Growth of the Modern Chinese Coal Industry

An Analysis of Supply and Demand, 1896-1936

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Until recently most scholars have been content to characterize the prewar Chinese economy as underdeveloped and stagnant. The static concept of underdevelopment, suggesting as it does an economy unable to provide a decent standard of living for its people, certainly describes the situation of prewar China. But it need not necessarily imply that the economy was stagnant; still less does it exclude areas or sectors of growth. Recent studies highlighting such pockets of growth are important as a way not only of achieving a more balanced picture of the economy, but also of avoiding facile overgeneralizations about the forces retarding Chinese development as a whole. Modern industry was one such sector where substantial growth did occur.

AUTHOR'S NOTE: *This article is based on a larger study I am preparing on the development of the Chinese coal industry, 1895-1937. I would like to thank Joe Moore and the other members of the seminars at the Department of Far Eastern History, Australian National University, and the Department of Economic History, University of New South Wales, for their helpful comments. The article has also benefited greatly from the suggestions made by the editor and referees of* Modern China. *I am particularly indebted to Professors Sydney Crawcour and Shannon Brown for their careful reading of drafts of the article and their help especially in matters of economic interpretation. Any mistakes that remain are my own.*

MODERN CHINA, Vol. 7 No. 3, July 1981 317-350

Previous discussions of Chinese industry have focused mainly on its supposed failure to develop, and have adduced various causes for this, ranging from the impact of imperialism or the feudal nature of Chinese society to the poverty of the Chinese peasant and the low level of agricultural technology. In fact, however, modern industry in China did grow substantially in the forty years after the Treaty of Shimonoseki (Chang, 1969: 74), and so several scholars have recently called for more attention to what did develop and to the factors behind it (Mah, 1977: 328; Donnithorne, 1977: 340).

This article makes a contribution in that direction by examining the growth of one of China's largest industries, coal-mining, between 1896 and 1936. For this purpose it uses a framework developed by American historians for the study of the history of industrial expansion, and focuses on changes in the supply and demand for coal occurring over this period, and on the most important causes of those changes (Fogel and Engerman, 1971: 98-162). Although the Chinese data will not permit the sort of sophisticated quantitative work done on American economic history, the quantitative and qualitative evidence available is sufficient to permit the formulation of reasonable and consistent conclusions.

The use of this framework implies a concentration on the analysis of the growth of the sector involved rather than directly on the explanation of the underdevelopment or supposed stagnation of the economy as a whole. Moreover, it directs the researcher's attention toward the growth of total output from modern mines, without distinguishing between, for example, that from Chinese and that from foreign mines. Total output is not the only important feature of an economy, but it is definitely one, and many discussions of the factors retarding Chinese growth have in the past used material bearing mainly on the fate of individual firms or groups of firms, leaving the question as to the effect on total output begging.

The coal industry was one of China's largest and most important industries. In terms of net value added (in 1933) only the

cotton textile and tobacco industries ranked with it in size, while only cotton textiles employed as many workers (Liu and Yeh, 1965: 69, 143, 569, 575). Moreover, coal, as an intermediate good, had a wide influence on the operation of other industries and areas of the economy. Between 1896 and 1936 output of coal from modern mines in China grew on average by 11.2% per annum. A major break in the trend occurred around the early 1910s: Output grew at 17.4% between 1896 and 1913 (and at 21.6% between 1902 and 1913), but only at 5.5% between 1914 and 1936 (see Table 1).[1] There were also a number of short-term fluctuations. Wartime conditions meant continued strong growth in the late 1910s, though at rates slightly lower than in earlier years. Growth was reduced during the civil wars of the 1920s, but resumed strongly in the mid-1930s. Interesting though these fluctuations are in their own right, however, the growth of output was sufficiently even to justify a general treatment of the factors influencing it. Moreover, while some attention is given to regional variations in the development of the industry, as a whole the article abstracts from these differences and presents an overview.

THE SUPPLY OF COAL

Before the start of modernization, the cost of coal production in a particular field was relatively constant, until the deposits accessible with traditional technology were worked out, after which it rose steeply. Many areas had coal near the surface which small mines could exploit, and so there was little prospect for an almost indefinite future of the exhaustion of accessible deposits nationally at the levels of demand then current. In fact, however, the high costs of distribution, especially over land, meant that consumers could take coal only from a mine very close by or from one for which water transport was readily available. Thus, small areas tended to be worked intensively and in some cases to reach the point of sharply rising production costs. The

TABLE 1
Chinese Coal Output, 1896-1936 (in thousands of tons)

Year	Output from modern mines	Total output
1896	489	
1897	539	
1898	783	
1899	842	
1900	n.a.	
1901	521	
1902	954	
1903	1,026	
1904	1,274	
1905	1,345	
1906	1,696	
1907	2,189	
1908	2,788	
1909	3,868	
1910	4,183	
1911	5,137	
1912	5,314	(9,068)
1913	7,678	12,880
1914	7,974	14,182
1915	8,493	13,497
1916	9,483	15,983
1917	10,479	16,982
1918	11,109	18,432
1919	12,805	20,147
1920	14,131	21,319
1921	13,350	20,507
1922	14,060	21,140
1923	16,973	24,552
1924	18,525	25,781
1925	17,538	24,255
1926	15,617	23,040
1927	17,694	24,172
1928	17,980	25,092
1929	18,854	25,437
1930	19,892	26,037
1931	21,093	27,245
1932	20,213	26,376
1933	22,075	28,379
1934	25,801	32,725
1935	30,093	36,092
1936	33,794	39,903

SOURCES: See note 1.
NOTE: n.a. = not available. Both this table and the discussion in the article as a whole exclude output in Taiwan but include that in Manchuria over the whole period.

importance of distribution costs in influencing the pattern of coal production was indeed as great as that of mining costs, not only at this but at all stages of the industry's development.

Several factors could influence the cost of mining coal in the long term. Technical progress and modernization might reduce

production costs, or allow more coal to be produced at a constant cost. Costs might also be raised or lowered by changes in the prices of the main inputs—land, labor, and capital—which might result either from an inelastic supply of the input as the industry expanded or from developments outside the industry.

In non-pit-head markets, changes in the cost of distribution were at least as important as those in the cost of extraction. Here, new or improved methods of transport could reduce the very sharp increases in the price of coal with increasing distance from the mine.

COAL RESERVES

The nonreproducible nature of the raw materials in an extractive industry imposes on it rising costs, at least in the very long term. Even apart from the role of OPEC, this feature has already become clear in the oil industry. In Japan rises in the price of coal were attributed as early as 1884 to the exhaustion of the deposits, and its shortage of resources led to Japan becoming a net importer of coal from the early 1920s (Imperial Maritime Customs, 1885: 16; Saitō, 1938: 179-181).

China's coal reserves are, however, very large. Even in the 1930s they were estimated at something over 200,000 million tons (Yuan-li Wu, 1963: 35), sufficient for over 5000 years of production at 1930s levels of output. While economically viable reserves, given existing means of transport, were less than this, the availability of resources was never likely in our period to hamper the growth of output in China. Nor was the supply of coking coal, which has troubled planners since 1949 (Hsia, 1971: 124; Howe, 1978: 107), a constraint before 1937, as the demand from the infant iron and steel industry was still at a very low level. The very paucity of information in the sources on rents and royalty payments implies that the cost of land (and raw materials) was not a major problem for the industry, and that the supply of raw materials was easily able to expand along with inputs of other factors. The mines at Jiaozuo in Henan paid only 0.04 taels per ton to landowners in 1915; although this rose by stages to 10 cents in 1933, this was still only about 2% of

the selling price, lower than the 1/35 paid on average in Britain in 1918, which in turn was the product of a long process of attrition of royalty payments from levels of around 20% in the early nineteenth century (Kuangye zhoubao, 28 April 1933: 1107; 21 October 1935: 676-677; Griffin, 1977: 20).

THE SUPPLY OF CAPITAL

While contemporary sources showed little concern at the availability of natural resources, many studies of coal mines, especially of Chinese-owned ones, suggested that "shortage of capital" was a central reason for their failure to develop (Gong, 1933: 112, 209; Jianshe weiyuanhui gongbao, June 1930: 95-96). Some theories postulate a highly inelastic supply of capital in underdeveloped countries because of low per-capita income and therefore low savings. Such an argument has been challenged by Baran (1973: 375-376) in general terms, and Riskin and Lippit, using Baran's concepts, have shown that in China there was a substantial surplus over subsistence and that the low level of productive investment cannot in itself and directly be attributed to the paucity of the surplus (Riskin, 1975; Lippit, 1978). If this surplus was not invested in coal mines it was because it was expended in luxury consumption or put to other uses, mostly outside industry, which brought a higher return to the private investor.

Others have stressed institutional constraints on the supply of the available capital to productive industry. No efficient institutions existed in prewar China for funneling this capital into industry. There was no organized capital market, and entrepreneurs recruited equity investment for their industrial enterprises either through personal connections or by telegraphed appeals (Shina kōgyō jihō, November 1922: 116; SMR, Chōsabu, 1937b: 458-459). In an industry like iron and steel, with heavy and indivisible capital requirements, this was a serious hindrance to growth (Rawski, 1975: 215-216), but indivisibilities were much less in coal-mining, where a range of technologies was available both to entrepreneurs opening up a new district and to an established company wishing to increase its output in the

short term without much expenditure of capital. When the Zhejiang provincial government sank mines at Changshan in order to supply coal to Hangzhou, shortage of funds constrained them to use traditional methods to extract the coal. Modern mines like Zhongxing in Shandong in the 1910s and 1920s and Zhongyuan in Henan even in the 1930s also operated small mines using traditional technology to make possible rapid adjustment to market conditions (Kuangye zhoubao, 14 February 1932: 145; 28 November 1936: 370-371; Hou, 1929: 95).

In any case, to show that capital shortage constrained the growth of the industry, it is necessary to demonstrate that insufficient funds were forthcoming, despite a high rate of return. In fact, large investments were made in the Chinese coal industry, as suggested by the increase in coal output alone. No reliable and consistent figures exist, but total investment certainly amounted to several hundred million *yuan*.

Capital came from both foreign and Chinese sources, and there is some evidence from the 1900s that the rate of interest required by foreign capital was lower than that for Chinese capital. While much of the foreign investment made in the period was the result of the "grabbing" of concessions by political or military pressure, many Chinese-controlled companies running mines that were later proved viable were obliged to resort to foreign loans when Chinese funds proved insufficient. Pingxiang in Jiangxi, Zhongxing in Shandong, Liuhegou in Henan, and Lincheng in Hebei were the most outstanding examples of this (Xu, 1947: 32-35, 172-177; Quan, 1972: 82; SMR, Kōgyōbu kōmuka, 1914: 125; Gu, 1916: sec. 8, 59; Wang Jingyu, 1957: 1062, 1111-1112). The reassertion of Chinese sovereignty during the rights-recovery movement ended the granting of new concessions (except in the important case of Manchuria), and from then on the inflow of foreign funds was limited mainly to the development and expansion of existing concessions. The restriction of the raising of capital to Chinese sources alone resulted in a higher cost of capital than would otherwise have been the case.

Chinese sources were, however, prepared to provide capital for profitable projects, particularly from the mid-1910s. Where they failed to do so it was the result more of low (mostly justi-

fiably low) profit expectations for the project in question than of any inelasticity in the supply of capital in general. When the Chinese failed in 1923 to raise their share of capital for the Luda Company in Shandong despite the reputed 30-million-yuan fortune of just one of the promoters, Wang Zhanyuan, it was because the company was, correctly, not seen as a high-earning prospect (Wright, 1980: 716-717). During the 1910s, after the supply of foreign capital had been cut off, and while coal prices were raised by the wartime boom, funds flowed into the industry. Chinese investors laid out large amounts on the equity capital of coal mines, and the rise of a modern Chinese banking system opened another potential source of local funds. Of the four mines, mentioned above, taking out foreign loans, three, Liuhegou, Lincheng, and Zhongxing, were able to redeem them in this period, though only the last of these emerged with a completely healthy financial structure (SMR, Chōsabu, 1937a: 83-90; Shina kōgyō jihō, January 1917: 67; Xu, 1947: 180-184; Kuangye zhoubao, 28 October 1929: 309). Equity investments were greatly diminished from the late 1920s because of much-reduced profit expectations as the civil wars interfered with the distribution of coal, but even mines with at best moderate prospects were still able to raise large loans from the banks: For instance, Liuhegou raised at least six million yuan (Kuangye zhoubao, 28 May 1934: 754). The availability of funds even in these circumstances indicates that capital supply was not a major constraint on the development of the industry.

LABOR

China is, in the popular view, almost the typical example of a country with abundant, indeed overabundant, labor supplies. Yet, in certain areas and at certain times, mining companies did encounter some difficulties in recruiting even unskilled labor. In Manchuria, an area particularly important for coal-mining, the Japanese-owned South Manchurian Railway Company (SMR) experienced during the late 1910s a labor shortage at its Fushun mines, at a time when demand was strong and the

company was making large investments in mining. The SMR was forced temporarily to ration sales in the booming export market, and tackled the problem of finding labor by raising wages and by setting up a system of recruitment offices in Hebei and especially in Shandong, which operated up to the world depression (Wang Qingbin, 1928: 279; SMR, 1928: 564-568).

Nor was supply infinitely elastic in the rest of China; it varied seasonally, particularly in the smaller mines. Both small unmodernized mines, such as those in Meixian, Guangdong, and Hancheng, Shaanxi, and the medium-sized modern mine at Jaiwang in Jiangsu, reported that wages had to be raised when labor was most needed on the farms (Hu, 1931: 311; Kuangye zhoubao, 7 July 1931: 841; 21 October 1931: 1057). More often, small mines closed down completely during the summer months, though demand fluctuations and climatic difficulties also contributed to this phenomenon (Kuangye zhoubao, 21 July 1930: 109). Large modern mines, however, worked throughout the year, and certainly by the 1930s their output showed little if any seasonal pattern; only a few mines, such as those of the Jinbei Company in north Shaanxi, lost a small part of their labor force in the farming season (Kuangye zhoubao, 14 November 1935: 730).

Particularly heavy demand for mining labor in any one area could also lead to a rise in real wages, though the lack of local price figures makes it difficult in many cases to distinguish real-wage from money-wage trends. Even in areas notorious for surplus labor, like Shandong, real wages rose in the Boshan mines during the boom of the late 1910s (Kuangye zhoubao, 14 August 1928: 180), and in 1931 money wages there are said to have risen by a massive 67%, though the north China (Tianjin) index of wholesale prices rose by only 6% that year (Nankai University, 1958: 11; Kuangye zhoubao, 28 July 1932: 499). The only time wages rose on a national scale, however, was in the late 1920s, and that was the result less of any excess demand for labor than of the coming to power of the Nationalist government, which was relatively sympathetic to the miners' demands.

The final problem in postulating a highly elastic supply of labor is the question of its quality. Skilled labor—both technical and supervisory—was certainly in short supply, and, as a result, techniques and organizational forms were adopted that might not otherwise have been the most efficient. For example, contract labor was used to circumvent the shortage of supervisors (Wright, forthcoming), but because of the abundance of small-time entrepreneurs, the type of skills needed for the job of contractor probably did not get more expensive as the industry expanded, so that the higher costs imposed on the industry by the system were fairly constant.

Mining companies overcame the shortage of technicians mainly by importing the foreigners, who, from Kinder at Kaiping in Hebei and Tyzack in Taiwan to Kauffman at Zhongxing, ran most Chinese mines up to the 1910s (Carlson, 1971: 12-13; Irish University Press, 1971: Vol. 11, 587). These engineers were paid salaries considerably higher than those of their Chinese counterparts: in 1915 the Chinese Engineer in Charge at Kailuan's Majiagou mine got 300 yuan/month, the Belgian at the same company's Zhaogezhuang colliery 600 (Gu, 1916: sec. 7, 58, 65; sec. 6, 13 for Jingxing). The greater technical experience of the foreigners may have compensated the companies for this expense. After a gap of fifteen years, Zhongxing reverted to the use of a foreign chief engineer when it embarked on a second period of modernization and expansion in the 1930s (Kuangye zhoubao, 14 January 1929: 488). In any case, as the supply of trained Chinese mining engineers increased, costs in this area were reduced.

Having said this, however, it remains true that the recruitment, at least of unskilled labor, did not in general act as a major constraint on the expansion of mining. The large mining companies were able to build up a permanent labor force and to recruit enough workers to fulfil their production plans. Outside Manchuria there are very few references indeed to output being restricted because of a labor shortage. Even in Manchuria the crisis lasted only for a year, and the SMR was able fairly rapidly to find sufficient labor, though problems of turnover continued

throughout the 1920s. Labor employed in modern industry made up only a fraction of 1% of China's total work force, and that working in coal mines only around one-fifth even of this minute proportion. In a country like China where there were large numbers of workers underemployed for at least parts of the year, any reasonable increase in employment would not affect the going wage rate.

TECHNOLOGY

The supply of the factors of production thus did not act as a serious constraint on the growth of output, which suggests that almost unlimited amounts of coal could be produced at a constant cost. There is, on the other hand, no evidence for a sharp fall in the price of any factor, and only in technological change can we look for a reduction in costs and thus in the price of coal sufficient to increase sales. What contribution did the new Western technology, embodied in mines constructed during this period, make toward raising productivity and reducing production costs?

There is no way of measuring changes in the industry's total factor productivity, and for the pre-1912 period there are not even any statistics on production costs or output per person. Hence, with many reservations, cross-sectional data must also be used as a proxy for changes through time. Sketchy figures for costs and output per person in neither case indicate any great rise in productivity resulting from the use of modern technology. Although some sources suggest a much higher output per person for modern mines (Torgashev, 1930: 517-518), information from areas where both types of mine operated—thus with at least comparable geological conditions—suggests no great difference. The same conclusion can be drawn for total costs. While it does not necessarily follow that a time series for average costs or output per person across the industry would give the same results, the operators of small mines exploiting seams close to the surface were able to get results as satisfactory as those of larger mines operating deeper seams (see also Griffin, 1977: 105).

This would, however, be to understate the contribution made by the modernization of coal-mining to the growth of the industry. Even if it did not reduce production costs, it greatly increased the amounts of coal that could be produced at a low costs. As suggested above, a mine using traditional technology, though it could extract limited amounts of coal cheaply, faced thereafter steeply rising costs. Premodern mines in the Kaiping area had reached this point by the 1870s, and were closing down because their coal was too expensive to attract customers (Irish University Press, 1971: Vol. 14, 316; Zhongguo shixue hui, 1961: Vol. 7, 114). There were, however, many areas in China suitable for such mining, and it is not easy to judge when such a constraint would have become operative on a national level. More important, once the railways had been built, large modern mines could use centralized loading facilities, which cost less to construct and to operate than branch lines to innumerable small mining concerns.

TRANSPORTATION

Because of the great bulk and low unit value of coal, the cost of distribution even with cheap modern transport accounts for a high proportion of final cost; with traditional communications its influence was overwhelming. Before 1880 any mining area had to be on a river or canal or by the sea if it was to serve any but very local markets, as traditional means of water transport were vastly cheaper than those of land transport. This factor had accounted for the prominence of the Tyne coalfields in Britain (Nef, 1935: 28-29), and in China the major areas of premodern production of coal, of which Leiyang in Hunan supplied the widest area (Richthofen, 1872: 11-19), mostly followed this pattern. The first two modern mines opened in the late 1870s, Jilong (in Taiwan) and Kaiping, were both well situated to use the sea to transport their coal to market. Any mine dependent on overland transport of its coal was inevitably limited to a small market unless there was a sizable local industry to use its coal, as there was, for instance, in Boshan, where the local iron,

ceramics, and glass industries provided the basis for the development of prosperous mines.

This situation was changed drastically by the advent of the railway. Even the shortest journey by land had been a severe bottleneck, and the first railway in China (excluding the abortive Wusong railway) was built to provide the Kaiping coal mine with a cheap means of land transport to the nearest point of shipment on a water route (Carlson, 1971: 18-22). The construction, mostly between 1903 and 1915, of the lines linking the major cities of north, northeast, and central China gave the greatest stimulus to coal-mining, acting, together with their branches (mostly constructed to carry coal), as the main arteries for coal transport over the next thirty years.

Unit transport costs, and therefore, because of the high proportion of transport in total costs, the final cost of coal at the market fell steeply once the railways were constructed. The average rate for transport by cart in north China was about 7.5 cents per ton km (Feuerwerker, 1977: 68; Arnold, 1926: 533, 744; Kingsmill, 1898: 136, 176), and by rail around 1 cent per ton km. While the latter figure was no lower than that for much traditional water transport, most coal deposits were in north China and therefore did not have access to the highly developed Yangzi valley waterways. Obviously the savings were greater the more distant the mine was from the market. Figures for the structure of costs (production, transport, and handling) of various coals in Beijing in the 1930s show that, had carts at 7.5 cents per ton km been used instead of railways to carry the coal, Jingxing coal (from 344 km away in southern Hebei) would have cost 270% more than it actually did, and Kaiping coal, which came 270 km from northeast Hebei, 200% more. Mentougou coal, mined in the Western Hills 44 km from Beijing, gained less from railway transport, but would still have cost 50% more had it been carried by cart (SMR, Sangyōbu, 1938: 313-314).

Similarly, assuming that imported coal from Japan cost about 9 yuan per ton in the coastal ports in 1913, and that production cost in China was 3 yuan (Gu, 1916: sec. 4, 11, sec. 5, 26, sec. 6, 25, sec. 9, 53; Tōa Dōbunkai, 1919: 908), the economic radius for

the production of coal was about 75 km if carts were used to carry the coal, but well over 500 km if railways were used. While the same factors protected Chinese coal from foreign competition in the inland markets, it was in the ports that the market was growing most rapidly.

PRICES AND PRICE ELASTICITIES IN THE MAIN MARKETS

Between about 1900 and 1915, the entire supply curve of coal in all major markets except those in the immediate vicinity of the mines shifted downwards as a result of the cheapening of transport made possible by the linking of large modernized mines to the railways. The cities of north China, dependent on land transport, reaped the main benefits. Even in Beijing, situated almost astride a coalfield, the reduction in transport costs, both for local coal and for other coals that were now competitive there, was sufficient to reduce the price of coal balls (briquettes) by 32% between 1900 and 1917, over which period the cost of living in general rose by 26% (Meng and Gamble, 1926: 56-59, 72). In cities further from their source of supply, the fall in price was greater—60% in Jinan, 157 km away from its source of coal in Boshan (Buck, 1978: 45). Prices must have fallen similarly in rural areas along the railway lines, but no figures are available.

Since Shanghai and the southern ports were well served by water transport, the railways brought fewer benefits, though costs were reduced for the journey between the mine and the port of shipment. In any case, in Shanghai Japanese coal exercised price leadership at least up to the 1920s and to some extent to 1933, so that the cheapening of Chinese coal had only an indirect effect on the general price level.

The effect price reductions had on sales depended on the price elasticity of demand for coal. Scattered qualitative references suggest that this was quite high. After the opening of the modern mine at Kaiping, native industries that had languished because of the high cost of the coal produced by the traditional mines revived with the supply of cheap fuel, though we can

quantify neither the decrease in price nor the increase in sales (Irish University Press, 1971: Vol. 14, 316). Later the availability of cheap transport (though in this case by water) had similar effects, as the Chief Manager of Kailuan reported in 1915:

> The consumption of coal, more especially by the native industries, shows a continuing tendency to increase year by year and coal as a commerical fuel is now being used in the far-off inland districts in much greater quantities than hitherto. . . . Native boats laden with export cargo, after discharging at sea ports, take back coal inland at very cheap rates of freight, and so distribution of coal becomes general all along the many waterways. There are no signs whatever of the former native fuel being reverted to; the native consumption of coal has come to stay and will probably continue to increase [London and China Express, 22 December 1915].

Sales specifically of Chinese coal were quite responsive to price changes also because imported coal held a prominent place in the coastal markets. The cheapening of Chinese coal drove foreign coal out of some of these markets, as when the availability of Kaiping coal meant that imports of foreign coal into Tianjin were reduced practically to nothing by the end of the 1880s. The process was said later to have been repeated in Qingdao, though the statistical picture there is less clear (Imperial Maritime Customs, 1906: pt. 2, Vol. 1, 80). Cheaper Chinese coal also took an increasing share of the Shanghai market, which, however, was still as easily accessible from Japan as from north China, so that only after the imposition of the tariff in 1933 was foreign coal virtually excluded.

Because of the high price of other fuels in rural areas, the cheap prices permitted by railway transport may well have permitted the sale of large amounts of coal in places where it was virtually unknown before. On the other hand, costs rose steeply with distance from the station, and in any case the peasants purchased only a small proportion of their fuel, and the price would probably have had to be very low indeed for them to buy coal instead of using other fuels which they could themselves collect on the farm or elsewhere.

THE DEMAND FOR COAL

The demand for coal fell into two major and one minor categories, each subject to different influences: demand from industry, demand from household users, and exports. Industrial demand changed as a result of the growth of coal-using industries, of variations in the price of other fuels (and of imported coal), and finally of technical progress toward economy in the use of coal. Changes in demand from households were a function of the growth of population, of rising (or falling) income per capita, of urbanization, and of movements in the prices of competing fuels. The level of exports depended on the competitiveness of Chinese coal in foreign markets and on the size of those markets; as supply was close to infinite elasticity, demand within China did not constrain the secular growth of shipments abroad.

There are no figures distinguishing sales of coal by modern mines from those of "native" coal. Table 2 gives estimates for the structure of total coal consumption by sector in 1915, 1923, and 1933. Most of the coal from "native" mines was sold for rural use, while the urban and transportation markets were served mainly by modern mines, though there was some competition between the two types of mine.

USE OF COAL BY INDUSTRY

Industrial use of coal has a long history in China (Read, 1939-1940: 119-133), and demand from traditional and rural industries remained important in the nineteenth and twentieth centuries. It encompassed a wide variety of patterns and is included in Table 2 in the catch-all category "rural use." The main rural industries using coal were iron, ceramics, glass, lime, wine-making, and sugar-processing (Williamson, 1867: 64-73; Richthofen, 1882: 202-207; Hou, 1932: 391; Kuangye zhoubao, 14 October 1935: 667). In remote areas like the southwest, a single small mine might serve a local industry, both little affected by the vagaries of the national market. More commonly the fate even of

TABLE 2

Estimates of the Use of Coal, by Sector: 1915, 1923, and 1933

	1915		1923		1933	
	million tons	%	million tons	%	million tons	%
Rural use	7.42	43.2	8.03	33.3	8.87	29.5
Urban commercial and household use	2.27	13.2	2.92	12.1	4.00	13.2
Industrial						
electric utilities	2.46	14.3	3.77	15.7	6.53	21.5
iron and steel	.20	1.2	.93	3.9	1.83	6.0
textiles	.96	5.6	.95	4.0	1.45	4.8
	.76	4.5	.99	4.1	1.30	4.3
Railways	1.15	6.6	2.11	8.8	2.72	9.0
Bunker	1.48	8.6	2.18	9.1	1.97	6.5
Exports	1.32	7.7	3.11	12.9	3.95	13.0
Used at mines	1.08	6.3	1.96	8.1	2.27	7.5
	17.18		24.08		30.31	
Output + Imports	14.90		25.92		29.88	

SOURCES: A detailed list of the sources and methods of estimation used in the compilation of this table is available on request from the author.

NOTE: These figures are only intended to give an approximate indication of the magnitudes involved. The first line in particular is subject to a wide margin of error. That category could alternatively be estimated as a residual, thus eliminating the discrepancy between the use and supply of coal. This discrepancy could also be the result of changes in stocks, or of incorrect estimation of small-mine output by the Geological Survey of China.

local mines was tied to wider market forces. Coal mines in central Hunan rose and fell with the expansion and collapse of the demand for antimony during and after World War I (Kuangye zhoubao, 7 September 1932: 587-589). In Hunan the switch by peasants to tobacco cultivation created a new market for coal to dry the leaves, leading to the opening of a number of small mines (Kuangye zhoubao, 21 June 1935: 417). When, as a result of the world depression and the occupation of Manchuria, the native industries along the railway in Shandong lost many of the distant markets upon which they depended, the Shandong coal market became depressed as a consequence (Jiao-Ji tielu guanliju, 1934: section on Zichuan, 11-12; Kuangye zhoubao, 7 August 1934: 908; SMR, Chōsabu, 1937b: 17, 544). Nevertheless, while traditional industry accounted for perhaps 20% of total consumption (half of "rural use"), modern industry provided the main dynamic influence on demand in the twentieth century.

The growth of modern coal-using industries (including transportation) dates from the mid-nineteenth century, when shipping began to use coal. The amount of power-driven shipping using Chinese ports rose almost continuously between 1878 and 1936 at an average annual rate of 5.3%. It constituted the largest source of demand on the China coast until the turn of the century: In the 1890s in Xianggang (Hongkong) around 60% of total sales were to shipping companies, and the situation was similar in Shanghai (Sumiya, 1968: 185, 349). This demand served, however, for most of the nineteenth century as a stimulus not to Chinese but to Japanese coal-mining. Modernized coal production in China remained negligible, and coal extracted from unmodernized mines was of too low and variable a quality for use by steam ships, so that throughout the century coal sold in Chinese ports was mostly foreign—British or Australian in the 1860s, Japanese from the 1870s. The first modern mines in Japan—Takashima and Miike in Kyūshū—relied heavily for their markets on exports to the China coast, which were mostly sold to shipping companies (Sumiya, 1968: 20-21, 96-97, 185). In this situation, moreover, ships naturally preferred, where possible, to take on coal in Japanese ports, where it was cheaper (Imperial Maritime Customs, 1885: 260).

The aggregate demand for bunker coal in East Asia continued to increase up to the early 1920s, after which it began to stagnate, though there was little if any fall up to 1937. The market remained unstable, though the construction of modern mines and transport facilities in China gave Chinese ports and Chinese producers a much larger share in the twentieth century. But because ships had more options in choosing their source of supply, sales of bunker coal in any particular port were more responsive to price changes than were other categories of demand, and were subject to large fluctuations depending on the relative price of coal in different ports. Thus in Dalian (Dairen) in 1921-1922, price-cutting by the SMR led to a steep rise in the amount of bunker coal sold, despite a fall in the trade handled by the port (SMR, 1928: 717).

In the 1900s the construction of the railways provided a dynamic new source of demand for coal. Of course the most important effect of the railways was to lower the supply price of coal in the main cities of China, but in themselves they were also an important source of demand. Several mines were opened or modernized in order to provide coal for railways: Lincheng in Hebei and Zhalainuoer in Heilongjiang were the outstanding examples (Kurgan-van Hentenryk, 1965: 73-74; Yang, 1933: Vol. 2, 81-83), but many other mines also relied on the railway companies for much of their sales. From being negligible in 1900, consumption of coal by the railways rose to 1 million tons in 1915 and to nearly 3 million by the mid-1930s. This rate of increase parallels closely that in the output of modern mines, railways taking for most of the period around 10% of their output.

Demand from modern industry dated also from the mid-nineteenth century, when the thirty government arsenals established between 1861 and 1895 began to use considerable amounts of coal. During the 1880s the Jiangnan arsenal, one of the largest, used at least 10,000 tons of coal a year (Liu, 1958: 43), so the arsenals probably used in all up to 100,000 tons a year. The need to supply the government arms factories with coal was behind the establishment of several mines, notably Jilong and Yixian (in Shandong, the forerunner of Zhongxing) [Brown

and Wright, forthcoming]. Consumer goods-processing industries, such as the sugar refineries at Xianggang and Shantou (Brown and Wright, forthcoming; Irish University Press, 1971: Vol. 14, 519) and a number of steam silk filatures, also consumed coal in substantial quantities (Shi, 1968: 83-101). In line with the slow development of Chinese industry, however, demand for coal from factories remained relatively unimportant until the twentieth century. Even later, modern manufacturing industries contributed less to total sales in China than in Japan. True, around 25% of coal sales were to modern industry in the mid-1930s as against perhaps 15% in the 1920s, but in Japan the proportion had risen from 17% in the late 1880s to around 70% in the late 1920s (Kōzan konwakai, 1932: Vol. 2, 187-189).

Chang's index of industrial production shows a 9.4% per-annum growth rate between 1912 and 1936,[2] which gives an approximate indication of the rate of growth of coal-using industries. The composition of industrial consumption reflected the characteristics of prewar Chinese industrialization. The iron and steel industry, of central importance for other coal industries,[3] played no such crucial role in prewar China, where the largest consumer goods industry, textiles, used as much coal (Wright, 1976: 225). From the 1910s the most dynamic area of demand was the generation of electricity, which increased at 17.5% per annum from 1912 to 1936, and consumed about 10% of the output of modern mines by the mid-1930s (Wright, n.d.: 9; Bureau of Mines, 1938: 347; Sheba, 1937: 831). This trend, a common one in other coal-using countries, represented in part a switch from direct to indirect consumption of coal by other industries and by households.

Manchuria diverged to some extent from the experience of the rest of China from the beginning of the century, and by the mid-1930s industrial development there under Japanese auspices created a situation materially different from that in China. Not only was industrial use of coal more significant as a percentage of the total—in most years over 30% of consumption within Manchuria, and by the mid-1930s well over 40%—but the rapid

industrialization of the region in the 1930s put a pressure on coal supplies which did not exist elsewhere in China. Moreover in 1936 the iron and steel industry accounted for 17% of total consumption, an indication that in this area, unlike the rest of China, a heavy industrial base was being established and was providing an important market for coal (Hori, 1935: 10-11; Sheba, 1937: 831).

Up to 1937 the growth in industrial demand was little affected by competition from other fuels. The only case in which fuel oil was beginning to be substituted for coal was powering ships, but even there 80% of all power-driven ships still used coal in 1936 (Sturmey, 1967: 84), so demand for bunker coal was at most 20% less than it would otherwise have been. In round figures that was about 400,000 tons, or just over 1% of output. For electricity generation, internal combustion engines were an alternative to coal-fired steam engines, but they were uneconomic for the larger plants, so, although used in a large number of small plants, they accounted for under 10% of the power generated (Directorate of Statistics, 1940: 84; Ministry of Industry, 1933: sec. 8, 1126-1138).

Part of the growth in demand for Chinese coal especially during the 1930s was due to import substitution. Even after the railways had been built, the lack of tariff autonomy and the geographical relationship between north China, Japan, and Shanghai had meant that Chinese and Japanese coal competed on roughly equal terms in the Shanghai market. The price of Japanese coal fluctuated mainly with the exchange rate and that of Chinese coal with the ease of supply allowed by wars and transport disruption, and in the short term sales of Chinese and foreign coal were very sensitive to changes in their relative prices. A permanent shift occurred from May 1933, when the import tariff on coal was raised from about 1.6 yuan to 3.5 yuan per ton and increased the price of Japanese coal sufficiently more or less to drive it off the market (North China Herald, 31 May 1933). Imports fell from 2 million tons in 1933 to just over .5 million in 1936, over which period the share of Japan coal in

the Shanghai market fell from 15.7% to 4.8% (SMR, Chōsabu, 1937b: 634; Guoji maoyi daobao, April 1934: 257). Increased demand in Japan and the recession in China also contributed to the decline in trade, but the timing of the decline and the fact that Japanese coal exports to other countries remained at previous levels suggest that the tariff was the major factor, raising the demand for Chinese coal by perhaps a million or more tons a year, or about 3% of output.

A third factor acting on the industrial demand for coal was technical progress in its use—increased thermal efficiency in power generation and increased economic efficiency in the use of power in industry. Worldwide, the effects of this technical progress were felt more strongly in the interwar period because they added to other intractable problems faced by the industry. In China, where demand was growing, there was less discussion of the problem, but in the electric power industry, where measurement of progress is most easily and often made, performance was improving quite rapidly: an uneven trend for the Shanghai Power Company between 1915 and 1931 indicates an annual 4.2% increase in efficiency (Luo, 1932: 66; North China Herald, 8 February 1933). In other industries progress was slower, in China as elsewhere (International Labour Office, 1938: Vol. 1, 96). The Shanghai Gas Company increased the amount of gas produced per unit of coal by 1.6% per annum in the 1920s (Bureau of Mines, 1938: 357). Of the railways the SMR reduced its consumption of coal per unit of traffic by 2.1% per annum between 1907 and 1936 (SMR, 1919: 284-285; 1928: 276-277; 1938: 332-333), but because of the growing obsolescence of their equipment and as a result of their complete disorganization during the civil wars, the Chinese national railways did not increase their efficiency at all, rather the opposite, in fact (Ping-Han tielu guanli weiyuanhui, 1932: 573-574).

Progress in fuel economy was also relatively slow in general manufacturing industry (where fuel was not such a large part of total costs) [International Labour Office, 1938: Vol. 1, 96], though an additional source of saving was increasing output per unit of power used. Improving efficiency probably reduced the growth of industrial demand for coal from the 9% rate of growth

of coal-using industry to perhaps 6-7%, a figure that fits quite well with the growth of sales estimated in Table 2.[4]

EXPORTS

Exports, nearly all to Japan, were of growing importance in total coal sales. Even allowing for its larger size, China had much greater reserves of coal than Japan; in the crucial case of coking coal, too, while the position in China was later to cause problems, Japan was even worse off. Of the other necessary resources, labor was also more expensive in Japan: by the late 1920s most Japanese hewers were paid over 2 yen a day, while those at Fushun got only about one-quarter as much (Kōzan konwakai, 1932: Vol. 2, 212-216; Hou, 1932: 227). Moreover, Japanese industry and its consumption of coal were growing rapidly, making likely a trend toward increasing exports once the supply of coal from modern Chinese mines got under way.

Chinese coal exports to Japan were of two types. Because Japan's supplies of coking coal were so inadequate, the metallurgical industries had to use at least some imported coal: The Yawata steelworks mixed Kaiping coal with its own Futase coal to make coke (Wu Bannong, 1932: 484). These imports of coking coal were encouraged by all sections of Japanese business. Cheap Chinese fuel coal, mainly from Fushun, on the other hand, put a ceiling on the price of Japanese coal, ensuring that the pressure of Japan's resources showed in a growing import balance, not in rising coal prices, which merely kept pace with those of manufactured products between the 1870s and the 1930s. In the process it affected the sales at least of marginal Japanese producers, who forced the SMR to agree to limit exports to Japan, limitations that were the more strict in periods of depression, such as the early 1930s (Tōa, September 1932: 126-139: Ohkawa, 1967: 192-193).

Though slowed down by these agreements, the growth of exports of Chinese coal to Japan was still rapid. From a very low base in 1910 they grew at about 12.5% a year to account for around 15% of output in 1930. The loss of Manchuria means that the post-1931 figures are not comparable, but exports of (mostly

coking) coal from "China proper" to Japan increased by over 30% a year in the mid-1930s, though ironically much of this coal went to fuel Japan's war industries and thus the invasion of China.

HOUSEHOLD USE OF COAL

Household consumption, while accounting for several million tons of coal, remained very small on a per-capita basis, and was very unevenly distributed geographically. In rural areas its use was unknown away from mining districts and railway lines, and only 1.3% of the households in Buck's 1921-1924 survey bought any coal at all (Buck, 1930: 399). The countryside of south and central China used very little coal, but in mining provinces such as Shaanxi it was a common fuel in the peasants' homes (Hatano, 1925: 243). Most of the remaining consumption was concentrated along coal-carrying railways: in Xinzheng xian, Henan, 99.3% of households bought coal, spending an average of 10 yuan a year; in Dingxian, Hebei, 58% of households bought coal and spent an average of 2.25 yuan (Buck, 1930: 398-399; Gamble, 1954: 114-115).

The first factor acting on household consumption was population growth—about 0.7% per annum between 1893 and 1933. The coal-consuming areas of the north and northwest had, however, much lower than average population growth rates, ones so low that they can be ignored. In Manchuria population almost septupled over those forty years (Perkins, 1969: 212), but while coal was relatively plentiful there, so were other fuels, and per-capita consumption of coal by households was not high (Hori, 1935: 29-32). The overall contribution of total population growth to increased coal consumption was very small.[5]

Average per-capita income is a highly controversial subject; many contemporary observers saw a sharp fall in living standards in the countryside, and some modern scholars follow them (Eastman, 1974: 183-212). Studies by Buck and more recently by Ramon Myers, on the other hand, suggest a standard of living that was constant or possibly even gradually rising, except for upheavals brought about by military disturbances (Myers, 1970). Short-term changes in income could certainly affect coal con-

sumption: The Datong mine in Anhui interpreted the fall in its local sales after 1932 as the result of the decline in peasant incomes after the Yangzi floods, and several mines in central China suffered from the same phenomenon (Kuangye zhoubao, 21 October 1933: 292-293). In the long term it remains unlikely that income rose sufficiently to have a marked effect on the demand for coal.

Per-capita use of coal was much greater in the cities. A survey in the 1930s of six major cities from Beijing to Guangzhou suggests an annual average use of household coal of 200 kg per capita, as against a national average of 25 kg. Not surprisingly, more was used in the northern cities: in Beijing around 300 to 400 kg, in Tianjin 250 to 300, and in Changchun as much as 700 kg. In Shanghai the figure was probably between 100 and 200 kg (Yuan-li Wu, 1963: 100; Perkins, 1969: 292-294; Hori, 1935: 104; Kuangye zhoubao, 14 August 1936: 155; Nichi-Man shōji kabushiki kaisha, 1937: 132; Tezuka, 1940: 166-167; Bacon, 1930: 208). A figure of 4 million tons—10% to 15% of the total—for consumption by urban commerical and household users in 1933 is consistent with the scattered references in the sources.

Within any given city, household use of coal was very unevenly distributed. Cross-sectional figures for Beijing show that, while expenditure on fuel was a fairly constant proportion of household budgets, demand for coal balls and even more so for coal rose sharply at higher income levels as they were substituted for kerosene (Gamble, 1933: 142, 332-334). Use of coal was very much concentrated in wealthier households and especially in foreign-style dwellings. A totally disproportionate amount was used by foreign residents: In Manchuria the Japanese, making up less than 1% of total population, consumed about one-third of the household coal (Hori, 1935: 33).

Total urban population increased by about two-thirds between the 1900s and 1938 (that is, by about 1.6% per year). The increase was largest in north China and Manchuria, where most coal was used. Urban population in Manchuria rose by about four times, that of Shandong by perhaps three times, while the population of Beijing doubled. The foreign population grew even more rapidly—at about 12% per annum between 1895 and 1929 (Huang and Pang, 1966: 218; Nankai Weekly Statistical Service,

9 February 1931). The concentration of urban growth in coal-consuming areas and the more rapid expansion of the foreign population meant that coal consumption grew considerably faster than did total urban population.

In the cities the main competitors to coal were firewood, charcoal, and kerosene. Sales of coal, firewood, and charcoal were probably quite responsive to changes in relative prices, but kerosene required different equipment to burn and therefore was less easily substituted, at least in the short term.[6]

In the countryside substitution between different fuels as relative prices changed was probably the most important single factor affecting consumption. In all countries, beginning with Tudor England, the exhaustion of timber resources was a central factor in the growth of the use of coal by both industries and households (Nef, 1935: 156-164, 201-223). China had gradually exhausted its timber resources over the centuries, and by the seventeenth century there existed a generalized crisis of timber supply. While this was solved primarily by adopting low-energy solutions to ecological problems, in areas where coal deposits were available it increased the incentive to exploit them (Adshead, 1974). The deforestation of the north China uplands with the expansion of population into marginal areas during the eighteenth century exacerbated the timber shortage in areas where coal was often present (Ho, 1959: 136-168). Thus, as timber prices rose, more attention came to be paid to coal deposits, though in China as in England the unpleasant characteristics of coal led to some consumer resistance to its use, even after it had become cheaper than other fuels (Kuangye zhoubao, 14 December 1933: 408). But relative prices were generally decisive in the end, and in Huxian, Shaanxi, in 1885 the local magistrate sent a servant to open a coal mine after wood had become scarce in the district (Kuangye zhoubao, 7 March 1931: 583). Similarly, in Yunnan householders turned to coal as the forest retreated (Kuangye lianhehui jikan, 3: diaocha, 20).

The twentieth century saw no amelioration of the problem. Higher prices of firewood encouraged the use of coal near Wuhu (Imperial Maritime Customs, 1932: 606), and in the north the switch from sorghum to cotton cultivation reduced the amount

of sorghum stalks available as fuel and raised the demand for coal along the Beijing-Hankou railway (Shina kōgyō jihō, August 1913: 69), while in Manchuria rising prices of timber caused a switch to coal (Torgashev, 1928: 388). Although in the short term substitution could go the other way, as when the falling price of firewood in Guangzhou in late 1930 led to its being used in place of coal, or when higher prices of Shandong coal in 1932 caused consumers to burn grass and firewood instead (Chinese Economic Bulletin, 10 January 1931; Ding, 1933: 3), the trend was gradually toward the use of coal. The increased demand generated in this way was less important for the industry than the rise of industrial or even urban household demand, but nevertheless Buck (1930: 403) saw the use of coal as one way to solve the fuel crisis in the Chinese countryside.

CONCLUSION

This study places modern coal-mining firmly among the pockets of growth in the Chinese economy. Like China's industry in general, it grew at a rate respectable by world standards, so that, except in the obvious sense that had it grown faster incomes would have been higher, it cannot easily be seen as a direct contributor to the country's economic ills. This conclusion is strengthened by the fact that the growth of demand was the main constraint on the expansion of the industry at least by the 1930s.

The very rapid growth in coal output during the first fifteen years of the century was due primarily to a sharp fall in the supply price of coal at most major urban markets at a time when demand was highly elastic over the range in question. Changes in the cost of coal transport were inevitably the most important because of the relative weights of production and distribution in costs at all but the best-situated markets. Nevertheless, the modernization of coal extraction, by preventing any rise in costs at the mine as increasing amounts of coal were shipped out and by making possible the economies of scale available in railway transport, was as integral a factor in the reduction of distribution costs as was the construction of the railways.

After the effects of the construction of the railways had worked through, there was no further major shift of the supply curve, and despite the continuing concern of contemporary mine owners and coal merchants to reduce costs, especially in the areas of taxes and of railway freight charges, it was unlikely that any substantial reduction in costs could have been achieved. Supply remained, however, highly elastic—indeed probably, within conceivable limits, infinitely so in the 1930s. Both the foreign presence, which was prominent in the industry, and the disturbances inherent in China's social structure, from which coal-mining suffered more directly than most other industries, were more instrumental in determining the pattern of output than in affecting its magnitude. Although the civil wars did disrupt transport and force companies to cut output, they did so far more for individual areas and mines than for the industry as a whole, where mines in less seriously affected areas made up most of the shortfall. Moreover, output recovered quite rapidly, so that by the 1930s excess capacity again meant that the level of sales was dependent on demand.

Demand had been increasing steadily but rather slowly ever since the mid-nineteenth century. There were few years, at least in the twentieth century, when increased industrial activity and growing urban populations did not add something to total demand at a given price. Household consumption, urban and rural, retained a considerable share in the coal market, but in general it was industry, broadly conceived, that provided the main motor of increasing demand: With a few exceptions (notably iron), modern industry probably did not displace coal consumption in the traditional sector, and so its use of coal represented a net addition to demand.

The proximate causes of the growth of demand for coal have been analyzed in this article, but the ultimate causes lie in the complex series of interrelationships that make up the whole economy. It is through assembling the evidence for the factors at work in different sectors that we can eventually hope to put together a picture of the way the totality worked, and thus to create a firm basis for generalizations about the factors working to promote or to retard China's development.

NOTES

1. From 1913 to 1936 the figures of the Geological Survey of China are used; see Yan (1955: 102-103). These figures do not cover the period before 1912, and the figure for 1912 is heavily influenced by underreporting during the revolution and is therefore not used. The series for modern mines between 1896 and 1912 is compiled from figures for individual mines taken from the following sources: Carlson (1971: 143, 146), Manshikai (1964-1965: Vol. 1, 309), Shina kōgyō jihō (December 1933: 72-73; December 1934: 113; May 1936: 65-66), Gu (1916: sec. 8, 32), Zhang (1936: 118-120), SMR, Kōgyōbu kōmuka (1914: 50), Tōa dōbunkai (1917: 897). The categories of "modern" and "native" mines are somewhat arbitrary, but, very broadly, a mine was "modern" if it used at least mechanical winding gear and cages. Total output, which included an initially large but stagnant "native" component, grew more slowly than that of modern mines, at 4.0% per annum between 1913 and 1936.

International comparisons are difficult, as no figures covering just "modern" mines are available for other countries, while in any case criteria for "modernity" would change through time. Thus the following figures comparing the rate of growth of output from modern Chinese mines with that of total output in other countries in conditions of accelerated economic growth must be viewed with some caution (asterisked percentages are from a very low base):

United Kingdom	1830-1850	4.2%
France	1830-1860	5.1%
Belgium	1831-1860	5.2%
China	1914-1936	5.5%
Japan	1900-1920	6.9%
China	1952-1978	7.0% (all mines)
United States	1850-1884	7.1%
Russia	1890-1913	7.9%
Germany	1850-1873	8.4%
China	1896-1936	11.2%*
Japan	1874-1900	12.4%*
USSR	1926-1939	14.4%

Sources: Mitchell (1975: 360-370), Ohkawa (1972: 267-269), Howe (1978: 106), Schurr and Netschert (1960: 491-492).

2. Chang's index includes coal-mining itself, and also the electricity industry, part of whose growth represented a switch of power consumption by the rest of industry from direct to indirect use of coal. Any attempt to correct the index to take account of these problems would suggest a far higher degree of accuracy than the index in fact possesses. It indicates an order of magnitude only.

3. In 1970 the Chinese iron and steel industry consumed about 44 million tons of a total output of 264 million (that is 17%) [Ikonnikov, 1977: 92, 163]. In 1975, about 90 million out of 427 million tons (21%) were so used (U.S. Central Intelligence Agency, 1976: 5, 15). Of British consumption (excluding exports), 29% was used before 1914 in the metallurgical industry (Jevons, 1915: 43).

4. By 1923 the main gains from the fall in transport costs had worked through, and increased sales were from then on primarily dependent on demand changes. The reduc-

tion in costs resulting from fuel economy could, depending on elasticities, have increased the demand for the output of the fuel-using industry to a sufficient extent that total consumption of coal would rise.

5. Much rural household use was supplied by the native mining sector and not from modern mines.

6. In Nanjing a well-organized foraging service gathered firewood and fuel from as far as 50 km from the city (Chinese Economic Bulletin, 5 December 1925). In Beijing higher coal prices cut back demand sharply in 1916-1917 (Shina kōgyō jihō, September 1919: 79).

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