Synthetic Rubber in the German War Economy. A Case of Economic Dependence

Douglas Todd [1]
H. M. Treasury, London

The event of war places strains on a nation's economy of many kinds. In particular, it becomes attractive for opponents to try and cut off or obstruct supply lines of strategic imported raw materials to the enemy through the imposition of blockades. In both World Wars this strategy was employed with varying degrees of success. The use of German U boats to disrupt and prevent supplies reaching Britain from the United States is well known. Similarly, the Allied Forces introduced a complex series of blockade measures and manoeuvres designed to weaken the German economy.[2]

A country exposed through dependence on foreign supplies of a commodity can react in several ways. In desperate circumstances it may be driven to the extreme of trying to reproduce the commodity in the home economy. Such strategies, of course, are not unknown in peacetime. There are numerous examples of nations which have imposed a tariff or quota system on the import of a commodity for the specific purpose of fostering the development of a domestic industry, in other words encouraging import substitution. The war situation of course is different. The matter is not one of simply re-allocating domestic resources in order to shift comparative advantage to further national development in the longer term. Rather, it can be the more immediate question of survival.

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[1] The author is a Senior Economic Adviser in H. M. Treasury. This article has been written in an entirely personal capacity and the usual disclaimer applies to the above and any other Government Department.

[2] See W. N. MEDLICOTT, 'The Economic Blockade' Vols I and II, HMSO, London, 1952.

The case of synthetic rubber in Germany provides an interesting example of an industry which developed initially in peace time under protection but which achieved its most rapid growth in the war economy.

Early Developments

It is helpful at the outset to outline some features of the development of synthetic rubber and of the experience and part played by German interests. These were to prove very important during the war years.

The product was discovered in various forms [3] by Russian, British and German researchers in the latter part of the nineteenth and early twentiath centuries. Interest was confined largely to experimentation on a laboratory scale and certainly, the early examples of synthetic rubber were technically far inferior to the natural product and very expensive. Progress in research continued, slowly, but during the first two decades of this century, increased natural rubber prices as a result firstly of the Great War and later through the rapid development of the US automobile industry, added a stimulus. Between 1901 and 1910, the price of natural rubber quadrupled.

German interests in the synthetic substitute product departed sharply from the research level only with the onset of wide-scale military offensives. For the first time the economy was cut off from a large proportion of total world supply since the Far Eastern plantations were dominated by British and other anti-German interests. The strategic importance of the material was such that Germany faced the prospect of losing a battle which had hardly started.

At a technical level German interests were centered around a Russian production process developed by S Kondakov in 1901. This method enabled a synthetic polymer to be derived from methyl. The Russians had tried to make production of methyl synthetic rubber a feasible commercial proposition and failed. However, the Bayer Company took up the challenge and by 1915 their plant at Leverkusen was producting two kinds of synthetic; a hard variety known as Methyl ' H ', and a softer product Methyl ' R '.

Information on the synthetic is sparse but the evidence suggests that the production process was crude, inefficient and expensive. The actual production rate is estimated to have been roughly 160 lbs per month and costs ran in terms

[3] The actual breakdown of natural rubber into its component parts was achieved first by Michael Faraday in 1826. The continuing problem was how to synthesise these components. For a detailed account of the early technical developments See W. WOODRUFFE, ' An Inquiry into the Origins of Invention and the Intercontinental Diffusion of Techniques of Production in the Rubber Industry '; Economic Record, Vol. 38, 1962, pp. 479–497.

of 70 pence to 80 pence per lb [4] about twice the price of natural rubber. One account relates how heavy German military wagons which were equipped with solid synthetic rubber tyres had to be raised up on jacks every night after a long journey in order to prevent 'flats' developing.[5] In spite of these technical difficulties, the German military was kept functioning.

With the return of peace in 1918, the Bayer Company dropped production of methyl rubber when supplies of natural rubber became available again. The indications are that those interested in synthetic rubber were becoming convinced that it was impossible to compete with the natural rubber product. Nevertheless, experience in Germany during the Great War had fostered a strong desire for some measure of independence.

In the mid 1920's the Bayer Company entered into an agreement with I G Farben, the giant chemical firm for the purpose of furthering research in synthetic rubber. The most significant development in research effort however, occurred in 1929 when I G Farben and the Standard Oil Company of New Jersey in the United States signed a formal contract which became known as the 'Division of Fields Agreement'. The Agreement contained a clause to the effect that each party should keep to its own field of interest. The IG was concerned mainly with chemicals, Standard primarily with petroleum and petroleum products. Certain minority rights were offered to Standard with regard to new processes for obtaining chemical products from oil or natural gas.

More significant was the condition that because I G had discovered an efficient method of deriving oil from coal, the Agreement "allocated any pooled patents and techniques to I G Farben for use in any part of the world, including the US. and to Standard the use of combined patents in any part of the world" excluding Germany.

Hence, Standard made its oil discoveries available to Germany through the I G while the latter retained control of its chemical processes everywhere including the United States.' " [6]

In 1930 the Joint American Study Company (JASCO) was set up for the purpose of handling the exchange of technical information under the 1929 Agreement. The capital of this company was owned jointly by Standard and the I G.

Events now began to move more quickly. Important discoveries were made on both sides of the Atlantic. In 1931 the Reverend J A Nieuwland, a professor of chemistry at Notre Dame University developed a heat resistant

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[4] All prices given in this paper are current prices, that is prices of the day.

[5] P. SCHIDROWITZ and T. R. DAWSON, 'History of the Rubber Industry', W. HEFFER and SONS, Cambridge, 1952 (p. 102).

[6] This feature of the Agreement has been heavily criticised by numerous writers on the subject of international cartels in the inter-war period. See for example, EDWARD S. MASON, 'Controlling World Trade', New York. McGraw Hill, 1946.

variety of rubber, now known as Neoprene. The Du Pont Company began to produce this on a tiny scale. The German researchers E Tschunker and W. Bock then developed the first of the famous ' Buna S ' general purpose synthetics. This was the first variety which could be regarded as a potentially serious competitor to natural rubber, particularly in the small and medium sized tyre market.[7] Nevertheless, Buna-' S ' in the early 1930's was still a comparatively rudimentary substitute and by no means as refined as the modern product.

The German ' Four Year Plan ' lauched in 1933 placed much importance on rubber generally and on the development of an independent synthetic product; the intention being to construct a plant capable of producing 1000 tons of Buna-' S ' per month within three years (this figure represented about 13 per cent of German consumption of natural rubber). In order to provide the required stimulus, the German Government imposed a combination of heavy duties and direct controls on all natural rubber imports with the result that for some time, considerable quantities of an inferior synthetic was absorbed under compulsion by German manufacturers. For example in 1938 the German Government issued an order that all bicycle tyres should be produced from synthetic rubber. Further, a general economy drive in the use of all rubber was launched. Consumption from both scrap, and reclaimed rubber and stock-building rose rapidly.[8] Two years later first, the German chemists Konrad and Tshunker produced what was then called ' Buna-N ', an oil-resistant variety (the modern name is Nitrile rubber). Because this product fell within the oil-natural gas interest, it was duly patented for production in the United States in 1937. Next, the Americans W. J. Sparks and R. M. Thomas of the Standard Oil Company produced the new now widely used ' Butyl ' synthetic which possesses outstanding resistance to air deterioration.[9]

Production volume however, seems to have increased most rapidly in the Soviet Union. Little is known about the precise nature of their industrial

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[7] The modern equivalent to Buna-' S ' is SBR (styrene-Butadiene rubber and formerly called GR-S in the United States).

[8] A similar reclaiming policy took place in Russia at the same time also. One commentator suggested that the Russians were using machines made in the UK which had no such policy. This was a point of some concern. See Hansard 3rd February 1942, col. 1128, House of Commons.

[9] The problems and controversies which arose concerning the transfer of technology through the Division of Fields Agreement are given a throrough airing in FRANK HOWARD's book ' Buna Rubber ', New York, D. Van Nostrand, 1947. In fact, Howard who was employed by Standard Oil played a central role in the working of JASCO and the Division of Fields Agreement. He did not emerge unscathed and was criticised strongly for his overly lenient attitude towards I. G. Farben (see G. STOCKING and M. W. WATKINS, ' Cartels in Action ', New York, The Twentieth Century Fund, 1946, pp. 98-100).

effort but by 1938, world synthetic rubber production could be summarised by the figures in Table I.

TABLE I

SYNTHETIC RUBBER PRODUCTION (LONG TONS)

	USSR	Germany	USA
1938	53000	5482	Experimental Quantities only

Russian chemists certainly were foremost in the early research but the basis for their comparatively large output remains something of a mystery. It is likely that petroleum was not used as a source of derivatives. Rather, the base products or monomers were based probably on the agricultural sector and obtained from starch, the chief source of which was potatoes and grain.

The War Years

The first German synthetic rubber plant set up under the Nazi four year plan was located at Schkopau. Others quickly followed, each acting as a testing ground where new techniques could be mastered and personnel trained. This method turned out to be extremely important with one plant learning from the others' errors.

TABLE II

GERMAN IMPORTS OF NATURAL RUBBER (,000 LONG TONS) [10]

1937	1938	1939	1940	1941	1942	1943	1944	1945
98	90	80	16	26	24	NA	NA	NA

German consumption of natural rubber in 1937 represented some 10 per cent of total world consumption. It can be seen from Table II above that imports began to decline rapidly. To compensate, however, domestic production of synthetic was rising sharply. By 1943, three large plants were producing well over 100,000 tons and a further installation was to come on stream later in that year. This time the German economy was not being caught unawares. It would be wrong entirely to suggest that German industry was able to continue operating with synthetic as if no change had occurred. We shall see later

[10] 'Plantation Crops' - Commonwealth Economic Committee Publications, 1950.

that difficulties were experienced, particularly in those sectors where natural rubber had overwhelming technical advantages, eg very large vehicle tyres. Nevertheless, all the indications are that Germany was able to maintain a sustained offensive. Her military forces were widespread and a large proportion of her vehicles were serviceable on the new Buna synthetic tyres. All of the German synthetic facilities were owned and operated by I. G. Farben.

TABLE III

GERMAN TOTAL SYNTHETIC RUBBER PRODUCTION (TONS) [11]

	1937	1938	1939	1940	1941	1942	1943	1944
General Purpose	2510	4634	21702	39035	68520	96990	114185	100665
Special Purpose	637	848	649	1431	1955	2721	3388	2590
Total	3147	5482	22351	40466	70475	99711	117573	103255

Table III illustrates the scale of the German effort where peak production of all synthetic types was achieved in 1943. In fact, by 1941, the synthetic production facilities were satisfying nearly the whole of immediate pre-war German total rubber consumption.

With the ending of the war allied inspection teams were able to asses accurately the true performance and significance of the German drive for self-sufficiency in synthetic rubber. From the Reports of both the British Intelligence Organisation and the Combined Intelligence Organisation investigation teams it is possible to make some rudimentary yet interesting comparisons of performance.

Table IV provides a summary and highly fragmented breakdown of production and unit costs for the three large plants. The Schkopau unit was fully integrated insofar as the base products (or monomers) from which synthetic rubber is derived, namely butadiene and styrene were manufactured also in the same installation. The plant, began in 1937, was almost fully completed by mid-1939, continued to operate right through the war. At the present time it is located and operating in East Germany. Table V presents a more detailed picture of the broad relationship between actual output and unit production costs. It would be dangerous to infer too much from these figures. The plants individually suffered from strategic bombing to a varying degree. For example, the sharply rising unit cost figure in the Hüls plant for 1943 Q3 was caused by the destruction by allied bombing of the main reactor unit.[12]

[11] H. BARRON, *Modern Synthetic Rubbers*, London: Capman and Hall Ltd, 1942.

[12] The Allied Combined Bomber Offensive included the German synthetic rubber plants as major objectives of strategy. See MEDLICOTT, *Op. cit.*, Volume II pp. 392-3.

TABLE IV

PRODUCTION AND COSTS - SUMMARY [1]

	Schkopau [a]		Hüls [b]		Ludwigshafen [c]		Leverkusen [d]	
	Output	Cost	Output	Cost	Output	Cost	Output	Cost
1937	2,110	48.3						
1938	3,994	45.5						
1939	20,173	33.3					1,126	
1940	34,899	26.0	2,226				1,898	
1941	40,705	25.0	25,020				2,641	
1942	57,313	26.6	36,680	29.2			2,814	
1943	67,703	NA	34,693	39.6	7,181		3,656	
				(28.4)				
1944	45,564	NA	39,105	28.0	11,955		3,129	50.8

[1] Notes to Table. All figures are for Buna-S with the exception of the Leverkusen plant which refer to Buna-N. Costs are expressed in US cents per lb – the conversion rates used were $ 1 US = 2.84 RM. The Huls 1943 figure is distorted by the effects of bomb damage in the third quarter; the bracketed figure is an average of the three relatively unaffected quarters.

[a] C105 XXII-22, Item 22, 'Synthetic Rubber Plant at Schkopau'
[b] C105 XXII-22, Item 21, 'Synthetic Rubber Plant at Hüls'
[c] C105 XXII- -, Item 22, 'I G Plant at Ludwigshafen'
[d] C105 XXIII- 4, Item 22, 'I G Farben - Leverkusen Works'.

A further indication of performance can be obtained by comparing planned and actual production rates across the plants. Table VI provides one measure of the achievement level through the years 1943 and 1944. The two largest plants, Schkopau and Hüls were very successful until the second half of 1944. Indeed, apart from 1943 Q3 at Hüls, production at these two plants never fell below 90 per cent of the planned figures until the second quarter of 1944. Although Hüls produced its own base products also, this level of performance is quite remarkable given the incredibly disruptive nature of productive conditions and the German domestic war environment generally. Although not quite as large as Schkopau, the Hüls plant incorporated an electric arc cracking process and was regarded as being the most modern and up to date of the three big units.

The Ludwigshafen installation was somewhat smaller and never achieved anything like the efficiency level of the two larger plants. The lack of vertical integration led predictably to supply shortages of basic feedstock and this together with bomb damage explains its somewhat poorer performance.

Leverkusen operated primarily as a research establishment rather than a production unit. Output was very small consisting mainly of the Buna-'N' variety. It is of interest to note that following detailed investigation of perfor-

TABLE V

BUNA-'S' MANUFACTURING COSTS (US CENT PER LB) AND OUTPUT (TONS) [1]

	Schkopau		Hüls		Ludwigshafen	
	Output	Cost	Output	Cost	output	Cost
1942 Q1			3,658	—		
2			8,942	30		
3			9.906	31		
4			10,695	26.6		
1943 Q1	16,249	24	11,327	26	153	
2	19,229	25	10,249	25	2,065	
3	17,357	24	2,668	73.3	1,812	
4	17,868	24	10,247	34.3	3,147	
1944 Q1	17,845	21.6	11,928	24	4,286	
2	14,020	26.0	9,921	28.3	5,137	36
3	6,620	26.0	9,987	31.6	2,267	
4	6,079	26.0	7,259	—	366	

[1] All figures are derived from material in the sources given in Notes to Table I.

TABLE VI

PLANNED AND ACTUAL TOTALS OF BUNA 'S' PRODUCED IN THE GERMAN [1] WAR ECONOMY - 1943 AND 1944
(tons per months - average)

1943	Schkopau	Hüls	Ludwigshafen	Total
1st Qtr.	6000 (5416)	3300 (3754)	300 (51)	9600 (9221)
2nd	6000 (5409)	3300 (3409)	900 (688)	10200 (9605)
3rd	6000 (5752)	3550 (845)	1500 (603)	11050 (7400)
4th	6000 (5956)	3800 (3389)	2000 (1049)	11800 (10394)
1944				
1st Qtr.	6000 (5948)	4000 (3976)	2000 (1425)	12000 (11349)
2nd	6000 (4673)	4000 (3307)	2000 (1712)	12000 (9692)
3rd	6000 (2207)	4000 (3329)	2000 (756)	12000 (6292)
4th	6000 (2026)	4000 (2420)	2000 (89)	12000 (4535)

[1] CIOS-XII-7, Item 22 - 'The I G Plant at Ludwigshafen' (pp. 18-19). The bracketed figures are for actual production totals achieved.

mance and methods, the allied inspection teams declared it — ' probably the best equipped and most modern plant of its kind in the world '.[13]

An obvious question to ask is how the production costs of general purpose synthetic (Buna-' S ') compared with natural rubber in the world market. First of all, Barron[14] suggests that the average price of all Buna-' S ' sold in Germany through 1944 was roughly 35 US cents per lb. Further, he estimates that production costs were about two thirds of this for the best period. Natural rubber was priced then at 22-30 US cents, that is about 15-35 per cent below the price of Buna-' S ' in the German economy. It should be mentioned that following the fall of Pearl Harbour the German economy gained some access to supplies of the natural product, hence dependence on synthetic was not complete. The allied blockades were, however, to prove very effective. In fact, the COIS investigations show that the Germans costed natural rubber at only 9.2 US cents per lb in making comparisons with synthetic unit costs for the Ludwigshafen plant.[15]

Taking these figures and regarding the price of natural rubber as the opportunity cost (shadow price) of producing output using the synthetic input, the available statistics for German GDP and Industrial Output suggest a crude resource cost of between 0.03 and 0.05 per cent of GDP. Measured in terms of Industrial Output which in 1936 was 31 per cent of German GDP, the figures are scaled up to roughly between 0.5 and 1.5 per cent. It must be emphasised of course that such a calculation is very rudimentary. It takes no real account of the true manufactiring costs of absorbing the technically inferior synthetic. Many of the observed inefficiencies in a typical manufacturing process and in the performance of the final product would not be recorded in the German National Accounts. It is difficult enough to imagine the conceptual problems now and in the late 1930's one must remamber that national economic accounting was in its infancy.

A fourth large unit with a planned capacity of 100,000 tons was to have been constructed at Auschwitz; the project was stillborn. Nevertheless, the drive was successful insofar as the German war effort on many fronts was maintained. Yet, in spite of the fact that all but the heaviest German vehicles were run on Buna-' S ' tyres, it cannot be claimed that adaptation was complete and painless. Dr Stocklin, the Leverkusen research chemist, when interviewed following the allied occupation, thought that Buna-' S ' had many technical disadvantages. He doubted very much whether it would have been used had natural rubber been freely availaole.[16] Further, I G Farben had experienced considerable difficulty in correlating abrasion resistance, tear resistance and

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[13] CIOS XXIII - 4, Item 22 - I. G. FARBEN, ' Leverkusen WORKS ', p. 4.

[14] BARRON, *Op. cit.*, p. 49.

[15] COIS XXI-7. Item 22, *op. cit.*

[16] BIOS 659, Item 22, ' Interview with Dr. Stocklin '.

hysteresis in a single artificial compound. In other words, Buna-' S ' products, particularly tyres had a reduced life.[17] As mentioned already, this was particularly true of heavy vehicle tyres; a deficiency which to this day has not been remedied.

There is evidence of an internal conflict of opinion on the success of the synthetic production programme. In the summer of 1944, Professor Albert Speer, Minister of Armaments and War Production, .was claiming that all plants had reached a capacity which would permit independence from imports for long periods of time. At the same time, however, others were arguing for more natural rubber imports so as to avoid a fall in product quality. Repair work for example, could at that time be effected only with natural rubber. Synthetic was next to useless for this.[18] Further, Professor Milward in his recent volume states ' Hitler had great hopes that Germany's reliance on expensive synthetic rubber might be ended by producing rubber on a large scale in Russia from the Russian dandelion and a special factory was erected. . . in the Ukraine for the purpose under direct control of the SS '.[19]

Some Further Comparisons

A feature concerning the role of synthetic rubber in the Second World War is that a major adversary of Germany, namely the USA found itself in an identical or even worse situation when immediately following the fall of Pearl Harbour, it was cut-off from supplies of natural rubber in the Far East. The situation was even more desperate insofar as the American economy had not considered seriously the prospect of commercial production of synthetic. This was despite the fact that it was a research partner with Germany in the inter-war period. The details of the American solution are not set out since they are documented admirably alsewhere.[20] Suffice it is to say that in the absence of synthetic, neither Germany nor the USA could have fought a war; that much now seems certain.[21]

Whilst the German programme was a major achievement, it is of some interest to compare the economic basis of this with that of the equally remarkable American effort. In 1941, the price of the US equivalent to Buna-' S ', ie GR-S (known now throughout the world as SBR — styrene — butadiene

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[17] It should be noted that all other countries experienced these same defects.

[18] See MEDLICOTT, *Op. cit.*, Vol. II, p. 401, 451-2. Also BIOS 659, Item 22, *Op. cit.*

[19] ALAN S. MILWARD, ' War, Economy and Society 1939-1945 ', Allen Lane London 1977, pp. 264-265.

[20] See for example F. A. HOWARD, *op. cit.* CHARLES F. PHILLIPS JR., ' Competition in the Synthetic Rubber Industry ', University of North Carolina Press, 1961.

[21] See US Special Committee to study the Rubber Situation, " Report of the Rubber Survey Committee ' 1942 (Baruch Report).

rubber) was 60 cents per lb; natural rubber was being purchased at 25 cents per lb.[22] The product was produced using two methods. The least efficient and first expedient was a crude alcohol process. Unit costs were 48-50 cents per lb. The second petroleum based process which is the early equivalent of modern production methods effected a dramatic cost reduction to 18-22.5 cents per lb.[23] But, this latter technique was introduced relatively late in the war.

From the CIOS inspections it is possible to make a somewhat closer comparison with the most efficient methods in the United States. The Table below for the Ludwigshafen plant and an average of US production facilities give operating costs under the most favourable conditions.

Buna- 'S' Manufacturing Costs at Ludwigshafen [24]	*cents-US per lb*
Units costs for the best quarter (March 1944)	36
Unit costs with full planned production (30,000 tons per annum)	31.6
Unit costs in 1945 peace conditions	26.6
Most optimistic unit cost assuming continued progress	24.0

USA; GR-S Manufacturing Costs - May 1944 [25]	*cents-US per lb*
Material and Labour	13.8
Research, Administration and Freight	1.1
Depreciation and Interest	3.6
Total	18.5

The United States figures above are all ex ante averages over the entire range of GR-S plants and hence conceal wide variations. Actual production costs varied from 27.2 to 14 cents per lb. The indications therefore are that the German production units, suffering from continued disruptions, breaks in supply lines and factory dislocations were unable to match the most efficient plants in the USA by mid-1944.

It is known from engineering studies that significant scale economies exist in synthetic rubber production. A fully integrated United States SBR plant of 30,000 tons capacity (very small by today's standards) could at the end of the war produce at a unit cost of about 19.5 cents per lb.[26] A plant of 100,000 tons capacity would be capable of producing at about 2.3 cents below this.

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[22] BARRON, *op. cit.*, p. 48.

[23] US Tariff Commission - 'Rubber' (War changes in industry No. 6), p. 7. See also P. T. BAUER, "The Rubber Industry', Cambridge, 1948, p. 299.

[24] CIOS XXI-7, Item 22.

[25] US Tariff Commission - 'Rubber' (War Changes in Industry No. 6), p. 7.

[26] J. F. BOHMFALK, 'Chemical and Engineering News', 24 July, 1950, pp. 2504-2509.

These estimates assume a petroleum based feedstock process. Further, the short run unit cost curve declines very sharply as capacity output at given plant size is approached. Between 50 and 90 per cent capacity, unit costs were estimated to 18 cents per lb.[27,28]

If these figures are taken as only a very rough indication of US performance at the end of the war, the impression is that the American economy was more successful in developing a reliable industry. Yet, over the greater part of US involvement, there is no evidence which suggests that they were economically more efficient than the German installations. The US petroleum based method did not begin to yield significant returns until mid-1944 and up to this time, synthetic rubber was both expensive and almost certainly no better technically than the German product. One highly informed post-war observer suggests that the average cost of all GR-S produced in the USA during the war was as as high as 32 cents per lb.[29]

Concluding Remarks

Foreign trade controls together with international information agreements jointly fostered the development of a synthetic rubber industry in Germany. It can be argued therefore that the onset of war in 1939 did not create disruptive conditions with the same force as those experienced in World War I. Certainly the American economy which had been a partner in the information exchange agreements did not use this information in the same way and was thus caught unprepared.

There seems to be no evidence which suggests that general purpose synthetic rubber was technically inferior in Germany. Indeed, it is likely that German manufacturers in the war conditions were able to adapt more quickly given their experience of import controls on supplies of natural rubber during the inter-war period. The major advance in efficiency in the US came not in product development but in the feedstock production process. Thus a significant reduction in unit costs occurred only in the late stages of the war. On average therefore and bearing in mind the increasing extreme environment created by the allied offensives, the German demands some comparison with the more sheltered United States facilities.

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[27] BOHMFALK, *op. cit.*

[28] A warning is necessary here. These figures are engineering figures; they do not imply that any given plant would have been capable of achieving them in practice. Managerial, organisational and other so-called X efficiency factors may well have constrained performance. Identifying the technical unit cost curve is one thing. Being able to actually operate on the curve itself is a function of many aspects of a plants *overall* efficiency.

[29] J. COLLYER, 'India Rubber World III', 1945, p. 560.

Lastly, it is of some significance to observe that once hostilities ceased, nearly all countries moved back rapidly to using natural rubber. The resource costs of using synthetic proved to be too great. The German plants in the western zone were dismantled as part of reparations. I G Farben was split up into three companies and it was only in 1953 that Dr. Erhard suggested the resumption of synthetic rubber production based upon the experience of I G.

In the USA nearly all of the plants, being Government facilities, were put into mothball. Eventually they were auctioned off to the private sector in 1955. Thereafter the American industry developed at an astonishing speed; it now produces about 70 per cent of total world supplies.