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The document is based mainly on information taken from two earlier ECLA studies[1/] analysing the effect of capacity on capital and production costs in a series of hypothetical steel plants of various sizes. The plants have been regarded as situated at a given location, and the costs have been determined for each of them; the costs have been classified under the main stages of production: reduction of the ore, steel making, continuous casting or cogging, and rolling. The cost figures for auxiliary departments have been distributed among the production departments in proportion to the use made of them by each department.

In document E/CN/12/764, the influence of the size of the operation on technical and economic relationships is analysed, and for this purpose the hypothetical plant capacities considered are 25,000, 50,000, 100,000, 200,000 and 300,000 annual tonnes of non-flat rolled products; as far as possible, a uniform sequence of production processes is used for all the plants, and the same inputs and general circumstances are assumed in all cases. The document also considers the results obtained using various alternatives in the 50,000 tonne plant.

The technology chosen for the main series is as follows: blast furnace, LD steel making, continuous casting and rolling of non-flat products. This sequence has been chosen even though the smaller plants might encounter technical difficulties in operating efficiently. The capital costs for each of the production departments and auxiliary departments are calculated separately and then the costs for the latter are distributed among the production departments. The result is that capital costs per tonne of liquid steel are $US 445 for the 25,000 tonne plant, and drop to $US 299 for the 100,000 tonne plant and to $US 215 for the plant of 300,000 tonnes capacity. The production costs are estimated at $US 219 per tonne in the 25,000 tonne plant, $US 130 in the 100,000 tonne plant and $US 97 in the 300,000 tonne plant.

1/ "Economies of scale at small integrated steelworks", by M. N. Dastur and Co. (E/CN/12/764), and "Las economías de escala en plantas siderúrgicas de tamaño medio y grande y la influencia de los adelantos tecnológicos en las inversiones y costos de producción", by Armando P. Martijena (E/CN.12/766).

Taking into account export prices in the main exporting countries and the need to cover other costs not considered in the study, the conclusion is reached that it is very hard to justify economically a plant producing non-flat rolled products with an annual capacity below 100,000 tonnes.

Document E/CN/12/766 analyses several situations. Reference is made here only to two series of comparisons: firstly, the production of flat-rolled products in plants with an annual capacity varying from 100,000 tonnes to 2.5 million tonnes, with the following production sequence: blast furnace, LD steel making, cogging and rolling; and, secondly, a set of comparisons of capital and production costs when certain alternative processes are used.

With regard to the first series of comparisons, the calculation of capital costs shows that these vary from $US 692 per annual tonne for the plant of 100,000 tonnes capacity to $US 252 in a plant of 2.5 million tonnes. Production costs vary from $US 177 per tonne in the smallest size of plant considered to $US 89 in the largest size.

By a reasoning similar to that used in evaluating the effects of economies of scale in plants producing non-flat products, it may be shown that it is hard to justify economically the construction of a plant for the production of flat products with a capacity below 300,000 to 400,000 tonnes.

The various alternative processes which were considered, solely in connexion with the production of flat products, include, at the reduction stage, the use of blast furnaces and electric reduction furnaces and the HyL direct reduction process. The steel-making processes include open hearth furnaces, electric arc furnaces and top-blown LD converters. With regard to rolling, the conventional processes of cogging and rolling and the continuous casting process are considered, in spite of the difficulties involved in the continuous casting of rimming steel, which is preferred in the production of sheets and plates. The maximum sizes considered in each case are those which are thought applicable in Latin America.

The calculations made justify the conclusion that, in reduction, the process with the highest capital costs is the blast furnace, although the difference between it and the electric furnace decreases with increasing size. In steel making, the top-blown oxygen converter proves the most suitable process, and, finally, with regard to rolling, the sequence continuous casting and rolling involves capital costs 12 per cent less than the conventional system of cogging and rolling, but the difference drops to 7 per cent in a plant of 1.5 million tonnes. With regard to production costs, it is found that, in all stages of the cycle, the combination of processes involving the least cost is that of a blast furnace, LD steel making, and continuous casting followed by rolling. If the cost of natural gas is fairly low, direct reduction may be competitive up to capacities in the neighbourhood of 500,000 tonnes annually.

The paper concludes with a study of the practical applications in Latin America of the conclusions derived from this study of economies of scale. The situation is clearly tending to improve. Whereas in 1961, 77 per cent of plants and 42 per cent of output were accounted for by plants with an annual capacity below 400,000 tonnes of ingot, in 1966 small plants of this size represented only 41 per cent of the total number and 11 per cent of output.

On the other hand, if the production of flat products is separated from that of non-flat products, it is found that only four Latin American plants in 1965 produced flat products at a rate above the economic minimum of 300,000 tonnes annually which was arrived at, five having outputs below that figure. As far as non-flat products are concerned, eight plants have capacities above 100,000 tonnes and six below, but several of the latter produce special steels.

If the existing production figures for plants are compared with the capacities of their rolling mills and the domestic markets in which they are operating, it is found that there is a tendency in Latin America to anticipate the growing demand for flat products and to build plants with capacities larger than the market existing at the time the plant is built. The same does not occur in the case of plants producing non-flat products, and the tables show a clear lag in the establishment of such plants.

Finally - as is logical in order to take advantage of economies of scale in reduction and steel making - of the total of fifteen plants appearing in table 18, eight plants with 80 per cent of total capacity in 1965 had rolling mills for flat and non-flat products supplied by common blast furnaces and steel-making installations.

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