THE EXPANSION OF TRADE AND THE DEVELOPMENT OF EUROPEAN INDUSTRY TO 1600*

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ABSTRACT: This paper describes the industrial development of Europe to 1600. The conventional history of industrial development sees technological progress as its primary cause. However, this paper argues that the source of rising productivity was not new technology but the reorganization of production in response to falling trading costs and the expansion of trade. The expansion of trade changed which goods were produced, where they were produced, and by inducing an increasing division of labor, how they were produced. Of course, technological progress did contribute to rising productivity. However, it was less an independent cause than a consequence of industrial reorganization, expanding trade, and falling trading costs.

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Historians of early European industrial development have generally understood it in 'Ricardian' terms. That is, they have considered technological progress, or the lack of it, to be the crucial determinant.[1] We shall see that this view is as mistaken with respect to industry as it is with respect to agriculture. The fundamental cause of development in industry, as in agriculture, was not new technology but the reorganization of production in response to falling trading costs and the expansion of trade. Falling trading costs and the expansion of trade changed which goods were produced and where they were produced. Also, by inducing an increasing division of labor, they changed how goods were produced. Of course, technological progress did play a role. However, technological progress was less an independent cause than a consequence—a consequence of industrial reorganization, expanding trade, and falling trading costs.[2]

The difference in the two views of industrial development can be illustrated by their different interpretations of the history of European textiles in this period. The Ricardian view attributes the rise of the rural woolen industry in England and the decline of its urban competitors in the Low Countries to the invention of the mechanical fulling mill.[3] Supposedly, this important cost-reducing innovation was well suited to the hilly terrain of England, which provided the necessary water power, but ill suited to the flat terrain of the Low Countries.[4] Moreover, it was the slowness of the technologically conservative, guild-dominated woolen industry of the towns to adopt this important innovation that led to the rise of rural manufacturing. Recent research has challenged this traditional narrative in all its particulars.[5] The fulling mill actually reduced cost only a little, and at a considerable sacrifice in quality—the real reason for the opposition of the urban guilds.

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[1]The term 'Ricardian', used in this sense is due to Grantham (1999). It signifies, not the theory of Ricardo himself, but the whole value-theoretic tradition that stems from his work. It is to be contrasted with the 'Smithian' approach adopted here. See Kohn (2001)a for a discussion of the distinction.

[2]This is very much the same story told by Szostak (1991) for the Industrial Revolution.

[3]This view is associated in particular with the work of E. Carus-Wilson (e.g., Carus-Wilson (1987)). See also Kellenbenz (1974). Fulling is the process of beating and shrinking woven cloth to increase its weight and bulk. Traditionally this was done by men treading the cloth. The fulling mill replaced feet with water-driven hammers.

[4]"Building fulling-mills in the land of the windmills was hardly practicable." (Kellenbenz (1974) p 49).

Water mills were in fact quite common in the Low Countries, although they were not used there at that time for fulling. And, as we shall see, the relationship between rural and urban manufacturing was far more complex than the traditional narrative suggests.

The 'Smithian' view that we shall pursue here suggests a different interpretation of the events. The expansion of trade in northwest Europe that began in the eleventh century led to the growth of urban woolen manufacturing. As trading costs fell and incomes rose, long-distance trade in textiles expanded from luxury fabrics to relatively inexpensive cloths—woolens from the North and cottons from the South. Lower trading costs promoted competition among producers and led to the concentration of production in the hands of the most efficient—the woolen producers of the Low Countries and the cotton producers of Northern Italy.[6] High-volume production of cheap textiles in these centers led to some important technological innovations. The development of these industries was, however, interrupted in the late thirteenth century by a series of wars that swept Europe and sharply raised trading costs. As the trade in inexpensive textiles became unprofitable, the export industries of Flanders and of Northern Italy switched to lower-volume production of luxury fabrics that could bear the higher trading costs. Meanwhile, protected from competition by these same high trading costs, small industries reemerged all over Europe to supply their local markets with cheap textiles. When war abated in the middle of the fifteenth century and trading costs fell again, trade in cheaper textiles resumed and with it industrial development. Flanders became once more a major exporter of inexpensive woolens; South Germany became an exporter of cotton fustians, and Northern Italy became an exporter of inexpensive woolens and silks. With rising middle-class incomes contributing to the growing demand for cheap goods, low trading costs and competition once again led to the concentration of production and to the renewal of technological progress.[7]

Before we take up this story in greater detail, let us take a look at the place of industry in the early European economy.

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[5]In particular, the work of John Munro. See, for example, Munro (1998).

[6]In the two urbanized central regions of the major zones of European trade: see Kohn (2001)b.

[7]For an overview of the changing trading costs over time and how they affected economic activity see Kohn (2001)a.

INDUSTRY IN THE EUROPEAN ECONOMY

In the period to 1600, Europe was 'preindustrial' in the sense that industry accounted for a relatively small part of the economy: less than ten per cent of the population made its living from manufacturing, mining, and construction.[8] Moreover, individual industries were themselves small: the famous woolen industry of Florence employed no more than 30,000 workers; in 1400, the English textile industry employed perhaps half that number. Manufacturing was more important in the towns, but, as we shall see, it played a role too in the countryside.

The largest manufacturing industry by far was textiles—mostly woolens, but also linens, cottons, and silks. Other important manufactures included leather goods, ceramics and glass, paper, metal goods, as well as producer goods such as ships, wagons, and containers.[9] Construction was a major employer during periods of economic and demographic expansion—especially residential construction in the expanding cities. Mining, throughout the period, focused on the extraction of precious metals, especially silver; however, copper became important in the fifteenth century, and the mining of iron and coal began to expand in the sixteenth.[10]

As in agriculture, a good deal of industrial production was for the producer's own use. In the countryside in particular, families built their own homes and made their own clothing and implements. Of the industrial output that did reach the market, much was sold by producers directly to local consumers.[11] Most of the rest was sold within the region, and only a little found its way into inter-regional or inter-zone trade. For example, while the cities of Northern Italy were renowned in the twelfth and thirteenth centuries for their exported manufactures, most of their output was sold within the region itself—in the cities themselves and in their rural hinterland. Their manufactures consisted mostly of cheap items such as coarse cloth and clothing, farm tools, and pottery.[12] Similarly,

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[8]Braudel (1972) p 427 quoting John Nef on Europe in the early seventeenth century.

[9]Sella (1977)

[10]Nef (1964)

[11]"Even as late as 1841 over 40% of industrial craftsmen were supplying exclusively local markets: before 1750 the proportion must have been a good deal higher" (Clarkson (1971) p 117).

[12]Jones (1997)

England, famous as a major exporter of woolen cloth by the late fifteenth century, nonetheless produced most of its output for the home market.[13]

TRADING COSTS AND MARKET INFRASTRUCTURE

The reason few industrial goods traded beyond the local or regional market was the cost of trading over greater distances. The cost of trading consisted of three elements—the cost of transportation, the cost of transactions, and the cost of finance.[14]

The cost of transportation was generally high—both the cost of carriage and the cost of predation (brigandage and tolls).[15] Transportation costs were less of an obstacle to trade in luxury goods because their high value relative to bulk or weight and their high margins. However, for cheaper goods and for industrial raw materials, transportation costs could be prohibitive. As we shall see, transportation costs were often the decisive factor in determining where and how goods were produced—especially cheaper goods.

Transactions costs arose both in the marketing of output and in the procurement of inputs. For producers serving a local market, marketing was easy. In many cases, artisans—from tailors to shipbuilders—worked to order according to a customer's directions. However, once trade extended beyond the local level, everything became more difficult. The lack of direct contact between producers and customers was particularly problematic because manufactured goods were so heterogeneous and variable in quality. There were many small producers, and they turned out products that varied enormously in quality and design. Moreover, even the same producer found it hard to ensure consistent quality because of the difficulty of controlling the chemical and physical properties of his materials. Much of the art of the smith, for example, lay in knowing which of the hundreds of types of iron available was best suited to a particular application.

The heterogeneity of products and of the diversity of customer tastes made distant trade a complicated problem in matching and mediation.[16] It was merchant middlemen who provided a solution. Merchants found the right goods for consumers and the right

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[13]Palliser (1983)

[14]See Kohn (2001)a

[15] See Kohn (2001)d for a discussion of transportation costs.

[16]Grantham (1999) "The markets of the pre-modern period were not Walrasian auctions, but matching processes operated by merchants…" (p 218)

markets for producers. If necessary, merchants would modify goods to suit consumer tastes. For example, in the thirteenth century, Florentine merchants imported unfinished woolen cloth from the Low Countries and had it dyed and finished to suit the tastes of different Mediterranean markets; in the sixteenth century, Venetian merchants did the same with unfinished woolen cloth from England.[17] As tastes changed, merchants provided producers with feedback from the market. Of course, mediating between producer and consumer exposed the merchant to considerable risk. Because of the slowness of communications, production to order for distant markets was generally out of the question. Merchants had no choice but to purchase goods from producers 'on spec' and ship them off in the hope of reselling them at a profit. And if the venture proved unsuccessful, it was the merchant who bore the loss.

The procurement of inputs was no less important to manufacturers than the marketing of output. To a large extent, the price of a manufacture good depended on the price of the raw materials: compared to today, materials were costly relative to labor.[18] Moreover, it was the quality of the raw materials that largely determined the quality of the finished product. For a long time, for example, the best wool came from England, and the highest-quality woolens could be made from nothing else. In general, materials came in a great variety of types and qualities, and the better or cheaper materials could often be obtained from more distant sources. While craftsmen catering to the local market often produced their own raw materials or purchased them locally, those hoping to compete in international markets usually had to procure their materials from far away. In doing so, they were once again entirely dependent on merchant middlemen. Merchants located materials, examined quality, arranged for transportation, and broke down quantities into smaller lots for sale to producers. Producers who were well served by merchant middlemen were therefore at a competitive advantage relative to those who were not. For example, manufacturers in a commercial center such as Venice had relatively easy access to the best materials: Venetian soapmakers could turn out a superior product because they

[17]Lane (1973) Ch. 12

[18]In luxury textiles, for example, the cost of the fiber and dyes could approach eighty per cent of the value of the finished product (Munro (1997)).

had access to olive oil from Apulia and soda ash from Syria rather than the animal fats and potash used by their northern competitors.[19]

When it came to financing, the needs of producers serving the local market were limited. For them, sale was immediate and inputs usually inexpensive or self-produced. Where more expensive inputs were needed, these were typically supplied and financed by the customer. However, for producers serving more distant markets, financing was a major concern. The need for financing was multiplied manyfold by the long delays involved in obtaining inputs from distant sources, in passing goods through the various stages of production, and in selling output in distant markets. Moreover, because materials were expensive relative to value added, the amount of financing required was enormous. Once again, it was merchants who provided the solution. Merchants financed the acquisition of inputs and the marketing of output, and by extending credit to producers they also financed the process of production. For example, the 'wool broggers' of Elizabethan England provided cottage weavers with the wool they needed against repayment when the cloth was sold. Attempts by the government to eliminate these 'parasitic middlemen' who, they alleged, made a living "not by honest labor but by taking advantage of [their] neighbours' necessities" were naturally met with storms of protest from angry weavers.[20] In other cases, merchants financed the process of production by paying for output in advance: this was, for example, a common practice in mining.[21] And the passage of products through the intermediate stages of production was again financed by merchants in one way or another, as we shall see presently. Merchants were able to finance the working capital needs of industry largely because they themselves had access to a well-developed system of mercantile credit.[22]

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[19]Lane (1973) Ch. 12

[20]Tawney (1925) p 49

[21]Nef (1987); Tawney (1925) p 51

[22]Mercantile credit and the working capital needs of manufacturing were well suited to one another, because both were relatively short-term. See Kohn (1999)a, Kohn (1999)b, and Kohn (1999)c on mercantile credit.

THE IMPACT OF EXPANDING MARKETS ON PRODUCTION

The expansion of trade raised agricultural productivity through three mechanisms: it gave producers an incentive to switch to more profitable outputs; it promoted the better utilization of resources through a restructuring of the process of production; and it induced technological progress.[23] The impact of expanding trade on industrial productivity was similar, but there were some important variations.

CHANGES IN OUTPUT

In agriculture, expanding markets raised the local prices of some products and lowered the local prices of others, causing producers to switch to types of output in which they had a comparative advantage. Comparative advantage in agriculture stemmed from differences in growing conditions and also from differences in transportation costs.

Industry too witnessed a process of specialization according to comparative advantage. Expanding trade among urban economies led each to specialize in particular manufactures. And expanding trade between town and country led the former to specialize increasingly in manufacturing and the latter in agriculture. However, as we shall see, rural industry later revived and came to complement urban manufacturing. It specialized in the stages and types of manufacturing in which it had a comparative advantage.

Comparative advantage in industry grew out of differences in factor costs, differences in technology, and differences in transportation costs. There were differences in the cost of labor: labor was relatively cheap in the countryside and particularly expensive in the urbanized central regions. There were differences in technology. As we shall see, technology diffused only slowly, and particular cities consequently maintained a technological edge in the production of certain products for considerable periods of time. Differences in transportation costs favored some locations over others for the production of particular goods. It was often more profitable, for example, to ship finished products than to ship raw materials. Consequently the North initially exported woolen textiles to the Mediterranean and imported cottons and silks. Similarly, the Baltic initially exported its grain to the Low Countries ‘embodied’ in beer. However, as transportation costs fell for bulk commodities, trade in raw materials expanded. The Mediterranean came to

[23]See Kohn (2001)c

produce woolens from imported northern wool, the North to produce cottons and silks from raw cotton and silk imported from the Mediterranean, and the Low Countries to produce beer from imported Baltic grain.[24]

Of course, the effect of transportation costs on comparative advantage depended not only on the cost of carriage but also on the cost of predation. For example, after a high tariff was imposed on the export of English wool, wool exports were largely replaced by exports of unfinished cloth, which bore a much lower tariff.[25] The woolen industry of the Low Countries, which had previously manufactured fine woolens from imported English wool, reoriented itself to finishing the imported English cloth and expanded its imports of wool from other sources to produce cheaper fabrics.

Considerations of comparative advantage alone are not enough, however, to explain the shifting patterns of manufacturing and inter-urban trade. These patterns reflect in addition a dynamic process in which trade led to the production of new goods and the production of new goods led to more trade.[26] Northern Italy, the urbanized central region of the Mediterranean zone, provides numerous examples of this process. Initially, Northern Italy imported fine cotton and silk cloth from the Levant for its own use and for re-export. Then, as trading costs fell, it began to import raw silk and cotton and to produce from them cheaper fabrics for the local market. As the silk and cotton industries developed, they began to export their output to markets throughout the Mediterranean—the Levant included—and in northern Europe. Other manufactures—including glass, soap, metal products, and paper—followed a similar pattern of development. First came import of the finished product; then manufacture of cheap substitutes for the local market from imported raw materials; then, as quality improved, growing exports. Of course, the switch from re-export of finished goods to import of raw materials and export of manufactures placed enormous demands on market infrastructure. Merchants had to

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[24]See Kohn (2001)b for more details on the effect of falling trading costs on the expansion of trade.

[25]By the 1490s, the export price of wool was more than double the domestic price (Munro (2000)).

[26]This process was first described by Jacobs (1969). It is the same process described in Kohn (2001)a in the context of trade and urbanization and invoked in Kohn (2001)b to explain the emergence of the urbanized central regions of the two major trading zones.

acquire the necessary foreign technology, organize production, procure the inputs, and market the finished product, as well as financing the whole operation.[27]

This process of trade generating production and production generating trade was reinforced by a second process that might be described as 'one thing leading to another'.[28] The early industrial development of the northern Netherlands provides some good examples. The high local price of grain drove Dutch merchants to seek out foreign sources of supply.[29] Since shipping costs accounted for a large part of the delivered price, they had a strong incentive to develop a shipping industry that would lower those costs. Shipping led to shipbuilding and to the manufacture of containers (barrels, sacks, and packing). These in turn led to the importation of lumber and to sawing (for residential construction as well as for shipbuilding and cooperage). Low shipping costs lowered the price of grain to the point that it became worthwhile to produce beer from imported grain (rather than importing beer from the Baltic). Low-cost shipping also enabled the Dutch to take over much of the trade with the Baltic. When the supply of one of their main Baltic imports, herring, began to dry up, they developed their own herring fishery in the North Sea (their shipbuilding skills enabling them to produce a new kind of ship to meet the needs of this kind of fishing). The growth of their herring fishery pushed them into the salt trade and into salt refining. Each of these steps in turn generated new industries and new exports—beer, ships, planks and barrels, herring, and refined salt.[30]

Of course, trade not only created new industries, it also undermined existing ones. One city's exports were imitated by another, which in turn became an exporter and so a competitor. Consequently, successful urban economies had to be constantly generating new industries to replace those that were declining.[31] Antwerp provides a good example of such dynamism. When its principal industry, woolens, was threatened in the late fourteenth century by lower-cost competition from England, it reoriented itself to finishing English cloth. In the fifteenth century it supplemented textiles with a number of

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[27][Mazzaoui, 1981 #1983 Ch. 3

[28]This second process, too, was first described by Jacobs (1969).

[29]See Kohn (2001)b

[30]de Vries and van der Woude (1997)

[31]Not all cities were equally successful in this respect. We shall discuss reason for these differences in Chapter 21.

luxury manufactures—printing, diamond-cutting, glass and mirrors, majolica tiles. The products of these industries, initially imitations of Italian imports made for the local market (mainly the Burgundian court), later became themselves important exports. In the sixteenth century, Antwerp added sugar refining (it was the main destination of sugar imports from the Atlantic islands), silk textiles, gold- and silversmithing, furs, and painting.[32]

RESTRUCTURING THE PROCESS OF PRODUCTION

The expansion of trade, therefore, contributed to industrial development and to increasing productivity by changing *which* goods were produced and *where* they were produced. However, it ultimately had an even greater effect on *how* goods were produced. As markets expanded, and as the production of particular goods became concentrated in particular locations, the growing scale of output allowed the process of production to be broken down into discrete stages. This division of labor promoted specialization—not specialization in the production of different goods, but specialization in the different stages of production of the same good.[33]

The transformation of woolen production in Flanders during the eleventh and twelfth centuries provides a good example of this process. As trade increased the demand for Flemish woolens beyond the capacity of rural producers to satisfy it, merchants began to organize production in the towns. This relocation led to a change in organization. When production had been located in the countryside, rural households had taken the raw wool, sometimes from their own sheep, and transformed it, with at most a little specialization within the household, into the finished product. However, once the industry was concentrated in the towns, the process of production could be broken down into separate sub-processes, each carried out by its own specialists. The list of sub-processes was long: parting, picking, greasing, combing, carding, spinning, twining, spooling, shearing,

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[32]This dynamic process—trade creating and destroying industries, which in turn are replaced by new industries—has much in common with Schumpeter's concept of 'creative destruction' (Schumpeter (1942)).

[33]In agriculture, trade transformed the process of production through commercialization—by inducing a transition from 'command' to market organization (see Kohn (2001)c). Industry, however, at least in the towns, had always been exposed to the market and so had always been commercialized, so the impact of expanding trade took a different form.

weaving, fulling, burling, dressing, dry-shearing, dyeing, finishing, and pressing and packing. Some sub-processes were subdived further: there were, for example, groups of dyers specializing in particular colors.

Such a restructuring was possible only in an urban environment. Only in the cities was the scale of output sufficiently large to keep specialists in each sub-process fully occupied. And only in the cities were trading costs sufficiently low to make this form of organization feasible. First, the breaking down of the process of production into separate sub-processes required a great deal of movement of intermediate product from one specialized producer to another: close proximity lowered transportation costs. Second, producers who were specialized to this degree were highly dependent on market infrastructure (that is, on merchants) to integrate the process of production—to move product along from one stage to the next. Towns provided the necessary commercial infrastructure. Third, the increasing roundaboutness of production implied an enormous increase in the amount of working capital tied up in the process of production. Urban economies had access to financial markets and financial intermediaries able to provide the necessary finance, as well as payments systems that could facilitate the large volume of intermediate transactions.[34]

This did not mean that the process of production had to be confined entirely to a single city. As we shall see, some sub-processes could be farmed out to the neighboring countryside, and even further afield as trading costs fell. Moreover, within the two urbanized central regions, internal trading costs were sufficiently low to permit a division of labor that spanned the entire region. For instance, in the medieval cotton industry, yarn and warp threads produced in Lombardy were used on standardized looms all over Northern Italy.[35]

INDUSTRIAL ORGANIZATION

The division of labor in industry was not that of Smith's pin factory, with different workers within a single enterprise specializing in different tasks. Rather, each sub-process

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[34]The modern theory of international trade attempts to capture this sort of effect of trade an industrial structure in models that incorporate economies of scale and of agglomeration (see, e.g., Helpman and Krugman (1985)).

[35]Mazzaoui (1981)

was undertaken by a separate and distinct enterprise, with intermediate products moving from one enterprise to another at each new stage of production. Such a breaking down of the overall process of production into sub-processes raises some issues of industrial organization. What determined the extent to which different processes were conducted by different enterprises? How were these enterprises related to one another? How were they related to the merchants who linked them with one another and with the final consumer?

DIFFERENT APPROACHES TO UNDERSTANDING INDUSTRIAL ORGANIZATION

The conventional story and its problems

The traditional story of the development of industrial organization is one of evolutionary stages, with the progression from one stage to another driven by the dictates of technology.[36] Independent producers initially sold directly to local customers. But, as technology advanced, efficient production required growing quantities of fixed capital and so increasing scale. The new technology produced more output, and so producers became ever more dependent on merchants to market the 'excess' in more distant markets. Eventually, producers lost their independence entirely and worked for merchants on a piecework basis under a system of domestic putting out. Then, as technology continued to advance, small producers lacked the resources necessary to exploit it. So merchants—who did have the resources—took over the process of production entirely, employing workers for a wage in the merchants' own workshops or factories. The independent artisan had been replaced by the wage laborer.

This story, however, does not sit well with the evidence. The 'stages' it describes did not, in fact, follow one another in sequence, but rather coexisted in time. At any one time, it was possible to find independent craftsmen selling directly to customers and to merchants, merchants relying on putting out, and merchant-manufacturers employing wage labor. For example, in Renaissance Florence, merchant-manufacturers of woolens and silks had some of the work done on their own premises, employing wage laborers. At the same time, they put out the weaving, and contracted out the dyeing to independent craftsmen. In contemporary Venice, on the other hand, production was mostly in the hands of independent masters, some of them employing considerable fixed capital; in the

[36]See, for example, Gras (1939).

private sector at least, wage labor was unknown.[37] In the textile industry of sixteenth-century England, there were different mixtures of arrangements in the different regions and in the manufacture of different textiles.[38] Even worse for the traditional story, there were cases in which the progression of 'stages' ran backwards. For example, the urban manufacture of textiles in medieval Flanders was initially controlled by merchant-entrepreneurs and only later did artisans come to gain a degree of independence.[39]

Moreover, the dichotomy between merchants and producers is fundamentally a false one. Artisans often took on a commercial role. Consider, for example, this description of the English woolen industry:

> The first rung of the ladder was occupied by weavers working for wages in other men's shops. As the next step one got one's own loom and set up on one's own account, buying wool and putting it out to be spun and perhaps the yarn to be dyed. This made one a weaver clothier… Climbing to the next rung made one a complete clothier with one's own weavers, shearman and dyer, and a spinning house of one's own where spinsters could be set to work at piece-rates and supervised by the master.[40]

Indeed, seeing the evolution of industrial organization as a struggle between merchants and craftsmen owes more to Marxist preconceptions ('capitalists' and 'workers') than to historical observation: "The exploitation of small masters by merchant employers, the conflict between industrial and commercial capital, and the class struggle, all these existed only in fevered imaginations. There was no 'class division', no classes, only the division of labor…"[41]

Finally, so far as the role of technology is concerned, we shall see that technological progress and the increasing use of fixed capital were not so much the cause of changes in industrial organization, as they were its consequence.

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[37]Laven (1966)

[38]Tawney (1925), Wadsworth and Mann (1931), Kerridge (1985).

[39]Lane (1963). We shall have more to say about this below.

[40]Kerridge (1985) p 183

[41]Kerridge (1985) p204

An alternative explanation based on transactions costs

A more fruitful way to understand the evolution of industrial organization is in terms of transactions costs. Both the breaking down of the process of production into sub-processes and the reliance of producers on merchants for marketing and materials created a great deal of mutual interdependence. Managing the resulting relationships involved transactions costs. In addition, as we have seen, production had to be financed—the demand was mainly for working capital but also and increasingly for fixed capital. The relationship between the providers and the recipients of financing also involved transactions costs. We can understand the different forms of industrial organization that emerged in terms of their ability to reduce the transactions costs involved in these commercial and financial relationships.[42]

In studying the organization of industry it is useful to begin, as we did when studying the organization of agriculture, with the basic unit of production—the individual enterprise.[43] The enterprise is the economic unit that marshals resources, adds value, and sells the resulting product. It consists of a web of relationships involving the parties who transact with it: those who supply materials, labor, finance, and management, and those who purchase its output. These relationships can take one of three forms: 'spot', contractual, or ownership. A spot relationship involves immediate exchange with no promise of future performance by either party: an example is an anonymous cash purchase in the marketplace. In contrast, a relationship that is contractual (whether explicitly or implicitly) does involve promises of future performance—for example, in the context of employment or lending. Ownership, the third type of relationship, is contractual but it implies in addition a degree of control over the discretionary decisions of the enterprise and a claim on its residual earnings—those left over after spot and contractual payments have been made. Each type of relationship involves its own costs and benefits. For example, the right to intervene directly provides an owner with better protection of his interests, but exercising this right takes considerable time and trouble. On the whole, relationships among the different parties to the enterprise—and so its

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[42]This is the approach to industrial organization adopted by the New Institutional Economics. For recent survey and assessment of this approach, see Williamson (2000).

[43]The following discussion is based largely on Hansmann (1996).

overall nature—evolve to reflect an efficient tradeoff between the costs and benefits to all the parties involved.

THE CANONICAL STRUCTURE

Considerations of transactions cost led in industry, as they did in agriculture, to the most common form of enterprise being one that combined ownership with management. In industry, this was the family firm rather than the family farm. This form of enterprise predominated, because it offered enormous advantages in terms of incentives: the owner-manager bore directly the consequences of his decisions, for good and for bad. Only in those cases in which the transactions costs of relationships with other parties become sufficiently important to outweigh these advantages do we see other forms of organization emerging.

The industrial family firm

The industrial family firm was typically quite small. Usually, it consisted of a single master working in his own home, drawing on his family for additional labor as needed, and training at least one child to take over the business. Larger enterprises might employ, in addition, one or more apprentices and a few journeymen—the former on the basis of a contract with parent or guardian, the latter paid a contractual daily or piecework rate.[44] For example, a typical London bakery in 1619 employed, in addition to the master baker and his wife, two apprentices and four journeymen, with some help from the master's children.[45] It was rare for an industrial enterprise to employ more than a dozen workers.[46] The textile industry of Antwerp was typical: it consisted of some three hundred workshops, each employing four or five men.[47]

When expansion of the market increased demand, it was generally met with an increase in the number of enterprises rather than with an increase in their size. In an expanding market, it was relatively easy for a journeyman to leave his master and set up on his own. Larger enterprises did exist, as we shall see, but their disadvantages generally

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[44]Hunt and Murray (1999) Hourly rates came into use only from the fifteenth century, with the spread of accurate clocks.

[45]Palliser (1983) Ch. 8

[46]Nef (1964)

[47]Van der Wee (1963)

outweighed their advantages. The larger the enterprise, the harder it was for the master to supervise his subordinates and therefore to ensure the quality of his product. Consequently, beyond a modest scale, two enterprises could produce more economically than a single enterprise of double the size.[48] Risk was another argument against expanding the scale of production. Markets were volatile and transportation unreliable. Rather than expanding the scale of his operations, a successful master might prefer to diversify by moving up into commerce or by acquiring land.

The role of merchant middlemen

The individual industrial enterprise—especially in textiles, but in other industries too—typically specialized in a particular sub-process of production. Consequently, enterprises formed mutually dependent groups, with intermediate products passing from one group to the next.[49] In this situation, the relationship between suppliers and customers was potentially fraught with difficulty and so subject to high transactions costs. For example, there were sometimes problems with the quality of yarn: spinners might adulterate their output with cheaper materials, so compromising the quality of the finished product. One solution to problems such as this was to internalize the relationship—to bring it within the enterprise. In this example, a weaver might employ spinners directly rather than purchasing yarn from independent suppliers. Often, however, such internalization was unnecessary, because the problem could be solved at lower cost by merchant middlemen mediating the trade in intermediate products. In the case of yarn, a weaver who purchased from a yarn broker rather than 'spot' in the marketplace could ensure the necessary quality. This was because brokers purchased regularly and in quantity from the same spinners, so that the latter had an incentive to maintain quality. For the spinner, the benefits of continuing business with the broker outweighed the short-term gains from deception.[50] In this way, the existence of a suitable market infrastructure

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[48]Similar considerations limited the maximum size of the family farm (see Kohn (2001)c). It seems plausible too that opportunity cost of the owner-manager, which set the minimum size of the family farm (see Kislev and Peterson (1982)), played a similar role in setting the minimum size of the industrial family firm.

[49]Palliser (1983) Ch. 8

[50]Miskimin (1977) Ch. 4

could permit small, specialized enterprises to remain competitive without any need to combine the different sub-processes within a single large firm.

The middlemen who mediated the process of production were themselves often producers—in woolens, for example, master weavers or fullers. Their technical expertise was of considerable help in their commercial activity, and the demands of this, generally local, trade were not so great as to interfere with their supervising the work of their own enterprises. However, when it came to marketing the finished product in distant markets or to procuring raw materials from distant sources, the merchants involved generally specialized in commerce and were not themselves engaged in production. This was because merchant enterprises too were typically family firms, with limited capacity for management attention. Commerce beyond the local level was a full-time job that left little room for extraneous activities. Moreover, the risk and volatility of such commerce demanded the maximum degree of flexibility and liquidity. Merchants were therefore loath to commit their capital to illiquid investments in production. As we shall see, there were exceptions to this separation of commerce and production, but there had to be significant benefits to outweigh the intrinsic disadvantages.

The guilds

Relationships between producers who specialized in different sub-processes and between producers and merchants—vertical relationships—were not the only source of difficulty and transactions costs. Horizontal relationships—among enterprises engaged in the same specialized activity—could also be an issue. Of course, such enterprises were competitors, so they certainly had an interest in restraining competition. However, as we shall see, there were other, more important ways in which the actions of one could affect the interests of all. To address these ‘external economies’, there emerged a type of organization that enabled industrial producers to act jointly in their common interest—the craft guild.

Craft guilds, which first appeared late in the eleventh century, were formal associations of masters of a particular craft.[51]

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[51] Apprentices and journeymen came under guild jurisdiction, but did not enjoy member rights. Craft guilds were apparently modeled on merchant guilds, which had appeared earlier, and on the religious

Historians have traditionally viewed the guilds with a jaundiced eye, seeing them essentially as 'combinations in restraint of trade' attempting to manipulate the market to their members' benefit. However, recent research has largely rejected this view.[52] Rather, it sees the guilds' fundamental economic role as being to regulate relationships among the producers of the same craft and between them and their suppliers and customers. The behavior of the guilds is best understood, not in terms of the pursuit of monopoly profits, but in terms of reducing transactions costs. Of course, as Adam Smith famously noted, once producers get together, for whatever reason, they cannot resist plotting to manipulate the market to their own advantage. The guilds were no exception. They regulated competition among their own members—for instance, by prohibiting advertising. And they attempted to restrict competition from others—producers in the countryside and in other cities—by limiting their access to the market. While they did sometimes succeed in having the city or territorial government pass the necessary legislation, effective enforcement was, of course, a very different matter.[53] The behavior of the guilds, then, was not entirely innocent of attempts at monopolization. However, as we shall see, this was not their primary purpose.

Perhaps the most important function of the guilds was to regulate the quality of their members' output.[54] Goods, especially those involved in inter-regional or inter-zone trade, were identified primarily by their city of origin: in the marketplace, this played the role of a brand name.[55] Consequently, an inferior product turned out by a one producer in a city could damage the reputation of all. To maintain standards, guilds regulated every aspect of production—materials, equipment, techniques, and output.[56] Although some historians have interpreted guild regulations, for example those restricting the hours of work and the

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societies that were associated with certain churches and monasteries Epstein (1991). We shall discuss merchant guilds in Chapter 14.

[52]Among those who have challenged the traditional monopolistic view are Lane (1973), Palliser (1983), Epstein (1998), and Richardson (1999).

[53]Pirenne (1937)

[54]Richardson (1999); Epstein (1998)

[55]Individual producers also had their own trademarks, but these were generally not as well known.

[56]See, for example, Noordegraaf (1997) on the Leiden woolen industry, Mazzaoui (1981) on Italian cottons, and Unger (1989) on German beer.

size of workshops, as attempts to limit output for monopolistic reasons, the principal motivation was in fact quality control. Work was restricted to daylight hours because quality could not be assured when working with inadequate artificial light.[57] Masters could not supervise effectively more than a certain number of employees. Similarly, guild restrictions on permitted techniques of production were not the result of 'conservatism' or of a desire to restrict output, but were intended, rather, to ensure quality.[58] To enforce these standards, guilds and municipalities appointed inspectors to examine workshops and their output. For example, in Hamburg, tasters waited at the exit to the harbor to inspect the quality of exported beer.[59] Goods that passed muster were marked with a city seal. In textiles especially, foreign purchasers were reluctant to buy unsealed goods.[60]

Municipal seals were the primary defense against another major threat to reputation—counterfeiting. The problem was widespread. For new producers, imitating the product of a town with an established reputation was an easy way to enter the market. For example, the Dutch entered the beer market in the southern Low Countries by imitating Hamburg beer, going so far as to ship their product in recycled Hamburg casks.[61] Moreover, if inferior goods could be passed off as the real thing, profits would be so much greater. The consequent reputational damage was borne principally by the producers of the city whose product was being imitated. Attempts by urban guilds to restrict textile production in the countryside or in small towns have been interpreted in monopolistic terms, whereas they were, in fact, mostly aimed at stopping counterfeiting.

A second major function of craft guilds was to regulate the training of apprentices.[62] The specialized technical knowledge required in the process of production was valuable, and apprenticeship was its main vehicle of transmission. By setting standards for terms of employment and pay and for 'graduation' to the status of master, guilds mitigated opportunistic behavior on the part of masters and apprentices—stealing apprentices trained by others, leaving a master before 'repaying' him for valuable training, employing

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[57]Another 'external diseconomy' of nighttime operation was the risk of fire.

[58]More on this below when we discuss technological progress.

[59]Unger (1989)

[60]Munro (2000) Products of individual producers often also carried specific trademarks.

[61]Unger (1989)

[62]Epstein (1998) sees this as the primary function.

apprentices under exploitative conditions. Regulation of apprenticeship had relatively little effect, however, in restricting entry to the craft (the monopolistic interpretation): municipal supervision of the guilds prevented it, and those not admitted to the guild could easily set up shop in the countryside or in unregulated towns.[63]

Guilds often regulated prices. Here too, the purpose was not monopolistic.[64] In the medieval urban economy everyone belonged to some guild. Each guild negotiated its prices with the municipal authorities, who balanced the interests of the guild's members with those of their customers—that is, of the members of the other guilds. In this framework, it was hard to support monopolistic prices. The motive for setting prices was, therefore, not monopolistic but rather to reduce transactions costs.[65] In the absence of price regulation, because markets were small and thin, there would have been a great deal of bargaining and considerable price fluctuation. This would have been detrimental both to producers and to consumers. Price regulation eliminated bargaining and reduced short-term price volatility, making the outcome of exchange more predictable.[66] By making exchange less costly and less uncertain, price regulation stimulated demand and promoted specialization and investment.[67]

One more way in which guilds reduced transactions costs was by providing 'private order'. The guilds instituted internal mechanisms to settle disputes that were able to do so at lower cost than the regular legal system. [68] They set up grievance procedures to provide dissatisfied customers with redress, avoiding the cost and delay of recourse to the ordinary courts.[69] And they resolved disputes among their own members. The guilds also

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[63]Lane (1973) Ch. 12; Palliser (1983) Ch. 8. Of course, this also limited the effectiveness of the guild in preventing opportunistic behavior.

[64]Richardson (1999)

[65]Epstein (1998)

[66]The guilds did not try to stabilize prices in the long run, but adjusted them to reflect persistent changes in costs and in demand. They were, essentially, attempting to approximate long-run competitive prices. (Epstein (1998))

[67]The guilds also regulated the market for inputs. They prohibited monopolization of essential raw materials, and regulated the use of common resources, such as water. (Epstein (1998))

[68]Pirenne (1937)

[69] Britnell (1996) Ch. 7

defended their members interests in conflicts with other groups—employees, merchants, and members of other guilds. Such defense was generally political, with lobbying at the city or territorial level, but it could involve the use of force. For example, a conflict between weavers and fullers in the Low Countries in the late thirteenth century escalated into all-out war between Flanders and France.

While the basic economic role of the guild was to reduce transactions costs, it also performed social functions. It provided a framework for religious, social and charitable activity, especially mutual aid among their members.[70] The benefits it offered included accident and health insurance, burial, support of widows and orphans, and retirement support. For example, the Venetian guilds of carpenters and caulkers required members who employed six or more workers to take on one 'veteran' master over age 55.[71] Guilds sometimes acted as credit cooperatives, in which members stood together as security for working-capital loans.[72] Guild members had a strong sense of corporate identity, and this was reinforced by public display on saints' days and municipal festivals.[73] The social function of the guild reinforced its economic function.[74] A member who broke the occupational rules faced the loss of the social 'safety net' that the guild provided. In a very uncertain world, this was a grave sanction indeed.

Guilds were entirely an urban phenomenon. They were, in fact, an integral part of urban governance. City governments delegated authority on many issues to these self-regulatory organizations and to a considerable extent they governed through them.[75] Where city government was weak, as in Sicily, guilds were absent.[76] Neither was there

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[70]Hunt and Murray (1999), Palliser (1983) Ch. 8

[71]Lane (1973) Ch. 12

[72]Pirenne (1937)

[73]Hunt and Murray (1999)

[74]Richardson (1999)

[75]In the late twelfth century many towns of Northern Italy established a Mercanzia, a kind of guild of guilds that included representatives of the associations of merchants, bankers, brokers, and crafts in the city. Through its own government mechanisms, legislation, and bureaucracy it coordinated and directed all aspects of production, commerce, and exchange. Guild statutes were subject to its approval and the Court of Mercanzia superceded the guild courts for major cases. (Mazzaoui (1981))

For more on city governance, see Part 5.

[76]Epstein (1991) Ch. 4

any guild organization in the country. There was no local government there from which a guild could derive authority, and poor communications made the cost of supervision—the guild's primary function—prohibitive. The very same industry might be organized in a guild if located in a town but not if located in the country. For example, the mines of Liège were within the city boundaries and so the mineworkers had a guild, while English mines were largely rural and mineworkers in England had no guild; similarly, the ironworkers of York had a guild, while those of the Midland villages did not.[77]

This then was the canonical structure of early European industry: small family enterprises, mostly specialized in particular sub-processes of production; coordination among them provided by merchant middlemen, some of whom were producers themselves; marketing of the finished product by merchants who specialized in commerce; external economies among producers at the same level of production addressed through guild organization. We find deviation from this canonical structure only when a relationship between an enterprise and some party to it was sufficiently problematic that a different structure could significantly lower overall transactions costs. This occurred with two categories of relationship—financial and commercial.

VARIATIONS IN STRUCTURE DRIVEN BY THE NEEDS OF FINANCING

The financing of working capital

In industry, most capital was generally working capital: fixed capital was less important than it was in agriculture. For the typical industrial enterprise, especially in textiles, the cost of material inputs was high relative to value added. In some cases, this was because of the expense of raw materials. For example, the value of the English wool used to produce luxury woolens might exceed two thirds of the value of the finished product.[78] But even when raw materials were less expensive, the division of labor meant that the value added at each individual stage was relatively small: the input of the typical enterprise was an intermediate product that already embodied considerable value added contributed by the preceding stages of production. The relative value of inputs—and so the cost of working capital–was therefore highest for those sub-processes that were

[77]Kellenbenz (1977)

[78]Munro (1997)

closest to the finished product. Compared to working capital, fixed capital was generally modest. Tools were simple and, for reasons we shall examine below, there was relatively little mechanization. Most manufacturing took place in the producer's home or in an adjacent workshop.

In the early stages of manufacturing or when the cost of raw materials was modest, producers were able to finance their working capital themselves. The English textile industry in the sixteenth and seventeenth centuries provides a number of examples.[79] Wool from hill sheep was relatively inexpensive and used only for cheaper woolens. In the Peak-Forest country, rural weavers—often part-time farmers—went to the regional town to purchase such wool from a wooldriver, and carried it home to be woven. They then returned to town to sell the woven cloth to an urban merchant, using some of the proceeds to purchase the next batch of wool. In the Southwest of England, the inexpensive cloth used to make cottons and friezes was largely produced by small groups of producers that were self-sufficient with respect to working capital.[80] Each group consisted of a farmer or small proprietor who provided the wool, a weaver, and a fuller. When a cloth was completed, the three associates would go into town together to sell it and to divide up the proceeds on the spot.

In the later stages of manufacturing, however, or when the cost of raw materials was high, producers usually required external financing. As we saw earlier, this often took the form of trade credit extended by the merchants who supplied the materials or who purchased the output. For example, wool and linen weavers in Elizabethan Lancashire largely used yarn that had been imported from Ireland. They obtained the yarn on credit from merchant importers, and paid them only after they had sold the woven cloth.[81]

However, trade credit—like any form of credit—exposes the creditor to risk: there is the possibility that the debtor, who obtains materials on credit or is paid in advance, may default. The risk of default depends on the riskiness of the enterprise and on the capacity of the borrower to bear the risk. The borrower's capacity to bear the risk depends in turn

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[79]Kerridge (1985)

[80]'Cottons' here are a form of woolen cloth, not cloth manufactured from cotton fiber. Friezes are a form of coarse woolen cloth.

[81]Wadsworth and Mann (1931)

on the size of the debt relative to his own resources. When the value of trade credit (the value of materials in process) was large compared to the value added by the producer, the risk of default was correspondingly great. A numerical example may help to illustrate this. Suppose our producer's materials, which he obtains on credit, cost 100 and that his product, on average, sells for 105: that is, his work adds 5% to the value of the materials. If the market price of the product falls to, say, 95 he may be unable to absorb the loss and to pay his supplier in full. This is because the producer is exposed to the risk of a change in value not only in his own 'product' (his value added), but in the value of the whole package—the value of the raw materials plus the value added by the sequence of producers before him. Only if he possesses significant resources of his own will he be able to absorb the ups and downs of the market without defaulting on his debt.

Putting out

The practice of putting out provided a solution to this problem. Under putting out, the supplier retained ownership of the materials and contracted with the producer to pay him solely for his value added. For example, rather than a merchant selling white cloth to a dyer who then resold it after dyeing, the merchant would retain ownership of the cloth, and contract with the dyer to pay him for his services. In this way the dyer was exposed only to the risk of his own business, dyeing, and not to the risk of the cloth trade in general. The latter was born by the merchant, who was better able to bear it. An alternative way to see putting out is as a form of secured lending: because the merchant retained ownership of the undyed cloth, it as though he was 'leasing' working capital to the dyer.[82] Putting out became the common form of industrial organization when trade credit involved too great a risk of default. This occurred in two types of situation—when the value of materials was high and when the producer was poor

As we have seen, the relative value of materials increased as production moved on from one sub-process to the next, with each additional sub-process adding value. Consequently, putting out was most common in the later stages of production. Returning to an earlier example, the urban drapers who purchased cloth 'on the bare thread' from rural weavers in the English Peak-Forest country then put it out to be fulled, frizzed,

[82]The 'rent' on this lease is presumably implicit in the rate the merchant pays the dyer. For more on leasing, see Kohn (2001)c.

finished and sometimes dyed. Similarly, the drapers who purchased 'plains' from associations of growers, weavers, and fullers in the Southwest, put it out for finishing to clothworkers and shearmen for conversion into cottons and friezes.[83] Moreover, in cases in which the raw materials were particularly expensive, putting out was the practice at *all* stages of production. For example, the merchants of late medieval and Renaissance Florence who organized the manufacture of fine woolens and silks from costly imported fibers relied on putting out for every stage of production from spinning through to finishing.[84]

Putting out was also the normal form of industrial organization in the countryside, where producers were relatively poor and therefore poor risks for trade credit. In the production of inexpensive textiles—cottons in Italy and in South Germany as well as inexpensive woolens in Northwest Europe—urban merchants put out spinning and sometimes weaving to rural producers. The practice was not limited to textiles: with the expansion in the sixteenth century of the manufacturing of cheap goods in the countryside, putting out became increasingly common in leather goods, metallurgy, metal and wood fabrication, printing, and paper-making.[85]

Although putting out had advantages over trade credit as a way of financing working capital, it was not without problems of its own. First, transactions costs were significant: putting out was demanding in terms of management, logistics, and record-keeping. Merchants, especially early in the period and in the more backward regions, were not always up to the task.[86] Second, putting out altered the ownership structure of enterprise and so introduced some additional incentive problems. The producers who received materials under putting out remained owners of their own individual enterprises. But the

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[83]The information is again from Kerridge (1985).

[84]de Roover (1948) The preparation of the raw fiber before spinning (sorting, cleansing, combing, carding) was typically done 'in house' on the merchant's own premises. We shall explore the reasons for this presently.

[85]Kellenbenz (1977) p 470; Palliser (1983) Ch. 8

[86]Van Werweke (1954) argues that putting out was infeasible in the twelfth-century Low Countries because of the lack of commercial sophistication and the absence of bookkeeping: "It is quite certain, indeed, that before the middle of the twelfth century the merchants were not able to write and could not keep written accounts." (p 240)

merchant doing the putting out became, in a sense, owner of the whole process of production. It was he who received the residual profit (or loss) from sale of the final product after contractual payments had been made to his sub-contractors under putting out. However, this arrangement was deficient in the second dimension of ownership—control. The merchant's ability to oversee was limited. Because the sub-contractors themselves no longer had a direct interest in the overall profitability of the whole process of production, this difficulty of oversight gave rise to two potential problems—embezzlement of materials and inferior quality.

Before we see how these problems of putting out were addressed, let us complete our discussion of how financial relationships affected industrial structure by considering the financing of fixed capital.

The financing of fixed capital

While in industry working capital was generally more important than fixed capital—in textiles particularly—the importance of fixed capital was growing. In fact, some industries were deploying substantial fixed capital by the end of the period. Mining and metallurgy, for example, required little fixed capital initially: mine workings were close to the surface—typically quarries or shallow caves; smelting was done in small hearths and forges located close by. However, by the thirteenth century, miners were beginning to dig deeper, in some cases using long adits (horizontal shafts) and horse- or water-driven pumps to control flooding; smelters were beginning to use water-powered bellows and water-driven hammers to crush the ore.[87] By the sixteenth century, these technologies were widespread. By then, iron smelters were using blast furnaces that cost over £1,000 each—an enormous expense when the annual income of a skilled worker was perhaps £5.[88]

Much of the financing for the increasing amount of fixed capital came from the producers themselves.[89] Weavers, for instance, mostly owned their own looms. Even in crafts where fixed capital was greater, such as in dyeing and in glassmaking, producers

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[87]Hunt and Murray (1999) Ch 2

[88]Nef (1964) Ch. 3

[89]Tawney (1925). Producers financed investment "piecemeal out of income".

often financed the investment themselves out of their own funds.[90] Highly skilled artisans such as dyers and glassmakers earned significant margins that provided them with the necessary resources. In mining, where the required investment in even the simplest working usually exceeded the means of a single-family enterprise, miners banded together in small partnerships. The partnership owned and operated the mine, and, after paying royalties to landowner and prince, divided up the residual earnings among its members. A similar arrangement was common in shipping: a group of merchants would pool their resources—in a share company, rather than in a partnership—to build and operate a ship.[91]

When the required investment in fixed capital exceeded the resources of the producers themselves, some form of external financing became necessary. When the size of the required investment was large and the asset long-lived, such financing tended to be long-term. To protect the provider of the financing against default, it tended to be secured. In industry, as in agriculture, the most common form of secured long-term financing was the lease: rather than lending the enterprise the money needed to acquire the asset, the lender himself invested in the asset and lent the *asset* to the enterprise.[92] For example, while, as we have seen, some glassmakers in fourteenth-century Venice owned their own furnaces, others leased them from guild members who were not themselves producers.[93] In the rural putting-out of textiles, poor spinners and weavers often lacked the resources to acquire spinning wheels and looms of their own: instead, they leased them from their merchant employers.[94]

Lease financing was most widespread, however, in industries linked to the land. From the earliest times, landowners had constructed on their land flour mills, wine presses and olive presses and leased them out to individuals who operated them as independent enterprises. Later, landowners constructed and leased fulling mills and paper mills in much the same fashion.[95] The owners of mineral-bearing land invested in refining and

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[90]See Lane (1973) Ch. 12 on fourteenth-century Venice.

[91]See Kohn (1999)d for more on the organization of partnerships and share companies.

[92]For a thorough discussion of leasing, see Kohn (2001)c.

[93]Lane (1973) Ch. 12. The guild regulated the terms of leasing.

[94]Holt (1997)

[95]Nef (1964) Ch. 3

forging facilities and leased these out, often to metal traders.[96] For example, many of the new blast furnaces constructed in Elizabethan England were built by landowners and leased out in this way.[97] Landowners invested in processing and refining facilities for two reasons. First, such investment increased the rents and royalties they could earn from their land by making it more attractive to farmers and to miners. Second, they had few good alternative outlets for their saving, since opportunities for financial investment were limited.[98] Moreover, many of the most energetic landowners were themselves merchants, who saw these land-related investments as a form of diversification.[99]

Leasing, so long as it involved a fixed rent, did not alter the fundamental nature of the enterprise. The enterprise remained a family firm, under the control of the owner-manager.[100] The provider of external financing received a contractual payment, like others who supplied resources to the enterprise. The owner-manager 'hired' capital just as he hired labor. So the need for significant fixed capital did not *necessarily* imply a change in the structure of enterprise or in the organization of industry. In some cases, however, the cost of financing could be reduced by giving the provider of financing an ownership interest in the enterprise. If the risk of default on a debt contract is significant, an equity contract, which gives the provider of finance a share in the profits rather than a fixed reward, may be preferable.[101] A provider of equity financing thereby becomes a part

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[96]Nef (1987)

[97]Palliser (1983) Ch. 8. "In the Elizabethan period the most active entrepreneur in the country was not some busy merchant or thrusting member of the new gentry, but a peer of ancient stock, George Talbot, 6th Earl of Shrewsbury." (p 258). Shrewsbury was one of the great ironmasters and also owned a steelworks, lead mines, coalmines, and glassworks.

[98]See Kohn (1999)a and Kohn (1999)d for a more extensive discussion.

[99]Sella (1977). See Kohn (2001)c for more. Merchants also invested in processing and refining for commercial reasons, on which more below.

One example of merchant investment: "…new pits, furnaces, and forges were opened on the land newly acquired by prominent upstarts such as the Barrals who had climbed to the top of the social ladder through the combination of commercial activities, tax-farming, and public office and were anxious to exploit the new resources now in their hands." (Sella (1977) p 408) However, traditional landowners were no laggards either: see footnote 97 above.

[100]Or small partnership under the control of the owner-managers.

[101]See Kohn (2001)c.

owner of the enterprise: he has a claim on part of the residual income and, to protect his interests, he needs to exercise some measure of control over its activities.

One form of equity financing was the equity lease. In Venice, where it was common, profits were divided equally between financier-lessor and artisan-lessee.[102] The popularity of this instrument in Venice, however, may have had more to do with the nature of the city's financial markets than with any particularly great degree of risk. The major financial market in Medieval Venice was the market in venture partnerships or *colleganza* (known elsewhere as *commenda*). This market evolved to finance the working capital needs of the city's maritime trade. With this instrument being so popular, it was only natural that it should be adapted to other uses—included the financing of local investment in fixed capital.[103]

Other forms of equity financing were adaptations of the partnership and of the share company. Originally, as we have seen, both of these forms of organization were legal frameworks enabling owner-operators to pool their resources to finance larger investments. However, when external financing became necessary, these frameworks were extended to accomodate purely financial investors as well.[104] In Germany, the mining partnership, which had originally involved only the miners themselves, was extended to include partners whose only role was to provide finance.[105] Share companies in shipping, once restricted to the merchants directly involved, began to sell shares to purely financial investors. From the fifteenth century, shares in companies operating cargo ships and fishing ships became a popular financial investment in the Netherlands. In the sixteenth century, this form of financing spread there to other industries that made heavy use of fixed capital. These included industrial windmills, refineries, breweries, tile works, and the large-scale digging of peat.[106] In Elizabethan England, share companies

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[102]Laven (1966) p 55...

[103] See Kohn (1999)d 1 for more on venture partnerships.

[104]The financial aspects of this are discussed in Kohn (1999)d. Financial investors were more usually family and friends than strangers, and "…more often than not those sources were too small to leave a clear trace in the annals of history." (Sella (1977) p 405)

[105]Nef (1987)

[106]de Vries and van der Woude (1997); de Vries (1974)

were set up in mining and metallurgy, bringing together German experts and English financial investors.[107]

So the demands of financing fixed capital, like the demands of financing working capital, could lead to forms of enterprise that differed significantly from the basic owner-manager family firm. Some of the resulting partnerships and share companies were quite large, employing dozens, or even hundreds, of wage laborers supervised by salaried managers.[108] In these enterprises ownership passed entirely into the hands of the providers of external finance and became separated from day-to-day management. Of course, the separation of ownership from management and the scale of these enterprises created new incentive problems that are familiar in today's economy. However, this form of industrial enterprise was to remain very much the exception until the late nineteenth century.[109]

VARIATIONS IN STRUCTURE FOR COMMERCIAL REASONS

In some cases, therefore, external financing, both of working capital and of fixed capital, led to deviations from the canonical structure of small, independent family firms linked by merchant middlemen and guild membership. In these cases, the protection afforded by ownership rights lowered the cost of external financing sufficiently to outweigh the disadvantages of departing from the canonical structure. However, there were also cases in which the protection afforded by ownership rights and control were of potential benefit to other parties to the enterprise—those having commercial rather than financial ties with it.[110]

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[107]Rees (1968)

[108]Nef (1987) We shall examine presently why some firms grew to so large a scale.

[109]Large-scale enterprises were however more common in commerce as opposed to industry, and we shall discuss the associated incentive problems in that context in Chapter 16.

[110]The New Institutional Economics frames the choice of structure, not in terms of ownership, but rather in terms of a choice between alternative forums for mediating transactions between the parties—a choice between ‘market’ and ‘firm’. Market relationships—whether spot or contractual—do not involve ownership; relationships within the firm do. For a particular relationship, the forum is chosen that minimizes transactions costs. This way of looking at the issue has its origins in the seminal article by Coase (1937).

An important source of difficulties that might be alleviated by ownership rights was the separation of commerce from production. Merchants often made significant investments in marketing infrastructure—in organizing transportation, in establishing branches in distant markets, and in developing a customer base. These investments left them vulnerable to interruptions in the supply of product and to failures in its quality.[111] Sometimes, this vulnerability was sufficiently important to lead them to take an ownership interest in the enterprises that supplied them with product.[112]

For example, many merchants who traded in metals found it advantageous to become involved in smelting.[113] As we have seen, it was usually landowners that actually invested in smelting facilities. But it was often metal traders who leased these facilities in order to ensure a steady source of supply.[114] Moreover, as the scale of mining increased in the fifteenth century, the necessary investments in smelting capacity and in mining sometimes strained the resources of landowners and princes. These naturally turned to merchants for loans. When, as frequently happened, the borrowers defaulted, the merchant financiers found themselves in possession of the assets that had secured the lending. This was, for example, how the Fuggers and Welsers came to own much of the silver and copper industry in Central Europe in the sixteenth century.

The Dutch herring industry affords a different example of increasing merchant involvement in production. This industry expanded rapidly in the fifteenth century following the decline of the Baltic fisheries that had until then been the main source of supply.[115] Dutch fish brokers were instrumental in organizing the partnerships (*partenrederij*) that operated the large boats required for deep-sea fishing (the *buizen* or herring busses). Partners in the enterprise included the skipper, a number of investors who provided the financing, and the broker himself. As part owner, the broker could ensure a steady supply of product, and he was also able to monitor its quality. The fish

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[111]In the terminology of the New Institutional Economics, the source of their vulnerability was 'asset specificity'.

[112]Supple (1977)

[113]Much of the following is based on Nef (1987) and Glamann (1977)

[114] "In the sixteenth century, merchants took a notable part in the smelting of copper from the ore… A copper dealer not involved in the refining of the ore was an exception…"(Glamann (1977))

[115]de Vries and van der Woude (1997) Ch. 7; Michell (1977); Unger (1996)

brokers also provided on-land processing and packaging and obtained the large quantities of salt that were needed to preserve the fish. Indeed, the brokers were able to raise the profitability of the enterprise considerably by utilizing the busses during the off-season to bring salt from its source in the Bay of Biscay.[116]

In yet another example, Florentine merchants trading in luxury textiles became involved in their production largely to ensure quality. The customers of the Medici, for example, included popes, princes, and nobles. In this market, quality mattered much more than price. To guarantee the necessary quality, the Medici controlled three industrial enterprises in Florence—one producing silk and two producing woolens.[117] In each case, the Medici entered into partnership with a master craftsman who directed the enterprise. While the Medici did provide most of the necessary financing, this was not the reason for their involvement: the capital requirements of textile manufacturing were modest and, in most cases, could be satisfied without merchant involvement.[118] Indeed, Venetian ambassadors to Florence were amazed at the extent to which its 'leading gentlemen' supervised their own cloth-making establishments—something unknown in Venice.[119] But Venetian industry was geared to a very different market, which required less meticulous quality control.

In each of these examples, direct merchant involvement in production proved to be more efficient than the canonical structure: that is, it incurred lower overall transactions costs. There were, however, cases in which merchants were directly involved in production for quite different reasons. As we saw earlier, trade led to production and production led to trade in a continuing dynamic process. When trade created a new opportunity for profitable production, there did not always exist an established industry

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[116]In the seventeenth century, the fish brokers increasingly became outright owners of fishing boats, largely abandoning the partnership structure. This provided them with an even greater degree of control.

[117]de Roover (1948)

[118]For example, the investment in one silk workshop was 5,000 florins, of which the Medici provided 4,200 florins and the manager the rest. Profits were split 60/28/12 among the Medici, the manager, and the assistant manager. de Roover (1948)

[119]Lane (1973) Ch. 12

organized along canonical lines ready to exploit it. When there was no such industry, merchants had little choice but to organize production directly themselves.[120]

The establishment of the urban textile industry in Flanders illustrates this point. As we saw earlier, expanding trade in the eleventh century created a growing market for Flemish woolens. Merchants were unable to meet this demand—either in terms of quantity or of quality—by purchasing from their traditional rural suppliers. So they set up workshops of their own in the towns, directly employing craftsmen who migrated there from the countryside.[121] It was only later, as the industry developed, with an increasing division of labor and specialization, that the canonical structure gradually emerged. By the late thirteenth century, merchants had disengaging from direct involvement in production. By then, the industry consisted largely of small independent producers, coordinated by middlemen (weaver-drapers), and supervised by guilds.[122]

FACTORIES AND THE SCALE OF PRODUCTION

Even when there were deviations from the canonical structure, they usually involved only changes in relationships without any change in the physical organization of production. Production continued to take place in small workshops, often in or alongside the home of the producer. All that changed was the relationship between these producers and others. Rather than the producer being sole owner of his enterprise, he shared ownership, in one way or another, with suppliers or customers.

There were, however, cases in which production became concentrated in larger establishments. This was particularly true in those industries that we mentioned earlier as employing substantial fixed capital—mining and metallurgy, shipbuilding, glassmaking, flour milling, brewing, sugar refining, soapmaking, printing, and papermaking. For example, in the sixteenth century, the Fuggers owned two highly mechanized plants for smelting silver and copper (*Saigerhütten*) that each employed scores of workers.

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[120] In its discussion of 'firm versus market', the New Institutional Economics generally assumes that there *is* a market—that the necessary market infrastructure exists. However, production may occur within the firm rather than being mediated by the market simply because the market and its infrastructure do not exist.

[121] Van Werweke (1954)

[122] Munro (1998); Nicholas (1992); Murray (1990)

Contemporary sugar refineries in Antwerp, paper mills in Lombardy and South Germany, and blast furnaces in Liège and England were not quite as large but were nonetheless of a significant scale.[123]

It would be natural to think that the larger size of such enterprises was a consequence of technology—that in order to exploit the advantages of machinery and other capital equipment, production had to be on a larger scale. However, as we shall see presently, it is more plausible that the causality ran the other way. Those industries in which production was concentrated in larger establishments, for whatever reason, were the ones most likely to see an increase in the application of fixed capital.[124] Let us therefore consider other possible reasons why it might have been necessary or beneficial to concentrate production at a single location

One important reason for the concentration of production was the application of scarce technical knowledge. A possessor of such knowledge has two ways he can profit from it. He can sell the knowledge itself, or he can sell products that embody it.[125] The former option is available only when transactions costs are kept sufficiently low by a well-functioning market for knowledge and by legal protection of intellectual property rights. These conditions simply did not exist in medieval and early modern Europe. Knowledge was therefore guarded jealously, being handed down from parent to child as a valuable legacy.[126] Consequently, the only way to profit from knowledge was to sell products that embodied it. If so, then clearly the more the better, and producers in knowledge-based industries did their utmost to expand their scale of operations.[127] Moreover, in order to apply their knowledge, they had to concentrate production in one place under their immediate supervision.[128] The 'chemical' industries, such as glass,

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[123]Nef (1987), Nef (1964)

[124]This is the view of Szostak (1991) on factories and mechanization in the Industrial Revolution.

[125]Demsetz (1988)

[126]Unger (1980) Introduction

[127] The indivisibility of knowledge creates economies of scale.

[128]Lane (1973) Ch. 12. Also Kellenbenz (1977) p 470: "When special knowledge and technical ability were required, the entrepreneur might concentrate the various processes of production under one roof and create a factory. This tendency had been visible in medieval Florence and Flanders, and it became more pronounced after 1500."

soap, dyes, and metallurgy, are a good example. They required a practical grasp of chemistry that could be acquired only through long trial and error. Production depended less on manual dexterity than on craft 'mysteries'—on knowing the right recipes and on being able to judge and control processes. Glassmaking, for example, required the use of three different types of furnace at different stages of production; the actual labor involved was largely unskilled.[129] Glassmaking establishments and those of the other chemical industries tended to be large.

A second motive for concentrating production in one place was closer supervision. We saw earlier that putting out suffered from two problems—embezzlement of materials and inferior quality—because merchants had only limited control over domestic workers, especially in the countryside. Consequently, where materials were particularly valuable or where quality control was especially important, entrepreneurs preferred to have the work done on their own premises.[130] For example, while most metalworking relied on small independent producers or on putting out, the minting of coin took place in large industrial establishments that sometimes employed hundreds of workers.[131] Minting was concentrated in one place to safeguard the precious metals that were the raw materials and to ensure consistent quality of the coinage. In textiles, cheaper wool and cotton were put out for spinning and weaving, but with the more expensive materials—fine wool and silk—the work was generally done in-house. Moreover, these more expensive materials were used in the production of luxury cloths where quality was paramount: it could be ensured only by close supervision by a master craftsman.[132] Silk workshops in particular grew to be quite large.[133] In sixteenth-century Venice, for example, contemporaries

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[129]Lane (1973) Ch. 12

[130]Szostak (1989) argues that the need for supervision was the principal reason for the emergence of factories during the Industrial Revolution and that mechanization came later and was a consequence of the resulting concentration of production.

[131]Spufford (1988)

[132]Kerridge (1985) argues that whether or not work was put out in the woolen industry of early modern England depended mainly on whether it "had to be done under the master's eye". Fine cloths needed close oversight, cheap cloths did not.

[133]The production of silk was also more demanding in terms of technical knowledge than wool, so the 'knowledge motive' was operative as well as the supervision motive.

complained of “the greed of certain persons who since they have twenty or twenty-five looms working are causing evident inequalities”.[134] In England, some woolen clothiers set up large establishments too: the most famous was John Winchcombe’s factory at Newbury in the early sixteenth century that boasted over a thousand employees.[135] But in woolens the advantages of large-scale production do not seem to have outweighed the disadvantages and such large enterprises were generally unsuccessful and were not emulated.[136]

A third reason for the concentration of production in one place was the cost of transporting bulky raw materials. Especially when the source of such a material was highly localized, the industry processing that material tended to locate close by. This was, for example, the reason why smelting facilities were located close to the mining areas and why they therefore operated on a relatively large scale.[137] Of course, when raw materials were geographically dispersed, transportation costs could work against concentration. For example, so long as the principal industrial fuel was wood, fuel-intensive industries located wherever there were forests. However, the shift from wood to coal in England in the sixteenth century changed this pattern. Because the sources of coal were highly localized, this attracted industries such as salt, soap-boiling, brewing, and lime-burning to the colliery districts, with production therefore becoming more concentrated. In salt for example, the casual workings of local peasants were replaced by large-scale enterprises using iron pans twenty feet or more square and employing as many as three hundred men.[138]

While these factors did sometimes lead to the concentration of production in one place and so to production on a larger scale, the resulting enterprises were still small by modern standards. There were a few genuinely large enterprises, but these were mostly state-owned.[139] The most famous was the *Arsenale* in Venice. Set up initially in 1104 by

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[134]Braudel (1972).

[135]Kellenbenz (1977) p470

[136]Palliser (1983) p 250

[137]Some refining processes were also 'mysteries' and, as we have seen, this provided another reason for concentration of production.

[138]Nef (1964) Ch. 3

[139]Nef (1964)

the Venetian government as a storage and repair facility for armaments, it continually expanded its activities and its size. By the sixteenth century, its main function had become the production and maintenance of galleys, and it employed two to three thousand workers—some 5% of Venice's entire labor force—in a complex that covered 60 acres.[140] Other governments, too, were involved in the large-scale production of warships and armaments. Other large-scale, state-owned enterprises included the tapestry workshops established by the kings of France. In none of these enterprises, however, was profitability a primary concern and indeed few if any were profitable.[141]

The main reason why industrial enterprises, at least in the private sector, remained relatively small was that the markets they served were small. Because trading costs were high, trade in industrial goods beyond the local and regional level was mostly limited to those goods that were relatively expensive. Since only the well to do could afford such goods, the market was limited. While the market for cheaper goods was much larger overall, because of trading costs, it was fragmented: local and regional markets were served largely by local and regional producers. However, it was not only the size of markets that limited scale; it was also their uncertainty. The cause for this was once again mainly trading costs: sharp increases in trading costs, mainly caused by wars, frequently interrupted trade.[142] Uncertain markets made investment in large-scale industrial facilities unattractive. Changing numbers of small independent enterprises or expansion and contraction of putting out provided a more flexible response to fluctuating markets.[143]

URBAN INDUSTRY AND RURAL INDUSTRY

The consideration of trading costs sheds light too on the relationship between urban and rural industry. The conventional story of hidebound urban guilds struggling unsuccessfully to suppress their lower-cost, technologically more advanced competitors in the countryside is very far from the truth. Urban guilds were not hidebound: as we

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[140]Lane (1973) Ch. 25; Steele (1994)

[141]We shall discuss the motives for the establishment of state-owned enterprises in Chapter 18.

[142]The main factor here was the 'predation' element of transportation costs: see Kohn (2001)d for more.

[143]"Putting out was the best way to lop temporary peaks of production and avoid the extravagance of a new shop" (Kerridge (1985) p 182). See also Supple (1977).

shall see, they objected to certain technologies principally because of their concern for quality. And their efforts to suppress rural, or more usually small-town, producers were mostly aimed at counterfeiters who were damaging the reputation of urban producers.[144]

In fact, the relationship between urban and rural manufacturing was generally not one of competition but rather of complementarity. Urban industry tended to specialize in luxury products and high-skill processes; rural industry tended to specialize in cheap goods for the local market or, organized by urban entrepreneurs, in low-skill intermediate products for urban industry. Urban and rural industry were complementary, because the two environments offered very different advantages.[145]

Cities offered, above all, low trading costs—both internally and externally. Low internal trading costs, together with relatively large volumes of production, promoted the division of labor and specialization.[146] The cities were well endowed with market infrastructure: commercial, financial, and transportation services were all readily available. Close physical proximity among producers made guild organization feasible.[147] It was good market infrastructure and guild organization that made possible the canonical structure of industrial organization. But putting out, too, was easier in cities: close proximity made it easier to keep track of expensive materials and to monitor producers.[148] Low external trading costs gave urban producers access to raw materials and to a large market for their output and provided the urban economy with new products it could imitate.

Cities offered a hospitable environment for 'startups'. The story of printing illustrates this rather well.[149] Printing began in Europe around 1450 the Rhineland. However, two of the first printers soon decided to move to Venice. Venice attracted them, not only because

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[144]For example, the 'new draperies' that the 'three cities' of Flanders tried to suppress in the thirteenth and fourteenth centuries were imitations of their trademark luxury woolens produced with inferior grades of wool Nicholas (1992).

[145]These differences created the conditions for specialization according to comparative advantage.

[146]As we have seen, this was true not only of individual towns, but also of the urbanized central regions of the two zones of European trade—the Low Countries and Northern Italy.

[147]Munro (1998)

[148]Who were often simultaneously monitored by their guilds.

[149]Lane (1973)

of its large local market, but also because its commercial infrastructure provided ready access to markets as far away as Portugal and Poland. Moreover, the market infrastructure there that already supported existing products could readily accommodate additional products at relatively low cost.[150] With respect to inputs, while no paper was actually produced in Venice, the excellent paper of Fabriano was marketed through the city and so readily available. And, of course, skilled labor was abundant. The division of labor in the production of many different products there created a pool of specialized, skilled labor that could easily be recombined in new ways or adapted to new tasks.[151] It is hardly surprising, then, that by the end of the fifteenth century, Venice had become the largest center of printing and publishing in Europe.

The countryside—which included small towns as well as villages and farmsteads—had its advantages too. One was close proximity to raw materials. Mining and metallurgy were usually located in the countryside, because that is where the mineral deposits were to be found.[152] In addition, the countryside was the source of the most important fuel—firewood. Because the cost of transporting firewood was high relative to its value, metallurgy and other fuel-intensive industries, such as glass, paper, and pottery generally located in rural areas where firewood was locally plentiful.[153] Small enterprises producing glass and paper were scattered throughout the woodlands of Europe.[154]

A second advantage of the countryside was its relatively cheap labor. Rural labor was cheap mainly because the demand for labor in agriculture was highly seasonal. For example, in grain-producing regions, peak demand for labor at harvest time could reach double its year-round level.[155] In the off-season, therefore, there was a great deal of idle labor available to be employed in other ways. Countryfolk engaged in a wide variety of

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[150]Another example of this is the ease with which the cotton industry developed in Northern Italy in the thirteenth century, because it was able to make use of the commercial infrastructure that served the already existing woolen industry. Mazzaoui (1981)

[151]Jacobs (1969)

[152]Nef (1987)

[153]Nef (1964); Palliser (1983) Ch. 8. Like metallurgy, these other industries too used other bulky raw materials that were to be found in the countryside.

[154]Nef (1964)

[155]Grantham (1993)

non-agricultural work in the off-season, and this included mining and manufacturing.[156] Of course, rural labor was not quite as cheap as rural wages would suggest. Workers in the countryside were less skilled than those in town, they often worked part-time, and they were less closely monitored. As a result, rural workers were less productive than those in town.[157]

The major disadvantage of rural industry was the high level of trading costs in the country. Greater distances meant slower and more expensive transportation and communications. Because production was less concentrated and coordination harder, the division of labor and specialization were more difficult and less likely to emerge spontaneously.[158] Commercial and financial infrastructure was greatly inferior to that of the cities. Indeed, industrial production in the countryside, beyond that for own use or local trade, depended entirely on the provision of market infrastructure by urban merchants: the same, after all, was true of agricultural production.[159] It was urban merchants who distributed raw materials to rural producers and who marketed their output.

So, to a large extent, rural industry was an urban creation. What sort of industry did urban entrepreneurs create in the countryside? In some cases, they merely improved on what they already found there. As we have seen, some industrial production was a normal side-activity of the rural household—textiles in particular. When the local product was particularly promising, merchants would see a potential for a wider trade and develop the local industry. In the case of Flemish woolens in the eleventh century, because rural trading costs were prohibitive, this had required relocating the industry to the cities. However, later on, with better transportation and improved commercial and financial infrastructure, merchants often found it worthwhile simply to upgrade production where they found it in the countryside. For example, urban merchants in South Germany took

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[156]See Kohn (2001)c. Not all country regions were equally engaged in industry. Thirsk (1961) argues that the pattern can largely be explained by the nature of the predominant crop and the resulting degree of underemployment of rural labor.

[157]Munro (1998)

[158]Although it does seem to have done so in the small metalwares industry of the English midlands in the sixteenth century Palliser (1983) Ch. 8.

[159] See Kohn (2001)c.

the existing rural linen industry there, which had produced mainly for regional consumption, and created from it Europe's major producer of fustians (a cotton-linen mix). They did so by bringing in imported cotton from Italy, by coordinating the rural division of labor, and by marketing the finished cloth in international markets.

Because of the high trading costs in the country, because rural producers were often poor, and because rural production was often initiated by urban entrepreneurs, putting out was much more common there as a form of industrial organization than the canonical structure. For example, while the northern Italian cotton industry, which it largely replaced, been organized along canonical lines, the German fustian industry largely relied on putting out.[160] Of course, a rural industry developed in this way had its limitations. In particular, it was not likely to turn out a high-quality product: the lower level of skills, the absence of guild regulation, and the difficulty of supervising a dispersed labor force all militated against it. Rural industries generally turned out cheaper products for relatively mass consumption. The German industry, for example, turned out only lower quality fustians with none of the pure cottons or of the wide range of products that were produced in Northern Italy.

A second, somewhat different, case of urban development of rural industry was the 'outsourcing' to the countryside of the relatively unskilled sub-processes of urban industry. Spinning was the classic example. In woolens, spinning accounted for about half of pre-finishing labor costs, and it required relatively little skill.[161] Exploiting low-wage rural labor for this task was an obvious economy. Whether it was profitable to outsource additional sub-processes to the countryside depended on the nature of the product. For luxury woolens, where quality was more important than cost, the tradeoffs

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[160]Mazzaoui (1981) Importers like the Fuggers of Augsburg and the Kresses of Nürnberg purchased cotton in Milan or Venice and brought it across the Alps to Germany. The same merchants handled the marketing of the output. The merchants of Augsburg, Nuremberg, and Regensburg commissioned orders from weavers in Ulm, Biberach, and other Swabian cities, advancing credit to them. The weavers, in turn, sent cotton to the countryside for spinning and warping by female workers. The linen yarn was purchased in the local market. Finishing (napping, bleaching, dyeing) was commissioned by the wholesale merchants.

The development of the cotton industry in England beginning in the late sixteenth century followed a very similar pattern Nef (1964)

[161]Munro (1998)

were unattractive: cheaper labor did not compensate for lower skills and more difficult supervision. On the other hand, for less expensive woolens, where cost was more important and quality less so, rural production made excellent economic sense. So for inexpensive woolens, weaving and fulling, in addition to spinning, might often be done in the countryside. Other industries followed a similar pattern—early stages of production in the countryside, finishing in the cities.[162]

The mix of urban and rural industry changed over time. Initially, as trade expanded during the Commercial Revolution, there was a dramatic growth of urban industry. Then, rising urban wages led to some outsourcing of low-skill work to the countryside.[163] This movement was facilitated by the increasing division of labor, which broke production down into simpler sub-processes that could readily be undertaken by less skilled workers.[164] From the middle of the fourteenth century, falling grain prices and rising urban wages accelerated the growth of rural industry. First, low grain prices meant a slump in the countryside, and this lowered rural wages and increased the supply of slack rural labor.[165] Second, rising wages in the cities contributed to a growing demand for cheap goods there, which could be produced more profitably in the countryside.[166] At the same time, long-distance trade in cheap goods was interrupted by widespread warfare, protecting rural producers from competition in their regional markets. From the middle of the fifteenth century, as war abated and the trade in cheap goods resumed, some of the new rural industries proved competitive and expanded to supply a wider market—most notably textile industries in the southern Low Countries, South Germany, and England. The economic expansion of the sixteenth century again reinforced the growth of rural industry by raising urban wages, which once again raised the cost of urban manufacture and increased the demand for cheap goods.

As rural manufacture expanded, taking work away from the cities, the cities shifted to work that was more 'up-market'—both in terms of products and in terms of processes.

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[162]Kellenbenz (1977) p470; Mazzaoui (1981) p 65 et seq.

[163]Stabel (1997); Mokyr (1990): "As manufacturing in urban areas became more expensive, industry discovered the countryside."

[164]Van der Wee (1993) Ch. 11.

[165]Slicher van Bath (1977)

[166]Hohenberg and Lees (1995)

For example, from the fourteenth century the cities of Flanders and Brabant increasingly switched from producing cloth to finishing cloth manufactured in the countryside (their own and that of England). They also expanded into the weaving of tapestries, the tailoring of finished clothes, and the manufacture of fashion accessories such as hats gloves, purses, and jewelry.[167] The value added in luxury products and in high-skill processes made the most of the human capital available in the cities and justified the high cost of urban labor.[168] This interplay between urban and rural manufacturing was part of the broader dynamics of urban manufacturing and urban trade that we described earlier. Cities lost processes and products to rural industry, just as they lost them to urban competitors, and they replaced them with other processes and other products.[169]

TECHNOLOGICAL PROGRESS

In industry, as in agriculture, the primary cause of rising productivity was not technological progress but a reorganization of production in response to the expansion of trade. As we have seen, the expansion of trade caused producers to switch to more profitable types of output. Also, by promoting the division of labor and specialization, it induced a restructuring of the process of production. Nonetheless, technological progress did contribute to rising productivity, although less than it would in later centuries. However, it was itself largely the consequence of the expansion of trade and of trade-induced reorganization.

INVENTION, ADOPTION, AND DIFFUSION

Expanding trade and reorganization stimulated technological progress at each of its stages. The first stage of technological progress, invention, is often fortuitous. However, inventors are certainly more motivated when seeking the solution to an existing problem. Expanding trade provided problems, often in the form of bottlenecks. For example, the extraction of silver from silver ore ran into difficulties in the 1550s as supplies of lead, a vital input, began to run short.[170] Metallurgists, seeking an alternative method that did not require lead, adapted the mercury-based amalgamation process that had been used to

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[167]Stabel (1997); Nicholas (1992)

[168]Van der Wee (1993)

[169]Van der Wee (1993)

[170]Blanchard (1976)

extract gold from its ore. As it turned out, this new technique opened up vast new supplies of silver from the silver haloids that proved to be abundant in the Americas.[171]

The reorganization of production also stimulated invention through the division of labor and increasing specialization. For example, in the early Middle Ages carpenters were jacks-of-all-trades. But as trade expanded during the Commercial Revolution they increasingly specialized as either housebuilders or furniture-makers. The latter further subdivided into joiners, turners, and carvers. Each of these crafts developed its own specialized tools.

Of course, a new invention did not by itself constitute technological progress. Before it could have an impact, an invention had to undergo a great deal of adaptation and modification—a slow, incremental process, largely the result of trial and error.[172] This process could begin only when the new invention was actually adopted by producers. But adoption was frequently slow: many inventions that later proved important were known for decades or even for centuries before they were put to widespread use.[173]

The obstacles to adoption were economic. While the act of invention may be fortuitous, the decision to adopt an invention is a matter of economic incentives.[174] Adoption often involves a substantial fixed cost—either an investment in fixed capital or the opportunity cost of other activities foregone. It also involves a considerable degree of risk. To overcome these obstacles, the expected return from the adoption of an invention must be substantial. It was generally a change in the marketplace—a change in relative prices—that made the expected return sufficiently large.

The importance of market prices for the adoption of an invention is nicely illustrated by the story of the *Saigerprozess*, a method of extracting silver from silver-bearing copper ore. The technique was invented by, or for, metal traders from Venice and Nürnberg in the late fourteenth century. This was a time of rising silver prices, and they were hoping to apply the new method to extracting silver from the argentiferous copper deposits of Central Slovakia. However, silver prices soon stabilized and copper prices

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[171]Blanchard, Goodman et al. (1992)

[172]Persson (1988)

[173] The same was true in agriculture: see Kohn (2001)c.

[174]See Kohn (2001)c.

fell, making the new technology unprofitable and causing its abandonment. To a large extent, the profitability of the process, and hence the supply of silver, depended on the price of copper, which was a joint product. In the middle of the fifteenth century, however, abundant new sources of calamine (zinc) were discovered in Europe. This permitted the renewed production of brass—not least for the manufacture of cannon—and sharply increased the demand for copper. With the demand for copper soaring and the price of silver rising again, the *Saigerprozess* began to see wide application.[175]

Expanding trade not only promoted invention and adoption, it also helped diffusion. Diffusion in this period was generally slow—not only because of weakness in the demand for new inventions (a reluctance to adopt new technology), but also because of limited supply. The possessors of scarce technical knowledge hoarded it as a valuable asset: as we have seen, there was no market for technology that would have permitted its rapid transfer. Although treatises in engineering, architecture, and shipbuilding did begin to appear with the advent of printing in the fifteenth century, they were of limited value. The techniques they described were either impractical or could not be applied without a great deal of 'tacit knowledge' that the books did not convey.[176] In reality, the only way to acquire a new technology was to acquire someone who possessed it. The principal vehicle of diffusion, therefore, was migration.

In a period of widespread war, epidemic, and religious persecution, there was a great deal of migration for non-economic reasons. And so, for example, the secrets of silk production—from raising silkworms to finishing the cloth—were carried from Sicily to Lucca by refugees, many of them Jewish, after the conquest of Sicily by the French in 1266. The technology spread to other Italian cities, especially Florence, when Lucca was conquered and sacked by Pisans and Florentines in the early fourteenth century.[177] In the same period, political unrest and warfare in Flanders drove Flemish refugees, skilled in the production of fine woolens, to England, Holland, Germany, and Italy.[178] The wars and persecutions of the sixteenth and seventeenth centuries were a rich source of technology

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[175]Blanchard, Goodman et al. (1992); Nef (1987)

[176]Mokyr (1990)

[177]Laven (1966); Mazzaoui (1981) p 65 et seq.

[178]Rosenberg and Birdzell (1986) Ch. 5; Nicholas (1992); Palliser (1983) Ch. 8. The Flemings brought many other skills to England—other industrial skills, such as brickmaking, and agricultural skills.

transfer. France gained Italian artisans in the first half of the sixteenth century, but then lost many skilled craftsmen of its own to England, Holland, and Switzerland as a result of its religious civil war in the second half of the century.[179] England and Holland were again the chief beneficiaries of the Spanish conquest of the southern Low Countries.[180]

Apart from these waves of refugees, there was a constant flow of economic migration.[181] Some of this was spontaneous, the result of individual craftsmen seeking better opportunities and higher returns to their skills. Cotton technology was probably brought to South Germany by Italian craftsmen crossing the Alps or by returning German artisans who had been trained in Italy.[182] German craftsmen, in turn, brought printing to Venice, as we have seen, and to England.[183] And German miners, metallurgists, and metalworkers carried their skills all over Europe and even to the Americas.[184]

Much economic migration, however, was deliberately fostered by governments seeking to establish or to strengthen domestic industries. In the thirteenth and fourteenth centuries, Italian cities offered skilled immigrants inducements such as citizenship, tax exemptions, bans on competing imports, rent-free shops and living quarters, and interest-free loans.[185] In the fifteenth and sixteenth century, Venice, Genoa, Lombardy, and France all actively recruited silk workers from Lucca and Florence in order to establish their own silk industries.[186] A succession of English monarchs, from Richard II to Elizabeth, recruited experts in mining and metallurgy from Germany and elsewhere to further the manufacture of armaments.[187]

Merchants, too, played an active role in the diffusion of technology. For example, the German metal traders who developed new techniques of mining and metallurgy tried to maximize the returns to their proprietary technology by applying it as widely as possible.

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[179]Cipolla (1967)

[180]Holderness (1997); Wadsworth and Mann (1931); Rosenberg and Birdzell (1986) Ch. 5

[181]Sella (1977)

[182]Mazzaoui (1981) Ch. 7

[183]Palliser (1983) Ch. 8. Papermaking was another skill brought to England by a German artisan.

[184]Nef (1987)

[185]Mazzaoui (1981) p 71

[186]Laven (1966)

[187]Rees (1968)

The Venetians and Nürnbergers who had developed the *Saigerprozess* did this by acquiring mines in all of the principal regions of production—the Erzgebirge, Tirol, Thuringia, and Slovakia. The Augsburg-Hungarian partnership of Fugger and Thurzo, which had developed the cementation process for extracting gold from auriferous silver, kept the technique a closely-guarded secret, but extended its application through acquisition and partnership to all the major regions of production, including Cuba and Mexico.[188] The great Augsburg house of Haug, Langnauer and Company was instrumental in establishing the Society of the Mines Royal and the Company of Mineral and Battery Works in England.[189]

TECHNICAL PROGRESS AND MECHANIZATION

Technological progress in industry was closely linked to the increasing use of fixed capital—'mechanization'. The pace of mechanization, and so the adoption of new technology, was constrained by three considerations—scale, cost, and quality. In each case, it was the expansion of trade and the reorganization of production that eased the constraint and thereby accelerated mechanization and technological progress.

Considerations of scale

The small-scale production that characterized the canonical organization of industry was generally unsuited to mechanization. Investment in fixed capital is often indivisible: there is a minimum size of the capital asset, and a certain volume of output is necessary to justify the expense. In most cases, the modest scale of production of the small family enterprise did not warrant such investment.[190]

The one industry in which, very early on, output did reach a sufficient scale to justify mechanization was the milling of grain.[191] Watermills had been widely used for this purpose in the Roman Empire, and they were common throughout Europe by the seventh

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[188]Blanchard, Goodman et al. (1992)

[189]Rees (1968)

[190]"Waterpower was an irrelevance to household-based urban, craft production, especially in an era of cheap human labor and expensive raw materials. Limited markets and low volume production were the final factors ensuring that–with the exception of the fulling mill–minimal use was actually made of most of the small range of powered machines available to medieval people." (Holt (1997) p157)

[191]Mokyr (1990), Holt (1997)

century.[192] The Domesday Book lists over five thousand watermills in England in 1086, or roughly one for every fifty households. Windmills first appeared in Europe in the late twelfth-century and were common by the end of the thirteenth. The technology of both types of mill improved steadily throughout the period and by the sixteenth century had reached a considerable degree of sophistication. If the use of water- or wind-powered machinery in other industries was limited, therefore, it was not for want of technology.

Sufficient scale requires not only an adequate overall volume of output, but the *concentration* of that output in one place. As we have seen, industries and even enterprises could grow quite large—through putting out—without the scale of the individual unit of production growing any larger than the domestic workshop. However, in some industries, for a variety of reasons, output did become concentrated in a single place, and it was in these industries that there was an increasing use of fixed capital.

As we have seen, one reason for concentrated large-scale production was the application of scarce technical knowledge. The 'chemical' industries—metallurgy, glass, soap, and dyes—tended to employ more fixed capital *because* the scale of production of the individual unit was larger. Moreover, the employment of fixed capital was an additional way for the possessor of scarce technical knowledge to increase his output and so the return to his knowledge.[193] We also saw that the cost of transporting bulky materials could be a reason for concentrating production. For example, smelting facilities, which had to locate close to the mines they served, often processed a large enough volume of ore to justify investment in considerable fixed capital.[194] We saw too that fuel-

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[192]Squatriti (1997) Bloch's belief that there was an explosive expansion in the use of mills in the eight century—a 'technological revolution'-was mistaken. He seems to have been misled by the selective survival of documentary evidence.

[193]Kislev and Peterson (1982) makes a similar argument with respect to the mechanization of the American family farm. Family farms did not become large in order to utilize new and better machinery. Rather farms became more mechanized for the same reason they became larger—to meet the increasing opportunity cost of the farmer's labor. To paraphrase Szostak (1991): manufacturers of farm machinery are more likely to develop equipment only suitable for large farms if large farms already exist.

[194]The third reason we distinguished for concentration, better quality control, did not seem to lead to increased mechanization to the same extent in this period. Perhaps this is because, as we shall see, mechanization itself often compromised quality.

intensive industries in England became more concentrated, and so more mechanized, when they switched from firewood to coal.

It was, of course, the scale of the individual process, rather than the scale of production as a whole, that determined the degree to which investment in fixed capital was justified. Consequently, the division of labor contributed to increasing mechanization, as the evolution of the loom in Flanders illustrates.[195] The unspecialized producers of woolens in the Flemish countryside had used the cheap and simple vertical loom, which had been common since Roman times. However, after woolen production moved to the towns in the late eleventh century and underwent a division of labor, specialized weavers began to use the more expensive horizontal pedal loom, which produced longer, heavier cloths.[196] Out of this developed the larger wide horizontal pedal loom that required two skilled operators and later three. It was this loom that was used to produce the heavier luxury broadcloths. The vertical loom continued to be used throughout the period in the rural manufacture of simple textiles—linens and rough woolens that were produced for own use and for the local market. Here, too, mechanization was a result, not a consequence, of changing organization and concentration of production.

In some cases, large-scale production resulted, not only in mechanization, but also in quite modern techniques of industrial engineering. For example, the *Arsenale* in Venice employed 'assembly lines' that put together standardized interchangeable parts.[197] To achieve the necessary standardization, the parts were manufactured on-site. To coordinate an operation of this scale and complexity, there was a layer of specialized managers consisting of foremen, supervisors, and clerical staff. It is clear that the *Arsenale* did not grow large in order to exploit these advanced industrial techniques. Rather, it grew large

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[195] Van der Wee (1993) Ch. 11; Nicholas (1992); Nicholas (1997)

[196]The horizontal treadle-loom, which allowed the utilization of very long warps originated in China where it was used to produce silk. It was later modified in Iran and Syria for the production of wool and introduced in Europe in the eleventh century. Mazzaoui (1981)

[197]Lane (1973) Ch. 25

because of government policy, and the techniques emerged naturally as a consequence of its scale of production.[198]

Considerations of cost

The pace of mechanization depended too on costs—in particular on the relative cost of materials and labor. Mechanization saved labor, but it was often wasteful of materials.[199] Since materials were often expensive relative to labor, this limited its appeal. Moreover, when the cost of materials was high, the potential reduction in cost from a labor-saving technology was limited. For example, in the manufacture of luxury woolens, the wool and the dye alone could account for eighty per cent of the final cost. Mechanical fulling saved a great deal of labor, but because labor was such a small part of total cost, it reduced the wholesale price by no more than three per cent.[200] Mechanization was more attractive in the production of cheap goods: materials were much less costly and so the cost of labor correspondingly weighed more heavily. Mechanization also became more attractive during periods in which the cost of labor rose, as it did following the Black Death.

The example of the Cistercian monasteries of the Middle Ages demonstrates that it was considerations of cost not technological backwardness that stood in the way of mechanization. The ideological commitment of the Cistercians to self-sufficiency made labor artificially scarce for their economic enterprises. To avoid having to hire outside workers, they developed large-scale industrial units that used water-driven machinery. While mechanization made sense for the Cistercians, it was uneconomic for market-oriented producers and no-one followed their example at the time.[201]

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[198]Szostak (1991), in discussing the Industrial Revolution, makes the same argument as that advanced here for mechanization being a consequence of changing organization and not *vice versa*. In the case of the Industrial Revolution, improvements in internal transportation and communications led to regional specialization and the concentration of production in factories. This in turn led to mechanization. The first factories used the same technology as domestic producers: power-driven machinery came only later. "Simply put, people are much likelier to develop technology suited only to factories after factories have come into being." p 9

[199]Masschaele (1997) Ch. 2

[200]Munro (2000)

[201]Holt (1997)

In the sixteenth century, the substitution of coal and peat for wood as industrial fuels—an important step towards the Industrial Revolution—was also a consequence of changing costs. The traditional story has industry exhausting the supply of firewood and so being forced to seek alternative fuels. More recent research on England has cast doubt on this: the real story is more complex and more interesting.[202] It seems that ironmasters were actually quite careful in managing their timber supplies as a renewable resource and that if there was a depletion in woodlands during the sixteenth and seventeenth centuries it was a result of the expansion of arable agriculture. Moreover, although timber prices were rising, they were doing so more slowly than other agricultural prices. Shortages of fuel were therefore not general but local. And they affected not industry, but the cities: while an industry that exhausted local supplies of firewood could move on to where fuel was more abundant, a city could not. The development of the coal industry in England was driven not by the needs of industry but by the demand for fuel for residential heating, especially in rapidly growing London. The development of the peat industry in Flanders and later in Holland was similarly driven by the heating needs of Antwerp.[203] The development of the coal and peat industries, and of the necessary transportation infrastructure, converted these cities and others from being areas of high fuel prices to being areas of low fuel prices. The low fuel prices attracted energy-intensive industries, which, because of the large local market, could be established at a scale sufficient to justify considerable mechanization.

Considerations of quality

The third constraint on the pace of mechanization was quality. Mechanized production, at least initially, produced goods and materials of a quality inferior to that obtainable from more traditional, labor-intensive methods. For example, in the twelfth century, the newly introduced spinning wheel turned out woolen yarn that was inferior to yarn produced with distaff and spindle. The spinning wheel was therefore used initially only for cotton yarn, whose quality it actually improved.[204] A second example is the blast furnace. Although the technology was available by the middle of the fifteenth century, it

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[202]Hammersley (1973), quoted in Palliser (1983) Ch. 8.

[203]de Vries (1974)

[204]Mazzaoui (1981) p 78

saw little use until the late sixteenth. This was because the cast iron that it produced was inferior in quality to wrought iron for most contemporary applications.[205] The fulling mill is a third example. Fulling mills were known in Italy in the tenth century, and spread from there to northwestern Europe in the eleventh. However, they did not see widespread use until the fifteenth century. Once again it was a matter of quality: mechanical fulling damaged the finest, most delicate woolens and was therefore considered inferior to the traditional method of foot fulling.[206]

The relative importance of quality and cost depended of course on the type of good produced. For luxury products, quality was paramount; for cheaper goods, quality was less crucial and cost could be decisive. So mechanization was of little appeal to the producers of luxury goods, and the pace of mechanization began to accelerate only with the beginning of large-scale production of cheaper goods for widespread distribution. For example, the spinning wheel was adopted by the woolen industry only with the expansion of trade in cheaper woolens in the thirteenth century.[207] Similarly, the rapid proliferation of blast furnaces in the sixteenth century resulted from the growth of a market for cheaper metal goods.[208] Fulling mills, supposedly absent from the 'flat' Low Countries, were actually used there in the thirteenth century when cheaper woolens were being manufactured in large quantities. However, they vanished in the fourteenth and early fifteenth century as Flemish producers refocused on luxury textiles. Fulling mills then reappeared in the Low Countries in large numbers in the late fifteenth and sixteenth centuries, with the resumption of large-scale production and export of cheaper woolens.[209] In England, the supposed home of the fulling mill, mechanical fulling coexisted with foot fulling—the former for cheaper cloth, the latter for luxury cloth.[210]

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[205]Nef (1987) The technology of the blast furnace was developed much earlier in China.

[206]Munro (1998)

[207]Mazzaoui (1981) Ch. 4

[208]And also from the growing demand for iron cannon which were made from cast iron.

[209]Van Uytven (1971)

[210]Holt (1997)

Cheap goods and mechanization

To a large extent, therefore, mechanization, and so technological progress in industry, depended on the expansion of the market for cheap goods. Luxury goods were not suited to mechanization. They were produced in too small a volume to justify large investments in fixed capital. The savings in labor cost that mechanization offered held little appeal, both because labor cost was less important than the cost of materials, and because demand for the product was not very sensitive to price. And the sacrifice in quality that was often required was unacceptable. For cheaper goods, the tradeoffs were very different. Quality was less crucial. Cost reduction was important, because demand was highly sensitive to price. Because materials were relatively less expensive, labor cost was more important. The only remaining obstacle was scale—a sufficient overall volume of production and the concentration of that production in one place. Overcoming this obstacle was a matter of expanding trade and falling trading costs.

Expanding trade contributed first of all by raising incomes. Because food and shelter accounted for the lion's share of working class and middle class budgets, it was only when incomes rose high enough that there was sufficient purchasing power left for anything else. The demand for cheap industrial goods was therefore very sensitive to changes in income. While total demand, and so overall production, depended on the expansion of trade, the concentration of that production depended on trading costs. The demand for cheap goods was mostly satisfied by small-scale producers at the local and regional level. Because margins were low relative to trading costs, longer-distance trade in cheap goods was generally unprofitable. However, when trading costs fell, imports were able to compete with locally produced goods, allowing for regional specialization in particular goods and the concentration of production. Industries that supplied a large market beyond their local areas could attain a scale that justified mechanization.

Mechanization, the guilds, and the progressiveness of rural industry

The sacrifice of quality required by mechanized production also explains guild opposition to certain kinds of mechanization, a position that has often been misinterpreted

as reflecting an innate conservatism.[211] As we have seen, a primary function of the guilds was to monitor quality to protect a town's 'brand image'. This was particularly important in the production of luxury goods. When it did not compromise quality, the guilds did not object to mechanization.[212] For example, in twelfth-century Italy, while the guilds prohibited the use of the spinning wheel for wool, they had no objection to its use for cotton.[213] Similarly, urban producers of woolens in the West Country of England made use of fulling mills, in or close by the towns, with no opposition from their guilds: presumably, the quality of the work was sufficient for the type of cloth they produced.[214]

The rise and fall of guild influence and power seems to have coincided with the changing relative importance of luxury goods and cheap goods. The guilds reached the peak of their importance during the 'Great Depression' of the long fourteenth century. As we have seen, this was a period in which rising trading costs ended inter-regional and inter-zone trade in cheap goods, causing the major industrial centers to refocus their efforts on luxuries.[215] Guild influence began to decline when trade in cheap goods resumed in the fifteenth and, especially, the sixteenth century, declining fastest in

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[211]An example of the classical view is Pirenne (1937): "Technological progress took on the appearance of disloyalty. The ideal was stable conditions in a stable industry." (p 186) Among those who have questioned this interpretation are Stabel (1997) (for Flanders) and Epstein (1998).

[212]The industrial output of sixteenth-century Venice was largely focused on luxury goods. The guilds therefore channeled competition into improving quality rather than reducing cost. They did not oppose innovations that improved quality. When the guild of teaselers applied to the Senate to ban a machine that raised the nap of cloth after fulling, they were turned down. However the Senate did require that cloth be marked to indicate whether it was teaseled by hand or by machine. (Lane (1973))

[213]Mazzaoui (1981) Ch. 4

[214]Munro (1998)

There were cases in which the guilds did stand in the way of technological progress, but it was usually the result of a conflict over demarcation. For example, when the London cutlers (who made handles for knives) developed silver plating, they ran into severe opposition from the goldsmiths, who considered it a violation of their monopoly. (Jacobs (1969))

[215]Some historians have attributed the growing power of the guilds in this period to rising protectionism in the face of declining trade. Supple (1977), for example, describes the guilds as "an institutional adaptation to static or circumscribed markets". The two explanations are not, of course, mutually exclusive.

precisely those regions where the production of cheap goods was growing most rapidly—in England and in the Netherlands.[216]

The progressiveness of rural industry has been attributed to its freedom from the supposedly stultifying control of the urban guilds. But, as we have seen, the guilds were not technologically conservative, and it is hard to believe that the rural environment was inherently more conducive to technological progress than that of the cities. It seems possible that the association between rural production and technological progressiveness is a spurious one. We have seen that cheap goods were more suited to mechanization because quality was less important and because they required less skilled labor.[217] We have also seen that cheap goods were better suited to rural production precisely because they required less skilled labor and because rural labor was cheap. So the association between rural production and technological progressiveness may simply reflect the association of both with the production of cheap goods.[218]

TRADING COSTS, THE EXPANSION OF TRADE, AND INDUSTRIAL DEVELOPMENT

The conventional history of industrial development sees technological progress as its primary cause and technological backwardness as its primary impediment. Increasing productivity is driven by technology. Advanced technology, embodied in fixed capital, requires production on a large scale: this in turn drives changes in industrial organization. The relationship between urban and rural production is understood in terms of technological progressiveness in the countryside versus conservatism in the guild-dominated cities. The pace of technological progress, the driving force in all of this, is largely determined by non-economic factors—cultural attributes such as natural inquisitiveness and scientific curiosity.

The story developed here is very different. The driving force is not technological progress but trading costs. Falling trading costs lead to an expansion of trade and to

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[216]On England, see Reed (1973) and Kellenbenz (1977); on the Netherlands, see Kellenbenz (1977) and de Vries and van der Woude (1997). Richardson (1999) suggests that a fall in the value of their social and religious services was responsible for the guilds' decline at this time.

[217]In general, mechanization itself reduced the need for skills.

[218]Mokyr (1990) notes that technological progress and mechanization facilitated the movement of production to the countryside: he cites the stocking frame and improvements in the spinning wheel.

industrial development; rising trading costs lead to a contraction of trade and industrial stagnation. Increasing productivity is largely the result of a restructuring of industry in response to falling trading costs and to expanding trade. These bring about changes in which goods are produced, in where they are produced, and in how they are produced. Changes in industrial organization are a response to this restructuring of industry and are best understood in terms of arrangements that minimize overall trading costs. Trading costs are the key too to understanding the relationship between urban and rural industry—one of complementarity rather than competition. It is trading costs again that determine the scale of production—through their effect on the overall volume of production and on its concentration in a single place. Technological progress is a consequence of all of these changes more than it is a cause: technological progress is held back not by the supply of innovation, but by the demand. It is increasing scale that leads to mechanization and not the reverse.

The increasing production of cheap goods is the key to industrial development and to technological progress, because cheap goods are far better suited to mechanization. Historians have tended to underestimate the importance of cheap goods during this period. This is partly because the production of luxuries and the trade in luxuries have left better records and partly because history tends to pay more attention to the lives and concerns of the great and wealthy. Nonetheless, in certain times and in certain places the trade in cheap goods was important. For example, writing in the late seventeenth century, Gregory King estimated the internal trade of England, mainly in cheap items of everyday household use, to be four times the size of its overseas trade; in the late sixteenth century, the balance may have been even more in favor of internal trade.[219] The production of cheap goods was particularly sensitive to trading costs. First, fluctuations in trading costs had a far greater impact on the trade in cheap goods than on the trade in luxuries. Second, because of the effect of trade on overall prosperity, trading costs had a greater impact on the demand of the middle and lower classes than on the demand of the wealthy.

Before 1600, there were two major periods of falling trading costs, increasing prosperity, and industrial progress—the Commercial Revolution of the long thirteenth

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[219]Palliser (1983) Ch. 9. Reed (1973) argues that it was internal trade more than foreign trade that was the engine of economic growth.

century and the period that began in the late fifteenth century. Each has been described by some historians as an early 'industrial revolution'. Both periods were characterized by increasing production of cheap goods and by more rapid technological progress. The first period of growth was brought to an end by widespread warfare that raised trading costs and interrupted trade. The second, too, was fated to be interrupted in a similar fashion in the seventeenth century. Nonetheless, in the economies of England and Holland at the close of the sixteenth century, with their focus on the production of cheap goods, we can already discern the outlines of the coming Industrial Revolution.

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