivity growth because of "the inheritance from the inter-war economy of craft trade unionism combined with monopolistic product markets and because the deal effectively precluded necessary reforms of industrial relations structures, vocational training and anti-trust policy while locking the economy into high levels of direct taxation and nationalisation".[50] Although our research does not extend to these issues, we do not wish to refute the claim that by the 1960s West Germany was a better functioning market economy than the United Kingdom.

Nor do we aim to downplay the significance of the highly favourable conditions faced by German industrialists seeking large-scale investment financing. In the 1960s, large firms had access to well-developed capital markets that had never really existed in Germany before. In the interwar period and during the early post-war years, the regulatory framework was not conducive to a high level of market capitalisation. However, the increasing importance of open credit markets did not diminish the unique role that banks had played in financing German industry. The 'special relationship' between big banks and big industry that involved a long-term commitment of financial institutions to manufacturing firms in their clientele, reaches back to the second industrial revolution, and was characterised by many as a major catalyst of German industrialisation.[51] Not only did this relationship survive the war and the post-war resettlement; it actually grew much stronger between the 1950s and the 1960s.

The disintegration of capital markets and the commanding heights of the financial sector was an essential component of Allied policy to dismantle monopolistic structures in the German economy. The three large universal banks – *Deutsche, Dresdner* and *Commerzbank* – were broken up into quasi-independent regional subsidiaries, and later into three regional banks each with independent legal status. This made the concentration of assets required to finance large-scale industrial projects extremely difficult.[52] Between 1950 and 1957, market capitalisation accounted for only ten per cent of gross investment in German industry.[53] Thus, short-term borrowing remained the most important source of investment financing besides retained earnings, with a share of forty per cent in 1950.[54] In December 1956, the Bundestag lifted all regulations limiting the concentration of financial institutions, and by 1960 the three large banks were able to re-establish their dominant position in the long-term credit market. Their role went beyond a direct source of financing as they became increasingly important intermediaries in the issuing of capital-market instruments for industrial corporations.[55]

Additionally, German manufacturers were guaranteed better access to cheap credit than their British counterparts because they faced much less crowding out in capital markets from sovereign bonds.

[49] Elbaum and Lazonick, 'Decline'; Kirby, 'Institutional rigidities'; Bean and Crafts, 'British economic growth'; Crafts, 'Never had it so good'; Prais, *Productivity*.
[50] Crafts, 'Adjusting', p 2.
[51] Veblen, *Imperial Germany*; Gerschenkron, *Economic backwardness*
[52] Pohl, 'Entwicklung', pp. 232-6.
[53] Bornemann and Linnhoff, *Währungsreform*, pp. 18-21.
[54] Baumgart and Moritz, *Finanzierung*, pp.84-5.
[55] Pohl, 'Entwicklung', pp. 236-40.

The ratio of national debt to GDP was extremely low in the Federal Republic in the post-war period. It peaked at 24.5 per cent in 1954 and declined to 16.7 per cent by 1962.[56] By contrast, the debt to GDP ratio never fell below one hundred per cent in the United Kingdom during the 1950s and 1960s.

However, the belated Americanisation of German industry required not only physical capital. Skill endowments in the industrial workforce had to be restructured as well. Craft-based production techniques, prevalent in most branches of European manufacturing until the early post-war years, relied heavily on the use of skilled manual labour. By contrast, large-scale serial production not only substituted capital for skilled labour, but also employed a large number of highly skilled technical personnel: production engineers and technicians. We do not have data to compare the composition of industrial employment according to qualification levels in the two countries over the whole period. However, we have enough evidence to show that the West German training system proved to be flexible enough to facilitate this technological transition. The number of apprentices in industry and handcrafts declined by twenty per cent between 1956 and 1960, despite the significant expansion of manufacturing employment.[57] By contrast, total enrolment in engineering schools increased by 62 per cent between 1958 and 1968, even though employment growth was much more modest than during the 1950s.[58]

Figure 3 about here

Figure 3 shows how the skilled-labour endowments of West Germany industry had evolved over the 1950s and 1960s. From 1962 onward, the federal employment and social statistics report detailed data on the composition of industrial employment, based on which we compute the share of both skilled manual workers, and engineers and technicians in total employment. For the 1950s, such figures are not available. However, the Federal Statistical Office conducted two large representative surveys on the structure of industrial wages and salaries in November 1951 and in October 1957.[59] From these sources we can determine the ratio of skilled workers to the manual workforce and the ratio of technical personnel to all salaried employees represented in the survey. The annual industry statistics, in turn, report employment broken down to salaried stuff and wage labour.[60] Therefore, we can use the above ratios to compute the share of skilled manual workers, and of engineers and technicians in total employment. The chart depicts a stong shift towards a more intensive use of highly skilled technical personnel and a parallel decline in the application of skilled manual labour between the late 1950s and the early 1960s. To the extent that this trend was not matched by, or was less dynamic in, British industry, it provides an additional explanation for the superior German productivity performance in large-scale manufacturing.

VII. Conclusions

In this paper, we offered a comprehensive reassessment of the relative productivity performance of British industry in West German comparison both before the outbreak of World War II and in the early post-war period. The economic consequences of the war for the Anglo-German productivity race cannot

[56] Sachverständigenrat, *Jahresgutachten 1964/65*
[57] Hoffmann, *Geschichte*, p. 112.
[58] Kultusministerkonferenz, *Ausbau*, pp. 1-4.
[59] *Statistik der Bundesrepublik Deutschland*, vol. 90-91 (1954), vol. 246.1-2 (1960).
[60] *Die Industrie der Bundesrepublik Deutschland*, Reihe 4: Sonderveröffentlichungen, No. 11 (1956); *Statistisches Jahrbuch 1958*

be overstated. In the mid-1930s, West Germany commanded a respectable lead over the United Kingdom in industrial labour productivity. By the early 1950s, this pattern had been completely reserved. Relative to the corresponding British level, value added per hour worked in German industry had declined by a quarter between 1936 and 1951. Our disaggregated analysis shows that the falling behind of West Germany was driven by the deteriorating performance of the capital goods industries most important for the war effort, which subsequently became the locomotives of the *Wirtschaftswunder*.

Until the early 1960s, the superior growth performance of German industry can be explained by precisely the elimination of the war-induced productivity gap. This result confirms the line of research that has linked the economic miracles of war-shattered states in the 1950s to a reconstruction dynamic. Britain's relative decline during the 1950s cannot be attributed to British manufacturing failure. If at any time during the post-war Golden Age, such failure occurred in the 1960s, particularly in industries dominated by large-scale and highly capital intensive establishments. Here, unsuccessful technological adaptation to the requirements of standardised mass production, weak competition rules and the lack of sufficient labour-market flexibility together with a comparatively poor investment climate, stressed by Broadberry and Crafts among others, were indeed instrumental. Alongside these factors, however, the superior German productivity performance in these industries also reflected the rapid adjustment of skilled labour endowments to the technological requirements of standardised mass production.

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Table 1: *The construction of industry PPPs for British and West German industry in 1951*

	No. of UVRs	Coverage Ratio		Purchasing Power Parities Fisher (DM/£)
		UK	Germany	Gross output
Total Manufacturing	**186**	**0.26**	**0.33**	**12.16**
Coal Mining	1	0.90	0.51	16.65
Textiles	12	0.40	0.53	9.96
Leather	4	0.59	0.32	7.48
Footwear	4	0.88	0.99	15.67
Clothing	22	0.67	0.59	14.54
Blast Furnaces	5	0.48	0.49	13.00
Iron Foundries	1	0.18	0.92	5.00
Non-Ferrous Metals	7	0.44	0.60	14.43
Fabricated Metal Products	4	0.04	0.07	13.87
Vehicles	2	0.05	0.11	7.50
Mechanical Engineering	35	0.19	0.20	12.51
Electrical Engineering	4	0.09	0.27	15.99
Optical and Precision Engineering	3	0.10	0.22	11.98
Grain and Milling	4	0.64	0.90	23.21
Milk Making and Dairy Products	3	0.51	0.04	7.18
Cocoa, Chocolate and Sugar Confectionary	4	0.55	0.67	6.34
Preserved Fruits and Vegetables	3	0.58	0.57	10.76
Margarine	1	0.10	0.47	16.92
Fish Curing	1	0.90	0.82	13.36
Tobacco	2	0.03	0.34	14.13
Preserved Meat	1	0.05	0.20	12.98
Bread and Flouring Mills	1	0.24	0.08	16.41
Mineral Water and Soft Drinks	1	0.72	0.62	9.51
Chemicals	22	0.18	0.20	10.99
Glass	2	0.15	0.37	8.82
Building Materials	2	0.27	0.29	14.77
China and Earthenware	2	0.07	0.14	15.26
Woodworking	5	0.09	0.17	11.61
Timber Industry	1	0.13	0.11	9.97
Paper and Board	4	0.10	0.13	12.24
Rubber and Asbestos	19	0.49	0.73	17.40
Miscellaneous	4	0.02	0.05	12.80

Note: The aggregate industry PPP is weighted by industry shares in gross value-added. For the total industry benchmarks measuring gross output per person employed or hour worked, we use a gross-output weighted PPP, which is 11.88 DM/£.

Sources: own calculation, see text for underlying sources.

Table 2: *Relative labour-productivity levels in West German industry in 1951 (UK=100)*

	Gross output per person	Value added per person	Gross output per hour	Value added per hour
Total Industry	**82**	**95**	**74**	**85**
Coal Mining	82	81	89	88
Textiles	90	114	83	105
Leather	75	103	66	91
Footwear	93	108	83	96
Clothing	97	95	86	84
Iron and Steel	93	134	84	121
Non Ferrous Metals	63	92	57	83
Fabricated Metal Products	82	51	72	45
Transport Vehicles	82	106	74	96
Mechanical Engineering	96	109	84	95
Electrical Engineering	84	89	76	81
Optical and Precision Engineering	90	115	78	99
Tobacco	19	18	16	15
Beverages	54	51	44	42
Food Products	126	200	104	165
Chemicals	98	120	85	104
Glass Products	122	136	107	119
Building Materials	60	76	53	67
China and Earthenware	84	90	74	79
Woodworking	74	100	63	86
Timber	129	144	110	122
Paper and Board	100	138	87	120
Rubber and Asbestos	54	87	50	80
Miscellaneous	52	84	46	73

Sources: own calculations, see text for underlying sources.

Table 3: *Alternative estimates of labour productivity in West Germany in 1950 (UK = 100)*

	Manufacturing	Total Economy	Description	Data source
Van Ark (1990)	74	-	Market prices instead of factor costs. Gross value added per person hour.	Backward extrapolation from 1967/8 benchmark of Smith, Hitchens and Davies (1982).
Van Ark (1993)	88.8	-	Gross value added per hour worked.	Backward extrapolation from 1987 benchmark.
O' Mahony (1999)	74	72	Value-added per hour worked. For the total, output per hour worked.	Extrapolation from 1987 benchmark (O'Mahony 1992), output per person employed.
Broadberry (1998)	96	71.5	Gross output per person employed	Extrapolation of 1935 benchmark Broadberry and Fremdling (1990).
Bos – Vonyo (2013)	81.5	-	Value added per hour worked	Derived from 1951 production censuses and labour statistics.

Sources: see text.

Table 4: *The construction of industry PPPs for British and West German industry in 1935/6*

	No. of UVRs	Coverage Ratio		Purchasing Power Parities Fisher (DM/£)
		UK	Germany	Gross output
Total Industry	**229**	**0.42**	**0.47**	**17.70**
Cotton Spinning and Doubling	1	0.72	0.78	20.17
Cotton Weaving	1	0.77	1.02	25.40
Woolen and Worsted	3	0.58	0.94	22.70
Silk and Artificial Silk	1	0.41	0.35	15.64
Jute	3	0.48	0.59	20.05
Hosiery	3	0.55	0.63	18.69
Leather (tanning and dressing)	5	0.37	0.49	29.12
Leather Goods	1	0.49	0.10	18.56
Clothing	4	0.09	0.19	21.02
Footwear	1	0.90	0.83	24.04
Iron and Steel (incl. Blast Furnaces)	3	0.91	0.93	18.67
Iron and Steel (other)	4	0.30	0.59	14.69
Iron and Steel Foundries incl. Hardware, Wrought Iron etc.	5	0.45	0.45	14.02
Tinplate	2	0.63	0.39	16.87
Chain, Nail, Screw and Miscellaneous Forgings	7	0.21	0.35	15.38
Wire	4	0.27	0.26	15.47
Tool and Implement	2	0.20	0.19	14.97
Cutlery	3	0.56	0.75	15.29
Non Ferrous Metals	15	0.67	0.48	15.40
Motor Vehicles	7	0.54	0.55	18.48
Mechanical Engineering	24	0.18	0.26	17.47
Electrical Engineering	8	0.22	0.21	13.99
Shipbuilding	2	0.36	0.31	17.19
Aircraft	1	0.14	0.03	17.70
Railways	3	0.16	0.46	20.84
Tobacco[a]	2	1.01	0.85	32.20
Grain Milling	1	0.74	0.96	29.59
Bread, Cakes, etc.	1	0.87	1.00	21.46
Biscuit and Cacao	5	0.85	0.78	21.87
Preserved Foods and Bacon	7	0.41	0.47	19.15
Butter, Cheese, Condensed Milk and Margarine	1	0.22	0.68	26.00
Sugar and Glucose[a]	2	0.76	1.31	31.99

Cattle, Dog and Poultry Foods	2	0.63	0.68	25.50
Brewing and Malting	2	0.89	0.74	18.71
Chemicals, Dyestuffs and Drugs	32	0.45	0.27	17.22
Fertilizer, Disinfectant, Glue, etc.	6	0.43	0.47	15.76
Soap, Candle and Perfumery	5	0.54	0.46	17.00
Paint, Colour and Varnish	6	0.35	0.43	13.36
Seed Crushing	3	0.58	0.56	18.11
Petroleum	2	0.71	0.47	25.40
Starch and Polishes	1	0.10	0.51	10.47
Explosives	1	0.32	0.11	15.08
Matches	1	0.97	1.00	8.96
Brick and Fireclay	4	0.66	0.69	14.84
China and Earthenware	4	0.22	0.54	15.86
Glass	4	0.35	0.24	17.59
Cement	1	0.91	0.96	14.80
Timber and Crates	3	0.35	0.61	10.21
Paper	5	0.75	0.41	14.40
Wall Paper	1	1.00	1.00	12.01
Manufactured Stationery	3	0.25	0.22	15.08
Pens and Pencils	1	0.16	0.53	13.81
Asbestos Textiles	2	0.19	0.08	17.11
Rubber	3	0.43	0.18	18.75
Plastic Materials, Buttons and Fancy Articles	1	0.12	0.17	15.08
Musical Instruments	1	0.29	0.10	24.66
Coke and By-Products	3	0.75	0.92	19.32

Note: The aggregate industry PPP is weighted by industry shares in gross value-added. For the total industry benchmarks measuring gross output per person employed or hour worked, we use a gross-output weighted PPP, which is 18.15 DM/£.

Sources: own calculations, see text for underlying sources

Table 5: *Relative labour-productivity levels in West German industry in 1935/6 (UK =100)*

	Gross output per person	Value added per person	Gross output per hour	Value added per hour
Total Industry	**101**	**108**	**105**	**112**
Coal Mining	151	1.31	150	130
Textiles	85	1.09	97	124
Leather	58	84	64	93
Footwear	77	70	80	73
Clothing	94	102	98	106
Iron and steel	179	149	183	152
Non Ferrous Metals	126	144	129	146
Fabricated Metal Products	101	111	103	114
Transport Vehicles	104	118	106	120
Mechanical Engineering	111	122	113	124
Electrical Engineering	121	143	123	145
Optical and Precision Engineering	91	104	93	105
Tobacco	20	18	22	20
Beverages	49	43	54	47
Food Products	98	129	106	140
Chemicals	116	111	121	116
Glass Products	84	94	86	96
Building Materials	76	85	78	87
China and Earthenware	113	132	115	134
Wood	128	143	135	151
Timber	163	170	172	179
Paper and Board	139	126	139	126
Rubber and Asbestos	93	103	102	113
Miscellaneous	63	77	70	84

Source: own calculations; see text for underlying sources

Table 6: *Index numbers for employment, value-added and labour productivity in 1951 (1936 = 100)*

	United Kingdom			West Germany		
	Y	L	Y/L	Y	L	Y/L
Mining and quarrying	91.8	98.9	92.8	114.3	147.3	77.6
Total manufacturing	**147.4**	**123.5**	**119.4**	**129.2**	**121.0**	**106.7**
Chemicals and allied products	205.6	188.6	109.0	147.0	169.1	86.9
Metal manufacturing	153.8	123.8	124.2	100.4	99.9	100.5
Engineering and vehicles	184.9	170.0	108.8	146.0	141.2	103.5
Textiles, leather & clothing	94.8	90.6	104.6	130.2	127.2	102.4
food, drink and tobacco	133.2	105.0	126.9	121.1	92.1	131.6
other manufacturing	140.8	114.9	122.5	118.9	113.1	105.2

Sources: see text.

Table 7: *Alternative labour-productivity estimates for West German industry in 1951 (UK = 100)*

	Extrapolation	Benchmark	Error (%)
Mining and quarrying	1.00	0.81	-18.79
Total manufacturing	**0.96**	**0.95**	**-1.27**
Chemicals and allied products	0.87	1.14	26.82
Metal manufacturing	1.04	0.97	-6.86
Engineering and vehicles	1.15	0.88	-26.54
Textiles, leather & clothing	0.99	1.10	11.03
food, drink and tobacco	0.67	0.89	21.35
other manufacturing	0.92	1.09	17.64

Sources: see text.

Table 8: *Decomposing aggregate labour-productivity in West German Industry (UK =1)*

	1935/6	1951
Aggregate labour productivity	1.12	0.86
Industry contributions	1.16	0.91
Residual	-0.04	-0.05

Note: labour productivity is measured as industrial value added per hour worked.

Table 9: *Relative levels of industrial value-added per hour worked in West Germany (UK = 1)*

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Mining	0.88	0.91	0.94	0.97	1.03	1.07	1.12	1.22	1.31	1.40	1.41	1.45	1.50	1.54	1.55	1.61	1.73	1.76
Food and Tobacco	0.73	0.76	0.81	0.84	0.88	0.90	0.97	1.01	1.04	0.92	0.96	1.01	1.03	1.08	1.11	1.12	1.32	1.17
Chemicals	1.04	1.15	1.17	1.14	1.17	1.15	1.25	1.32	1.33	1.27	1.28	1.37	1.40	1.42	1.45	1.49	1.58	1.62
Iron and Steel	1.22	1.26	1.17	1.20	1.29	1.27	1.32	1.41	1.46	1.53	1.58	1.65	1.56	1.65	1.59	1.67	1.88	1.95
Non-Ferrous Metals	0.83	0.84	1.04	1.07	1.09	1.11	1.20	1.24	1.27	1.38	1.45	1.45	1.45	1.56	1.53	1.59	1.70	1.71
Mechanical Engineering	0.95	1.03	1.04	1.01	1.06	1.09	1.12	1.18	1.17	1.16	1.14	1.19	1.17	1.16	1.17	1.14	1.15	1.06
Electrical Engineering	0.83	0.90	0.90	0.97	1.03	1.06	1.09	1.11	1.09	1.19	1.20	1.24	1.23	1.27	1.38	1.33	1.34	1.42
Transport Vehicles	0.96	1.11	0.97	1.10	1.13	1.23	1.15	1.30	1.32	1.25	1.34	1.37	1.44	1.40	1.32	1.35	1.28	1.29
Fabricated Metal Products	0.45	0.46	0.49	0.48	0.49	0.51	0.53	0.56	0.62	0.63	0.70	0.74	0.72	0.71	0.74	0.79	0.82	0.78
Textiles	1.05	1.18	1.14	1.20	1.25	1.28	1.41	1.54	1.57	1.66	1.75	1.87	1.84	1.87	1.93	1.95	1.94	1.82
Leather	0.91	0.97	0.98	1.02	1.10	1.19	1.31	1.34	1.42	1.47	1.44	1.66	1.67	1.73	1.69	1.72	1.87	1.79
Clothing and Footwear	0.89	0.89	0.94	0.99	0.98	0.96	1.02	1.03	0.99	0.99	0.92	0.99	0.96	0.97	1.00	1.01	0.98	1.00
Building Materials	0.67	0.70	0.72	0.73	0.76	0.79	0.87	0.94	0.95	0.94	0.94	0.99	1.01	0.94	0.95	0.97	0.96	0.93
China and Earthenware	0.79	0.81	0.82	0.87	0.91	1.05	1.03	1.03	1.03	1.08	1.12	1.17	1.16	1.16	1.21	1.20	1.24	1.21
Glass Products	1.19	1.22	1.19	1.23	1.16	1.31	1.39	1.49	1.49	1.50	1.53	1.61	1.61	1.68	1.84	1.92	1.81	1.86
Lumber and Woodworking	1.00	1.04	1.05	0.99	1.09	1.19	1.26	1.35	1.35	1.46	1.46	1.66	1.72	1.74	1.90	2.20	2.21	2.35
Paper, Printing, Publishing	1.13	1.42	1.27	1.20	1.19	1.24	1.32	1.34	1.35	1.31	1.38	1.41	1.39	1.38	1.46	1.48	1.54	1.63
Miscellaneous	0.78	0.74	0.74	0.74	0.75	0.83	0.89	0.93	0.99	0.99	1.06	1.13	1.12	1.16	1.23	1.27	1.26	1.28
Total Industry	**0.85**	**0.91**	**0.90**	**0.91**	**0.94**	**0.97**	**1.01**	**1.06**	**1.08**	**1.08**	**1.11**	**1.17**	**1.17**	**1.19**	**1.21**	**1.24**	**1.27**	**1.28**

Sources: see text.

Notes: Industries where West Germany productivity levels were above the British equivalents in 1951 are in bordered rubrics. Grey shades indicate the year when an industry caught up with its British counterpart in labour productivity. Electrical engineering includes optical and precision instruments as well.

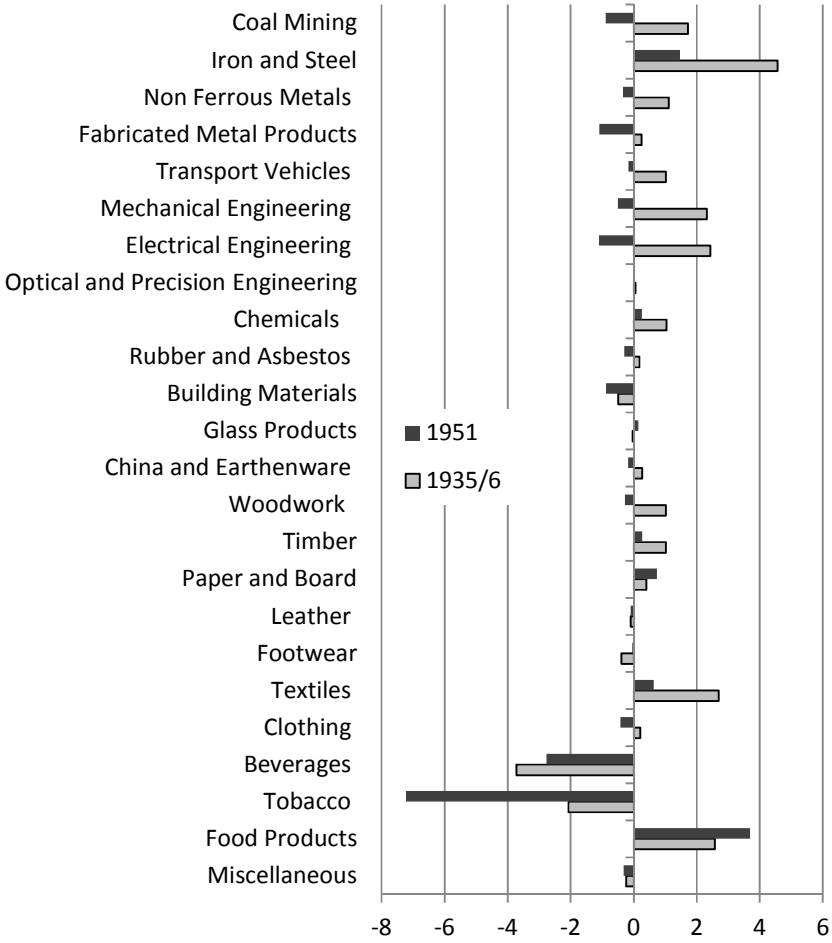

Figure 1: *Industry contributions to the aggregate manufacturing labour-productivity gaps*

Notes: On the construction of the diagram, see text.

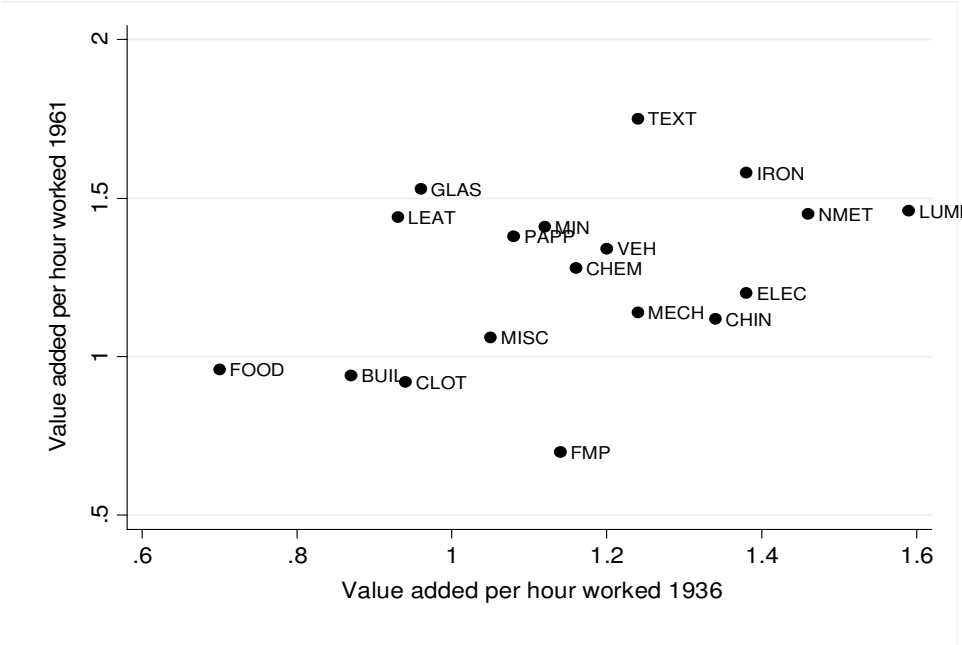

Figure 2: *Relative levels of labour productivity in West German industry (UK = 1)*

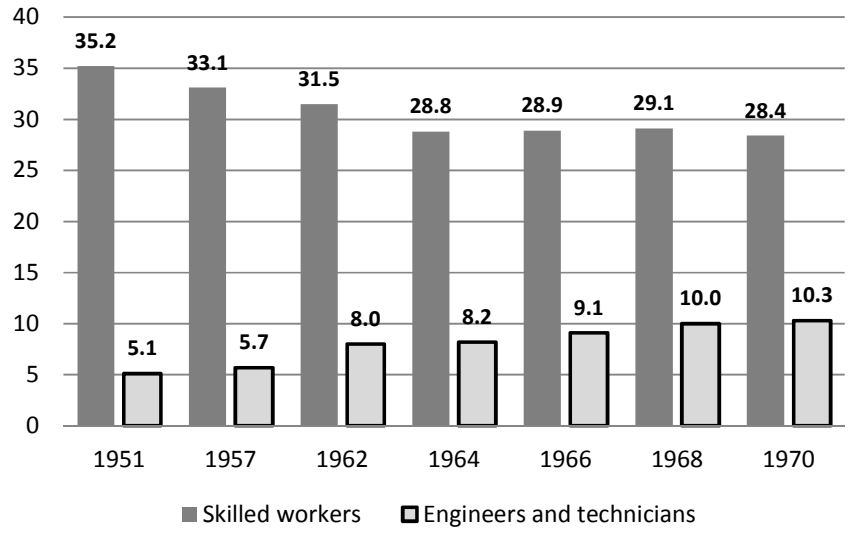

Figure 3: *The share of skilled manual workers and salaried technical personnel in total industrial employment in West Germany (%)*

Sources: see text.

Appendix Tables

A1: The classification of industry branches into industries for 1951

A2: Detailed information on data sources and adjustments to data for the 1951 benchmark

A3: Detailed information on data sources and adjustments to data for the 1935/6 benchmark

A4: The classification of industry branches into industries for 1935/6

Table A1: *The classification of industry branches into industries for 1951*

Included industries UK	Included industries West Germany
Coal Mining	
Coal Mines	Kohlenbergbau
Textiles	
Cotton Spinning and Doubling; Cotton Weaving; Woollen and Worsted; Rayon, Nylon etc. and Silk; Flax Processing; Linen and Soft hemp; Jute; Rope, Twine, Net; Hosiery and other Knitted Goods; Lace; Carpets; Narrow Fabrics; Canvas Goods and Sacks; Made-up Household Textiles; Textile Finishing; Textile Packing; Flock and Rag; Hair, Fibre and Kindred Trades	Textilindustrie
Leather	
Leather (tanning and dressing); Fellmongery; Leather Goods;	Ledererzeugende Industrie; Lederverarbeitende Industrie
Footwear	
Boots and Shoes;	Schuhindustrie
Clothing	
Tailoring, Dressmaking etc.; Hats, Caps and Millinery; Glove; Umbrella and Walking Sticks; Fur	Bekleidungsindustrie
Iron and Steel	
Blast Furnaces; Iron and Steel (melting and rolling); Steel Sheets, Tinplate; Wrought Iron and Steel tubes; Iron Foundries	Hochofen-, Stahl- und Warmwalzwerke; Schmiede-, Press- u. Hammerwerke; Eisen-, Stahl- und Tempergießereien
Non-Ferrous Metals	
Non-Ferrous metals, Precious metals refining;	Metallhütten und Umschmelzwerke; Metallhalbzeugwerke; NE-Metallgießereien;
Fabricated Metal Products	
Cutlery; Hardware, Hollow-ware Metal Furniture and sheet; Brass Manufacturing	Schneidwaren- und Besteckindustrie ; Schloss- u. Beschlagindustrie; Heiz-u. Kochgeräteindustrie; Blechwaren-u. Feinblechpackungsindustrie;
Transport Vehicles	
Motor Vehicles and Cycles; Railway Locomotive Shops and Locomotive Manufacturing; Railway Carriages and Wagon and Trams; Carts, Perambulators, etc.	Fahrzeugbau; Fahrradteile -und Kraftradteile;
Mechanical Engineering	
Machine Tools; Textile Machinery and Accessories; Small Arms; Construction Engineering; Mechanical Handling Equipment; Printing and Bookbinding Machinery;	Maschinenbau; Stahlbau

Mechanical Engineering (general)	
Electrical Engineering	
Electrical Engineering (general); Electric Wires and Cables; Radio and Telecommunication; Batteries and Accumulators; Electric Lighting Accessories and Fittings	Elektrotechnische Industrie
Optical and Precision Engineering	
Scientific, Surgical and Photographic Instruments etc.Watch and Clock	Feinmechanische und Optische Industrie sowie Uhrenindustrie
Tobacco	
Tobacco	Tabakverarbeitende Industrie
Food Products	
Grain and Milling; Milk Products; Cocoa, Chocolate and Sugar Confectionary; Preserved Fruit and Vegetables; Margarine; Fish Curing; Preserved Meat; Wholesale Slaughtering; Bacon Curing and Sausage; Bread and Flour Confectionery	Mühlenindustrie; Molkereien und milchverarbeitende Industrie; Süßwarenindustrie; Obst u. Gemüse verarbeitende Industrie; Ölmühlen- und Margarine-Industrie; Fischverarbeitende Industrie; Fleischwarenindustrie; Brotindustrie;
Beverages	
Brewing and malting; Soft Drinks, British Wines and Cider	Brauereinen und Mälzereien; Mineralwasser- und Limonaden-Industrie
Chemicals	
Manufactured Fuel; Dyes and Dyestuffs; Fertiliser, Disinfectant, Insecticide and Allied Trades; Coal Tar products; Chemicals (general); Drugs and Pharmaceutical Preparations; Toilet Preparations and Perfumery; Explosives and Fireworks; Paint and Varnish; Soap, Candles and Glycerine; Polishes; Ink; Match; Oils and Greases; Seed Crushing and Oil Refining; Glue, Gum, Paste and Allied Trades; Plastic materials	Chemische Industrie
Glass Products	
Glass Containers; Glass other than Containers	Glasindustrie
Building Materials	
Brick and Fireclay; Cement; Building Materials; Roofing Felts	Industrie der Steine und Erden
China and Earthenware	
China and Earthenware; Abrasives	Feinkeramische Industrie
Timber	
Timber	Sägewerke und Holzbearbeitung
Woodworking	
Furniture and Upholstery; Soft Furnishing; Shop and Office Fitting; Wooden Containers and Baskets	Holzverarbeitende Industrie
Paper and Board	
Paper and Board; Wallpaper; Cardboard Box, Carton and Fireboard Packing	Papierverarbeitende Industrie; Holzschliff, Zellstoff,

Case; Manufactures Stationery, Paper Bag and Kindred Trades	Papier und Pappeerzeugung
Rubber and Asbestos	
Rubber, Asbestos	Kautschukverarbeitende und Asbestindustrie
Miscellaneous	
Musical Instruments; Jewellery and Plat; Linoleum, Leather Cloth and Allied Trades; Brushes and Brooms; Toys and games; Sport Requisites; Miscellaneous Stationer's Goods; Cinematographic film production; Cinematographic film printing; Plastic Goods and Fancy Articles; Incandescent Mantels	Kunstoffverarbeitende Industrie; Musikinstrumenten-, Turn, und Sportgeräte, Spiel und Schmuckwarenindustrie;

Sources: see text.

Table A2: *Detailed information on data sources and adjustments to data for the 1951 benchmark*

Census description

In the British census, establishments were classified to trades according to the nature of their output. An establishment engaged in multiple activities, e.g. a firm engaged in machine-tool production and casting, was classified to a trade if the principal products of that trade accounted for a greater proportion of the value of its output than did the principal products of any other trade. Offices, warehouses, laboratories and other ancillary places of business, which were separated apart from the producing work, were not regarded as separate establishments, and the persons employed were included on the return for the works. If firms with more than one establishment were unable to make separate returns for each establishment, they were generally allowed to make one return covering all establishments in one trade. In Britain, proprietors employing an average of less than ten people were not required to report detailed returns. However, small firms were required to provide information on the annual average number of male and female workers and the nature of their business. In trades in which the output of small firms was thought to have accounted for a relatively high proportion of the total output, small firms were required to complete a simplified form.

In the German census, firms active in multiple industries were placed in the industry group where the core of their business was, as measured by the number of employees engaged in production. This method of classification differs from the British method, where the value of output was used to locate the core of the business. However, it seems reasonable to expect that these methods will not deviate too much, since output value and employment are highly correlated.[a] In the German census, the same rule applied: information is provided only for firms that employed at least ten persons. The German census provides no information when there are less than three firms operating in an industry on confidentiality grounds.

Data adjustments

In a few industries adjustments were needed in order to construct a consistent benchmark. Below the adjustments are in detail explained.

- One problem in the engineering sector is that in the British census most products are quoted in numbers, whereas in the German census products are quoted in tons. Since we have no information on the products, besides a description, we cannot compare these two quantities. To overcome this problem we have used the British trade statistics, in which export is quoted in tons. We deducted five per cent of the value of export, since export process are quoted f.o.b., and we want to use a proxy for ex-factory prices. Comparing tons of machines with tons of machines is still problematic, since we have no information on the quality of products, and machinery is less homogenous than other products in this comparison. Given that there is no other method of comparing that is preferable, we will use this approach. However, caution has to be taken in interpreting these results.
- For musical instruments there was no detailed information for 1951 in the German source, but we were able to use the 1952 data, and extrapolate this to 1951 using trade statistics.
- In the vehicle branch we were not able to match cars, since Britain provides numbers and Germany tons of cars. We were able to match motorcycles and engines. We took the PPP from mechanical engineering as a proxy for the PPP for cars, and weighted this PPP with the motorcycle/engines PPP to obtain a PPP for the whole vehicle branch.
- For footwear and leather we took the weighted average of the footwear and leather branch as a proxy for the PPP in these two branches.

Sources: Trade and Navigation Accounts (1952). Note: a). For the correlation between the net value of production and the number of employees we obtain a coefficient of 0.83 for Germany and 0.97 for the UK. Both coefficients are significant at the 1 percent level.

Table A3: *Detailed information on data sources and adjustments to data for the 1935/6 benchmark*

Census description

The German census data comprise the German Empire within the borders of 1937, thus Saarland is included but Austria and Sudetenland are excluded. The census covers all production units with five employees or more. In industries where material inputs were considered to be important, information for all establishments was presented. This was for example the case in mining, fuel, iron and steel and chemicals. For other industries, such as bakeries and printing offices, the cut-off point for reporting was not five but ten employees. The British census covered Great Britain and Northern Ireland. Proprietors employing ten or more employees were required to report detailed returns. . However, small firms were required to provide information on the annual average number of male and female workers and the nature of their business.

Data adjustments

In some industries there were some difficulties, since the Sleifer data set on West Germany provided information on a different level of aggregation than was presented for the whole of Germany. This problem manifested itself especially in the weaving mill industry, were we have only information on the aggregate sector for West Germany. At the more disaggregate level, the Sleifer data set only present gross output for the whole of Germany. Since part of the industries belonging to weaving mills work with cotton, and part of them with other materials such as jute etc., we need to attribute these parts to the cotton and jute sector. To make a fair division of gross output and value added for West and East Germany, we assume that the weaving mills will have the same division of gross output over the two parts of the country as the cotton and jute sectors themselves. We assume that the division of employment between East and West Germany in the sectors belonging to weaving mills will be the same as the division in employment in the industries to which these sectors belong. Thus, we take the employment division of cotton for the cotton weaving mills, and the employment division of the wool industry for the wool weaving mills. That is, we assume that the production of cotton and jute goods is locally concentrated. Additionally we have to assume that the input-output ratios of the sub-industries of the sector are identical to the input-output coefficient of the total industry.

Excises and duties

We adjusted for excises and duties. In the British case we adjusted silk, drugs, matches, printing, aerated waters, tobacco, sugar and beer. The duties are mentioned in the General Report of the census. In Germany the sources included taxes for margarine and edible oils.

Sources: see text.

Table A4: *The classification of industry branches into industries for 1935/6*

Included industries UK	Included industries West Germany
Mining	
Coke and By-products	Kokereien
Textiles	
Cotton Spinning and Doubling; Cotton Weaving; Woollen and Worsted; Silk and Artificial Silk; Jute; Hosiery; Elastic Webbing; Coir Fibre, Horse-hair and Feather; Linen and Hemp; Textile Finishing; Lace; Rope, Twine and Net; Canvas Goods and Sack; Flock and Rag; Packing; Roofing Felts; Fellmongery	Baumwollspinnerei und –Zwirnerei; Baumwollweberei; Wollwäscherei; Wollwäscherei und Wollkämmerei; Kammgarn- und Ramiespinnerei und –Zwirnerei; Weberei Wollner u. Wollhalt. Oberbekleidungsgewebe; Sonstige Wolweberei; Seidenweberei; Kunstseiden- und Zellwollindustrie; Jutespinnerei und –Zwirnerei; Jutteweberei; Tricotagestickerei; Strumpfwirkerei; Strumpfstrickerei; Reissgereien; Streichgarnspinnerei und –Zwirnerei; Flachs- und Hanfrösterei; Flachsspinnerei und –Zwirnerei; Hanf- und Hartfaserspinnerei und –Zwirnerei; Bekleidungsstoffweberei; Nähfäden-, Stopf-, Stick- und Handarbeitsgarnherstellung; Herstellung von Band- und Flechtartikeln, Posamenten usw.; Herstellung von Stickereien, Spitzen usw.; Herstellung von Zelten, Planen, Säcken; Filzherstellung; Industriewatteherstellung; Verbandwatteherstellung; Herstellung von Verbandmitteln; Rosshaarspinnerei und Stepperei; Netzindustrie; Textilausrüstungs- und Veredelungsindustrie
Leather	
Leather (Tanning and Dressing); Leather Goods; Fellmongery	Lederfabriken und Gerbereien; Lederzurichtereien; Ledertreibriemenindustrie (einschl. Herstellung technischer Lederartikel); Leder- und Sattlerwarenindustrie; Lederhandschuhindustrie
Footwear	
Boot and Shoe Trade	Schuhindustrie
Clothing	
Clothing: Tailoring, Dressmaking, Millinery, etc.; Hat and Cap Trade; Glove Trade; Fur; Umbrella and Walking Stick	Bekleidungsindustrie; Pelzveredelung; Pelzverarbeitung
Iron and Steel	
Iron and Steel (Blast Furnaces); Iron and Steel (Smelting, Refining and Rolling); Iron and Steel Foundries; Hardware, Hollow-ware, Metallic Furniture and Sheet Metal; Wrought Iron and Steel Tube; Tinplate; Chain, Nail, Screw and Miscellaneous Forgings; Wire; Tool and Implement	Hochofenwerke; Flussstahlwerke (einschl.der damit verbundenen Stahlformgiessereien); Schweissstahlwerke; Warmwalzwerke (einschl. Der damit verbundenen Hammer und Presswerke); Eisen-, Temper-, und Stahl-Gießereien; Metallgießereien; Herd- und Ofenindustrie; Blechwarenindustrie; Sonstige Zweigen der Eisen- und Stahlwarenindustrie; Drahtwarenindustrie; Werkzeugindustrie
Non-Ferrous Metals	

Aluminium, Lead, Tin, etc. (Smelting, Rolling, etc.); Gold and Silver Refining; Finished Brass; Plate and Jewellery)	Kupfer-, Blei- und Silberhütten; Kupferraffinerien und –Elektrolysen; Gold und Silberscheideanstalten; Zinkhütten; Zinkhütten und Entzinnungsanstalten; Tonerfabriken; Aluminiumhütten; Gewinnung von Nickel und Kobalt; Gewinnung von Wolfram, Molybdän u. anderen Metallbau; Herstellung von Ferrolegierungen, Elektrokorund, Karborund; Walz-,Press-und Hammerwerke der Nichteisenmetallindustrie; Herstellung von Warmpressteilen der Nichteisenmetallindustrie; Metallschmelzereien; Edelmetall- und Schmuckwarenindustrie
Fabricated Metal Products	
Cutlery	Feine Schneidewarenindustrie (einschl. Schlägeindustrie)
Vehicles	
Motor and Cycle	Kraftfahrzeugindustrie; Herstellung von Kraftfahrzeuganhängern und Kraftfahrzeugaufbauten; Fahrradindustrie und Herstellung von Kinderwagen; Fahrzeugteileindustrie
Mechanical Engineering	
Mechanical Engineering	Werkzeugmaschinenindustrie; Textilmaschinenindustrie; Herstellung von Maschinen für das Bekleidungsgewerbe; Landmaschinenindustrie; Herstellung von Maschinen und Apparaten für die Papierherstellung, Papierverarbeitung und für das graphische Gewerbe; Büromaschinenindustrie; Herstellung von Maschinen und Apparaten für Müllerei, Nahrungsmittel- und Genussmittelindustrie u.ä.; Armaturenindustrie; Sonstiger Maschinenbau; Kessel-und Apparatebau
Electrical Engineering	
Electrical Engineering	Herstellung von elektrischen Maschinen Apparaten und Zubehör der Stark- und Schwachstromindustrie; Kabelindustrie; Elektrokohleindustrie; Batterie- und Elementen Industrie; Akkumulatoren Industrie; Glühlampen- und Leuchtröhrenindustrie;
Optical and Precision Engineering	
Scientific Instruments, Appliances and Apparatus; Watch and Clock	Optische, fein- und medizinmechanischeindustrie; Herstellung von orthopädischen Erzeugnissen und hygienischen Bandagen; Grossuhrenindustrie; Taschen- und Armbanduhrenindustrie; Photographische Industrie
Railways	
Railway Carriage and Wagon Building;Carriage Cart and Wagon	Waggonbau; Feld- und Werkbahnwagenbau
Tobacco	
Tobacco	Tabakindustrie
Food	
Grain Milling; Bread Cakes, etc.,; Biscuit; Cocoa and Sugar Confectionary; Preserved Foods; Bacon Curing and Sausage; Butter, Cheese, Condensed Milk and Margarine; Sugar and Glucose; Cattle Dog and Poultry Foods; Fish Curing	Getreidemüllerei; Schälmühlen; Brodindustrie und Bäckereien; Süßwarenindustrie; Teigwarenindustrie; Fleischwarenindustrie; Obst- und Gemüsekonservenindustrie; Herstellung von Rheinischkraut; Obstsaft- und Fruchtweinindustrie; Senfindustrie; Gewürzindustrie; Kartoffeltrocknerei; Nährmittelindustrie; Kaffee-Ersatz-Industrie; Dauermilchindustrie;

	Schmelzkäseindustrie; Margarine- und Speisefettfabriken; Zuckerindustrie; Futtermittelindustrie; Fischindustrie;
Beverages	
Brewing and Malting;Spirit Distilling;Spirit Rectifying, Compounding and Methylating; Aerated Waters, Cider, Vinegar and British Wine; Wholesale bottling	703.1 Malzindustrie; Brauindustrie (einschl. Braumälzerein); Landwirtschaftliche Kartoffelbrennereien; Melassebrennereien; Hefelüftungsbrennereien; Spiritusreinigungsanstalten u. Spiritusvergällung in Monopollägern; Kornbrennereien; Weinbrennereien; Herstellung von Trinkbranntweinen aller Art; Obstsaft- und Fruchtweinindustrie; Traubenschaumweinindustrie
Chemicals	
Chemicals, Dyestuffs and Drugs; Fertiliser, Disinfectant, Glue, etc.; Soap, Candle and Perfumery; Paint, Colour and Varnish; Seed Crushing; Petroleum; Starch and Polishes; Explosives; Matches	Schwefelsäureindustrie; Sulfat und Salzsäureindustrien; Sodaindustrien; Alkalielektoolyse Industrien; Herstellung von Wasserstoffsuperoxyd, Natriumperborat, u.a. Perverbindungen; Herstellung von Schwefel, Schwefelkohlenstoff u. Rhodanverbindungen; Herstellung von Cyan- u. Eisencyanverbindungen; Wasserglas und Bleicherdeindustrie; Herstellung von Metallsalzen u.a. Chemikalien; Industrien des Phosphors; Thomasschlackenmühlen; Holzverkohlungsindustrien; Herstellung von Essigsäuren aus Acetylen; Lösungsmittelindustrie; Industrie der organischen Säuren und ihrer Salze; Industrie der Organ. Zwischenprodukte; Teerfarbenindustrie; Herstellung von Gerb- und Farbstoffextrakten; Herstellung von Nitrozellulose und davon abgeleiteten Produkten; Herstellung von Äcetylzellulose, Viskosefolien, u.a. Zelluloseprodukten; Lithopone, Blancfix und Titanweissindustrie; Herstellung von Blei weis, Bleiglätte und Bleimennige; Herstellung von Zinkweiß; Erdfarbenindustrie; Ruß und Schwärzindustrie; Herstellung von verdichteten Gasen; Aktivkohleindustrie; Herstellung von Klebstoffen; Stickstoffindustrien; Karbid und Kalkstikstoffindustrien; Knochenverwertungsindustrie; Herstellung von Haut- und Lederleim, Gelatine und Kunstdärmen; Wachsveredlungsindustrie; Herstellung von Kerzen und Wachserzeugnissen; Stearin-industrie; Seifen-, Waschmittel- und Glyzerinindustrie; Kosmetische Industrie; Buntfarbenindustrie; Herstellung von Naturharzprodukten; Lack und Anstrichmittelindustrie; Herstellung von Druckfarben und Druckwalzenmassen; Farbwarenindustrie; Ölmühlen; Ölveredelungsindustrie; Gewinnung von Benzin u. anderen Mineralölderivaten; Herstellung von mineralische Schmierölen und fetten; Herstellung von technische Öln und Fetten; Stärke- und Stärkeveredelungsindustrie; Sprengstoffindustrie; Herstellung von Zündstoffen und Sprengkapseln; Pyrotechnische und Zündwarenindustrie; Zündholzindustrie; Herstellung von Hilfsmitteln für die Textil- und Lederindustrie; Herstellung von Atemschütz und Frischluftguterärten; Industrie der Kunststoffen Fischmehl- und Tranfabriken
Glass	
Glass	Glashüttenindustrie; Hohlglas veredelnde und Glas verarbeitende Industrie; Flachglas veredelnde Industrie

Building Materials	
Brick and Fireclay; Cement	Ziegelindustrie; Kalksandsteinindustrie; Industrie feuer- und säurefester Erzeugnisse; Zementindustrie
China and Earthenware	
China and Earthenware	Steinzeugindustrie; Feinkeramische Industrie
Timber	
Saw-mill Products; Wooden Crates, Cases, Boxes and Trunks Trade;	Sperrholzindustrie; Sägewerke (einschl. Schwellen- und Mastenfabriken); Hobelwerke; Furnierwerke; Holzimprägnieranstalten; Sperrholzindustrie; Kistenindustrie
Wood	
Furniture and Upholstery; Cane and Wicker Furniture and Basketware Trade Coopering Trade; Wooden Crates, Cases, Boxes and Trunks Trade	Möbel- und Bauteileindustrie; Klavier-, Harmonium- und Orgelbau; Holzwarenindustrie; Holzmehlindustrie; Fassholzsägerei und Fassindustrie; Kistenindustrie; Holzwolleindustrie; Stuhlrohrfabriken; Korbwaren- und Korbmöbelindustrie; Herstellung von Schilfrohr- und Strohgeweben, Flaschenhülsen und Trinkhalmen; Korkindustrie; Borsten- Faserstoff- und Haarzurichtereien; Bürsten- und Pinselindustrie; Herstellung von Waren aller Art aus chemischen Kunststoffen sowie aus natürlichen Schnitz- und Formerstoffen
Paper	
Paper; Wall paper; Manufactured Stationery; Pens and Pencils	Holzschleifereien; Zellstoffindustrie; Papier- und Pappenfabriken; Tapetenindustrie; Papierveredelungsindustrie; Papierwarenindustrie; Füllfederhalterindustrie
Rubber and Asbestos	
Asbestos Goods and Engine Boiler Packing; Rubber	Asbestindustrie; Herstellung von Kautschukwaren (ausgenommen Bereifungen und Gummischuhe); Bereifungsindustrie; Gummischuhindustrie; Herstellung von Kautschuk-Regeneraten, -Plastikaten und –Präparaten; Herstellung von Guttapercha- und Balatawaren
Miscellaneous	
Plastic Materials, Buttons and Fancy Articles; Musical Instruments	Herstellung von Waren aller Art aus chemischen Kunststoffen sowie aus natürlichen Schnitz- und Formerstoffen; Kleinmusikinstrumentenindustrie; Herstellung von Saiten aller Art; Herstellung von Sprechmaschinen; Klavier-, Harmonium- und Orgelbau; Spielwarenindustrie (einschl. Herstellung von Christbaumschmuck); Herstellung von Linoleum, Wachstuch, Kunstleder und verwandten Erzeugnissen; Herstellung von Glühstrümpfen

Sources: Board of trade, Final report on the Fifth Census of Production; Bundesarchiv Berlin-Lichterfelde, BA R310.