



Adam Smith's division of labor and structural changes

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Abstract

This paper considers two different cases of division of labor: (i) the subdivision of different operations in order to produce a particular product in a given firm or plant; (ii) the specialization of firms in the same industry. Division of labor of the former type is limited by demand for output of a particular firm or plant, while division of labor of the latter type is limited by demand for the industry as a whole. It is argued that, in the case of an industry producing a homogenous product, an increase in the scale of production of any particular firm is likely to be associated with changes in the internal division of labor. In the case of inter-firm division of labor, decreasing unit costs may result from lateral disintegration. Finally, in the case of an industry producing a composite commodity (that is, a commodity composed of many different sub-commodities), firms', disequilibrium behavior may lead to concentration of each firm to fewer sub-commodities, in the anticipation of the entry of new firms, or as a result of it. © 2000 Elsevier Science B.V. All rights reserved.

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1. Two different kinds of the divisions of labor

Structural changes may be defined as changes in the composition, i.e. in the relative weights of significant components of systems (Ishikawa, 1987; Pasinetti and Scazzieri, 1987). Adam Smith's division of labor, which is limited by the extent of the market, causes such changes in the structure of firms and that of industries.

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Smith gives two different kinds of illustrations of the divisions of labor; one is concerned with the subdivision of different operations to produce a given product, the extent of which is limited by the demand for output of a firm or a plant, while the other is concerned with an inter-firm division of labor or the specialization of firms in the same industry, the extent of which is limited by the demand for the industry as a whole.

The illustration of the former division of labor is drawn from the pin making example in the *Wealth of Nations*:

“The trade of the pin-maker; a workman not educated to this business, nor acquainted with the use of the machinery employed in it, could scarce, perhaps, with his utmost industry, make one pin in a day, and certainly could not make twenty. But in the way in which this business is now carried on, not only the whole work is a peculiar trade, but it is divided into a number of branches, of which the greater part are likewise peculiar trade. One man draws out wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations, to put it on, is a peculiar business, to whiten the pin is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, which, in some manufactories, are all performed by distinct hands, though in others the same man will sometimes perform two or three of them. I have seen a small manufactory of this kind where ten men only were employed,... Those ten persons could make among them upwards of 48 000 pins in a day. Each person, therefore, ... might be considered as making 4800 pins in a day.” (Smith, 1976, pp. 14–15).

Then Smith describes the effect of the latter division of labor in nail making in the following extract:

“A smith who has been accustomed to make nails, but whose sole or principal business has not been that of a nailer, can seldom with his utmost diligence make more than 800 or 1000 nails in a day. I have seen several boys under 20 years-of-age who had never exercised any other trade but that of making of nails, and who, when they exerted themselves, could make, each of them, upward of 2300 nails in a day.” (Smith, 1976, p. 18).

In Section 2 we summarize and extend our previous considerations (Negishi, 1989, pp. 89–95) on the division of labor of the first kind (e.g. Smith’s subdivision of operations in pin making). Then, Sections 3 and 4 are devoted to division of labor of the second kind (e.g. Smith’s smith who specializes in nail making). Finally, Section 5 concludes the paper.

2. The case of an industry providing a homogeneous product

Consider a firm in an industry producing a homogenous product. For the sake of simplicity, let us suppose that only labor is necessary to produce the product. The entrepreneur can divide the production process into many operations so that a laborer can specialize in a limited number of them. Given the total number of laborers to be employed, m , the entrepreneur decides the degree of the division of labor (number of operations to be assigned to a laborer) so as to maximize the average productivity of labor, $a(m)$, which is an increasing function of m , i.e. $a' > 0$.¹ Then, the level of output of the firm is $x = a(m)m$ and the average cost of production is $wm/a(m)m = w/a(m)$, where w is the given rate of wage.

The average cost of the firm is decreasing with respect to the level of output, since

$$dm/dx = 1/(a + a'm) \quad (1)$$

and

$$d[w/a(m)]/dx = -wa'/[a^2(a + a'm)] < 0. \quad (2)$$

With respect to division of labor within a firm, modern economic theory's evaluation of Smith was not very high (see for example, Richardson, 1975). While diminishing cost caused by such division of labor must produce concentration and, in the end, monopoly, Smith was not troubled by this inconsistency between competition and increasing returns. This evaluation was based, however, on the Walrasian view of competition in traditional general equilibrium theory. In this view, a firm's scale of production should be limited by the increasing cost of production, since it can sell whatever amount of product at the given unchanged market price. Smith should be evaluated higher, however, if we follow a more recent view of competition, i.e. the Sraffian view, in which firm's scale of production is limited, not by cost, but by the deficiency of demand (see, Sraffa, 1925; Negishi, 1989, pp. 93–94, Negishi, 1998; Whitaker, 1990).

As far as an increase in the demand for the industry not only induces the entry of new firms, but also expands the scale of production of each firm, it causes changes in the structure of firms, i.e. in the structure of intra-firm division of labor, and reduces the cost and price of the product.

3. The case of inter-firm division of labor

Although the name of Adam Smith was not mentioned, it is Pigou (1932) who emphasized the significance of the division of labor of the second kind (e.g. Smith's case of the smith who specializes in nail making):

¹ From the point of view of a single laborer, his own productivity can be increased by specializing into fewer operations than those assigned by the entrepreneur. This is not permitted, however, by the entrepreneur who has to take the balance of the production process of the firm into consideration.

“When an industry is on a small scale, the firms belonging to it all engage in producing a number of different types or variations of their commodity. They are, more or less, firms of all work. There is not a sufficiently wide or assured market to allow of close specialization. As, however, the general demand grows, it becomes more and more worth while for firms to specialize on particular types — the increased specialization of its component firms made possible by an enlargement in an industry as a whole often involves a large reduction in costs. This reduction might, so far as pure theory goes, be accompanied by no change, or even by a decrease, in the size of the typical firm.” (Pigou, 1932, p. 219).

Pigou’s theory of increasing returns based on specialization of firms in an industry was empirically supported by the international comparison in the early twentieth-century of large-scale cotton industry in England and small-scale cotton industry in Germany:

“The range of work undertaken by the typical factory in Germany is far greater than that undertaken by the typical factory in England. Hence naturally the skill of the operation is less in Germany; more time is wasted and factory organization is less perfect.” (Chapman, 1904, p. 166).

Robinson (1933) was, however, critical of Pigou. While she recognized the importance of the principle of lateral disintegration (the specialization of firms on a narrower and narrower range of products), which was exemplified by the contrast between the larger and more highly specialized British cotton industry and the smaller and less specialized German one, Robinson remained skeptical of Pigou’s theory of decreasing cost:

“This principle of lateral disintegration is of the greatest importance in the real world, but will it serve to explain the existence of decreasing costs under conditions of perfect competition? If an industry grows up from the first in a perfect market, we should expect it to develop from the beginning the maximum possible degree of specialization.” (Robinson, 1933, p. 338).

Finally, Richardson (1975) also considered that Smith’s division of labor of the second kind important from the point of view of his theory of economic growth:

“At one stage of a country’s economic growth, the market may be large enough to support the trade of a carpenter, but only as markets further expand would this trade come to be further differentiated into those of joiner, cabinet-maker, wheelwright, plougherite, cart-maker, and the like.” (Richardson, 1975).

Since, according to Richardson, there always exist unexploited opportunities for such a division of labor, Smith’s theory of growth seems to imply endless development of the economy. Richardson admitted, however, that it is difficult to reconcile this with Smith’s prediction of the possibility of a stationary state.

4. A composite commodity composed of many different sub-commodities

Consider an industry, the product of which is not homogeneous, but heterogeneous in the sense that it is a composite commodity composed of many different sub-commodities. For the sake of simplicity, suppose that the composition of this commodity is given and unchanged. In other words, sub-commodities are always demanded proportionally. Let us also suppose that all the sub-commodities have the same, identical U-shaped average cost curves. Then, the scale of all the firms is determined at the minimum point of the average cost.

In Fig. 1, the level of output of the industry is measured horizontally, and price and cost are measured vertically. The demand curve for the industry is DD initially, and point A is the initial equilibrium with output OB and price (= average cost) AB . Suppose at this point that all firms are producing all sub-commodities. When demand is increased to $D'D'$, the equilibrium point is shifted from A to F , with the level of output increased more than three times from OB to OG , and price is reduced from AB to FG . At the new equilibrium F , the number of firms is three times larger than at the equilibrium A , and each firm is producing only one-third of all sub-commodities. The reason why the price (and the cost of production) is reduced from AB to FG is that each firm is now specializing in the production of a fewer number of sub-commodities.²

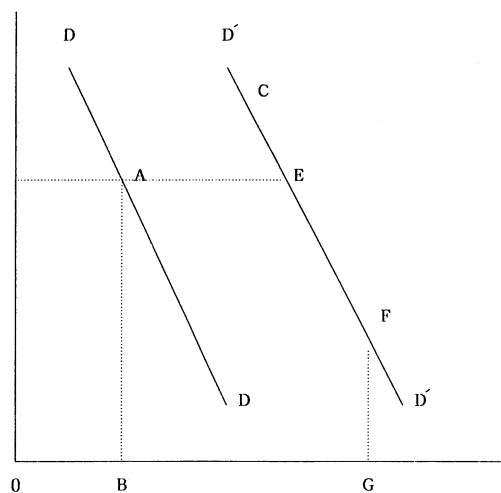


Fig. 1. The division of labour of the second kind.

² It is assumed that the minimum point of U-shaped average cost curves of sub-commodities moves downwardly to the right, when the number of sub-commodities jointly produced is decreased.

Now one can protest, with Robinson, that there is no reason why points A and F be equilibria, since firms can reduce cost further by specializing to the production of a fewer number of sub-commodities. Against this criticism, perhaps we may argue that there is no incentive for further cost reduction at such an equilibrium where price is equalized to the minimum average cost (in which normal profit is assumed to be included) and there is no competition for markets among firms. In other words, incentive for cost reduction by further specialization only appears at disequilibria where firms compete with each other for markets,³ as Adam Smith pointed out:

“The increase of demand, though in the beginning it may sometimes raise the price of goods, never fails to lower it in the long run. It encourages production, and thereby increases the competition of the producers, who in order to undersell one another, have recourse to new divisions of labor and new improvements of art which might never otherwise have been thought of.” (Smith, 1976, p. 748).

As for the incentives for cost reduction at disequilibria, perhaps we may consider the following three hypotheses:

1. When demand is increased from DD to D'D', firstly the existing firms increase their supplies, with supply curves being their marginal cost curves which start from the point of the minimum average cost A and rise, say through point C along D'D' (“in the beginning it may sometimes raise the price of goods”). At point C, such *rising costs* in the existing firms may induce firms to consider the cost reduction by the further concentration to a fewer number of sub-commodities, perhaps in anticipation of the entry of new firms.
2. At point C, the price, which is higher than the minimum average cost AB, induces the entry of new firms. As the supply is increased, the price is reduced along the new demand curve D'D'. This process may not be terminated at point E, but may be continued to F, where price FG is lower than the minimum average cost AB. The resulting *negative profit* (or the rate of profit lower than the normal rate) may induce firms to consider cost reduction by the concentration to a fewer number of sub-commodities.⁴
3. *Newly entering firms*, possibly with the entrance cost, may begin to consider cost reduction by the concentration to a fewer sub-commodities, “in order to undersell” the existing firms and to enter their markets. Then, to defend their own markets, existing firms must follow new firms and reduce the cost of production through specialization to fewer sub-commodities.

³ There is, therefore, no difficulty in reconciling the existence of unexploited opportunities of further division of labor among firms and Smith’s prediction of the possibility of a stationary state (see Section 3).

⁴ If we take this hypothesis, however, we have to admit that not only an increase but also a decrease of demand might reduce the cost of production through firm’s specialization to fewer sub-commodities.

5. Concluding remarks

The division of labor of the first kind, which is planned by the entrepreneur in a single firm, can somehow be dealt with by the equilibrium theory of a competitive industry. The division of labor of the second kind, which is carried out unorganizedly by many different independent firms in a competitive industry, however, cannot be explained without the careful consideration of the disequilibrium behavior of firms. To understand this process, we need a new dynamic disequilibrium theory of firms, the full development of which, unfortunately, is yet to come.

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