The Expansion of the Motor-Cycle Industry in Germany and in Great Britain (1918 until 1932)

Helmut Braun - Christian Panzer

University of Regensburg - Germany

1. Introduction

In analysing the development of the motor-cycle industry and the use of motor-cycles in the 1920s, the third stage of the well-known Schumpeterian schedule explaining the spread of technological progress can be called upon:[1] The first Schumpeterian stage, in this case the invention of the motor-cycle, dates back to the nineteenth century. At that time, in many European countries, inventors constructed prototypes of motor-cycles from pieces of handcraft combining a bicycle or tricycle frame first with a steam-engine[2] and later with an internal-combustion engine[3]. The second Schumpeterian stage in practice occurred between 1894 and 1898 with the first commercial presentation of a functioning motor-cycle.[4]

[1] J. A. Schumpeter: *Theory of Economic Development,* (Cambridge/Mass. 1934), Part II; *Business Cycles: A theoretical, historical, and statistical analysis of the capitalist process,* (New York/London 1939), Vol. 1, Part III; *The creative Response in Economic History,* in *Journal of Economic History,* VII (1947), pp. 149-159.

[2] The first two bicycles powered by steam engines were presented for patenting in 1869 by the Frenchmen Pierre Michaux and Louis Gabriel Perraux. D. C. Field: 18. Mechanical Road-Vehicles, in: C. Singer, E. J. Holmyard, A. R. Hall and T. I. Williams (eds.), *A History of Technology,* Vol. V, The Late Nineteenth Century c.1850 to c.1900, (Oxford 1958), pp. 414-437, here: p. 424f.; I. McNeil: 8. Roads, Bridges and Vehicles, in: I. McNeil (ed.), *An Encyclopaedia of the History of Technology,* (London, New York 1990), pp. 431-472, here: p. 447.

[3] There is broad consensus that the first bicycle powered by a petroleum-driven motor was constructed in 1885 by the German inventor-engineer Gottlieb Daimler. M. Limpf, *Das Motorrad. Seine technische und geschichtliche Entwicklung, dargestellt anhand der einschlägigen Fachliteratur* (=Abhandlungen und Berichte des Deutschen Museums, Vol. 51), (München, Düsseldorf 1983), pp. 8-12.

[4] After unsuccessful experiments with steam-engines in 1889, the Munich engineers Heinrich and Wilhelm Hildebrand together with Hans Geisenhof and Alois Wolfmüller constructed an iron-framed bicycle powered by a workable four-stroke, twin cylinder internal combustion

In the third stage of the *Schumpeter*ian cycle, diffusion processes follow the innovation: Adopters, here motor-cycle drivers as user of these devices, and imitators, here firms building motor-cycles, diffuse the new technology. But empirical data relating to motor-cycle history do not reveal a major break-through of this means of individual transport until the beginning of World War I. Like the automobile, the motor-cycle was too expensive for the ordinary person both to purchase and use.[5] Furthermore there were still difficulties in its practical use[6] and there was, above all in Imperial Germany, no appreciation of it on the part of society who possessed the means to buy it. Therefore, the growth of motor-cycles for private use only was nearly negligible until 1914.[7] However, World War I cleared away the

engine in Germany in 1894. They obtained a German patent adopting the term "Motorrad" (motor-bicycle/motor-cycle) and founded the firm Hildebrand & Wolfmüller for serial production and sale of their motor-cycles in Germany, England, and Italy and, produced under license, in France. M. Limpf, *Das Motorrad*, (1983), pp. 12-16.

[5] Taxes connected with motorised mobility are an indication of the motor-cycle and the motor-car as a luxury good, above all in Germany: Taxation of gasoline, some fees and taxes concerning the use of the vehicles and communal road-charges. A. Zatsch: 'Allen Fehlzündungen zum Trotz. Die Wirkung der Steuergesetzgebung auf die Verbreitung des Automobils (bis 1933)', in: H. Niemann, A. Hermann (eds.), *Die Entwicklung der Motorisierung im Deutschen Reich und den Nachfolgestaaten*, (Stuttgart 1995), pp. 169-183.

[6] For example an insufficient supply of gasoline, the poor condition of roads and institutional obstacles like the prohibition of using motor-cycles in villages at night. Additionally, some technical features had to be introduced to improve the practical use of motor-cycles step by step: For example electrical magneto-ignition with spark-plugs displaced the hot bulb; gear-transmission with clutch and roller-chain, belt or exceptional flexible shaft used engine power effectively; drum-brakes, Dunlop's rubber pneumatic-tyres and first forks with spring-suspension improved security, reliability and comfort until 1914. P. Simsa: 'Das Wunder auf zwei Rädern', in: C. Bartsch (ed.), *Ein Jahrhundert Motorradtechnik*, (Düsseldorf 1987), pp. 8-40; M. Clarke, *100 Jahre - Das große Buch des Motorrads*, (München 1987), p. 22; H. Wilson, *Motorrad Total*, 2. ed., (Stuttgart 1999), pp. 10-13.

[7] This can be verified by figures for the year 1914 (corresponding figures for 1907 are in brackets): In Imperial Germany, for example, 83,333 (25,815) motor vehicles for personal transport were in use; of which 23,481 (16,019) motor-cycles and 59,852 (9,796) automobiles. A total of 9,886 (1,406) motor-vehicles were used in public personal transport, 43,048 (14,112) for vocational, agricultural or commercial purposes, and 30,399 (10,287) for private enjoyment and sport only, 8,853 (5,167) of which were motor-cycles. Kaiserliches Statistisches Amt (ed.), *Statistisches Jahrbuch für das Deutsche Reich*, Vol. 35, (1914), p. 138f.; own calculations. In Great Britain 1907 a total of 35,000 motor-cycles were in use, but without any exact specification. *The Motor Industry of Great Britain*, (= The Statistical Department of the Society of Motor Manufacturers and Traders), (Great Britain 1937), p. 59.

remaining technical problems as well as removing the important socio-economic circumstances hindering the break-through of motorisation in the countries analysed. Then the third Schumpeterian stage of a major expansion started again under the special economic circumstances in Great Britain and Germany during the 1920s.

To analyse this development we use the findings of modern diffusion theory explaining the diffusion of a new technology, in our case the motor-cycle: Both supply-side and demand-side factors[8] during the relevant period will be considered and especially the specific economic situation of the countries chosen.

2. Theoretical elements for explaining the diffusion of a new technology: A synopsis

2.1. Fundamentals of diffusion theory

Two perspectives had to be examined: on the one hand we argue from the point of view of firms manufacturing motor-cycles, aggregated as a new branch of commerce or industry. Here imitation processes run off in a dynamic market; some firms or brands were founded or disappeared. On the other hand we argue from the perspective of the adopter of a new technology, in our case (civil) consumers buying and using motor-cycles. The interactions between the firms supplying motor-cycles and the demand from consumer/user, the so-called adaptation process, will be discussed too.

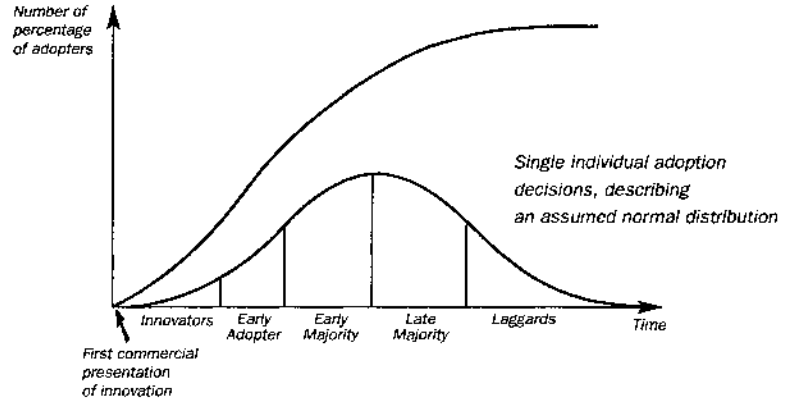
Looking at the perspective of adoption, the successful process of the diffusion of an innovation can be empirically described by an S-shaped curve, a so called growth-curve. Over time, information on the utility of the innovation is communicated through certain information channels to potential individual adopters among the members of a social system, for example in a geographic region, country or in a special social group.[9] The successful use of the innovation by a small group of early adopters,

[8] The importance of demand-side factors in explaining the diffusion of innovations is discussed by J. Schmookler, *Invention and Economic Growth*, (Cambridge, Mass. 1966).
[9] E. M. Rogers and F. F. Shoemaker, *Communications of Innovations - A Cross-Cultural Approach*, 2nd edn., (New York, London 1971), pp. 10-12.

the so-called opinion leaders,[10] persuade more and more potential adopters to buy and use the innovation too. The early majority of adopters convinces prospective customers of a later adoption. Thus, in a descriptive analysis an economically yet inexplicable band-wagon-effect[11] generates a growth-curve, for example, on the basis of a cumulative normal distribution.[12]

The slope of the diffusion-curve aims at a ceiling where all potential adopters in a social group and/or in a geographic area have by now really adopted the technologically unmodified innovation during the time of this process. The demand is satisfied and the market has reached a new point of equilibrium after the process of creative destruction[13] of the former equilibrium arising from the original commercial presentation of the innovation.[14] But this point of equilibrium is only in a relation to the observed technologically constant innovation, the "first generation" in this kind of innovation.

GRAPH 1: Diffusion of a technologically unmodified innovation (stylised)



Source: Own presentation, based on E. M. Rogers, Diffusion on Innovation, 4. Ed., New York, London 1995, p. 262.

[10] Opinion leaders are globally-orientated and open-minded persons looking permanently for innovations in order to test them; publicising behaviour creates trends. A. L. Greer, 'Advances in the Study of Diffusion of Innovation in Health Care Organizations', in *Milbank Memorial Fund Quarterly*, Vol. 55, (1977), pp. 505-533.

[11] E. Mansfield, *Industrial Research and Technological Innovation*, (New York 1968), p. 137.

[12] S. Davies, *The Diffusion of Process Innovations*, (Cambridge, Mass. 1979), pp. 8-13.

This descriptive approach of a stylised adoption process is empirically verified by some diffusion processes in historical time,[15] it but lacks an microeconomic explanation for the individual decisions for adopting or rejecting the innovation by specific users in different social systems. Potential adopters do not find themselves at the same time and in all regions in identical technical and socio-economic circumstances.[16]

To explain the speed of adoption processes one research line of the diffusion theory primarily emphasises demand-side factors: Potential adopters do not only recognise and calculate the potential utility of the innovation for themselves but it is necessary that they have the monetary and institutional[17] abilities to buy the innovation. Increasing monetary abilities are indicated by increasing real income or the wealth of a society. In addition, all kinds of adopters, as well as imitators, need a generally positive attitude towards technical progress.

Another analytical perspective is the rate and velocity of the imitation process: here it is not the adopter as the user or consumer of an innovation who is at the centre of the analysis, but the firms who imitate the innovation through constructing copies of it and sell these imitations in competition with the pioneer. If effective patent rights and the hidden knowledge of the pioneer firm are excludable, imitator firms can produce the innovation at lower costs.[18] Thus, more and more imitating firms enter the profitable market but competition lowers the prices of the original

[13] J. A. Schumpeter, *Kapitalismus, Sozialismus und Demokratie*, 2nd edn. (Munich, 1950), p. 134.

[14] E. M. Rogers, *Diffusion of Innovations*, 3rd edn., (New York, London 1983), pp. 245-251; J. S. Metcalfe: "The diffusion of innovation: an interpretative survey", in: G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.), *Technical Change and Economic Theory*, (London, New York 1988), pp. 560-589, here: p. 561.

[15] Examples are presented by E. Mansfield, *Industrial Research*, (1968) and E. Mansfield, *The Economics of Technological Change*, (New York 1968).

[16] Z. Griliches, 'Hybrid Corn: An Exploration in the Economics of Technical Change', in *Econometrica*, Vol. 25, (1957), pp. 501-522, here: pp. 503f. and T. Hägerstrand, *Innovation Diffusion as a Spatial Process*, (Chicago, London 1967).

[17] For example a driving-licence as a permit required by the state to use special innovations. The obligation to hold a driving-licence and the additional requirement for a legal liability insurance policy, shows higher running costs of use than most of the individual transport innovations.

[18] Pure imitators do not have any research and development costs.

innovation and its imitation. But lower prices could be compensated by reduced costs created by the nature of the imitation process. Thus, the diffusion of knowledge is driven forward by dynamic forces like learning by doing, learning by using[19] and irreversible dynamic scale economies in production and selling through informational increasing returns,[20] as well as externalities, for example the creation of useful networks[21] for operating the innovation. Yet these dynamic forces contradict the assumption of a technologically constant innovation: imitating firms are able not only to produce simple copies but can improve the basic innovation gradually by new, better, and not only technical solutions, to the existing detailed problems. However, over time these gradual improvements lead to a "newer generation" of the innovation with higher potential in utility and/or profitability for a now more widely defined circle of prospective customers as potential adopters. Thus, the market equilibrium reached by the now "old" innovation will be replaced by an improved "newer generation", with a new ceiling and equilibrium on a higher level and tied to lower production costs and selling prices for the "newer generation" of the innovation.[22] These supply-side effects create new potentials of prospective customers on the demand-side for the now improved innovation.[23] This combined effect of supply-side factors and demand-side factors reflects an adaptation process that explains the diffusion of permanently improved innovations.[24] Therefore the sloping

[19] N. Rosenberg, *Inside the Black Box: Technology and Economics*, (New York 1982), Chapter 6.

[20] W. B. Arthur, 'Competing Technologies: an Overview', in G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.), *Technical Change and Economic Theory*, (London, New York 1988), pp. 590-607, here: p. 591.

[21] Useful networks for individual transport innovations are service stations both for gasoline and repair and the general improvements in the network of roads quantitatively and qualitatively.

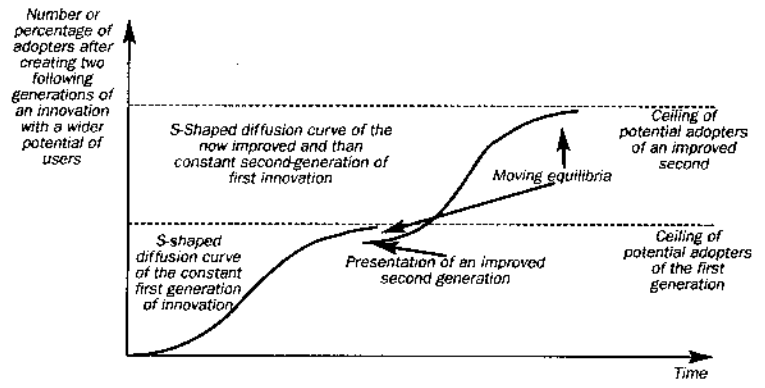
[22] Frequently, the "newer" generation of an innovation is more reliable and easier to use. Accordingly, not only production costs and prices are lower but the whole handling costs of this "newer" generation are as well. Additionally, the historical path of expanded network-externalities is important.

[23] P. A. David, 'Technology Diffusion, Public Policy, and Industrial Competitiveness', in *National Academy of Sciences* (ed.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, (Washington D. C. 1986), pp. 373-391, here: p. 384f.

[24] L. A. Brown, *Innovation Diffusion: A New Perspective*, (London, New York 1981).

curve does not reach an a-priori fixed, defined ceiling or a stable equilibrium. So called moving equilibria are typical for both supply and demand-side driven dynamic processes of technological development as the following graph illustrates.[25]

GRAPH 2: Diffusion-process of improved generations of an innovation with moving equilibria and ceilings



Source: B. Gold, 'On the Adoption of Technical Innovations in Industry: Superficial Models and Complex Decision Processes', in *OMEGA International Journal of Management Science*, Vol. 8, (1980), pp. 505-516, here: p. 508, figure, own modifications.

But in order to be able to evaluate these processes we have to pay attention to the parallel growth of latent substitutive technologies, too.

2.2. Peculiar features relating to the development of motor-cycles

Before discussing the historical development of the diffusion of motor-cycles in two specific nations, a comment on the peculiarities of motor-cycle markets is necessary: a special feature of the supply side is the partial appearance of only ready-made manufacturers, typical and perfect imitators without any individual claim to drive technical progress forward by their own research and development of a given innovation. This kind of firm

[25] B. Gold, 'On the Adoption of Technical Innovations in Industry: Superficial Models and Complex Decision Processes', in *OMEGA International Journal of Management Science*, Vol. 8, (1980), pp. 505-516, here:p. 508f.

buys most central parts of a motor-cycle, for example complete engines ready for fitting, wheels, gears, carburettors, and other parts from ancillary firms. Without any capital investment in research and development and the presentation of newly developed motor-cycle models at (international) races or exhibitions, the purchased parts are only assembled and equipped with the brand name of the imitating manufacturer. This kind of production allows quick entry into the motor-cycle market with negligible capital costs, and a quick exit from it as well, if profit margins decline. Thus, firms belonging to other branches of industry, for example producers of sewing-machines, bicycles or even a simple blacksmith could make a "hit and run" on the motor-cycle market with products of poorer quality usually for local markets at low prices. These extremely ready-made manufacturers compete with reputable and innovative firms with their more expensive but high quality brand-products.

Furthermore, a peculiar feature of the demand side of the motor-cycle market is the double-edged dependence on the level of individual real income: The level and the path of real income development at times is so high that people from the same geographic region are able to buy motor-cycles. However, if wealth or real income surpasses a critical but not quantifiable level, the demand for motor-cycles switches to a more convenient but expensive substitution product, the automobile, as a competing vehicle for individual transportation.[26]

Another feature of both automobile and motor-cycle markets is the quick flow of information on technical progress by means of regular national and international exhibitions[27] and races.[28] In these sporting

[26] For example, better protection against rain is an argument. But it should not be forgotten, that an automobile reflects a higher social status for the owner.

[27] In 1914 an international motor-cycle exhibition, the later *Salon di Milano*, was combined with the Italian motor-vehicle race *Giro Motociclistico d'Italia. Associazione Nazionale Ciclo, Motociclo ed Accessori* (ANCMA) (ed.), *L'ANCMA ha cinquant' anni: 1920-1970*, (Udinese 1971), p. 16; S. Piacentini, L. Rivola: *Storia del motociclismo*, (Milano 1980), p. 28.

[28] The most prominent race is the annual English Tourist Trophy (TT) on the Isle of Man, since 1907 a pure motor-cycle race with excellent reputation over more than 250 kilometres with diverse road qualities. B. Holliday, *Motorcycle Parade. A Pictorial Review of Design and Development*, (Bakerville 1974), pp. 9-10. Economically, victory at TT was very important: after winning TT the English brand *Scott*, for example, sold 550 motor-cycles in 1913, but had only sold 250 a year before. H. Krackowizer, *Motorräder. Berühmte Marken von AJS bis Zündapp*, (München 1981), p. 239.

competitions the reliability and performance of the products are tested in different areas of use, where different solutions to technical problems have to bear national and international comparisons. In theory, races and exhibitions have the function of information channels distributing the state of the art of performance and special solutions to technical problems among competing firms who adopt the best technical solutions presented. Additionally, special publications and periodicals report on races, technical progress and new models from foreign and domestic firms.[29] In this way, national and international markets are competitive and transparent for firms producing and improving the convenience product "motor-cycle" and for the consumer/user as well. Thus, import and export activities depend only on institutional circumstances set by governmental policy.

3. An overview of the general economic circumstances after World War I

Both victorious Great Britain and defeated Germany suffered economically from the consequences of World War I, but to a different degree. Production of war-related goods and rationed resources for civil production created a post-war lack of civil consumer goods in the material sphere; capital market war-financing in these countries created an excess money supply in relation to the supply of material goods. In such circumstances a process of inflation can be expected; it is set out for both countries in Table 1.

In Germany, the process of inflation accelerated to so-called hyperinflation in 1922/1923: Attempts to dry up the excess money supply by means of a taxation policy failed.[30] At the beginning, a moderate inflation seemed to simplify problems caused by the imminent massive unemployment of returning soldiers and the conversion of

[29] In Germany, the periodical *"Das Motorrad. Illustrierte Zeitschrift für die Gesamt-Interessen der Motor-Radfahrer und technisches Organ zur Verbreitung des Motorrades"*, was first published in Breslau in 1903. *"Das Motorrad"*, No. 3, 17, Januray 2003.
[30] F. Blaich, *Der Schwarze Freitag. Inflation und Weltwirtschaftskrise*, (München 1990), pp. 41-43

industry to civil production. Additionally, the political situation in defeated Germany was very unstable because of domestic policy problems. Meeting the costs of the French occupation of the *Ruhr* area in January 1923 by a rapid printing of new paper money and the inflation process brought about hyperinflation. By the end of the year 1923 the purchasing power of the currency collapsed completely in Germany as well as its exchange rate abroad.[31] After the stabilisation of the German currency in 1923/24 and a preliminary adjustment of the volume of the reparations by the Dawes Plan in 1924, a very short economic boom in industrial production occurred in 1924/25, followed by a short rationalisation crisis in 1925/26 with expanding production together with expanding unemployment.[32]

TABLE 1: Cost of living indices in Germany and Great Britain

Year	Germany	Great Britain (U.K)
1918*	196	124
1919	269	131
1920	661	152
1921	870	138
1922	9.766	112
1923	10.324 billion	106
1924	83	107
1925	91	107
1926	92	105
1927	96	102
1928	99	101
1929**	100	100
1930	96	96
1931	88	90
1932	78	88

*) 1914 = 100 per cent.
**) 1929 = 100 per cent.

Source: B. R. Mitchell, *European Historical Statistics 1750-1975*, 2nd rev. edn., (London, Basingstoke 1981), pp. 778-784.

[31] F. Blaich, *Der Schwarze Freitag*, (1990), pp. 19-50.
[32] K. Borchardt, 'Wachstum und Wechsellagen 1914-1970', in H. Aubin, W. Zorn (eds.), *Handbuch der Deutschen Wirtschafts- und Sozialgeschichte*, Vol. 2, (Stuttgart 1976), pp. 685- 740, here: p. 704.

Before the currency reform, German unemployment as a significant factor in the purchasing of new products had been under control until the extreme circumstances of 1923. After the stabilisation of the German currency, unemployment showed a volatile process of immediate economic adjustment. But after 1929 (only officially registered) unemployment increased enormously up to 30.1 per cent in 1932. Table 2 shows the annual rates of unemployment.

In Great Britain an inflationary process occurred as well. Problems of industrial conversion, strikes, bottlenecks in production together with a small volume of civilian goods were some of the causes. But divergences between the excess money supply and the supply of material goods remained under control, although a depreciation of the pound sterling helped exports and increased the

TABLE 2: Unemployment in percentages of the workforce in Germany and Great Britain

Year	Germany	Great Britain (U.K)
1918	1.2	0.8
1919	3.7	2.4
1920	3.8	2.4
1921	2.8	14.8
1922	1.5	15.2
1923	9.6	11.3/11.6*
1924	13.5	10.9
1925	6.7	11.2
1926	18.0	12.7
1927	8.8	10.6
1928	8.4	11.2
1929	13.1/4.3**	11.0
1930	15.3	14.6
1931	23.3	21.5
1932	30.1	22.5

*) Until 1923 unemployment in trade unions; additionally for 1923 and subsequent years, averages of monthly numbers of registered wholly unemployment though the percentages relate only to insured workers who were unemployed.
**) Until 1929 unemployed in trade unions; additionally for 1929 and subsequent years, averages of monthly number of registered unemployment.

Source: B. R. Mitchell, *European Historical Statistics 1750-1975*, 2nd rev. edn., (London, Basingstoke 1981), pp. 174-180.

money supply.[33] Table 1 shows that the immediate post-war British inflation rate was negligible compared to the German one. After 1921, British prices measured in cost of living terms were nearly stable. But Table 2 shows, after the year 1920, a significantly higher rate of unemployment, with a constant level of unemployment of nearly 12 per cent annually during the period from 1921 till 1930.

Another indicator for macroeconomic activity was the annual index of manufacturing production, as Table 3 reveals: Great Britain reached the 1913 pre-war level late in 1929. The years before show a very volatile development and a sharp crisis from 1921 to 1923. Germany reached the pre-war level, earlier, first in 1926/27, but then declined subsequently. In the United States, this index showed, with the exception of 1921, a "golden age": from 1921 till 1929 this index grew from 98 up to 180.8.

As a further indicator, both for macroeconomic activity and the

TABLE 3: Annual indices of manufacturing production in the United Kingdom, Germany, and in the United States (1920 - 1932, base: 1913 = 100 percent)

Year	United Kingdom	Germany	United States
1920	92.6	59.0	122.2
1921	55.1	74.7	98.0
1922	73.5	81.8	125.8
1923	79.1	55.4	141.4
1924	87.8	81.8	133.2
1925	86.3	94.9	148.0
1926	78.8	90.9	156.1
1927	96.0	122.1	154.5
1928	95.1	118.3	162.8
1929	100.3	117.3	180.8
1930	91.3	101.6	148.0
1931	82.4	85.1	121.6
1932	82.5	70.2	93.7

Source: League of Nations (Economic, Financial and Transit Department), *Industrialisation and Foreign Trade*, (United States 1945), p. 134.

[33] D. Aldcroft, *The British Economy*, Vol. 1: *The Years of Turmoil 1920-1951*, (Harvester Press 1986), pp. 2-5.

individual wealth position, indices of weekly real wages should be noted for the countries being studied and additionally for the United States:

Great Britain neared the pre-war level in 1925 - 1926, exceeded it in 1927 and then stagnated until 1930. Surprisingly, real wages rose during the Great Depression. However, in Germany the pre-war level was surpassed first in 1928. Prior to this, the index was significantly lower compared to Great Britain. But after 1929, the German real wage index declined sharply and in 1930 returned to the level of the British index. The same index shows significantly higher and relatively stable rates for the United States, always over the pre-war level. But from 1931 onwards, a sharp decline occurred.

Comparing German and British economic development with the United States of America, we note that modern branches of industry, for example the US automobile industry, US photo and film industry and US electro-mechanical engineering had surpassed Europe.[34] The high US real-wage level together with the price reduction for the Ford Model T after revolutionary mass-production technologies had been introduced, signalled a break-through in automobile mass motoring.[35]

TABLE 4: Weekly real wages in the United Kingdom, Germany and the United States (1924 - 1932, base: 1913 = 100 percent)

Year	United Kingdom	Germany	United States
1924	94	70	126
1925	98	87	125
1926	99	90	125
1927	104	97	129
1928	102	108	131
1929	103	110	132
1930	106	105	125
1931	115	100	123
1932	114	94	112

Source: K. Dederke, *Reich und Republik 1917-1933*, (Stuttgart 1969), p. 279.

[34] F. Blaich, *Der Schwarze Freitag*, (1990), p. 80.

[35] H. Pohl, 'Die Entwicklung des Verkehrswesens in den vergangenen 100 Jahren', in H. Pohl (ed.), *Die Einflüsse der Motorisierung auf das Verkehrswesen von 1886 bis 1986* (= Zeitschrift für Unternehmensgeschichte Beiheft 52), (Stuttgart 1988), pp. 1-16, here: p. 6.

As a result, the American motor-cycle industry stagnated technologically and in sales figures. The biggest US motor-cycle firms were by far Indian and its important rival Harley-Davidson.[36] At this time heavy-built four stroke V-due-cylinder and in-line four-cylinder engines with capacities mostly about 750 cc dominated.[37] Thus, US motor-cycles were expensive both to buy and to run. Economically, these motor-cycles could not compete with small and cheap automobiles: In 1929, some 144 automobiles were produced for only one motor-cycle; in 1926 the relation was of 90 automobiles to one motor-cycle. During the years 1926 to 1932 the rate was of five persons to one automobile, but 1,000 persons to one motor-cycle.[38]

4. Diffusion processes of the motor-cycle in Germany and Great Britain

4.1. The German motor-cycle industry: Description and explanation of the historical lines of development.

4.1.1. Examination at the industry level. Twenty-eight manufacturers of motor-cycles existed in Germany in 1914.[39] But only a small number of firms, in particular *NSU* and *Wanderer*, produced motor-cycles specifically for military use before and during World War I.[40] These firms

[36] In 1903, the Harley-Davidson Motor Co. was founded in a small backyard wooden barn; after the declaration of war Harley-Davidson delivered nearly 25,000 motor-cycles to the army. Civil production in 1920 reached 28,000 units and passed the rival Indian. But the US-motorcycle industry fell into an economic crisis at the beginning of the twenties. For example, the annual production of Harley-Davidson sank temporarily to under 10,000 units, with the lowest point of 4,000 units in 1933. U. Riegel, *Motorrad Oldtimer Katalog* Nr. 7, (Königswinter 1999), pp. 35-41.

[37] H. Wilson, *Motorrad total*, (1999), pp. 17-41.

[38] Own calculations using Statistisches Reichsamt (ed.), *Statistisches Jahrbuch für das Deutsche Reich*, Vol. 52, (1933), p. 69* and Statistisches Reichsamt (ed.), *Das deutsche Straßen- und Wegewesen im öffentlichen Haushalt mit einem Überblick über das Straßen- und Wegewesen im Ausland, Einzelschriften zur Statistik des Deutschen Reichs*, (Berlin 1934), p. 48.

[39] Own calculations using E. Tragatsch, *Alle Motorräder 1894-1981*, Vol. 1, 9th edn., (Stuttgart 1992).

[40] R. Hiller, *Die Entwicklung des Zweitakt-Motorrades*, (Berlin 1963), p. 34.

earned high profit margins[41] and secured detailed know-how in order to create technically superior motor-cycles for later civil production.

Immediately after the end of the war, a period of social and political disorder followed.[42] It was attended by general and sometimes unauthorised strikes, particularly in the public railway system,[43] which generated the first impetus on the demand side for individual transportation. Another impetus was generated by the process of hyperinflation: people looked to the purchase of all kind of material goods, for example motor-cycles, for safety. Thus, more and more new motor-cycle producers emerged, but most of them were only small and local ready-made manufacturers who assembled available, and sometimes used, parts to create simple but cheap products with no after-sales service.[44] In addition, well-known firms such as BMW [45] and DKW had to switch their pattern of war production to civilian goods

[41] For example, *NSU* paid dividends between 12 per cent and 25 per cent during the period 1915 until 1918. F. K. Siebold, 'Die wirtschaftliche Lage der deutschen Fahrrad-Industrie in der Zeit nach dem Kriege einschließlich des Jahres 1923', Dissertation, (Univ. Munich 1924), p. 45.

[42] H. Hürten, 'Bürgerkriege in der Republik. Die Kämpfe um die innere Ordnung von Weimar 1918-1920', in K. D. Bracher, M. Funke, H.-A. Jacobsen (eds.), *Die Weimarer Republik 1918-1933. Politik Wirtschaft Gesellschaft*, (Bonn, Düsseldorf 1987), pp. 81-94.

[43] Between 1919 and 1920 nearly ten regional general strikes occurred; two of them were strikes by railway workers. H. Michaelis, E. Schraepler, Ursachen und Folgen. *Vom deutschen Zusammenbruch 1918 und 1945 bis zur staatlichen Neuordnung Deutschlands in der Gegenwart. Eine Urkunden- und Dokumentensammlung zur Zeitgeschichte*, Vol. 3, (Berlin), o. J., Appendix IV, Document 801, S. 559-561.

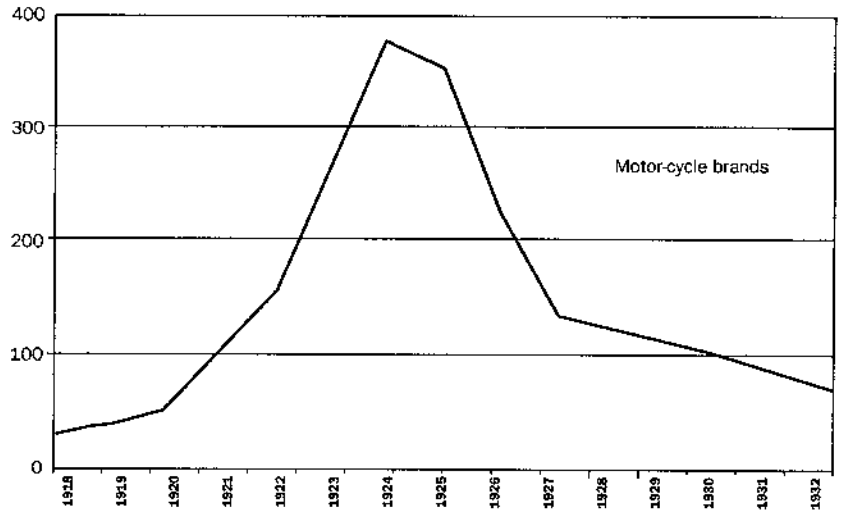
[44] E. Tragatsch, *Motorräder - Deutschland. Österreich. Tschechoslowakei*, 4th edn., (Stuttgart 1974), p. 30. The automobile industry took a similar path of development: When hyperinflation came to an end, 86 automobile brands, most of them only ready-made manufacturers of used parts, existed. But in 1930 a total of only sixteen brands had remained. F. Blaich, 'The Development of the Distribution Sector in the German Car Industry', in A. Okochi, K. Shimokawa (eds.), *Development of Mass Marketing. The Automobile and Retailing Industries, International Conference on Business History 7*, Proceedings of the Fuji Conference, (Tokyo 1980), pp. 93-117, here: pp. 93-95.

[45] As a former producer of aeroplane engines, BMW changed in 1920/21 to the production of ready-to-fit motor-cycle engines for other firms. In 1922/23 followed the production of complete motor-cycles followed under the company's own brand-name BMW. E. Tragatsch, *Alle Motorräder 1894-1981*, 8th edn., (Stuttgart 1990), pp. 74-75; E. Tragatsch, *Motorräder*, (1974), p. 53. In 1928 BMW decided to build small automobiles under *Austin* license, the so-called Dixie. At this time, the forming of a national trust embracing the dominant car producers like Opel, Daimler-Benz, Brennabor, Horch, Wanderer and

or began to establish regular production of motor-cycles, for example Ardie.[46]

Graph 3 shows the establishing of many new motor-cycle brands after the currency reform of 1923/24. This demonstrates the take-off of popular motoring with motor-cycles in Germany in the middle of the 1920s, illustrating the theoretically assumed ending of a typical imitation process. Indeed this imitation process created some new firms and brands, but most of them were only short-lived, ready-made manufacturers with the above-mentioned attributes. Between 1919 and 1926 a total of 326

GRAPH 3: Motor-cycle brands in production (Germany)



Source: E. Tragatsch, *Alle Motorräder*, (1990), own calculation and presentation.

Nationale Automobil-AG (NAG) was discussed. Therefore, new automobile brands like BMW or NSU were not desired. G. D. Feldman, 'Die Deutsche Bank und die Automobilindustrie', in *Zeitschrift für Unternehmensgeschichte*, Vol. 44, 1999, pp. 3-14, here: p. 7.

[46] After the war, Ardie and the later motor-cycle producer Zündapp were newly founded firms in Nuremberg one of the traditional centres of German motor-cycle manufacture with already well-known pre-war brands like (German) Triumph and Victoria. Further traditional centres were Bielefeld, the Neckar area (NSU), in Saxonia, Zschopau (DKW) and Munich in Bavaria with BMW. R. Hiller, *Die Entwicklung*, (1963), p. 33f.

new firms were created and soon eliminated by dynamic market forces. After only one year or less of production, 19 new brands disappeared, and 10 of them had been founded in 1925. Ninety-six brands survived up to two years, 123 brands up to three years. Sixty-four brands stayed up to four years on the market, and only 19 of the new founded brands survived for five years or longer.[47]

Between 1925 and 1927 the number of motor-cycle brands declined sharply from 360 to 223 in 1926, with only 139 manufacturing firms in 1927. In 1928 a total of 126 firms were competing for the market. During the period 1929 -1932 the number of firms producing motor-cycles fell from 110 in 1929 to 67 in 1932 due to the Great Depression. Thus, by 1926/27, the market structure of the motor-cycle industry was cleared of small and inefficient firms; moreover the sharp, so-called rationalisation crisis of the whole German economy, and from 1929 onwards the general contracting effects of the Great Depression, further decimated the industry. The last factor was strengthened by the German government's sharp deflation policy as well. As a result of the fundamental changes in the structure of demand, which are discussed in the following section, from 1930 onwards some smaller brands were taken over by bigger firms: for example, in 1930 *NSU* took over *Wanderer* and *DKW* took over *Schüttho f* in 1932.[48] In 1931 the market share of the seven biggest firms amounted (in total) to 55 per cent of the total market.[49] The development of the number of brands shows typical elements of a dynamic imitation process: rapid growth-rates at the beginning of the process ("band-wagon-effect") and then a sharp decline eliminating the majority of marginal sellers by the working of market forces.

4.1.2. Consumer levels. Post-war disorders were removed by the mid-twenties and the hidden need for individual transportation was met by a slow growth in real income and a larger supply of new and cheap

[47] Own calculations using E. Tragatsch, *Alle Motorräder*, (1990).
[48] E. Tragatsch, *Motorräder*, (1974), pp. 242, 297.
[49] The "Big Seven" were NSU, D-Rad, DKW, Zündapp, Ardie, BMW and (German) Triumph. Reichsverband der Automobilindustrie (ed.), *Tatsachen und Zahlen aus der Kraftfahrzeugindustrie*, (Berlin-Friedenau), Vol. 1931 and 1932.

motor-cycles.[50] This process of the adoption of the motor-cycle by the consumer is set out in graph 4, which shows the number of motor-cycles in use each year and an additional graph relating to so-called *Kleinkrafträder* and automobiles:

The individual decision to adopt motor-cycle technology was influenced by the State: from 1922, both motor-cycles and automobiles were subject to a 15 per cent value added tax imposed generally on luxury goods.[51] Additionally, in April 1922 a special tax on the engine-horsepower of motorised vehicles was introduced.[52] The tax on luxury goods was removed in 1926 and the special tax on engine-horsepower was subsequently modified. From then on the special tax on motor-cycles was generally less prohibitive and was subject to lower tax rates compared with the special tax rates on automobiles. The so-called *Kleinkrafträder*, including motor-cycles with engines whose piston displacement was under 175 cc and later, in 1929, under 200 cc, were made tax free,[53] and the user did not require a driving-licence.[54] On the supply side, these measures promoted the production and sale of motor-cycles with higher performance two-stroke engines under the tax limit. This relaxation in the imposition of prohibitive taxes came with greater state intervention to improve the quality of the road system.[55] Other factors on the supply

[50] Compared with total production, the German export was negligible. In 1925 only 1,351 motor-cycles were exported, in 1926 2,156, in 1927 3,715, and in 1928 4,681. In 1929, the export increased to 7,540 motor-cycles, stagnated in 1930 with 7,554 units and 7,085 in 1931. In 1932, export declined rapidly to 3,487 units. Presumably, this was a consequence of the sharp depreciation of the British and other currencies in 1931/32. Reichsverband der Automobilindustrie, *Tatsachen und Zahlen aus der Kraftfahrzeugindustrie*, Vol. 1937, p. 95.

[51] G. D. Feldman, *Die Deutsche Bank*, p. 6; F. Blaich, *Der Schwarze Freitag*, (1990), p. 42.

[52] *Kraftfahrzeugsteuergesetz vom 20*, (April 1922), in *Reichsgesetzblatt*, Teil I, 1922, p. 396.

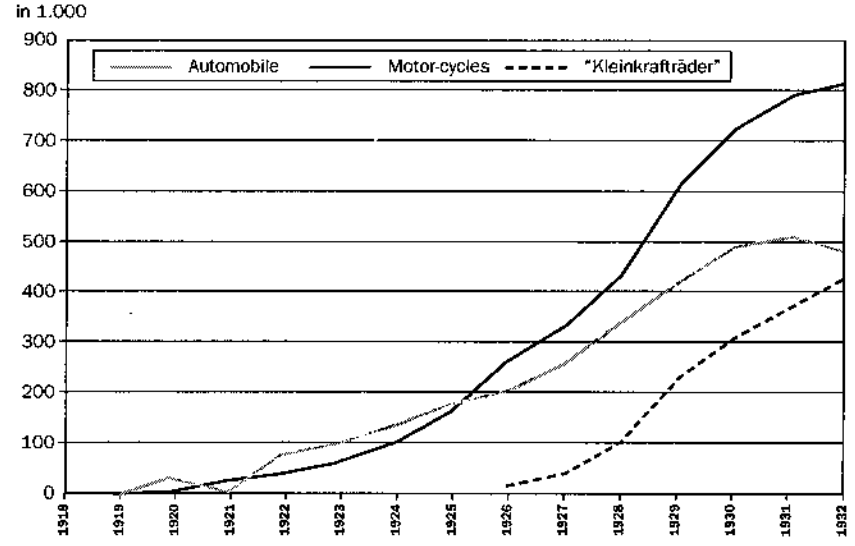
[53] *Änderung des Kraftfahrzeugsteuergesetzes 15*, (Mai 1926), in *Reichsgesetzblatt*, Teil I, (1926), p. 223. W. Christenn, *Die deutsche Motorrad-Industrie und ihre steuerliche Belastung*, (Diss. München 1929).

[54] P. Friedmann, 'Der Kampf um die Kraftfahrzeugsteuer', in *Das Motorrad*, Vol. 11, (1931), no. 12.

[55] If public expenditure on roads was 100 per cent for the year 1926, in Germany the index was 139 in 1927, 122.3 in 1928, 125.8 in 1929 and 117.2 in 1930. The index declined rapidly to 82.1 in 1931 and 59.8 in 1932. In Great Britain the index stagnated, fluctuating from 100.0 to 116.5 in the period 1926 - 1929. In 1930 the index rose to 159.4 and 168.8 in 1931; in 1932 the index declined to 135.3. Statistisches Reichsamt (ed.), *Das deutsche Straßen- und Wegewesen*, (1934), p. 47.

side enforced the adoption of motor-cycles: DKW offered not only technological improvements[56] for cheaper, but still high quality motor-cycles, but also the financial innovation of payment through instalments.[57] Following DKW, other firms created a network of service and sales outlets in Germany and trained mechanics specifically for their brands, in order to guarantee the reliability of their products, too. In the terminology of the diffusion theory, "learning by" effects and network-externalities[58] were at work.

GRAPH 4: Motor-vehicles in use (Germany)



Source: Statistisches Reichsamt (ed.), *Statistisches Jahrbuch für das Deutsche Reich*, Vol. 41-51, (Berlin 1920-1933), different pages, own presentation.

[56] The use of moulded steel-frames (the German so-called *Preßstahlrahmen*) and two-stroke engines with specific higher performance in comparison with a four-stroke engine of the same piston displacement lowered the costs of production. F. Bach, W. Lange, S. Rauch, *DKW - MZ: Motorräder aus Zschopau und Ingolstadt*, (Stuttgart 1992), pp. 12-14.

[57] P. Kirchberg, *Die technisch-konstruktive Entwicklung der DKW Kraftfahrzeuge und Motoren, maschinen-schriftliche Expertise*, (Dresden 1987), p. 15.

[58] An example of network externality was the rapid growth in gasoline stations after 1925 in Germany: In 1925 only 2.2 gasoline stations served 1,000 motor-vehicles. In 1931, 36.4 gasoline stations served 1,000 motor-vehicles in Germany, but in England the number of gasoline-pumps in use was more than double. E. Nielsen, *Das Tankstellenwesen des deutschen Kraftverkehrs*, (Würzburg 1935), pp. 5-24.

Economically important for expanding demand was a sharp fall in the price index of motor-cycles: while in 1925 the price-index was 100 per cent, it decreased to 90.8 per cent in 1926, 81.6 per cent in 1927, 78.5 per cent in 1928, 74.2 per cent in 1929, 70.1 per cent in 1930 and 65.8 per cent in 1931.[59] Following the period of hyperinflation and currency reform, the market eliminated marginal suppliers, reviving firms that came close to effective mass production. Despite higher quality, performance and reliability, firms had to offer cheaper products, because the motor-cycle market was more competitive than the automobile market and also benefited from government tax policy. During the 1920s, and increasingly during the 1930s, mass motoring in Germany was motoring by motor-cycles, frequently financed by hire purchase sale.[60] But the structure of demand changed dramatically during the Great Depression. In 1929 less than 57 per cent of production consisted of light-engined tax- and driving-licence free motor-cycles. In 1932 their share of annual new production was 73.5 per cent. The production of motor-cycles with cilinder rating from 200 cc to 350 cc halved during this period.[61] A sharp rise in unemployment, an increase in gasoline prices and decreasing wages led to increasing demand for cheap motor-cycles.[62] This combination of demand-side and supply-side forces is an example of the adaptation perspective in the diffusion theory.

But the sale of light-engined *Kleinkrafträder* was less profitable for motor-cycle manufacturers and, fighting for customers, some marginal sellers undercut published prices. As a reaction, established retailers and motor-cycle manufacturers formed a cartel regulating quotas, terms and

[59] *Reichsverband der Automobilindustrie* (ed.): *Tatsachen und Zahlen*, Vol. 1931, p. 68.
[60] Hire purchase was often organised by special financing institutions, for example the Motorrad-Finanzierungs GmbH, Berlin, and the Autokreditanstalt A. Lehner & Co., Berlin, which financed the instalment sale of automobiles. The default rate for motor-cycle financing was only a half per cent in September 1929; the default rate for financing automobiles was higher. After the collapse of some of those special financing institutions in 1929/30, firms like Brennabor, Opel and Wanderer followed the pioneer *DKW* and financed instalment sale directly. M. Böttger: Die Absatzfinanzierung von Kraftwagen und Krafträdern in Deutschland, (Diss. München 1933), pp. 26, 40-49.
[61] *Reichsverband der Automobilindustrie* (ed.): *Tatsachen und Zahlen*, Vol. 1931, 1932 and 1933.
[62] Statistisches Reichsamt (ed.): *Die steuerliche Belastung der Kraftfahrzeuge im In- und Ausland, Vierteljahreshefte zur Statistik des Deutschen Reiches*, (Berlin 1933), p. 142.

conditions, the so-called *Überwachungsausschuß der Motorradwirtschaft (Übamo)* in 1930. If a retailer ignored the terms of the cartel, it was forced out of the market.[63]

4.2. The British motor-cycle industry: Description and historical lines of development

4.2.1. Industry levels. At the beginning of World War I, more than a dozen out of a total of 163 British motor-cycle producing firms manufactured motor-cycles for military use.[64] Some of these firms, namely James, Enfield and Birmingham Small Arms (BSA) were important producers of weapons and had therefore close ties with military authorities.[65] During the Boer War (1899-1902) and the wars in the Balkan states (1912-1913) the British Army gained positive practical experience in the military advantages of motor-cycles.[66] Thus, the motor-cycle was more established in the British Army during World War I than in other countries: for example, motor-cycles manufactured by the firms Douglas and Phelon & Moore (P & M) were used to dispatch information; Clyno and Chater Lea motor-cycles were equipped with a side-car and a machine-gun. In total, British firms[67] produced more than 40,000 motor-cycles only for British troops.[68] Moreover, although it is not exactly quantifiable, more than 20,000 British motor-cycles were ordered by the allied troops.[69] But in the case of Russian orders many thousands of machines were not delivered.[70]

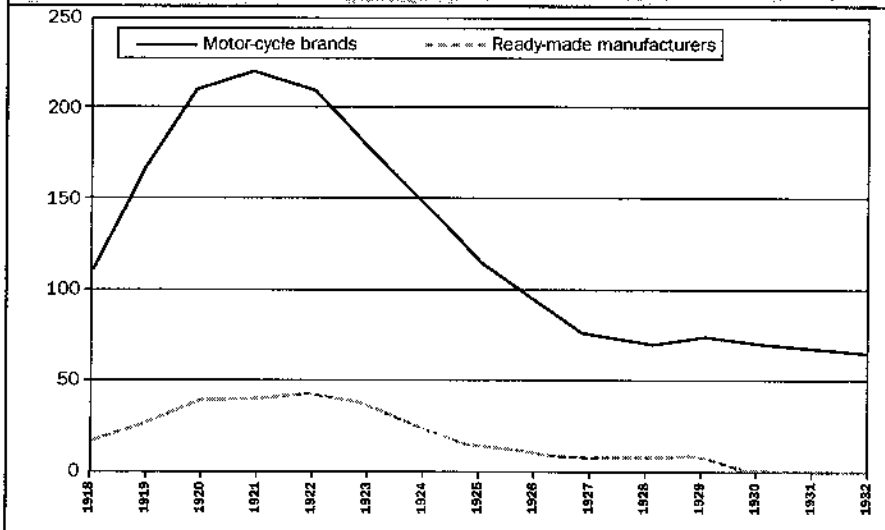
[63] 'Rationalisierung der Motorradwirtschaft', in *Das Motorrad*, Vol. 10, (1930), p. 2168.
[64] E.Tragatsch, *Alle Motorräder 1894-1981*, 9th edn., (Stuttgart 1992), own calculation.
[65] For general amalgamations between British weapon industry and government authorities A. J. Arnold, '"In the Service of the State"? Profitability in the British Armaments Industry, 1914-24', in *Journal of European Economic History*, Vol. 27, (2/1998), pp. 285-314.
[66] C. Rey, H. Louis, *Berühmte Motorräder 1896-1950*, (Munich 1977), p. 10; M. Limpf, *Das Motorrad*, (1983), p. 23.
[67] Important firms during the war were Triumph, Douglas, Phelon & Moore (P & M), Norton, Premier, Sunbeam, Rover and Humber. M. Limpf, *Das Motorrad*, (1983), p. 22.
[68] C. Rey, H. Louis, *Berühmte Motorräder*, (1977), p. 80; H. Krackowizer, *Motorräder*, (1981), p. 239; Olyslager, *Motorcycles to 1945*, (London 1975), p. 64.
[69] S. Ewald, G. Murrer, *Enzyklopädie des Motorrades. Marken, Modelle, Technik*, (Augsburg 1990), p. 148, p. 361, p. 385, p. 396; E. Tragatsch, *Motorräder: Berühmte Konstruktionen*, Vol. 2, (Bielefeld 1979), pp. 137-138; D. Richmond, *Das Buch vom Motorrad*, (Stuttgart 1980), p. 12; E. E. Thompson, *Motorräder seit 1900*, 2nd edn., (Zürich 1978), p. 115.
[70] Especially a greater number of motor-cycles produced by Norton and Clyno. S. Ewald, G. Murrer, *Enzyklopädie*, (1990), p. 361.

During the war some firms stopped motor-cycle production and concentrated on weapons; these included James, Rudge and, later, Chater Lea.[71] And some small brands stopped their civil motor-cycle production primarily as the result of the enlistment of personnel for military service; in 1916 the civil production of motor-cycles was forbidden by government order.[72] Thus, 163 motor-cycle brands including 22 ready-made manufacturers on the British market in 1914 were reduced to 105 brands including 13 ready-made manufacturers in 1918.[73] Some of the bigger suppliers of motor-cycles widened their production capacities as a result of the expansion of military demand and export orders, but smaller suppliers reduced it and/or changed to the sole production of weapons. This supply-side structure was, by the end of the war, also complicated by the following effects: some British producers of aeroplanes, such as Sopwith, Gloucester or Martinsyde, lacking military demand, changed to producing civil goods, such as motor-cycles. Other producers of weapons and motor-cycles,[74] expanded their former production of motor-cycles, or returned to it after the war, for example Matchless and James.[75] Furthermore, a large number of new motor-cycles in depots[76] and used military motor-cycles were offered to the market.[77] Despite these supply effects, returning soldiers created an excess demand, particularly for cheap but also for reliable and light-engined motor-cycles.[78] As was to happen in Germany nearly four years later, but without the economic effects of hyperinflation, in Great Britain, a striking development in the founding new motor-cycle brands can be observed, as it is shown in graph 5.

[71] S. Ewald, G. Murrer, *Enzyklopädie*, (1990), p. 107, p. 279; H. Krackowizer, *Motorräder*, (1981), p. 224.
[72] S. Ewald, G. Murrer, *Enzyklopädie*, (1990), p. 171.
[73] Own calculations using E. Tragatsch, *Alle Motorräder*, (1992).
[74] The best example was BSA. R. Bacon, *Motorcycles of the 1930s*, (Osprey/Lancashire 1987), p. 48.
[75] C. Rey, H. Louis, *Berühmte Motorräder*, (1977), S. 58; E. E. Thompson, *Motorräder*, (1978), S. 145; R. Bacon, *Motorcycles*, (1987), p. 48; S. Ewald, G. Murrer, *Enzyklopädie*, (1990), p. 279, p. 318.
[76] Especially the undelivered Russian order of Norton's.
[77] After World War I until 1920, British military authorities sold nearly 60,000 of military used motor-cycles at low prices in Great Britain and in the colonies. G. C. Allen, *The Industrial Development of Birmingham and the Black Country*, (London 1966), p. 400; E. Tragatsch, *Motorräder: Berühmte Konstruktionen*, Vol. 3, (Bielefeld 1983), p. 85.
[78] J. Porazik, *Motorräder aus den Jahren 1885 bis 1940*, (Hanau 1983), p. 7.

Starting with 105 established and revived brands in 1918, graph 5 shows more than a doubling of motor-cycle brands from 1920 to 1922, including around 20 per cent only ready-made manufacturers.[79] Analysing this rapid development in more detail, we can identify effective working market dynamics behind the static stock-figures in graph 5.[80] Thus, in 1919 60 new brands reached the market, and 6 disappeared; in 1920, 53 new brands entered the market, but 18 disappeared. In 1921 the dynamics of the market removed 28 brands but 28 new brands were founded. The trend reversed in 1922, when only 25 new brands reached the market but 51 dropped out. From 1923 onwards more firms gave up than were founded. With a peak of 44 ready-made manufacturers in 1922, this kind of motor-cycle producing

GRAPH 5: Motor-cycle brands in production (Great Britain)



Source: E. Tragatsch, *Alle Motorräder*, (1990,) own calculation and presentation.

[79] Extreme examples for only ready-made manufacturers were the firms Martin, Barr & Strouds and Victoria. It can be assumed that only the "brand-sign" on the gasoline-tank was its own production. E. Tragatsch, *Alle Motorräder*, (1894), bis heute, 2nd edn., (Stuttgart 1977), p. 377.

[80] Differences concerning the stock-figures resulted in an overlapping of yearly periods and, in a small number of cases, of missing data regarding the founding, liquidation, take-over and change in the brand-name. A small number of brands existed for less than a year.

firm fell rapidly in number to nine in 1927 until 1929. Furthermore, in 1932 six brands and in 1933 eight brands disappeared.[81]

4.2.2. Consumer levels. Despite the sharp decline in privately used motor-cycles (153,000 units) and automobiles (142,000 units) after 1916, in 1918 78,000 automobiles and 69,000 motor-cycles were in use in Great Britain.[82] Compared with Germany, Great Britain was much more motorised both with motor-cycles and automobiles. The economic circumstances discussed above led to further demand for individual, but cheap transportation. The supply of militarily used motor-cycles did not satisfy the demand for motor-cycles.[83] Therefore, the motor-cycle industry expanded not only with the rapid founding of new brands but also through rapid growth in production with 65,000 motor-cycles in 1919 to 100,000 units in 1920.[84] As the market swept away some of the new brands during 1921 - 1923, the production of motor-cycles decreased to 80,000 units in 1921 and 60,000 in 1922. This shows parallels with general economic development, because after 1920/21 unemployment grew until 1922 and British inflation decreased between 1920 and 1923. The index of manufacturing production also declined sharply in 1920/21 (from 92.6 to 55.1) and revived slowly in 1922 (73.5) and in 1923 (79.1, base year 1913 = 100). Unemployment stagnated in 1923 and in the following years affected nearly 12 per cent of the workforce up to 1930, but the cost of living index was nearly stable at this time. During the period 1923-1927 annual British motor-cycle production doubled from 80,000 units in 1923 to 160,000 in 1927, but it is noteworthy that in 1923, with more than 16,000 units, in 1924 nearly 38,000 units and in 1927 with 53,000 units, nearly one in three manufactured motor-cycle was

[81] Own calculation using E. Tragatsch, *Alle Motorräder*, (1992).
[82] B. R. Mitchell, *British Historical Statistics*, (Cambridge 1988), p. 557.
[83] The demand for new automobiles could only be satisfied by imports mostly from the United States, with a demurrage of nearby seven months and rising prices. Therefore a substitution in the demand of automobiles to motor-cycles occurred. Another argument were high prices for fuel. J. Foreman-Peck, S. Bowden, A. McKinlay, *The British Motor Industry*, (Manchester 1995), pp. 68-69.
[84] The figures now mentioned can be found in S. Koerner, 'The British Motor-cycle Industry during the 30s', *Journal of Transport History*, Vol. 16, (1995), pp. 55-76, here: p. 57.

exported.[85] At this time, and for many years to come, British motor-cycles dominated the re-established (in 1920) annual Tourist Trophy race, the most highly-reputable TT.[86] British importation of foreign motor-cycles was quantitatively negligible for the rest of the 1920s,[87] with 1,481 units in 1919, 4,277 units in 1920, and 2,130 units in 1921 and with sharply decreasing figures thereafter, in spite of the McKenna duties. Already in 1928 the total production of motor-cycles fell to 145,000 units with nearly 60,000 for export. Production stagnated in 1929 at 147,000 units with 62,377 destined for export, and declined sharply to a total of 126,500 motor-cycles, of which 42,689 were exported in 1930. From 1930 to 1931 production plummeted to 74,400 motor-cycles in 1931 and 70,400 in 1932; in 1931 only 23,247 units and in 1932 under 20,000 were exported but from these figures we can see that the production of motor-cycles declined significantly after 1927, and before the beginning of the Great Depression. The decline was moderate in 1928 and 1929 as a further expansion of exports took place. A sharp fall in production in 1930 and 1931 coincided with the general decrease in export figures, but the export quota was traditionally high and nearly stable at one third of production even during the Great Depression.[88]

High export levels aside, graph 6 exhibits the number of motor-cycles in use in Great-Britain. Automobiles for private use are also included in the graph.

The graph shows that in 1925 the automobiles in use greatly exceeded the figures of motor-cycles in use; only between 1919 and 1925, with a

[85] By end of the 1920s the British motor-cycle industry was highly acclaimed: the Pope's escort in the Vatican state was motorised by British products. S. Koerner, 'The British Motor Cycle Industry, 1935-1975', unpublished Dissertation, (Centre for the Study of Social History, University of Warwick 1990), p. 12.

[86] I. McNeil, *Roads, Bridges and Vehicles,* (1990), p. 448.

[87] The importation of luxury goods like motor-cycles was burdened by a customs duty of 22 2/3 per cent for vehicles from Commonwealth nations and 33 1/3 per cent for vehicles from other nations. These so-called McKenna duties came into force in 1915 until 1922. In 1923 the McKenna duties were abolished, but increasing imports (1,011 motor-cycles in comparison to 80,000 produced in Great Britain) led to the re-introduction of the McKenna duties in 1924. G. Maxcy, *'The Multinational Motor Industry,* (London 1981), p. 66; J. Foreman-Peck, S. Bowden, A. McKinlay, *The British Motor Industry,* (1995), pp. 76-77.

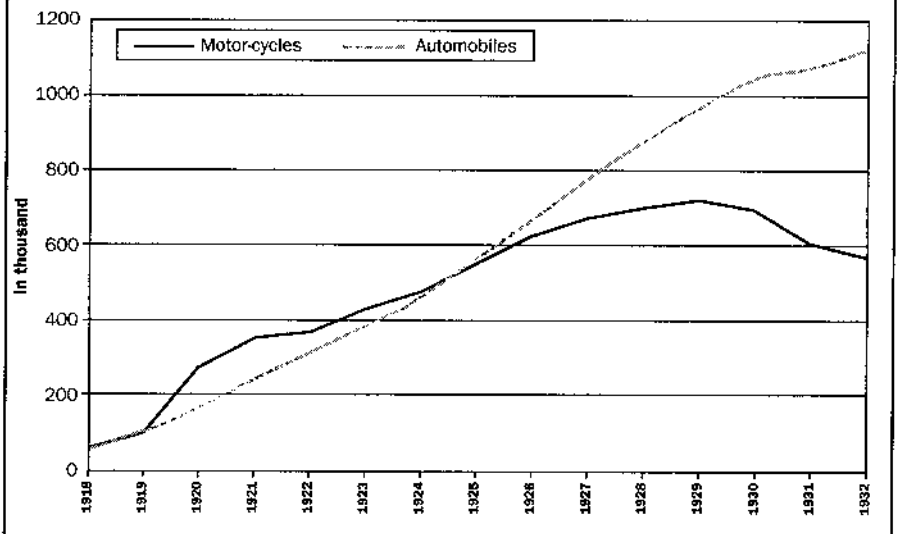
[88] S. Koerner, *The British Motor-cycle Industry,* (1995), p. 57.

peak in 1921, were more motor-cycles in use than automobiles. This contrast with the findings concerning Germany in 1924/25.

On the supply side, the British motor-cycle industry concentrated on the development of heavy engined, expensive, sporty and prestigious models. Motor-cycles with a cylinder displacement of more than 1,000 cc were built.[89] But so-called *near-a-car* motor-cycles, tricycles and motorcycles with side-cars came into production, too. Just after the war, the first low-engined motor-scooters appeared, but they were not important in the industry.[90]

Increasingly, the car industry and US imports offered an economic alternative. In 1924, a small car with 11.9 horsepower was sold for £325, and had running costs of 2.29 pence per mile. A motor-cycle with side-car and four horsepower was sold for £135 and had running costs of 1.36 pence per mile.[91] Thus, cost differences were quite evident but narrowed

GRAPH 6: Motor-vehicles in use (Great Britain)



Source: B. R. Mitchell, *British Historical Statistics*, (Cambridge 1988), p. 557, own presentation.

[89] D. Richmond, *Das Buch vom Motorrad*, (Stuttgart, 1980), p. 13.
[90] C. Rey, H. Louis, *Berühmte Motorräder*, (1977), p. 13; D. Richmond, *Das Buch*, (1980), pp. 12-13.
[91] J. Foreman-Peck, S. Bowden, A. McKinlay, *The British Motor Industry*, (1995), p. 70.

in the following years. The Great Depression had a fundamental influence on the British motor-cycle industry. The liquidation of firms, take-overs, reduction in capacity and reorganisation processes occurred.[92] Because of the lack of profitability, firms were now forced into an unexpected and quick diversification towards low engined and cheap motor-cycles.[93]

In spite of the crisis, some people still earned enough to buy automobiles. The automobile industry had lower losses of sales (ten per cent during the period 1929-1931) than the motor-cycle industry.[94] The automobile industry offered so-called *baby-cars* as an economically relevant alternative to motor-cycles with side-car without protection against rain.[95]

Thus, the production structure of the British motor-cycle industry had parallels to the German industry. But in Germany, this adjustment process occurred some years before and without the acute economic pressure of the Great Depression. Moreover , British tax policy relating to motorised vehicles lowered the high level of the taxation of automobiles: the average tax on used automobiles, based on horsepower, amounted to £17 12s. in 1922 and declined consistently to £15 8s. in 1925, £14 4s. in 1928 and £13 14s. in 1932; the average tax on used motor-cycles based on horsepower ran from £2 13s. 6d. in 1922, £2 15s. 6d. to £2 13s. in 1930.[96] There were special taxes on tricycles and on motor-cycles with side cars.[97] During the period in question, taxes on motor-cycles stagnated, but taxes on automobiles were reduced by the government.[98] This tax reduction policy contrasted with the policy adopted by the German government.

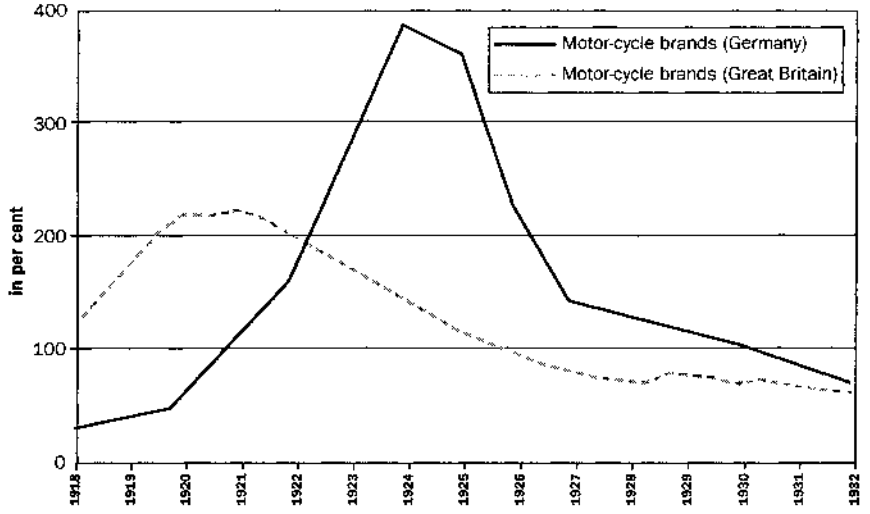
[92] S. Ewald, G. Murrer, *Enzyklopädie*, (1990), p. 158, E.E.Thomson, *Motorräder*, (1978), p. 155; E. Tragatsch, *Alle Motorräder*, (1977), p. 47; H. Krackowizer, *Motorräder*, (1981), p. 16.
[93] C. Rey, H. Louis, *Berühmte Motorräder*, (1977), p. 16. The only exception was the brand Ariel, which produced a very small number of heavy engined devices during the crisis. C. Rey, H. Louis, *Berühmte Motorräder*, (1977), p. 16.
[94] J. Foreman-Peck, J. Bowden, S. McKinlay, *The British Motor Industry*, (1995), pp.67-70.
[95] 'The British Motor Industry', in *The Economist*, (28 October 1933), pp. 805-808; T. Barker, D. Gerhold, *The rise and rise of road transport, 1700-1990*, (Cambridge 1995), p. 67.
[96] 'Statistical Abstract for the United Kingdom', No. 72 and 82, in *Her Majesty's Stationary Office (HMSO)*, (1929 and 1939), (reprinted Liechtenstein 1966), pp. 258, 334.
[97] *The Motor Industry of Great Britain (The Statistical Department)*, (Great Britain 1938), pp. 18-25.
[98] A system concerning driving-licences was first introduced in 1930. *The Motor Industry of Great Britain*, (1938), p. 19.

5. Comparative discussion and concluding remarks

Pre-war Great Britain was generally more motorised in comparison to pre-war Germany, but both countries were clearly less motorised with automobiles than the United States: As shown above, the early US mass-production of cheap automobiles substituted the demand for motor-cycles quickly and partly before World War I. After the war, the US-automobile industry flourished and rapidly promoted the diffusion of this technology but the US-motor-cycle industry declined. Macroeconomically, a "golden age" can be identified by the indices of the weekly real wages and the manufacturing production as presented in tables 3 and 4.

During World War I, the motor-cycle was more important and established within the British Army than in the German Army. But for both economies World War I improved the reliability and the production effectiveness of motor-cycles, especially in firms producing models for military use; additionally British firms could realise economies of scale by quantitatively significant export orders. Nevertheless, this industry

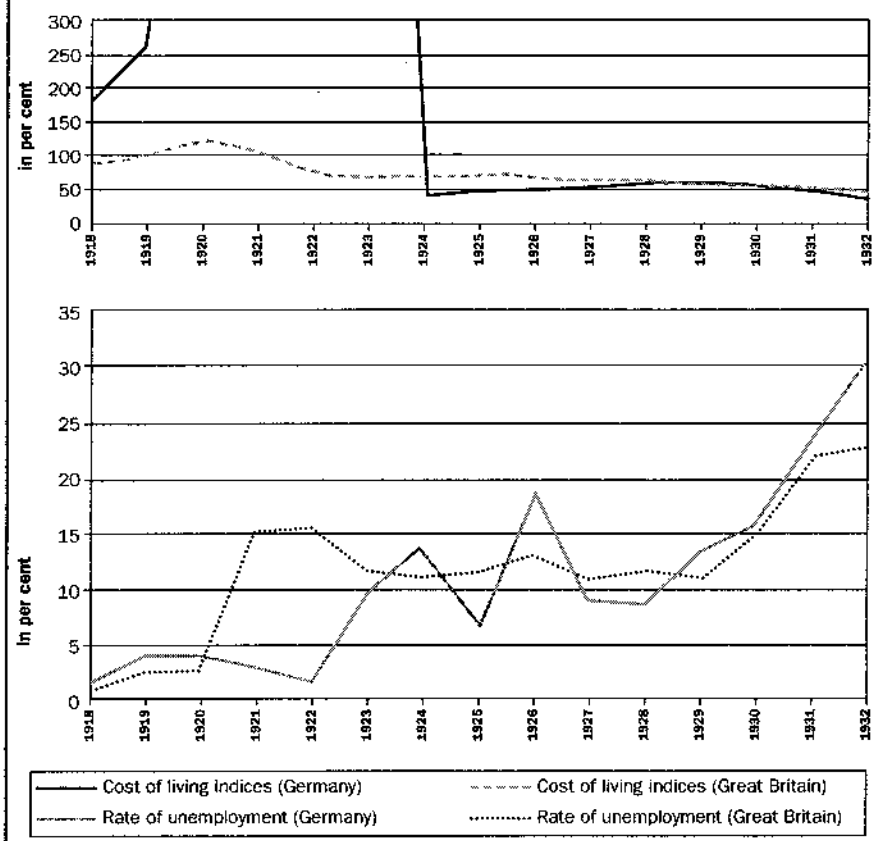
GRAPH 7: Motor-cycle brands in production (Germany and Great Britain)



Source: See graphs 3 and 5 above.

faced new circumstances after the end of the war in both countries, which suffered economic problems due to inflation, unemployment, a low and more or less stagnating index' of production and of real wages. But in both countries, those macroeconomic indicators show differences in their level and their rate of change over time. The motor-cycle industry flourished in both countries and demonstrated the typical theoretically assumed Schumpeterian diffusion processes in the stages of imitating and adopting a technology. For a comparative analysis, the following

GRAPH 8: Cost of living indices and rate of unemployment (Germany and Great Britain)



Source: See tables 1 and 2 above.

graph 7 contains data on the development of the brands of the motor-cycle industry in Germany and Great Britain.

In Great Britain, the expansion of firms producing motor-cycles started nearly half a decade earlier than in Germany - but in Great Britain the first two years after the war show a relatively moderate inflation and the country did not experience the effects of hyperinflation which propagated the search for real goods. In graph 8, we give graphical information on the rates of unemployment and of cost of living indices in both nations.

During the years 1918 - 1920, the unemployment rate was low in both countries, but lower in Great Britain than in Germany. In 1921 and 1922, the unemployment rate rose sharply in Great Britain, but the cost of living declined remarkably between 1920 and 1923. However, in Germany unemployment was very low in 1921 and 1922, but rose sharply in 1923 and 1924 during the period of hyperinflation and the subsequent currency

GRAPH 9: Indices of manufacturing production and weekly real wages (Germany and Great Britain)

Source: See tables 3 and 4 above.

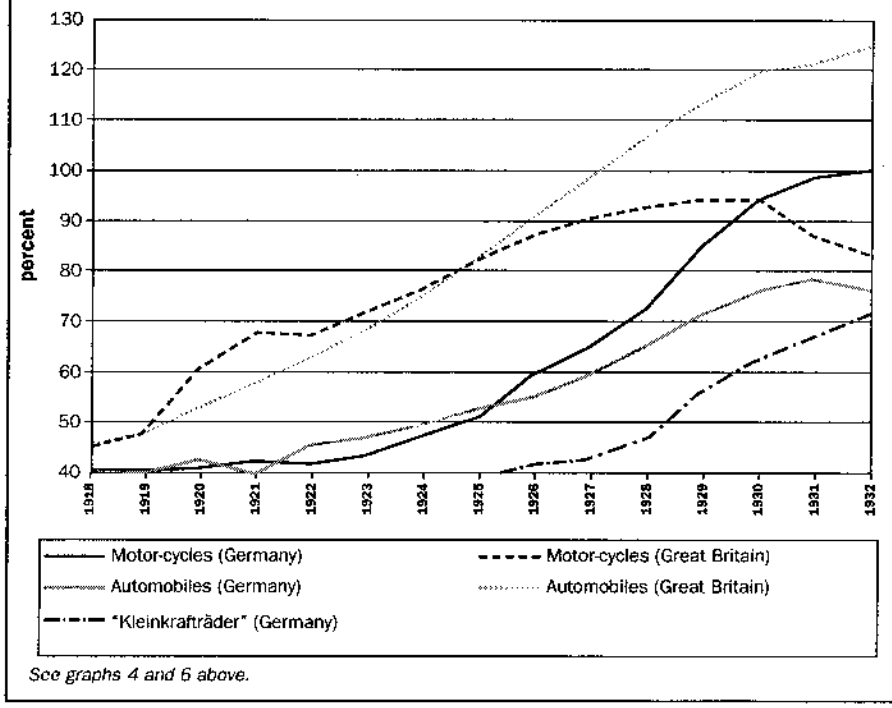
reform. Additionally, we show the development of indices of weekly real wages and manufacturing production graphically.

From 1924 until 1927, and presumably for the years before, the index of weekly real wages was significantly lower in Germany than in Great Britain. Manufacturing production was very volatile; the indices stayed low under the pre-war level for many years in both countries.

In the next stage, we analyse the development of motor-cycles and automobiles in use for both nations together. For Germany, an additional graph shows the so-called tax and licence-free *Kleinkrafträder* in use. Graph 10 shows a surprising trend.

In the middle of the 1920s, when direct post-war troubles had been overcome in Europe, the trends for motor-cycles and automobiles in use diverged in the two states. To explain these surprising developments, we add curves of macroeconomic aggregates in a graph illustrating the situation in Great Britain.

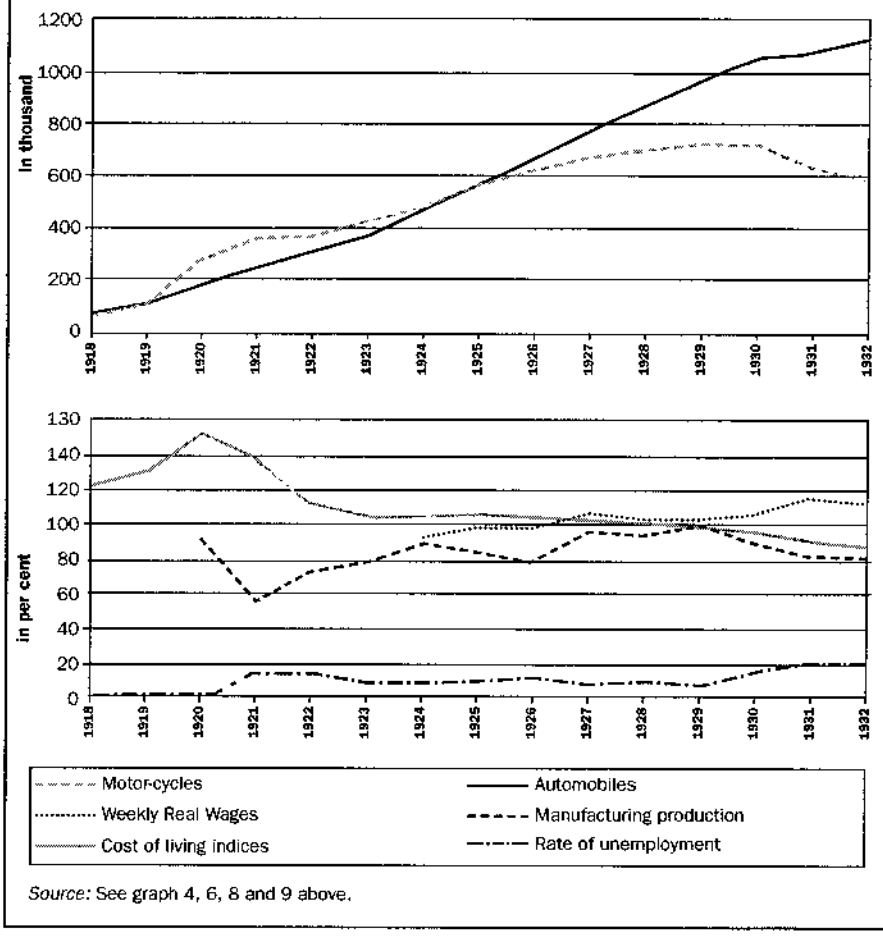
GRAPH 10: Motor-cycles and automobiles in use (Germany and Great Britain)



See graphs 4 and 6 above.

In 1925/26, in Great Britain the index of weekly real wages nearly reached the pre-war level, the costs of living were stable at a low level and the rate of unemployment was stable at a high level; only the index of manufacturing production reached the pre-war level first in 1929. As a consequence of these "stable times", the number of automobiles in use overtook that of motor-cycles in use. Now the path of motorisation development was dominated by the automobile. The following graph 12 shows the German situation.

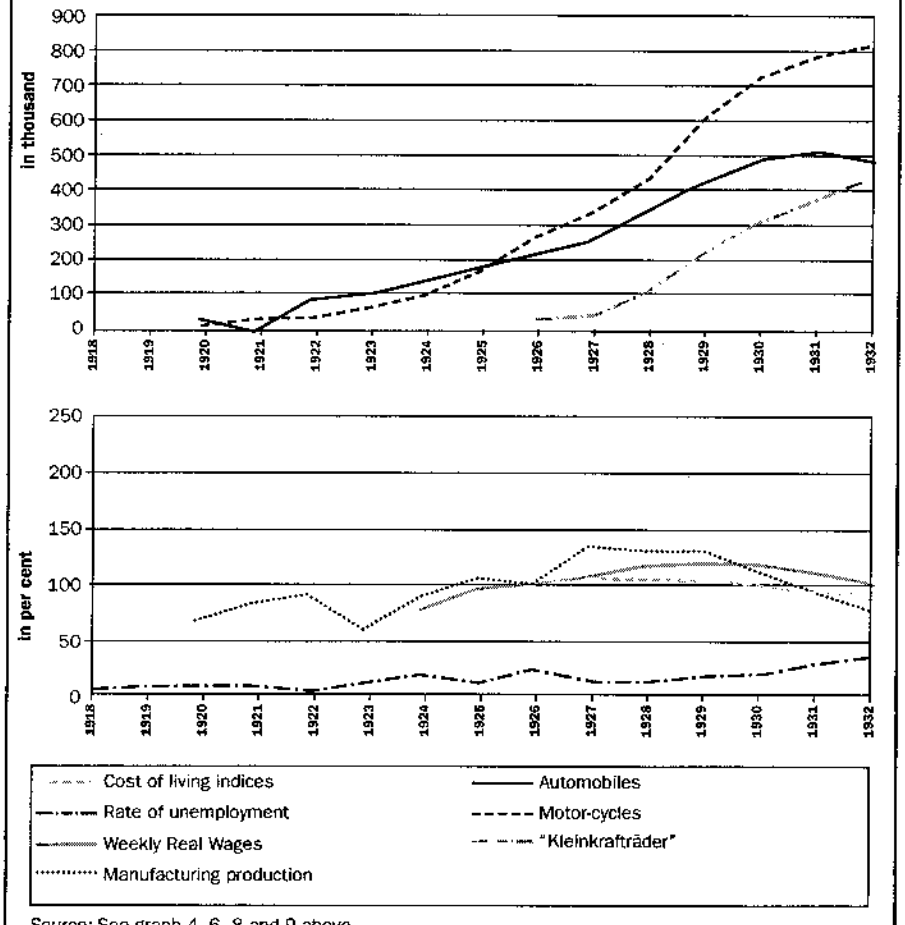
GRAPH 11: All vehicles in use, combined with graphs concerning some macroeconomic indicators (Great Britain)



Source: See graph 4, 6, 8 and 9 above.

At the same time, in Germany, the index of weekly real wages had not yet reached its pre-war level; this occurred first in 1927/28. The costs of living were stable, in comparison to the hyperinflation years before. The rate of unemployment was very volatile. The annual index of manufacturing production showed greater fluctuations compared with Great Britain, but reached its pre-war level earlier, in 1927, and expanded more quickly subsequently. But in contrast to Great Britain,

GRAPH 12: All vehicles in use, combined with graphs of some macroeconomic indicators (Germany)



Source: See graph 4, 6, 8 and 9 above.

the number of motor-cycles in use overtook that of the automobiles in use 1924/25. In Germany, it seemed that the population was more sceptical of the future, understandably because of the uncertain economic events during the past years.

As further elements of explanation of the demand-side factors discussed above, we analyse factors on the supply side, but since these are discrete variables, we do not present any graphs.

The growth in motor-cycles was promoted in Germany by a significant change in the government's tax policy in 1926. However, Britain's government lowered tax-rates on automobiles continuously from 1922 and tax-rates on motor-cycles remained stable. In both countries competition between motor-cycle firms was not hindered and partial economies of scale together with price reductions were realised. Despite the low prices and quality offered by foreign firms, the German automobile industry tended to secure high prices for its products by forming cartels. The motor-cycle industry did this first at the beginning of the 1930s. By the mid-1920s, German motor-cycle firms began to produce more and more lower-engined and cheaper models.

These developments in Germany and Great Britain were accentuated by the economic effects of the Great Depression. During the period 1929 - 1932 Germany suffered economically more than Great Britain, as the figures of macroeconomic aggregates show. Therefore German motoring generally resorted to light-engined and cheap motor-cycles. This tendency indicates quantitatively a further diffusion of motor-cycle technology, but on a level that was technologically inferior although an economically indispensable standard. Using the terminology of the diffusion theory, the "newer generation" of German motor-cycles during the Great Depression were characterised by a lower level of technical performance, but by remarkably reduced buying and running costs. This was an economic advantage that was decisive during the time of crisis. Thus, new potential adopters of cheaper motor-cycle technology went into action.

The British motor-cycle industry, however, produced primarily heavy powered and expensive models and exported, on average, a significant one third of its total production. Consequently, the costs and prices of

these motor-cycles do not differ significantly from those of small automobiles - in contrast to the German case. After a nearly similar post-war pattern, in the middle of the 1920s the motor-cycle industries in both countries chose different paths of development. In Germany, a broad process of motorisation with motor-cycles occurred, caused by the "unstable" macroeconomic circumstances that affected the demand-side and by government incentives as well as the production-structure of motor-cycle firms on the supply-side. In Great Britain, a wider diffusion of the automobile occurred, caused by a "slower but stable" macroeconomic situation on the demand side and government incentives for automobiles as well as by the inflexible, export orientated reactions of motor-cycle firms on the supply-side. As a result, in 1930 the number of motor-cycles in use in Germany exceeded the number in Great Britain.

From the perspective of the supplying firms a similar development in both countries can be observed: In Germany and Great Britain, the number of brands expanded very quickly - earlier in Great Britain, but with more new brands in Germany. Market forces, however, removed most of the marginal sellers and most of the ready-made manufacturers founded in years of overshooting demand. In addition, in many cases not only technological but financial and organisational innovations responded to demand, such as the introduction of hire purchase sales and better service, which helped the industry to survive the generally bad economic circumstances. In this respect, German firms were more innovative than British ones, and more flexible in meeting the requirements of an "adaptation" process of the motor-cycle market.