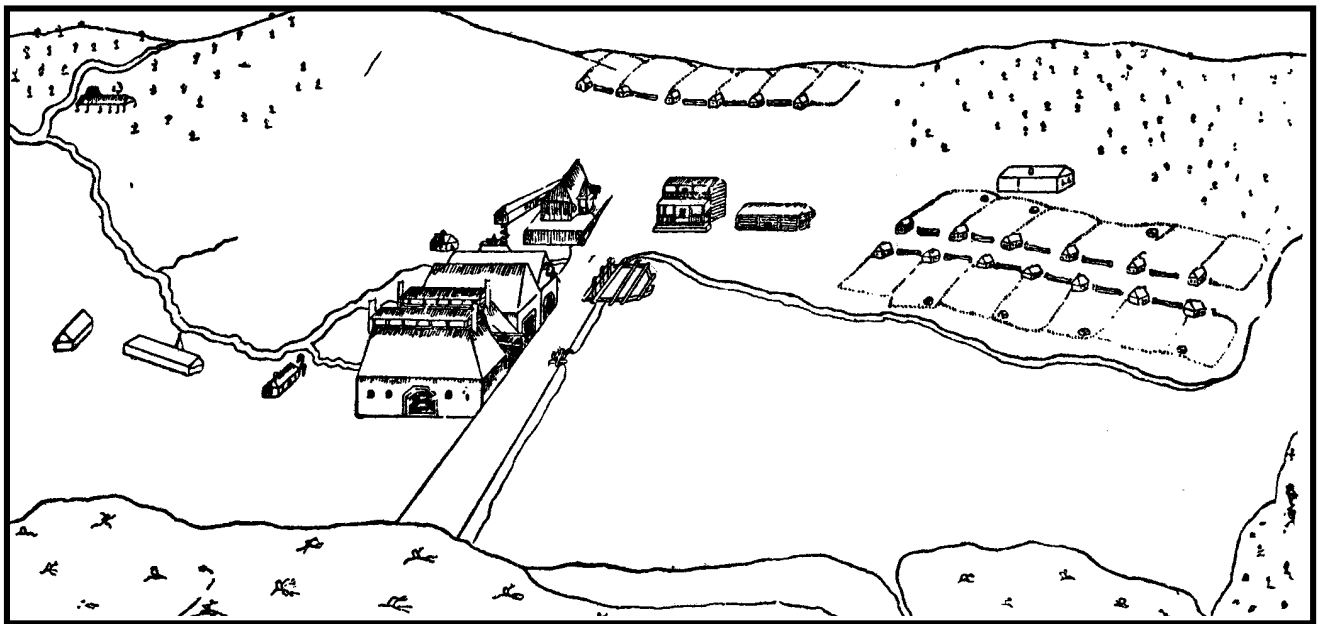


# Russia and international iron markets, ca. 1740-1850

Ian Blanchard



Conference 'Trade, commodity markets and the mercantile contribution to industrialisation'

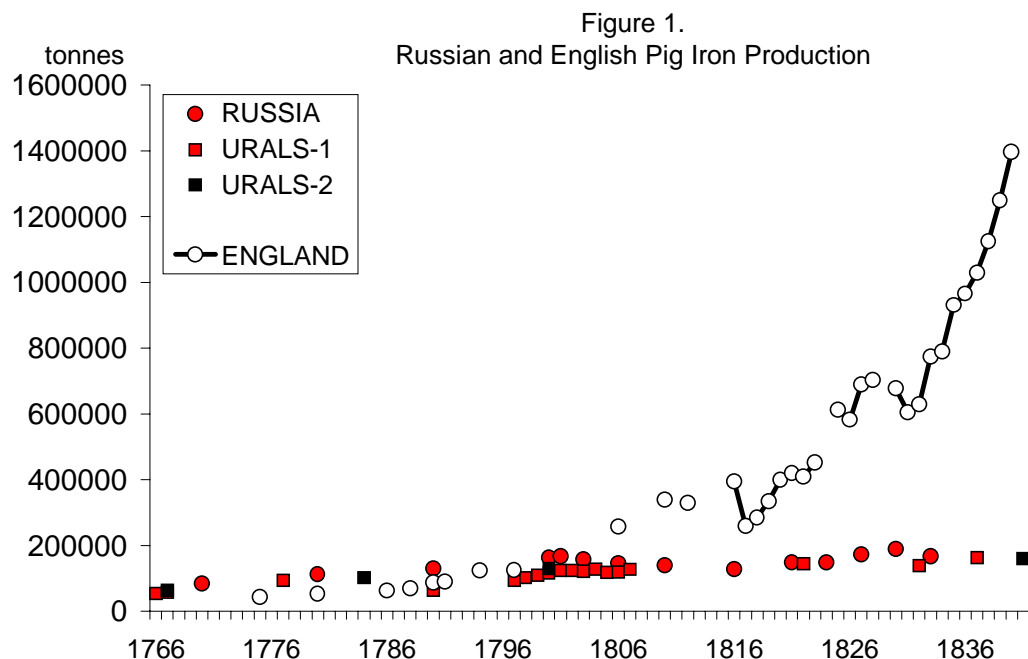
Session: Commodity markets and industrialisation

Held at The University of Glamorgan, 20-21 April 2001

## Russia and international iron markets, ca. 1740-1850

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It has become a commonplace of the historiography of the Russian charcoal-iron industry that during the years ca. 1740-1800 it established a dominance in the production of, and international trade in iron. It is claimed that this hegemony resulted from low fuel costs, ensured by abundant timber supplies, and cheap labour costs deriving from the use of serf-labour. A continuing adherence to this latter system, arising from an innate conservatism amongst the aristocratic entrepreneurs of the Ural's industry, however, is said to have prevented their adoption of the new iron smelting and refining technologies of the English "Industrial Revolution".<sup>1</sup> Thereby their plants were rendered obsolete and the Russian industry, during the years, ca. 1800-1850 was totally eclipsed by its British counterpart (figure 1<sup>2</sup>).



In this paper it is hoped to suggest that the dominance of the Ural's charcoal iron in the period ca. 1740-1800 did not rest on the availability of cheap industrial inputs but on advanced technologies which gave producers a competitive edge on international markets. Second, it will be suggested that that this technological impetus did not wane in the period ca. 1800-1850 and that in the mid-nineteenth century

factory-gate prices in the Urals were indistinguishable from those of the most advanced contemporary British plants. Russia's loss of international markets in the nineteenth century was a result of tariff-discrimination against its product not technological inferiority. Ousted from international markets, Ural's production continued to increase but now on the basis of sales to domestic consumers, a task fraught with difficulties, but one which revealed that the Russian iron producer-fabricator was economically as, if not more, efficient than his contemporary British counterpart.

## I

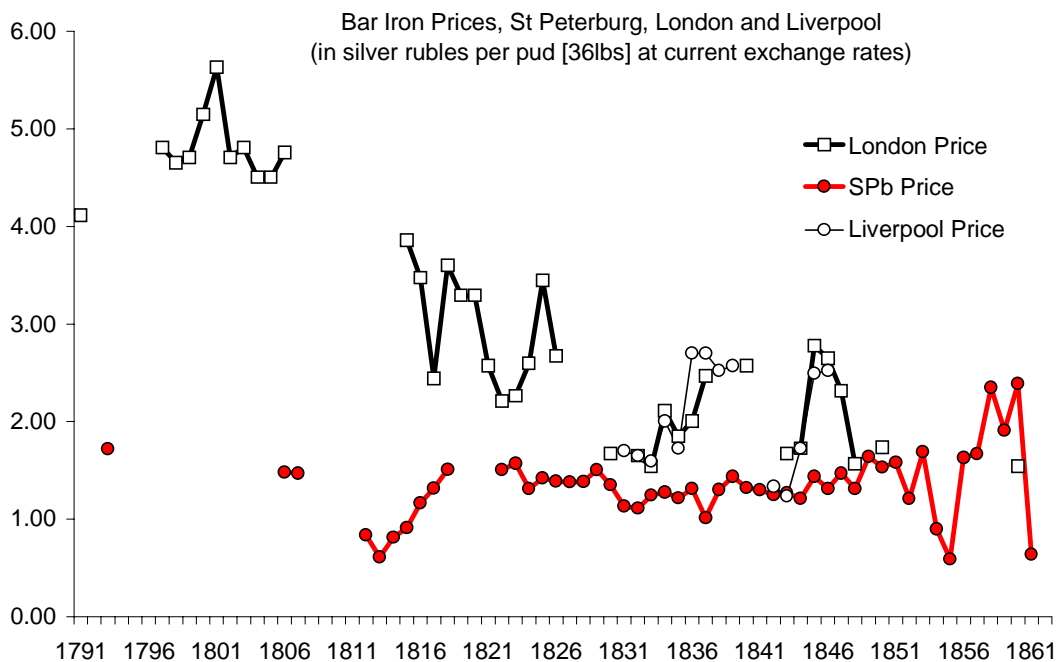
In the course of the eighteenth century Swedish and then Russian iron had come to dominate international, and particularly British, markets.<sup>3</sup> The dramatic expansion came first in Sweden. Its bar iron exports increased from a quite insignificant figure in the seventeenth century to more than 25,000 tonnes at the end of that century and to about 40,000 tonnes in the late 1730s. Then followed a period of stagnation, which was prolonged by political decisions around the middle of the century: production was restricted, partly with the aim of limiting charcoal consumption and partly in the hope of stabilizing prices by diminishing output, or at least keeping it constant. The export figures from the end of the century were only slightly higher, a little more than 45,000 tonnes, than before. Russia, on the other hand, had in the seventeenth century been an importer of iron. The enormous eighteenth-century growth of the nation's industry was localised in the Ural region. From very modest beginnings, as will be seen in figure 1, it developed gradually, reaching nearly 40,000 tonnes in 1760 and 50,000 in 1770. In 1800 after a final expansive effort during the last two decades of the century, it reached 100,000 tonnes. The Swedes, faced from the 1760s with this new competitive force, assumed that the Russians exported about half of their bar iron, a figure largely confirmed by contemporary customs-production statistics. On the all-important English market, the Russians had been quite insignificant up to about 1730; they reached half the Swedish figure as late as the 1750s. But they completely outdistanced the Swedes halfway through the next decade. In the period 1770-1800 they accounted for 60% of total English iron imports, which in turn served to satisfy at least half of that nation's consumption of malleable iron.

From the 1730s the Russian star was in the ascendant. Production and exports expanded rapidly until the industry became the premier European producer, dominating that continent's iron markets. Production growth in the Urals was achieved at this time, 1734-1807, in a hostile environment, essentially by extensive methods. The number of operational blast furnaces increased: their number rose from 15 in 1734 to 74 in 1807. Median furnace output remained stable at about 1,206 tonnes and average furnace output actually fell, from 1,342-1,265 tonnes, as the ore base servicing incremental capacity deteriorated. Extensive growth in the industry thus displayed a normative pattern of diminishing returns.<sup>4</sup> Increased sales on international markets during this period thus rested on having relatively lower production costs than those of their competitors. Until ca. 1740 such relatively lower production costs may have existed in Russia because of the diminutive level of silver stocks in that nation and the relatively high purchasing power of imported supplies of that metal.<sup>5</sup> As, from 1740-1790, that nation's monetary stocks rapidly increased and

international silver-purchasing price parity was achieved, however, any such “monetary” advantage enjoyed by producers disappeared.<sup>6</sup> Export growth at this time was based upon “real” rather than “monetary” factors. Nor did Russia enjoy any particular “real” labour-raw material price advantage during the years of export growth from 1740-1790.

Stands of timber were indeed abundant in the Urals at this time, but because wood was a renewable agrarian product yields were conditional upon environmental factors. Even in the relatively favourable conditions, prevailing during the early eighteenth century the Russian “coaler” was a high-cost producer.<sup>7</sup> Regionally adverse climatic conditions resulted in long timber maturation periods and necessitated that Uralian iron-masters “set aside wood for the whole works that is not less than thirty years, being near to the factory in which it is adjacent.”<sup>8</sup> Their English counterparts at this time could depend upon a twelve-year renewal cycle for coppice timber. The relatively fast-growth characteristics of the arboreal varieties-pine, fir, birch, aspen and larch- which made up the nation’s woodland cover, moreover, produced wood, which was converted into charcoal at lower conversion rates than English beech or oak. Thus whilst Russian wood was cheap<sup>9</sup> the “coalers” raw material costs were about forty per cent higher than those of their English counterparts. Russian unit labour costs, for “coalers” employing the prevailing Anglo-Russian technologies, were also higher. With the “real” resource cost of their charcoal being more than twice that of their English counterparts, therefore, Russian iron-masters were seriously disadvantaged when in the 1730s they began for the first time to attempt a penetration of international markets.

Figure 2.



Their response was to innovate, introducing a new and far more productive charcoal-making technology.<sup>10</sup> Accordingly, when Russian “coalers” were faced from ca.

1760-1790 with a rise in timber prices of even greater dimensions than in the West,<sup>11</sup> unlike their English counterparts, who failed to innovate, they had the means to compensate. With the diffusion of the new technology, Russian charcoal prices were stabilized at a level below those prevailing in the West. Thereby Russian iron-masters established a competitive advantage over charcoal producers elsewhere. They also secured lower fuel costs than those prevailing in the English coke-smelting industry. Indeed so successful was the Russian iron industry that, until ca. 1825, if unimpeded by war or commercial restrictions, it could consistently undersell even the most efficient English competitor on the London market.<sup>12</sup> As a Parliamentary Commission of that year revealed, English bar iron was totally uncompetitive on international markets, the nation's comparative advantage lay in the export of castings and fabricants.<sup>13</sup> It was only with the introduction of "hot blast" in 1828 that British (or rather Scottish) iron production could come into its own. Thereafter British iron prices fell (figure 2<sup>14</sup>) and for the first time, the Scottish, if not the English product began to find a place on international markets. Russian charcoal-iron producers at the same time, however, by the use of the Ekman gas generator and reheating furnace, were able to effect similar improvements in fuel input consumption and remain competitive with their British rivals. In terms of best practice, in 1850 Russian charcoal iron and Scottish coke iron production costs were broadly similar.<sup>15</sup>

Nor was this a result of differential labour costs. Possessional and assigned peasants concentrated in the Russian metallurgical industry were a "privileged" group who, thanks to government wage legislation, saw a steady increase in their earnings.<sup>16</sup> Incomes here were both relatively and absolutely enhanced, rising in nominal monetary terms 2.3-fold and composite natural-monetary terms 3-fold between 1801/10-1841/50. Whilst the possessional worker had earned about half that of his "free" counterpart (and a twelfth of the peasant) in the 1800s, by the 1840s he had moved to a position of parity with the peasant. At the latter date he enjoyed broadly the same consumption pattern. Grain (50kg a head a year) comprised 40 per cent of food consumption and 20 per cent of total expenditures, dairy produce (60 litres) and flesh (57kg) 60 per cent of food consumption, the latter elements being more than double that of his western European counterpart.<sup>17</sup> The Russian iron-master thus benefited from neither cheap wood nor labour. His low costs were a result of high productivity levels achieved by organizational and technological innovation. This allowed the Urals charcoal iron producer to maintain his competitive position in relation to his British coke-smelting rival throughout the years 1780-1850. Russia's loss of international markets in the nineteenth century was a result of tariff-discrimination against its product not technological inferiority.

## II

As has been indicated above, during the years, ca. 1740-1800, as Russian bar iron exports had rapidly increased, Great Britain had provided the major market for these wares (figure 4<sup>18</sup>). In the period 1770-1800 they accounted for 60 per cent of total English iron imports, which in turn served to satisfy at least half of that nation's

consumption of malleable iron.<sup>19</sup> Aware of the necessity of protecting England's new, but high-cost and inefficient, coke smelting iron works, however, the British government from 1790 began to raise tariffs against Swedish and Russian imports (table 1<sup>20</sup>). Thereafter, until ca. 1826, if unimpeded by war or commercial restrictions, the Russian product, if not the Swedish, could potentially undersell English iron on the London market, but was prevented from doing so by a tariff, which was steadily enhanced to £ 6. 10s.0d per ton in 1815.<sup>21</sup> As a result of this British tariff increase and Napoleonic trade embargoes, both total Russian bar iron exports and those destined for the United Kingdom declined markedly. Total exports fell from some 3.5 million puds (56, 270 tons) in 1793 to 0.887 million (14,260 tons) in 1817.<sup>22</sup>

Table 1

Price differential between Russian and British bar iron, 1790-1815, compared to the duty on foreign bar iron (in £ per ton of bar iron)

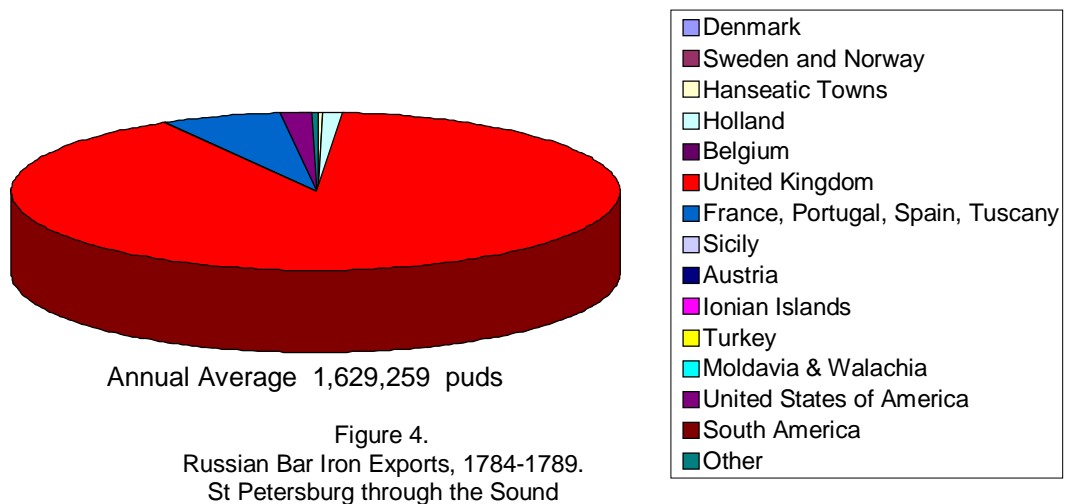
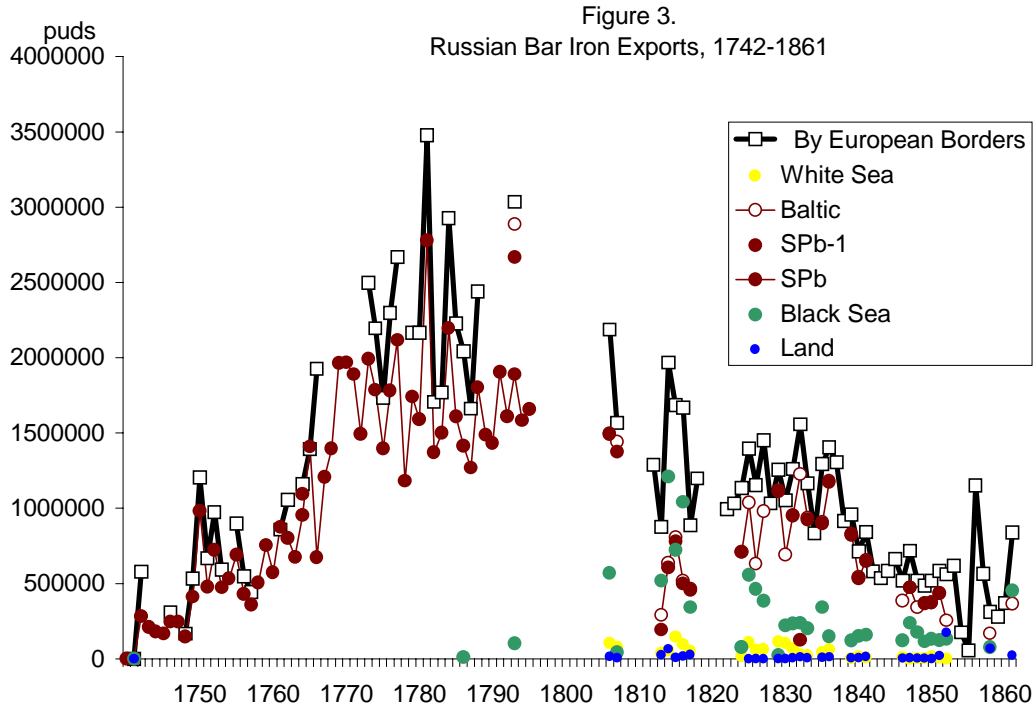
Date	Russian bar iron, including duty, higher by	Amount of duty
1790	£1.48	£2.81
1795	£1.75	£2.81
1800	£4.50	£3.78
1805	£4.75	£5.05
1810	£6.75	£5.49
1815	£5.50	£6.49

Nor with the subsequent heavy reduction of the British tariff in 1826 (to £1.10s.0d a ton) was the Russian product able to re-establish its former position on that nation's market. The fall in English bar iron prices, ca. 1800-1830 (figure 2) to a position of parity with Russian ones ensured that the Russian bar-iron trade could effect but little market penetration. In the 1780s the Russians had exported 23,700 tons of bar iron annually to Britain. During the 'thirties and 'forties of the nineteenth century they were only able to export there some 3,200 tons of Russian iron a year on average and in the 'fifties this fell to some 1,700 tons.<sup>23</sup> In conditions of manufacturing price parity between the two nations, such as prevailed during the years 1828-1851, the Russian product could make but little headway on the British market. Yet it should perhaps also be noted that the British product was no more successful in penetrating the Russian market in free trade conditions after 1850.<sup>24</sup> From ca. 1800-1850 the commercial battle between the world's two great iron-making powers was fought out on third-party markets.

Even as Russian iron exports to Britain were first impeded, in 1790, by the imposition of tariffs, St Peterburg shippers began a process of market diversification. Until the outbreak of the French Revolutionary Wars this largely involved increased exports<sup>25</sup> to the United Provinces (220 tons)<sup>26</sup>, the Austrian Netherlands (42 tons) and France (1,535 tons)<sup>27</sup>. As the British tariff began to bite and Russian bar-iron exports, from St Petersburg via the Sound, to the British market stagnated (23,500 tons),

therefore, the iron trade continued to expand as new markets were opened up. With the outbreak of war, however, this situation was transformed. British naval blockades and the subsequent imposition of the Napoleonic Continental System impeded Russian access to European markets via the Baltic and led to a redirection of the iron trade via Arkhangel'sk which occasionally (1805 and 1812-5) augmented the burgeoning new trade via port of Odessa (figure 3<sup>28</sup>). This realignment of the Russian iron trade, moreover, was also associated with a continuing market diversification. Until the Napoleonic invasion of Russia in 1812 both processes continued apace. In 1810 Russia was still exporting some 35,000 tons of iron, or a level comparable with that of exports during the pre-war years, but only some 8,000 tons were now exported to Britain. A not insignificant proportion of the residual exports now passed to the United States.<sup>29</sup> Indeed from 1796-1810 it was the United States which had become the principal non-British market for Russian bar iron, some 4,000-6,000 tonnes being exported thence during the first decade of the nineteenth century.<sup>30</sup> The events of 1812, however, were to prove disastrous for both the Russian industry and trade.<sup>31</sup> The Napoleonic invasion and war with France seriously undermined the St Peterburg iron trade and resulted in a diversion of about half of total supplies towards the Black Sea ports of Rostov-on-Don and Taganrog from whence it was trans-shipped to Odessa and the Mediterranean ports beyond. As an ally of Great Britain, moreover, Russia was also affected by the outbreak in that year of hostilities between that nation and the United States which from 1812-1815 brought Russian-American trade to a halt and allowed Swedish iron to displace the Russian product on that market. In these circumstances the Russian bar-iron trade seriously declined, only some 23,300 tons being exported on average annually during these years.

Nor did peace in 1815 significantly alter this situation. Faced with renewed competition the British imposed in that year a new and draconian tariff on Russian bar-iron imports and before this was removed in 1826 the French had also followed suit. From 1815-1840 combined sales (3,300 tons) on these markets amounted to no more than quarter of the Russian trade. The United States, with Russian iron imports of some 11,033 ton in 1829, now not only in relative but also in absolute terms, became the Russian iron-masters' major foreign customer (figure 5<sup>32</sup>). Yet even here they could not re-establish their previous hegemony over the market. During the years 1821-1824 about three times as much Swedish as Russian iron was imported into the United States and in 1825-1828 about four times.<sup>33</sup> The threat to the Russian's position thus came not from the rolled and hammered products of the British coke-smelting industry which were imported into the United States only in tiny quantities at this time. Its main competitor was the Swedish charcoal-iron industry, which at this time was rapidly adopting the "new" *lancashire* refinery process and associated rolling mills.<sup>34</sup> As in the 1840s, however, the American iron industry began to develop, Swedish iron-masters found themselves in a position where "no way could be found of bringing the manufacturing price of Swedish iron a good deal lower" and their trade collapsed.<sup>35</sup> The Russians, whilst lowering the export price of their bar-iron at this time (figure 2), fared little better.



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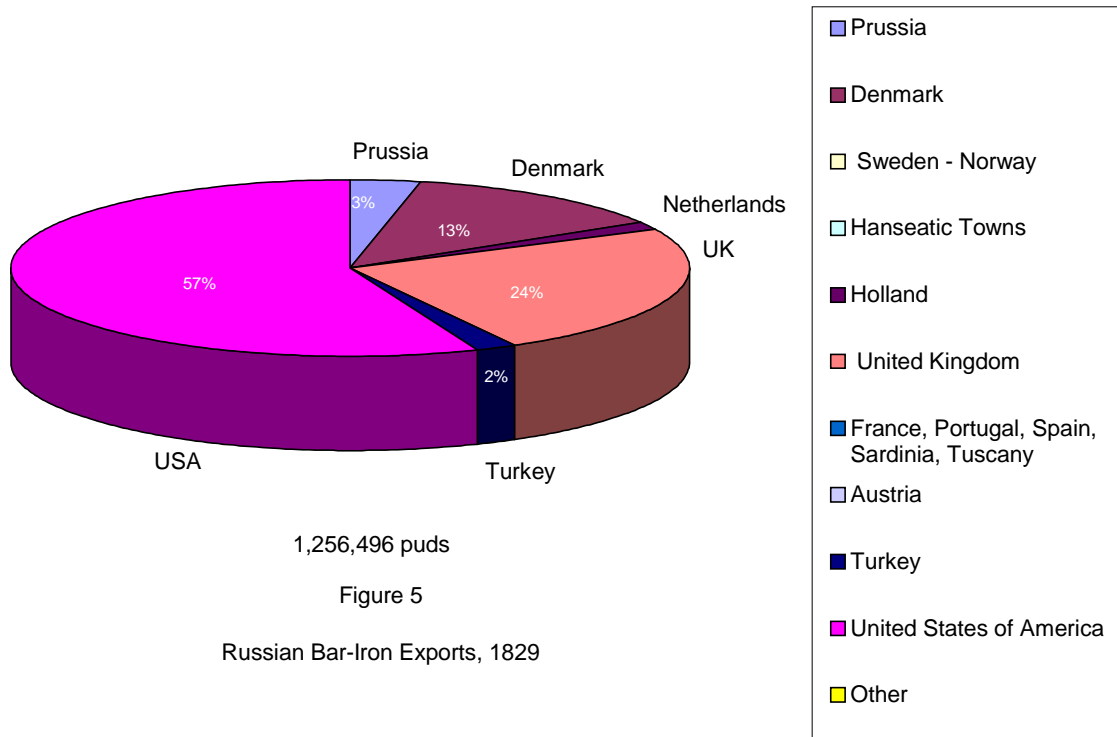
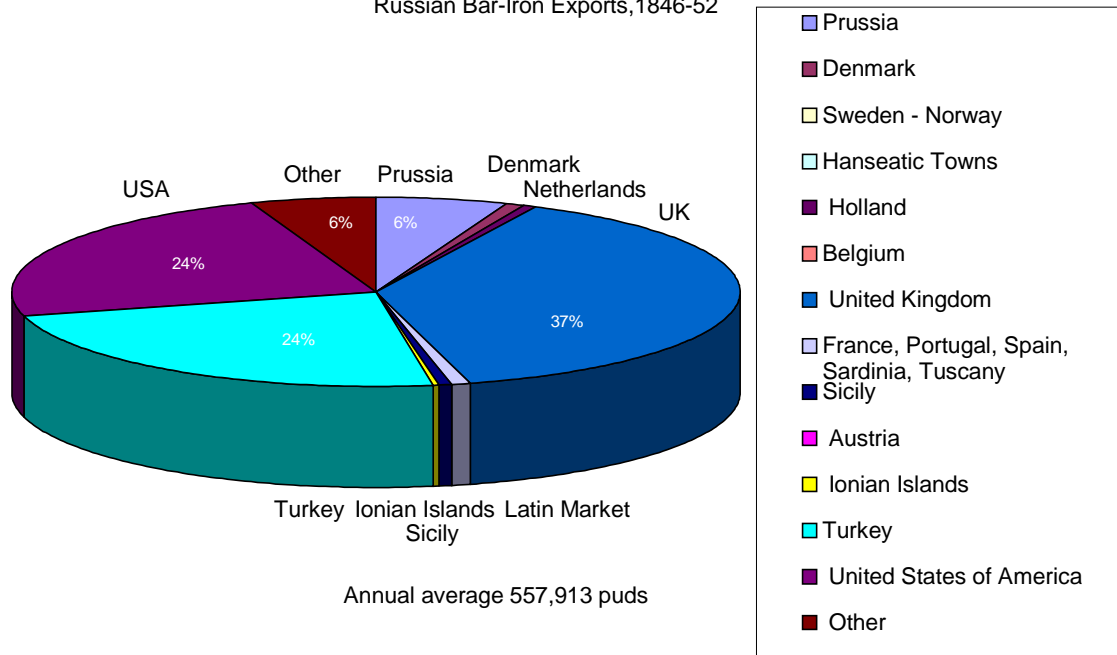


Figure 6.  
Russian Bar-Iron Exports, 1846-52



Excluded by the imposition of tariffs and the development of import-substituting iron industries (in the United Kingdom, France and the United States) the Russian producer again had in the 1840's to seek new outlets for his wares (figure 6). These "new" markets, in the Baltic (Denmark, Prussia and the Hanseatic towns) and the Mediterranean (Spain/Portugal, Sicily, the Ionian Islands and Turkey) where their product was still able to hold its own against its competitors, however, had but little potential for increased sales.

Table 2.

Russian Iron Production and Sales 1780-1850.

IRON INDUSTRY	1782	1807	1822	1838/43	1851
Output (million puds)	6-6.4	7.7	8.8	9.8	10.9
Exports (million puds)	3.8	1.6	1.4	1.2	0.6
Export / Output %	60-63	20	16	12	6
Retained output (million puds)	2.2-2.6	6.1	7.4	8.6	10.3
-do- per head (pud/cap)	0.08-0.1	0.14	0.16	0.16	0.18

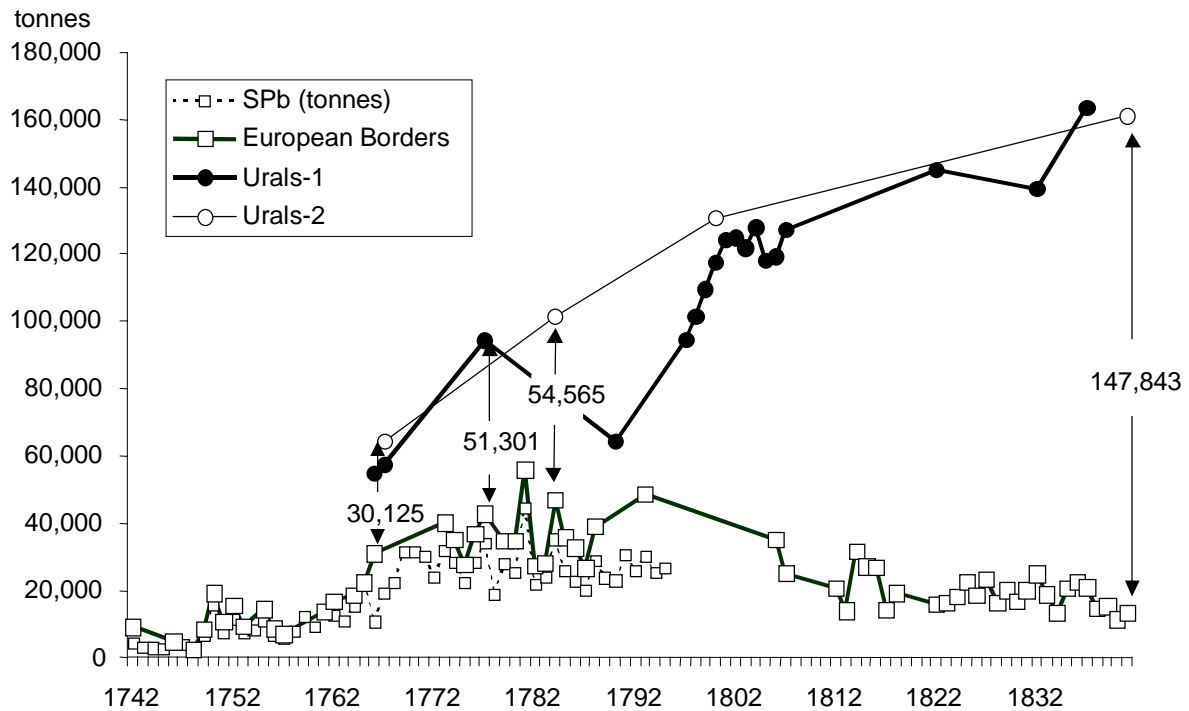
Ousted from international markets by the imposition of tariffs and the development of import-substituting iron industries, Ural's production, however, did not decline. Rather it continued to significantly increase. No longer did exports, which amounted in 1850 only to some six per cent of total production, however, play a significant role in this process (table 2). Rather the industry's growth took place on the basis of sales to domestic consumers, a task fraught with difficulties, but one which revealed that the Russian iron producer-fabricator was economically as, if not more, efficient than his contemporary British counterpart.

### III

As tariffs were imposed against its products abroad, Ural's producers from 1788-1807 re-orientated output towards the home market. As a result the most rapidly growing sector of manufactory was now metal fabrication, which during these twenty years quadrupled the size of its work force. As exports of iron had diminished, largely as a result of tariffs imposed in Britain to protect its inefficient new coke-fuelled industry, more and more of the produce of the Urals industry had been sold at home. Employment in domestic metal fabrication increasing from 24,000 to 95,100 in the 1800s when it comprised 20 per cent of the manufacturing labour force. When, tariff discrimination against the Russian product extended from Britain to France and then the USA this trend continued apace.

Figure 7.

Urals Production, Export and Domestic Sales



In spite of a continual search for new foreign outlets for the product, as one after the other foreign governments put up tariffs against Russian iron (which at factory prices was still price competitive with Scottish iron in 1850), exports fell until they were largely confined to markets in the Ottoman Empire. Increasingly the product was sold to domestic fabricators, who over the years 1788-1850 set more and more men (1807 95,113; 1850 125,372) to work creating a major industrial complex.<sup>36</sup> Central to the distributional network<sup>37</sup> of this complex was the Nizhnii Novgorod fair where producers sold some 4.5 - 5.5 million puds ( or approximately half of total output ) of the ferrous metal a year in the 1850s to the Yaroslavl merchant Pastukhov (0.9 million puds), who distributed it to *kustari* workers in Novgorod, Tver (nail makers) and Yaroslavl (agricultural and other peasant implements); the Nizhnii Novgorod trader Rukavishnikov (0.25-0.29 million puds), for his steel works and distribution within the province, and a host of others, distributing iron to the metal workers of the northern industrial provinces. Smaller quantities were sold at Moscow (0.3 million puds), Kiev (0.25 million puds), Karkhov (0.175 million puds) and Riga (0.008 million puds). Of overwhelming importance to producers, however, were the metal workers of the non-black earth industrial provinces of the north who largely obtained supplies of the metal from Nizhnii Novgorod and, converting it into fabricants, sold their wares in growing quantities to an increasingly impoverished peasantry. Sales increased to this group almost three-fold (figure 6)<sup>38</sup> over the years from 1782-1850, members of a fifty per cent larger population<sup>39</sup> each acquired twice as much iron, in the form of fabricants, as before (table 2). This took place, moreover, in spite of a fall

in "real" per capita income from 68 to 24 silver roubles, or to almost a third its former level.<sup>40</sup> In these circumstances, it might have been anticipated that, at constant prices Russian per capita iron consumption would have fallen to about a third (0.03 puds/cap) and total sales to domestic consumers by about a half. Yet by ca. 1850 per capita iron consumption had actually doubled (to 0.18 puds per capita). By reducing prices some six –fold (assuming unitary price elasticity), iron producers-fabricators effected a doubling of sales to the increasingly impoverished peasantry. In part this was achieved by the organizational-technologies changes, which as noted above, transformed Urals bar-iron production. These coupled with transport improvements along the Volga navigation, resulted between 1793-1832 in a 42 per cent fall in the price of bar-iron on the St Petersburg market (figure 2). These changes in the primary production process however were eclipsed by those taking place in the iron-fabrication sector of the industry.

Table 3

Real industrial wages 1800-1850. (Index 1800/10 = 100)

Date	Free labour.	Possessional	Average per capita NI.(index)
	Cotton weaver	labour <sup>41</sup> weaver/iron master	
1800-10	100	100	100
1811-20	51	109	47
1821-30	40	212	-
1831-40	31	-	29
1841-50	25	234	-
1851-60	22-37*	-	35

NOTE.\* The second figure indicates the wage of a factory rather than a kustari worker

A fall in kustari wage rates to approximately a quarter their former level (table 3)<sup>42</sup> coupled with a 2.5-fold increase in productivity (largely achieved by increased labour intensity but also in the 1840s by the introduction of new technology and industrial organization), which paralleled that of the barschina-serf,<sup>43</sup> were sufficient to reduce unit labour cost to about a tenth their former level. Overall production costs/prices, assuming a 1:5 base-year weighting of raw material-labour costs, accordingly, fell almost six-fold, allowing metal fabricators to sell twice as much of their product, even to the acutely impoverished members of the Russian peasantry.

The Russian producer-fabricator's British counterpart enjoyed a much more congenial market situation. Even in 1800 iron consumption in Britain was far higher

(0.5 puds/cap) than in Russia. Over the next sixty years, as population increased by a quarter and per capita income rose by a half,<sup>44</sup> moreover producer-fabricators, accordingly might reasonably expect to see the aggregate market for iron almost double (+87.5%) in size. By organisationally and technologically innovating and reducing prices to a third their former level and displacing foreign imports, in this situation, moreover, (assuming unitary price elasticity), they would be and were able to secure a five and a half-fold increase in sales during the years 1800-1840/50. By any economic criteria, therefore, in terms of organisational and technological efficiency, Russian charcoal iron producers-fabricators were at least as, if not more, efficient than their contemporary British counterparts, producing and utilising the products of the new coke-fuelled iron industry during the years 1780-1840.

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#### ENDNOTES

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<sup>2</sup> SOURCES: URALS-1 (listings of individual plant output). Chulkov', M D, *Istoricheskoe opisaniie rossiiskoi kommertsii pri vsekh' portakh' i granitsakh do nin' nastoyashchago i vsekh' preimushchesshvennikh ukazonenii po onoi gosudarya imperatora Petra velikago i nin' blagopoduchno tsarsshvuyushchei gosudarini imperatritsi Ekaterini velikiya* (St. Peterburg, 6 vols. in 21 books, 1786), VI/2, pp.547-598. Baklanov, N, *Tekhnika metallurgicheskogo proizvodstva XVIII v. na Urala* (Moscow-Leningrad, 1937), app. 3, pp. 310-323. Hermann, B F J von, *Sochineniya o Sibirskikh' rudnikakh' i zavodakh', sobanniya nadvornim' soveshnikom' i akademikom Ivanom' Germanom'* (St. Petersburg, in 3 chast', 1797-1801), I, pp 194-203 and *Die Wichtigkeit des Russischen Bergbaue* (St. Petersburg, 1810); *Annuaire du journal des mines de Russie*, XIII (St. Petersburg, 1840). Yatsunskii, V K, "Materiali po istorii ural'skoi metallurgi v pervoi polovine XIX v." *Istoricheskii arkhiv*, IX (1956) URALS-2. (Aggregate data of "Urals" production 1766-1900) Yatsunskii, V K, "Krupnaya promishlennost' Rossii v 1790-1860" in M. K. Rozhkov (ed.), *Ocherki ekonomicheskoi istorii Rossii pervoi polovine XIX veka. Sbornik statei* (Moscow, 1959). ENGLAND, Hyde, C K *Technological Change and the British Iron Industry, 1700-1870* (Princeton, 1977), pp. 67, 223-252.

<sup>3</sup> The following paragraph is based upon the classic studies of Hildebrand, K-G *Fagerstavrakens historia*, I (Uppsala, 1957); "Foreign markets for Swedish iron in the eighteenth century", *Scandinavian Economic History Review*, VI (1958); *Svenskt järn. Sexton- och sjuttinndratalen. Exportindustri före industrialismen* (Stockholm, 1988) translated as *Swedish Iron in the Seventeenth and Eighteenth Centuries. Export Industry before Industrialization* (Stockholm, 1992) and "Swedish and Russian Iron in the Eighteenth Century" in Blanchard, I et aliis, *Industry and Finance in Early Modern History. Essays presented to George Hammersley on the occasion of his 74th Birthday* (Stuttgart: Franz Steiner Verlag, VSWG-Beihefte, 98. 1992), pp.226-244.

<sup>4</sup> See sources listed in note 2 series URALS-1 above.

<sup>5</sup> Newman, J., *Russia's Foreign Trade, 1680-1780* (unpublished Edinburgh Ph.D thesis, 1985), pp. 164-5.

<sup>6</sup> Blanchard, I., *Russia's "Age of Silver." Precious Metal Production and Economic Growth in the Eighteenth Century* (London, 1989), pp. 335-355; Mironov, B N., *Khlebnie tseni v Rossii za dva stoletiya, XVIII-XIX vv.* (Leningrad, 1985)

<sup>7</sup> Blanchard, I., "Times of Feast, Times of Famine: A critical examination of recent British research concerning market structures and trends in the production of carboniferous fuels, 1450-1850" in Paul

Benoit and Catherine Verna (eds.) *Le charbon de terre en Europe avant l'usage industriel du coke* (Turnhout: De Diversis Artibus t. 44 [ns.7]. Proceedings of the XX International Congress of the History of Science, Liège 20-26 July 1997, vol. IV. 1999), pp. 71-75.

<sup>8</sup> Hennin, Wil'helm de, *Opisanie ural'skikh i sibirskikh zavodov 1735*, edited by M A Pavlov (Moskva, 1937), pp. 354-371

<sup>9</sup> At some 56d sterling equivalence for one Kentish cord at the current 1704 exchange rates in comparison with 72d for the Kentish wood, largely as a result of differences in the relative purchasing power of silver in England and Russia- I Blanchard, *Times of Feast, Times of Famine*, p.71 n.32.

<sup>10</sup> Described in Blanchard, I., *Times of Feast, Times of Famine*, pp. 72-74.

<sup>11</sup> Mironov, B N ., " 'Revolyutsiya tsen' v Rossii v XVIII v.", *Voprosi istorii*, 11 (November, 1971), pp. 54-5.

<sup>12</sup> Hyde, C K., *Technological Change*, pp. 104-5.

<sup>13</sup> *Report of the Select Committee on Manufactures, Commerce and Shipping* (PP., 1836, VI)

<sup>14</sup> SOURCES. St Peterburg export price: Pokovski, V E (ed.), *Sbornik svedenii po istorii i statistik vneshnei torgovli Rossii* (St Petersburg, 2 vols., 1902); London: Gayer, A.D., Rostow, W.W. and Schwartz, A.J., *The Growth and Fluctuation of the British Economy, 1790-1850. A Historical, Statistical and Theoretical Study of Britain's Economic Development* (Oxford, two volumes, 1953), I, pp. 74, 127-8, 151-2, 193, 229, 261, 291, 321; Liverpool: Mitchell, B.R. and Deane, P., *Abstract of British Historical Statistics* (Cambridge, 1962), pp.492-3.

<sup>15</sup> Yatsunskii, V A., "Materialy pravitel'stvennago obsledovaniia zavodov chernoi metallurgii Rossii v pervoi polovine 50-kh godov XIX v. kak istoricheskii istochnik" in *Voprosi sotsial'no-ekonomicheskoi istorii i istochnikovedennia perioda feodalizma v Rossii. Sbornik statei k 70-letuiu A A Novosel'skogo* (Moskva, 1961), pp. 352-362.

<sup>16</sup> See page 11 below

<sup>17</sup> On the iron workers of the Urals - see the studies of Esper, T: "The condition of the serf workers in Russia's metallurgical industry, 1800-1861", *Journal of Modern History*, L (1978); "Hired labour in the metallurgical industry of the Urals during the late serf period", *Jahrbücher für Geschichte Osteuropas*, XXVIII (1980) and "The income of Russian serf ironworkers in the nineteenth century", *Past and Present*, No. 93 (1981)

<sup>18</sup> Bang, N E. and Korst, K., *Tabeller over Skibsfart og Varetransport gennem Øresund, 1661-1783*, (København, 2 vols., 1930-53) and computer print-offs of Sound Toll Registers, 1784-1795 kindly provided by Professor Johannson.

<sup>19</sup> See page 1 above.

<sup>20</sup> Hyde, C K ., *Technological Change*, table 6.3, p.105

<sup>21</sup> Scrivenor, H., *A Comprehensive History of the Iron Trade* (London, Second Edition, 1854), p.131

<sup>22</sup> Russia, *Departament' Vneshnei Torgovli, Gosudartstvennaya Torgovlya ... goda v' raznikh eya vidakh*, various years (Sankt Peterburg, 1803-1861)

<sup>23</sup> Ibidem

<sup>24</sup> Blanchard, I., "Russian railway construction and the Urals charcoal iron and steel industry, 1851-1914," *Economic History Review*, Second Series, 53/1 (2000), p.108

<sup>25</sup> In 1793 St Petersburg also exported some 12,533 tons of bar-iron to intra-Baltic markets.

<sup>26</sup> Most of which was re-exported to more southerly continental European ports.

<sup>27</sup> Particularly at Marseilles-Toulon C-G Hildebrand, *Foreign markets*, pp. 48-9.

<sup>28</sup> Russia, *Departament' Vneshnei Torgovli, Gosudartstvennaya Torgovlya ... goda v' raznikh eya vidakh*, various years (Sankt Peterburg, 1803-1861)

<sup>29</sup> Adamson, R., "Swedish Iron Exports to the United States, 1783-1860", *Scandinavian Economic History Review*, XVII (1969), pp. 70-1.

<sup>30</sup> Ibidem, table 1, p. 61

<sup>31</sup> Kafengauz, B B., "Voina 1812 goda i ee vliyanie na sotsial'no-ekonomicheskuyu zhizn' Rossii (po materialam predpriyatii N Demidov)", *Voprosi istorii*, no.7 (1962), pp. 69-80.

<sup>32</sup> Russia, *Departament' Vneshnei Torgovli, Gosudartstvennaya Torgovlya 1829 goda v' raznikh eya vidakh*, (Sankt Peterburg, 1830)

<sup>33</sup> Adamson, R., *Swedish Iron Exports*, pp. 75 ff.

<sup>34</sup> Attman, A., *Fagerstabrucks Historia*. Vol. II. *Adertonhundralet* (Uppsala, 1958).

<sup>35</sup> Adamson, R., *Swedish Iron Exports*, p.103.

Conference 'Trade, commodity markets and the mercantile contribution to industrialisation'

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<sup>36</sup> Strumilin, S. G., *Istoriya chernoi metallurgii v SSSR* (Moskva, two volumes, 1954), I, pp. 348, 360, 370)

<sup>37</sup> Yatsunskii, V K, "Geografiya rinka zheleza v doreformennoi Rossii," *Voprosi Geografii*, XV (1960)

<sup>38</sup> See references in notes 2, 18 and 22.

<sup>39</sup> Kabuzan, V. M., *Narodonaslenie Rossii v XVIII-pervoi polovine XIX veka* (Moskva, 1963)

<sup>40</sup> Blanchard, I., "Russian and Soviet Economic Development in Historical Perspective, c. 1700-1998" in Elspeth Reid et aliis (eds.) *Edinburgh Essays: Russia on the Edge of the Millenium*. Introduction by Dennis Ward. (Nottingham, 2000), pp. 101-132.

<sup>41</sup> See references in note 17.

<sup>42</sup> Still the best study on earnings in this sector is the translation of M I Tugan-Baranovsky, *The Russian Factory in the Nineteenth Century*, originally published in 1898)

<sup>43</sup> Rudolf, R. L., "Agricultural Structures and Proto-industrialization in Russia: Economic Development with Unfree Labour", *Journal of Economic History*, XLV (1985) and the same author's "Family Structure and Proto-Industrialization in Russia", *Journal of Economic History*, XL (1980).

<sup>44</sup> Crafts, N F R., *British Economic Growth during the Industrial Revolution* (Oxford, 1985)