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WORKING GROUP ON ECONOMIES OF SCALE IN
THE LATIN AMERICAN AUTOMOTIVE INDUSTRY

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ECONOMIES OF SCALE IN THE CHILEAN MOTOR-VEHICLE INDUSTRY

prepared by

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Note: The meeting of this Working Group is one phase of the project "Prospects and possible forms of regional integration in the automotive industry in Latin America" that is being carried out by the Economic Commission for Latin America (ECLA) and the Inter-American Development Bank (IDB), with the collaboration of the United Nations Industrial Development Organization (UNIDO).

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I. INTRODUCTION

The aim of the present study is to analyse the technical and economic factors affecting the cost of an automobile currently produced in Chile. The vehicle selected for the purpose of the study has the following characteristics:

1. Small family-size, four-door car, with engine capacity of between 800 and 1,300 cc.
2. Market penetration in 1966 and 1967 of more than 10 per cent.
3. Comparatively "economical" price.

Having broken down cost components, we paid special attention to the question of the proportion of national parts used in car assembly, which at present amount to 58 per cent of the f.o.b. factory price.

The study was carried out using the prices that prevailed in May 1968, with a parity exchange rate of E° 6.52 to the dollar.

Studies were made of the economies of scale that would be brought about by stepping up the manufacture of national components.

An analysis was also made of the variation in the cost of national parts, both marginal and accumulative, in relation to the proportion of national parts used in vehicle assembly.

Moreover, the national parts used were broken down into groups of components with similar characteristics, and we studied the effect of economies of scale on these different groups. From the point of view of manufacture, a critical analysis was made of the national components currently used in national manufacture.

In addition, a chart was drawn to illustrate the various cost components at different production volumes and as a function of the proportion of national parts used in assembly, in order to give some idea of how costs are affected by the different variables considered.

It should be pointed out that in this study a constant level of technology - namely, that which existed in Chile in 1968 - has been assumed to exist at the various stages of production.

/II. ANALYSIS

II. ANALYSIS OF COST STRUCTURE

1. Definitions

Before dealing with the subject of the present study, some definitions are given of terms which are commonly used in Chile's motor-vehicle industry and which are of basic importance in the subsequent analyses.

Inefficiency coefficient is the ratio of the value of a motor-vehicle part in Chile to its f.o.b. value at plant in the country of origin of the vehicle concerned.

$$\text{Inefficiency coefficient} = \frac{\text{Value in Chile (dollars)}}{\text{Value f.o.b. country of origin (dollars)}}$$

The escudos were converted into dollars at a rate of 6.52 escudos to the dollar, which was the bank rate for future operations at the time this study was prepared, i.e., May 1968.

Omissions are motor-vehicle components manufactured in Chile, which are therefore not imported from the country of origin.

Percentage of national integration represents the sum of the f.o.b. value of omissions at plant in the country of origin as a percentage of the f.o.b. value of the complete vehicle at plant in the country of origin.

2. Analysis by groups of parts

The parts making up a complete motor vehicle vary widely in manufacture, size, raw materials, weight and level of technology. There are undoubtedly many angles from which to undertake a study, but few would lead to practical results.

Example: A classification according to raw material would lead to such absurdities as comparing a mudguard with a wheel hub or a cigarette-lighter, or a door-handle with a carburettor.

A classification according to manufacture would result in comparing a boot cover with a washer.

In a classification according to the level of technology used, a gear-box would be considered in the same group as a radio.

/In fact

In fact, the use of traditional classifications would obviously give rise to difficulties. Therefore, the classification adopted comprises ten groups of manifestly different types of parts. It is based on the technological and industrial processes involved and the prevailing technological and economic conditions, in the hope that useful conclusions can be reached.

It should be noted that this classification is applicable only to the present situation in Chile and to the parts considered in this study.

The following groups were considered:

A. Electrical equipment
B. Assembled components
C. Casting
D. Cold-worked metal
E. Forging
F. Plastics
G. Rubber
H. Upholstery
I. Standard parts
K. Glass

The analysis covers only the parts produced locally under conditions of constant technology.[x]

(a) Electrical equipment

This group includes all items in the electrical system of the motor, and accessories such as cables, headlights, interior lights and the windscreen-wiper system.

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x Translator's note: This means that technological conditions do not vary as production increases.

The most important parts in this group - generator, starting-motor distributor and windscreen-wipers - are only assembled in Chile. The cost of die-making is therefore spread over a large volume of production supplying several countries, and has little effect in raising the cost of these parts, i.e., 1.17 per cent, assuming an annual production of 1,000 vehicles. This percentage is worked out on the basis of amortizing the cost of die-making over three years, which is the period considered throughout this study and is based mainly on obsolescence and wear and tear.

Accordingly, the cost of these parts is accounted for mainly by their components, which are mostly imported. The balance corresponds to the value added in assembling them and to some secondary locally-produced items which are incorporated in them, such as washers, screws, terminals, etc.

For the reasons mentioned above, the economies of scale for these parts are practically nil under present conditions in Chile. Thus, if production is raised from 1,000 to 8,000 sets per year, the inefficiency coefficient drops by only 0.17 (from 2.67 to 2.50), i.e., approximately 7 per cent (see figure 1).

This situation must change in the future as the domestic content of these parts increases, in line with the programme envisaged. The company supplying most of these components is devoting its attention to this project and plans to manufacture the major part of them itself.

In view of the above considerations, the facilities for the production of these parts in Chile consist only of assembly and test benches; therefore, the manpower employed is not necessarily highly skilled.

Other parts included in this group, such as electric cables, terminals and headlights, are not only assembled in Chile but most of their components are also manufactured locally. Domestically-produced dies and some more comprehensive processes accordingly result in greater economies of scale than the average for the group; but the value involved is so low that it scarcely alters the results obtained for the group as a whole.

/(b) <u>Assembled</u>

(b) Assembled components

This group consists only of components which are made up of numerous parts manufactured by different processes. This makes it impossible to classify them in one clearly-defined group. They include the heating system, shock absorbers, radiator, jack, mounted ash-tray and rear-view mirror.

All the parts in this group have in common that they demand a great deal of mainly qualified labour. "Labour" is therefore an important factor in their total cost.

Although the dies used to produce these parts are usually fairly numerous, they are small and have a low unit cost. On the basis of the same amortization periods as were taken in the case of group A, the cost of amortizing these dies amounts to 3.44 per cent.

In view of the wide variety of parts, the values given earlier must only be considered as indicating a statistical average.

The plant used to manufacture this kind of part is also fairly varied; all the equipment, however, is large and complex and involves extensive investment that can only be amortized under high output conditions. Because of this and because the manufacturing process entails laboratory work, this group presents an economy of scale of a mere 10 per cent (a fall in the inefficiency coefficient from 3.35 to 3.03) as the number of annual units is increased from 1,000 to 8,000. This derives from the fact that somewhat larger production levels are needed to bring about any significant reduction in the unit cost (see figure 1).

(c) Casting

This group comprises all metal parts, whether ferrous or non-ferrous, that are obtained by casting.

Examples: brake drums, water pump, spring supports, exhaust multiples, handles, etc.

Investment in models and core boxes, which for the purposes of this study have been included under die-making, is a fairly important factor in the cost structure of these parts, not so much because they are high in themselves as because they are indispensable for every single one of the parts. This item thus constitutes 8.50 per cent of the total cost of the parts.

/The cost

The cost of raw materials is another major factor in the manufacturing process of these parts in so far as they are usually heavy and/or made of costly, and mostly imported, alloys.

Another item that adds seriously to their cost is the specialist labour needed at the machining stage, as this generally involves precision work. Since automation is uneconomical at our present levels of production, the work has to be done by conventional machine-tools at a correspondingly higher cost.

The long series of complicated and expensive processes that these parts have to go through mean that greater economies of scale are possible with this group. By increasing the number of annual units from 1,000 to 8,000, its inefficiency coefficient is reduced from 3.24 to 2.71, which represents about 16 per cent (see figure 1).

The necessary plant is once again a major factor, especially casting equipment. Sand recovery and conditioning systems, thermal treatment plant, transport, laboratories, etc., all need large-scale investment to obtain the standards of quality required in the motor-vehicle industry.

(d) Cold-worked metal

This group comprises a large number of metal parts obtained by means of cold-stamping, cold-folding and/or cold-cutting.

Examples: motor support, bumper support, mudguards, petrol tank, mouldings, suspension brackets, silencer, air filter, wheels and certain body parts.

Die-making accounts for a large share (23.20 per cent) of the cost of producing this group of parts since most of them need several dies which, in some cases, are very large and/or high precision tools. Naturally, the cost of each die depends on the complexity, size and tolerances of the parts to be manufactured.

The processes involved in making these parts are usually simple. Once they have been stamped, folded and/or cut, they only need to be welded or perforated and coated. The amortization of the die-making therefore becomes the most important cost factor for low production levels, which means that major economies of scale (about 26 per cent) are possible when the number of annual units is increased from 1,000 to 8,000. The inefficiency coefficient drops accordingly from 3.19 to 2.35 (see figure 1).

/The plant

The plant for this kind of processing mainly consists of a pressing machine. It must be remembered that the scale of investment is closely allied to the size of the plant and the quality and capacity of the presses, as regards not only the actual cost of the machine but that of the necessary additional equipment as well.

These machines require specially trained operators.

(e) Forging

This group comprises all the hot-stamped parts, such as wheel hubs, springs, axles, change levers, jack arms, etc.

For all the components described above, adequate die-making capacity for their production is essential. On the other hand, since the forging dies have been projected for low levels of production, their cost is relatively low. Their incidence in the total cost of the parts is only 3.6 per cent.

As regards raw material, the situation is similar to that of die-casting where the parts are generally heavy and, in some cases, require expensive raw materials.

Labour is another important factor in this group of parts, since they require precise final metal-working which cannot be carried out through the automation processes employed at high production levels.

The various processes to which these parts are normally subjected - including metal-working and heat treatment, which require heavy initial investment - give this group one of the highest average inefficiency coefficients (3.58 per thousand sets a year). The economy of scale obtained by raising production from 1,000 to 8,000 sets a year is only 10 per cent (fall in inefficiency coefficient from 3.58 to 3.22).

Forging, heat treatment, laboratory work and metal-working installations always require heavy investment.

(f) Plastics

To this group belong all those parts, made of a great variety of plastics, which have been extruded or obtained by pressure injection.

Examples: arm rests, door handles, insulating strips, ornaments, tubes, etc.

/All the

All the machines used in the manufacture of this type of parts have a high output capacity and thus a long time is spent in preparing the machine and making tests compared with the time spent on producing a small series.

If to these remarks it is added that the die-making accounts for 28.4 per cent of the value of the parts, it is obvious that the economy of scale for this category of parts is very high. When production is raised from 1,000 to 8,000 units a year, the inefficiency coefficient falls by about 30 per cent (from 2.74 to 1.87). It is seen that the inefficiency coefficient for 8,000 sets of parts (1.87) is one of the lowest (see figure 1).

Current capacity is not very great, being limited to one or two machines requiring little space and a handful of specialized staff.

(g) Rubber

This group includes moulded or extruded parts in various types of rubber, such as: tyres, tight joints, silent blocks, assorted fittings, inner tubes, fan belts, etc.

The raw material for the manufacture of these parts is imported and is an important factor in their cost.

Manufacturing capacity ranges from small installations of slight economic significance to large factories producing high-quality goods and employing complex technology, specialized staff and expensive machinery.

The economy of scale for this group of products is very small. The inefficiency coefficient varies by only 3.5 per cent according to whether 1,000 or 8,000 units are produced annually (from 2.16 to 2.09). The reason is the inclusion in the group of tyres, which account for a large proportion of the goods produced in this group, being components which are mass-produced for all models of cars and for spares. Thus, the volumes considered here are insufficient to alter costs.

For the same reason the dies employed for the manufacture of this group of products appear to be of little importance and account for only 3.1 per cent of their cost.

(h) Upholstery

This group of products includes all parts used for the interior lining of the car, such as, seat upholstery, roof covering, padding, carpets and soundproofing, window handles and seat frames.

/As practically

As practically no die-making is involved in the manufacture of products in this group, the main installations required are cutting frames and moulds.

Without doubt, most of the cost is absorbed by the raw material and labour, which, together with the small installation requirements, account for a very low economy of scale: the inefficiency coefficient drops by 4 per cent between an annual output of 1,000 and 8,000 units (from 1.89 to 1.82) (see figure 1).

(i) Standard parts

As the name implies, this group includes all standardized parts which can be used in the manufacture of an automobile or any other product. Of the most important parts in this group, mention may be made of bolts, nuts, lubricants, etc.

It is not thought necessary to discuss the parts in this group, since in any case the economy of scale is practically nil: the inefficiency coefficient falls from 1.66 to 1.64 when output is raised from 1,000 to 8,000 units annually (see figure 1).

It should be pointed out that these inefficiency values are the lowest of all those obtained.

(j) Glass

Only a very simple and low-cost die-making process is required for this group of parts. The principal component of cost is, of course, the raw material.

Installations are large and costly, and require a large body of staff.

The economy of scale for this group was obtained directly from the only manufacturer currently operating in Chile. The inefficiency coefficient falls from 3.24 to 2.94 (about 9 per cent) when output is raised from 1,000 to 8,000 units a year (see figure 1).

/III. ECONOMIC

III. ECONOMIC ANALYSIS OF THE COST

1. Method

For the purposes of this economic cost analysis, an effort was made to select the most representative motor vehicle on the national market which combined the largest number of requirements to make it suitable for use as a family car, personal vehicle or taxi.

It is a four-door vehicle in the 800 to 1,300 cc. and, in the last two years, has commanded over 10 per cent of the market.

The economic and technical analysis of this vehicle covers the 271 parts that involve national integration.

The technical analysis was based on all the manufacturing plans and technical specifications and on a study of the process employed in each case. The study was prepared by the manufacturers themselves.

The economic analysis was broken down into eight sets of statistics, four of which correspond to the growth in inefficiency at various volumes of production (1,000, 2,000, 4,000 and 8,000 units per year), and four to the groups examined in the previous chapter in terms of their inefficiency coefficients at production levels of 1,000, 2,000, 4,000 and 8,000 units per year.

These statistics were obtained by means of form # 1, a copy of which is attached to this document; the complete results, filling 1,600 pages, have not however been included.

In order to obtain the cost of each part, the sixty-five companies producing the 271 parts were asked to give quotations for annual outputs of 1,000, 2,000, 4,000 and 8,000 units.

These companies include INSA, CIMET, FERRILOZA, FENSA, SGM, FAMAE, ACEROS ANDES, MAPESA, MANUFACTURAS CHILENAS DE CAUCHO, ROCKWELL STANDARD, SYLLEROS HNOS., FEMSA, CRISTAVID, RODILLO, SHYF, etc.

It should also be pointed out that, apart from those referred to above, the companies are only small industries - some of them merely workshops. Consequently, many of them lack the necessary staff to conduct a study of economies of scale. This study therefore had to be carried out by the authors of this document in consultation with the company executives.

/It must

It must also be remembered that the economies of scale have been calculated on the basis of existing technological conditions, whereas, to achieve real economies, it would be necessary to allow for new techniques that could be introduced at higher production volumes.

An example of this can be found in the machining of brake drums. This operation can be carried out either by conventional methods, in which case the major cost factor will be the labour, or by a fully automated transfer machine, in which case the most expensive factor will be the amortization of the machine.

In the first case, output is low and economies of scale virtually nil. In the second, however, production will be high and the economies of scale considerable. If only a limited number of parts are manufactured, the most economical solution will be the conventional method, but if high volumes of production are required the transfer machine will offer a much lower unit cost.

Thus, as the volume of production increases it becomes possible to introduce more advanced technologies and, above a given output, to achieve greater economies of scale.

2. Inefficiency in relation to the percentaje of national integration

As the percentage of national integration increases, so the manufacturers are called upon to supply parts which are more difficult to produce, owing to problemes with raw materials, lack of suitable plant, inexperience of the subsidiary industry or the need for more expensive dies.

Any one of these factors, or a combination of them, entails greater inefficiency in manufacturing the parts.

If the parts involving national integration are placed in order of inefficiency and the inefficiency coefficient measured in segments representing 5 per cent integration, then they can be set out in a graph in which the ordinates are the inefficiency coefficients for each (marginal) segment (see figure 2).

/In figure

In figure 2, the value of the last part produced in each segment, weighted according to its percentage share therein, was entered in order to determine the exact value of each segment.

Figure 2 has been plotted at eleven stages of integration (from 3 to 53 per cent), wherein the first corresponds to the average inefficiency coefficient of a group of parts incorporating 3 per cent integration, the second to that of a group of parts incorporating 8 per cent integration, and so on in segments of 5 per cent up to 53 per cent.

The figure shows four curves corresponding to production levels of 1,000, 2,000, 4,000 and 8,000 motor vehicles per year.

The average inefficiency coefficient of each segment was obtained by comparing the value of 1 per cent of the segment with 1 per cent of the f.o.b. value in the country of origin.

The value of national parts was obtained for each volume of production by adding to the unit price set by the supplier the value of the corresponding dies, amortized over three years' production, in view of the fact that the dies are owned by the assembler. Three years was taken as an average figure since dies usually have to be replaced or changed every three years owing to design changes. It should be noted that the figures given do not include purchase tax, because the vehicle considered was assembled in the department of Arica.

In this figure, the curves appear to be in a different order at different volumes of production; this is attributable to the fact that at each volume the parts are classified differently and many times parts with a high percentage of integration move from one segment to another at different volumes of production.

Figure 2 distinguishes three areas with different characteristics:

Area 1 with 3 to 13 per cent integration;

Area 2 with 13 to 48 per cent integration; and

Area 3 with 48 to 53 per cent integration.

In area 1 the coefficient of inefficiency rises by 0.068 for each 1 per cent of integration; the corresponding figure for area 2 is 0.056 and that for area 3 is 0.47.

/The first

The first area is a short segment comprising 10 per cent of integration and containing simple parts, with isolated cases of parts having an inefficiency coefficient of less than one.

This area can be termed the adjustment sector since it is dominated by unusual parts which are not generally representative and consequently are not worthwhile commenting upon.

The third area, from 48 to 53 per cent, where the inefficiency coefficient rises by 0.47 per cent for each 1 per cent of integration, compared with 0.068 and 0.056, respectively, for the first and the second areas, would seem to be completely out of all proportion and clearly shows the maximum level which the national industry can attain at the present stage.

This third area also shows which items should be developed or replaced in order to reduce the disturbing upswing in the figure; these generally include castings and large cold-stamped parts, for example, bodywork components.

Figure 3 shows the levels given in figure 2 by percentage of national integration. Annual car production was placed on the abscissa and the coefficient of inefficiency on the ordinate, and the parameters are 5 per cent segments of national integration.

Figure 3 indicates that sizable economies of scale appear only above 43 per cent of national integration, with the inefficiency coefficient falling from 7.16 per 1,000 units produced annually to 5.37 for 8,000 units.

The second area contains the main bulk of the national parts, comprising 35 per cent of the vehicle, and is undoubtedly the most homogeneous area of the curve. Hence it was considered to be the area that best represents current national circumstances.

Figure 4 was constructed on the basis of the classification of parts made for figure 2, with the percentage of national integration on the abscissa and the cumulative average level of inefficiency on the ordinate. It shows the average level of inefficiency to be taken into account in assembling a vehicle at given levels of national integration.

/Figure 4,

Figure 4, also like figure 2, shows, albeit less strikingly, that the future prospects of the Chilean motor-vehicle industry are worth examining only up to the level of 48 per cent of national integration. Above this point, from 48 to 53 per cent of national integration, the situation is completely incompatible with Chile's current industrial circumstances. Chile is not equipped to move above this point. It needs to develop specialized industries, since using existing installations to produce the parts that would have to be incorporated in order to raise the proportion of nationally produced parts above 50 per cent would involve a sacrifice in terms of cost and quality.

Up to the 48 per cent level, Chile's average inefficiency is 2.25 and 2.03 for productions of 1,000 and 8,000 units respectively, and these levels are quite comparable with the difference between the c.i.f. and f.o.b. costs of the parts.

It should be noted that, because of their high level of industrial development, countries such as the United States cannot achieve an inefficiency coefficient lower than 2.25 in the production of 1,000 units per year, mainly owing to the cost of amortizing equipment designed for mass production.

Furthermore, the curves given in figure 4, covering up to 48 per cent, will not remain constant over time since, as production increases, more specialized installations will become justified and they will supply parts at more reasonable prices and of a more suitable quality to the motor-vehicle industry.

Moreover, the industries that are already capable of producing parts using suitable technologies will gradually begin production runs in which economies of scale will make themselves felt.

In any case, the base for this study can be found in figure 4, covering up to the level of 48 per cent national integration. Above that point, with an increase in production and a reasonable and well-planned increase in the level of national integration, it will be possible to reduce the level of inefficiency.

This figure also has four curves showing production of 1,000, 2,000, 4,000 and 8,000 vehicles per annum.

/3. Bases

3. Bases for a policy of integration of national parts and components

The bases for an integration policy have been given in figure 5.

In this figure the costs of an automobile in different circumstances have been shown on the axis of ordinates using a scale of comparison with the present cost in Chile which has been given a value of 100 (point (x) in figure 5).

Two scales of 0-100 per cent have been drawn on the absciss axis, one from right to left representing the proportion of parts from the country of origin included in the automobile, and the other from left to right representing the proportion of national parts used in the manufacture of the automobile.

The f.o.b. cost of the complete automobile in the country of origin is 32 on the scale, and the straight line (1) of the figure shows the f.o.b. cost of the imported parts at different stages of integration of national parts.

The straight line (2) represents the c.i.f. price, that is, (1) plus freight and insurance. The c.i.f. cost of the complete automobile is 47 on the scale.

The line (2) is not really a straight line but has been considered as such for the purpose of simplification.

Only one part of the line is straight, and the configuration of the rest depends on which parts are chosen for national production. For instance, if Chile chose to manufacture bodywork components, which in general are bulky and fragile, there would be a saving on freight and packing, which are more expensive than for other components.

The result of considering these variations would be a sharply fluctuating curve incapable of analysis. The c.i.f. value is roughly 45 per cent greater than the f.o.b. factory price owing to the heavy cost of packing and freight, since the merchandise is light and fragile and is transported in bulk.

The straight line (3) represents (2) plus customs duties and taxes. The cost of the complete automobile under these conditions is 109 on the scale.

/The remarks

The remarks made in respect of (2) are necessarily valid for (3).

Port costs, transport, storage, use of cranes for loading on to lorries, freight from the port to the assembly plant, import rights in the Department of Arica and import rights from Arica into central Chile amount to approximately 130 per cent of the c.i.f. value of the vehicle considered.

The "A" group of curves in figure 5 is the same as in figure 4 (accumulated average inefficiency), so that by adding "A" to straight line (3) we obtain the current cost of the automobile in terms of the proportion of national parts used in its manufacture. It should be pointed out that this price does not include the following costs: general expenses of manufacture, financing, guarantee assembly plant, profit, freight and insurance to the place of sale, profit margin and sales tax.

Curve "A" plus straight line (2) gives the same result minus customs duties, taxes port expenses, storage, etc.

A long section of the (A + 2) group of curves is more or less horizontal, which would justify up to 38 per cent of incorporation of national parts without unduly affecting the cost of the automobile. The gradual movement from (A + 2) to (A + 3) is simply a matter of tax policy and, as can be seen, the optimum point of integration of national parts would increase up to point (x).

The close relationship between the optimum point of integration of national parts and the burden of taxes and customs duties is understandable.

These two variables, namely, the level of integration and the tax burden, are the most susceptible of movement to affect the cost of the Chilean motor car. If the cost of a complete imported automobile (47) is compared with the value of an automobile manufactured with 38 per cent of national parts (curve of 1,000 units per annum) (about 50), it is seen that if output is raised to 8,000 units per annum, the present cost would be lowered by only 3 units on the scale, whereas the difference in respect of taxes for a complete imported automobile is 62 units on the scale.

Figure 5 also provides the following information on the possibility of incorporating 58 per cent of nationally produced parts:

/(i) Considering

(i) Considering only the value of nationally produced parts (A curves), it is found there is a saving of 17.5 per cent under this head when production is raised from 1,000 to 8,000 vehicles a year.

(ii) If the cost of the motor car excluding customs duties and taxes is considered (A + 2 curves), it is found that there is an economy of scale of 13 per cent when production is raised from 1,000 to 8,000 vehicles annually.

(iii) Considering the total cost of the automobile (A + 3 curves), the economy of scale obtained by raising annual production from 1,000 to 8,000 is only 9.5 per cent.

As can be seen, a fairly large saving of 17.5 per cent in the cost of the nationally produced parts becomes a saving of only 9.5 per cent in the cost of the complete automobile, including imported parts and customs duties.

To this cost must now be added general manufacturing expenses, the financing and profit of the assembly plants, freight and insurance to the place of sale, the cost of the guarantee, the profit margin and sales tax, so as to arrive at the final sale price.

Thus, in the final price, the proportional saving obtained for an automobile incorporating 58 per cent of nationally produced parts, when production is raised from 1,000 to 8,000 units annually, could be estimated at less than 6 per cent.

This figure illustrates the following points for a national integration of 58 per cent:

(i) On the basis of the value of national integration alone (curves A), a rise in annual production from 1,000 to 8,000 vehicles would mean a saving of 17.5 per cent;

(ii) On the basis of the cost of the motor vehicle, excluding duties and taxes (curves A + 2) a rise in annual production from 1,000 to 8,000 vehicles would mean a saving of 13 per cent;

(iii) On the basis of the cost of the motor vehicle (curves A + 3), a rise in annual production from 1,000 to 8,000 vehicles would mean a saving of only 9.5 per cent.

/It will

It will be noted that the saving of 17.5 per cent on the cost of national integration (if production rises from 1,000 to 8,000 vehicles a year), which is fairly significant, is reduced to only 9.5 per cent if account is taken of the total cost of the vehicle including that of imported parts and customs duties.

The items which must be added to this cost to obtain the sales price to the public include general manufacturing costs, the financial costs and profit of assembly plants, freight and insurance to place of sale, cost of guarantee, marketing margin and sales tax.

Therefore, in the sales price to the public, the proportion of the saving that would be obtained with 58 per cent national integration, if annual production were to rise from 1,000 to 8,000 vehicles, is estimated at less than 6 per cent.

IV. CONCLUSIONS

From the data set forth in the previous sections it may be concluded that three main factors would make for decided progress in the motor-vehicle industry, with improvements in cost and quality, which in turn would help to boost the level of technology of national industry in general. These factors are:

1. National integration
2. Production
3. Tax policy

It may be inferred from the figure that, at the present level of duties and other charges applicable to this industry (curves A + 3), the optimum economic level of national integration is between 48 and 53 per cent, depending on the annual volume of production; therefore the present proportion of 58 per cent means a substantial increase in the cost of the vehicle.

Chile has a low level of production of motor-vehicles and an excessively wide range of models, so that seldom more than 1,000 vehicles of each model are produced per year.

This has led to an unnecessary rise in the cost of locally-produced parts, with an inefficiency coefficient of 7, for the following main reasons:

/(a) The

(a) The uneconomic step of setting up an assembly-line, with the appropriate tools and machines, for these levels of production;
(b) The high cost of the dies which are required for most of the motor-vehicle parts - that change from one year to another - whose amortization has to be borne by a comparatively small group of parts.

With such low levels of production, no manufacturer is likely to obtain proper equipment to produce parts of this type, and he relies rather on semi-artisan production which results in products of poor and widely varying quality in parts of a medium technological standard; whereas with adequate facilities it would be possible to manufacture parts of a higher technological standard and of better and more even quality, and to reduce the industry's inefficiency.

Given these factors, the following conclusions can now be reached:

1. National integration

At the present stage, the system employed to oblige assembly plants to produce more automobile components has led to the situation indicated in the last segments of figure 2. A short period of only 4 or 6 months has been allowed for increasing the degree of integration, which means that countless low-technology and high-inefficency small parts are now being incorporated in the manufacturing process owing to the impossibility of producing any other kind of part in such a limited time. Between 1968 and 1969 the Government allowed assembly plants to maintain the same level of national integration; nothing, however, has yet been decided for 1970 and 1971 whereas, if any increase is planned for 1970, manufacturers should already be developing the new parts.

The necessary inducements have to be provided to encourage the installation of industries capable of manufacturing motor-vehicle components of a higher technological standard less inefficiently.

It is our opinion that a national integration policy of the kind put forward by the Mexican Ministry of Industry and Trade in December 1968 would be best suited to Chile's requirements. Mr. Octaviano Campos Salas,

/speaking in

speaking in general terms, stated that in future the percentaje of integration in Mexico would rise steadily and that the Government, rather than fix the minimum level of integration any higher than the current 60 per cent, would make it obligatory to incorporate in Mexican-produced vehicles all parts and components that manufacturers already operating in Mexico are able to offer assembly plants at 1.6 or less times the cost of omiting the parts and importing them from the country of origin.

In the case of new industries that wish to benefit from this special provision, the coefficient shall be only 1.2.1/

This system has the advantage of enabling a country to manufacture a large number of components (with the consequent increase in the percentaje of integration), since once their cost has been reduced to less than 1.6 times the omission value they command the entire country's motor-vehicle market, at no extra production cost.

2. Production

Production of domestic parts should be increased in the following way:

(a) By cutting down the number of different models, retaining only those needed to satisfy the requirements of the Chilean market and maintain a healthy degree of competition.

This would bring greater efficiency and correspondingly better quality and lower prices, so that Chile would eventually possess more technologically advanced and highly specialized industries: the advantages of such a situation, at both the national and international levels, are undeniable.

(b) By increasing the market for motor-vehicle components manufactured in Chile.

The development of the Andean sub-regional market, wisely supported by the Chilean Government, and of the Latin American Free Trade Association (ALALC) are extremely important factors, particularly for the motor-vehicle industry.

1/ cf. Mr. Octaviano Campos Salas' speech at the inauguration of the AUTOMEX assembly plant in Toluca, Mexico, which one of the authors attended.

/Hitherto, Chile's

Hitherto, Chile's trade in motor-vehicle parts with Argentina and Mexico has come up against difficulties with the subsidiary industries in these countries, which find their sales being reduced by a foreign competitor.

The problem of costs also comes into the picture here, since transport and insurance must be added to Chile's high production costs, in addition to the fact that the parts have to compete with local prices in a foreign country. This problem can only be solved by a clear and precise Latin American complementarity policy and by agreements between regional manufacturers as to output and number of models.

Some progress is apparent in this respect since motor vehicle giants such as FORD, CHRYSLER, GENERAL MOTORS, PEUGEOT, RENAULT and others are setting themselves up on their own or in association with assembly plants representing their makes in several Latin American countries, and this automatically brings some degree of standardization of the models that each manufacturer produces regionally.

This is of major value to Latin American governments since it opens up vast possibilities for developing larger and more flexible regional markets along with and leads to the kind of planned domestic industrial development that has excellent prospects for the future.

3. Tax policy

Finally, in view of the taxes that are added to the cost of the vehicle, the country's tax policy can be a valuable means of regulating the market.

At all events, defining a tax policy is a highly complicated matter, since it involves a multitude of factors that we are not in a position to assess. We can therefore merely recommend that a study be carried out by the appropriate persons so as to determine what tax policy would best serve the interests of the motor-vehicle industry.

A N N E X

Table 1

MOTOR-VEHICLE PRODUCTION BY ENTERPRISE a/

Enterprise	1962	1963	1964	1965	1966	1967	1968
Tecna	48	264	216	264	192	480	30
Samafa (Fiat)	688	1 536	600	960	1 608	1 440	4 188
Nun y German	333	744	940	710	1 004	2 548	1 080
Indumotora	437	812	816	816	600	1 680	2 280
S.I.C.A.	50	156	288	288	456	1 116	2 232
Chilemotores	-	-	-	312	1 198	1 200	1 296
Citroen	2 197	1 813	1 533	1 350	1 350	1 935	2 835
Incoda	-	34	60	300	40	120	60
Emssa	150	702	420	516	-	352	879
Federick N.S.U.	562	338	387	480	-	100	1 050
Renault	-	-	248	446	-	-	57
Nissan	114	-	577	636	-	-	420
Ford Motor Company	-	274	-	-	600	2 052	1 635
Integrauto	13	-	72	72	48	144	-
Socoven	499	-	288	220	-	-	-
Importadora Willys	60	24	-	6	-	-	-
S.C. Bolocco	532	696	776	312	-	-	-
Importadora Wal	-	-	96	96	-	-	-
S.A. Importadora Skir	162	288	288	696	-	-	-
Importadora Fisk	129	114	78	60	-	-	-
American Motors	96	114	120	144	-	-	-
Total	6 071	7 909	7 803	8 684	7 096	12 157	18 042

Source: CORFO and Motor Vehicle Committee.

/Table 2

Table 2

MOTOR-VEHICLE PRODUCTION BY MAKE [a]

Make and model	1962	1963	1964	1965	1966	1967	1968
1. Chevrolet Chevy II	374	372	336	264	-	960	-
2. NSU Prinz	562	330	387	480	-	100	1 050
3. Opel Rekord	144	390	384	216	-	-	-
4. Peugeot 404	30	156	288	280	456	1 116	2 232
5. Austin Mini	-	-	72	168	-	-	879
6. Morris Mini	6	-	36	12	-	352	-
7. Datsun	78	-	253	192	-	-	420
8. Fiat 600	281	576	264	600	960	728	3 540
9. Fiat 1 100	407	960	336	360	-	-	-
10. Citroneta	2 197	1 813	1 533	1 347	720	1 620	1 980
11. Simca 1 000	399	744	940	710	1 004	1 996	-
12. Simca 1 300	-	-	288	41	-	-	-
13. Chevrolet Corvair	30	-	-	-	-	-	-
14. Studebaker Lark	432	308	215	-	-	-	-
15. Isaria	10	-	-	-	-	-	-
16. Isard	10	-	-	-	-	-	-
17. Lancia	10	-	-	-	-	-	-
18. Vauxhall	-	144	216	144	192	-	-
19. Volvo	-	288	288	596	-	-	-
20. Skoda	-	34	-	-	-	110	60
21. Triumph Herald	-	-	72	48	48	144	-
22. Rambler Classic	-	-	48	96	-	-	-
23. Ford Falcon	-	-	-	73	406	792	840
24. Fiat 1 300	-	-	-	-	648	720	648
25. Acadian Beaumont	-	-	-	-	-	480	30
26. Dodge Dart	-	-	-	-	-	552	1 080
	4 970	6 115	5 956	5 627	4 434	9 670	12 759

/Station Wagons

Station-wagons

Make and model	1962	1963	1964	1965	1966	1967	1968
Susulight	150	-	-	-	-	-	-
Isaria	50	-	-	-	-	-	-
Hillman Husky	-	-	204	96	-	-	-
Ford Falcon	-	-	-	50	-	-	-
Renault R-4	-	-	-	350	-	-	57
	200	-	204	496	-	-	57
Jeeps							
Land Rover	129	114	78	60	-	-	-
Willys	60	24	-	-	-	-	-
International	-	48	48	-	-	-	-
	189	186	126	60	-	-	-
Vans							
Susulight	88	-	-	-	-	-	-
Opel	48	-	-	-	-	-	-
Austin	-	132	144	156	-	-	-
Morris	-	366	-	60	-	-	-
Skoda	-	-	60	302	40	-	-
Furgoneta AZU	-	-	-	3	630	315	855
	136	498	204	521	670	315	855
Pick-up trucks							
Chevrolet C-1434	404	168	384	552	600	-	-
Morris	222	-	-	-	-	-	-
Austin	100	120	-	-	-	-	-
Datsun	36	-	324	444	-	-	-
Standard	18	-	24	-	-	-	-
International	100	268	308	216	-	-	-
Simca	240	-	-	-	-	-	-
Studebaker	-	72	-	-	-	-	-
Ford F-100	-	274	-	312	792	408	456
C.W.C. 1 001	-	-	96	96	-	-	-
Willys 230 Pick Up	-	-	-	6	-	-	-
Chevrolet CS-10 734	-	-	-	-	-	720	1 080
Ford F-350	-	-	-	-	-	792	576
	1 120	902	1 136	1 626	1 392	1 920	2 112

/Lorries

Lorries

Make and model	1962	1963	1964	1965	1966	1967	1968
Chevrolet	-	230	-	-	168	-	1 200
Ford F-600	-	-	-	-	600	1 259	1 059
	-	230	-	-	768	1 259	2 259

a/ Source: CORFO and Motor Vehicle Committee.

/Form 1

Form 1

Description: Item:

K.D.Nº.

Number per vehicle

Unit cost on the basis of the parts

US dollars	Escudos

Total cost of parts

US dollars	Escudos

Percentage over cost of parts

Unit weight

Total weight

Percentage over weight

Date:

Rate of exchange

Comments:

Supplies:

Cost of matrix equipment:

Unit price:

Total price

Charge for matrix equipment

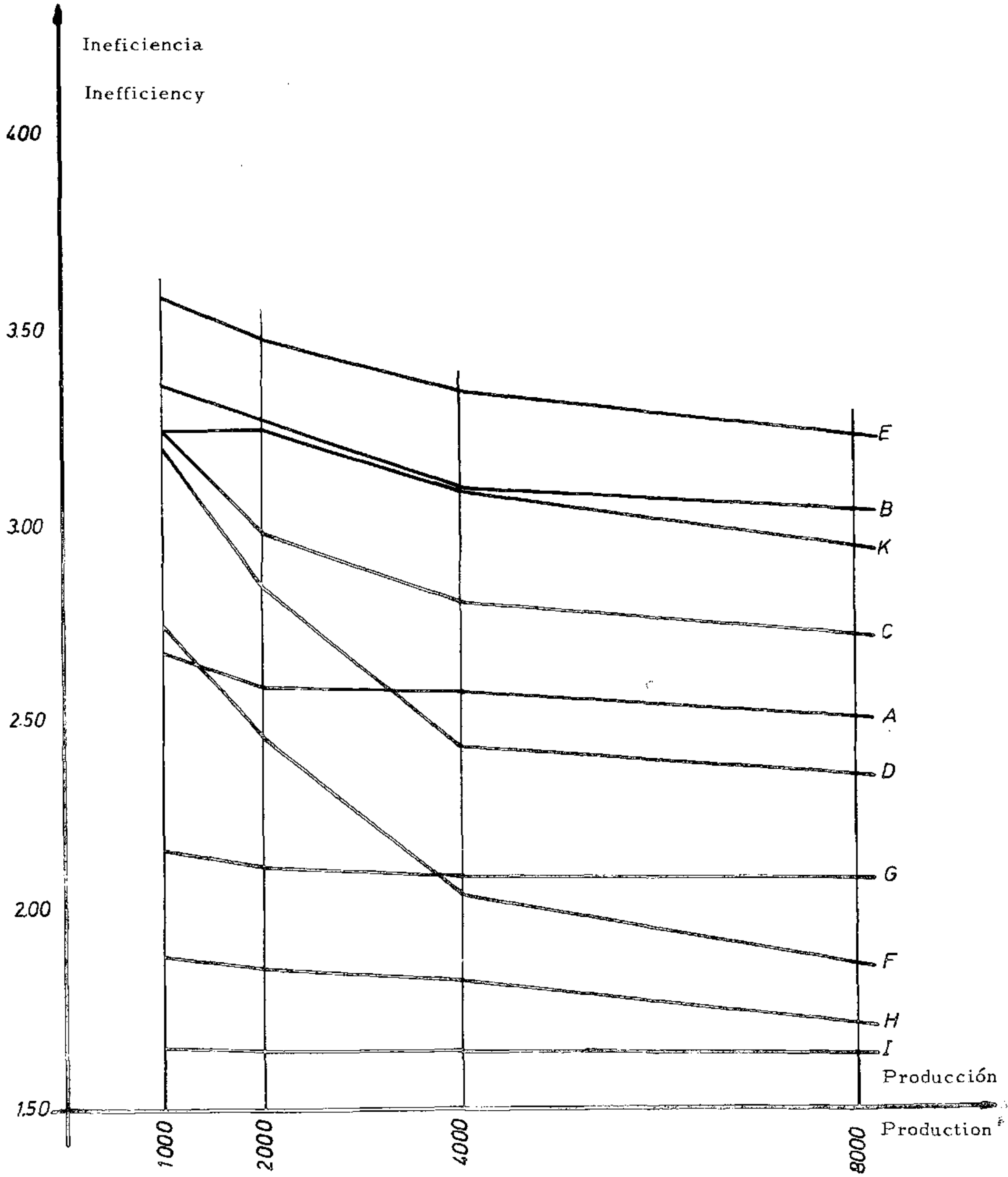
T O T A L:

Inefficiency coefficient, including amortization of the cost of the matrix equipment

Group

/Figure I

GRAFICO Nº1



A. Equipo Eléctrico
B. Conjuntos Armados
C. Fundición
D. Metal formado en frío
E. Metal formado en caliente
F. Plásticos
G. Gomas
H. Tapicería
I. Partes Standard
K. Cristales

A. Electrical equipment
B. Assembled components
C. Casting
D. Cold-worked metal
E. Hot-worked metal
F. Plastics
G. Rubber
H. Upholstery
I. Standard parts
K. Glass

GRAFICO Nº2

(Ineficiencia promedio por tramos)
(Average inefficiency by sector)

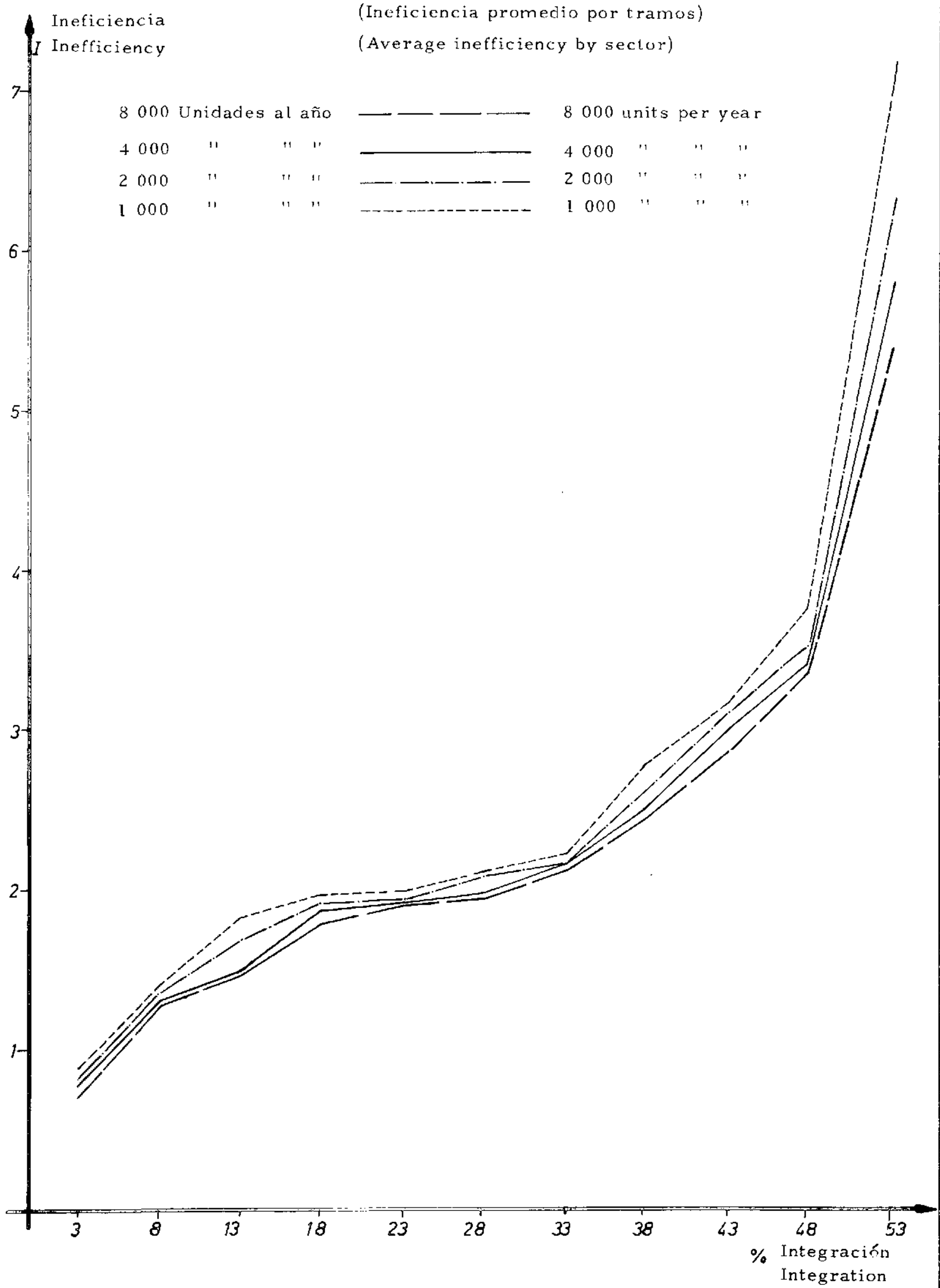


GRAFICO Nº3

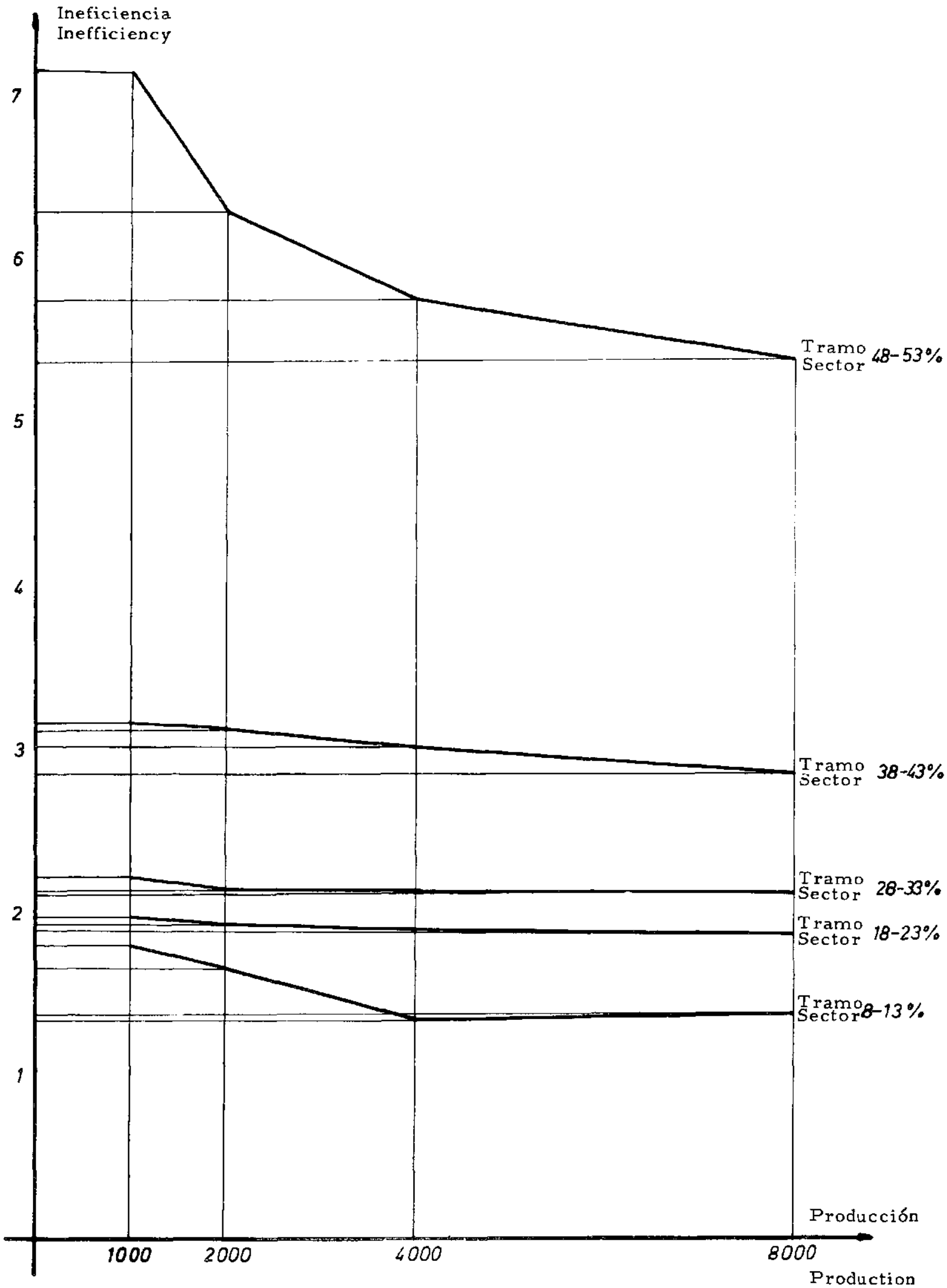

Ineficiencia
Inefficiency
7
6
5
4
3
2
1
Tramo
Sector
48-53%
Tramo
Sector
38-43%
Tramo
Sector
28-33%
Tramo
Sector
18-23%
Tramo
Sector
8-13 %
Producción
1000
2000
4000
8000
Production

GRAFICO Nº 4

(Ineficiencia promedio acumulada)

(Cumulative average inefficiency)

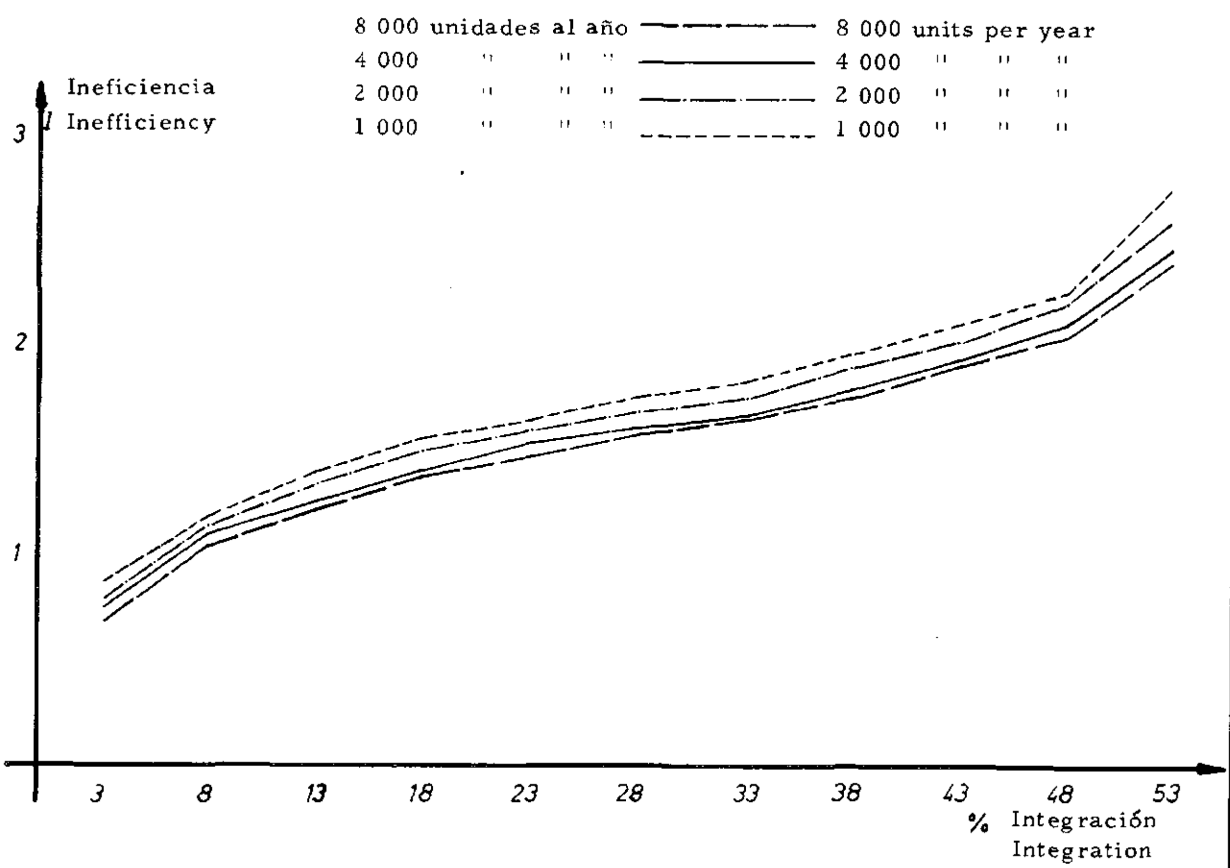
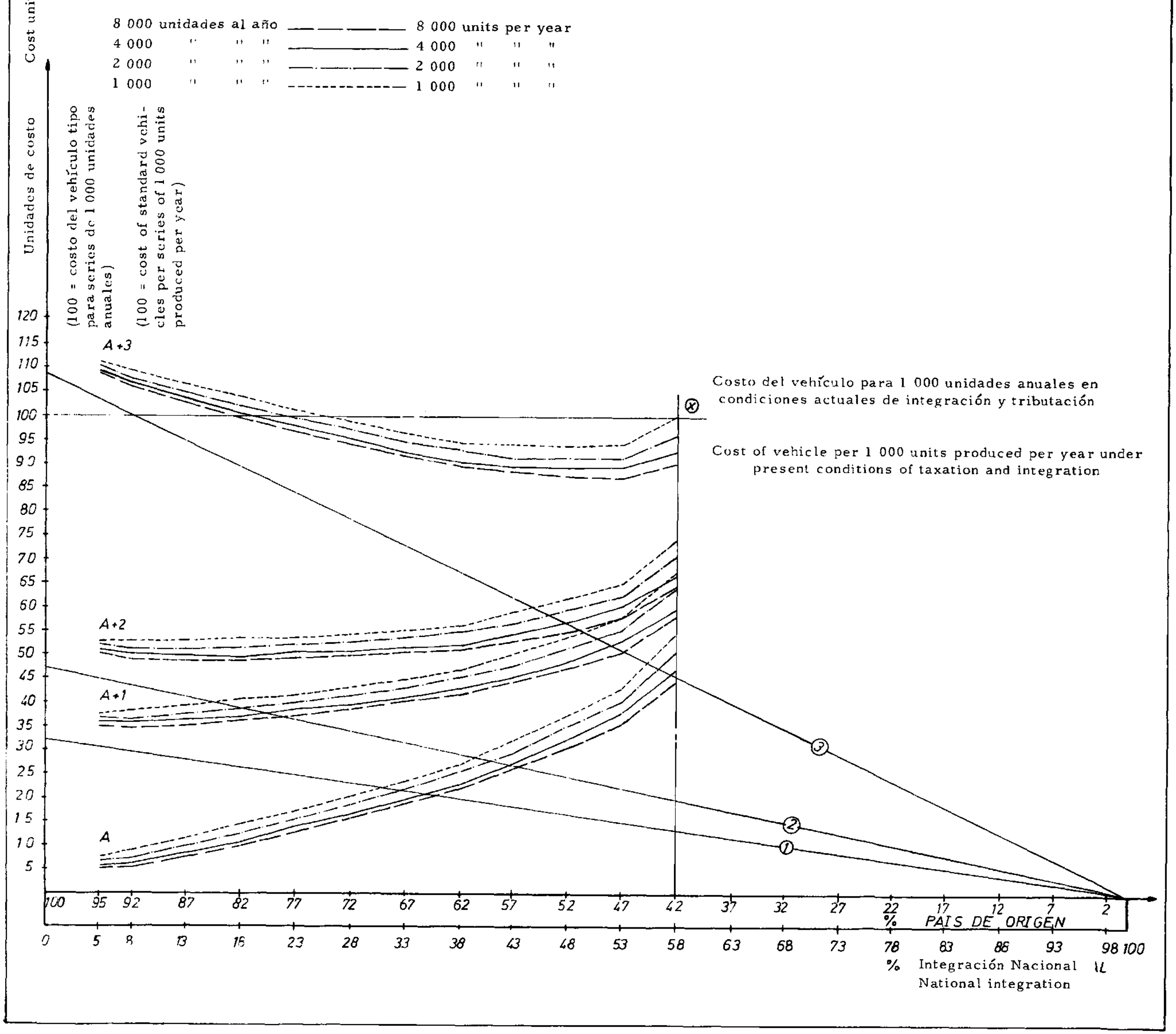


GRAFICO Nº5



8 000 unidades al año — 8 000 units per year
4 000 " " " — 4 000 " " "
2 000 " " " — 2 000 " " "
1 000 " " " — 1 000 " " "
Cost units
Unidades de costo
(100 = costo del vehículo tipo para series de 1 000 unidades anuales)
(100 = cost of standard vehicles per series of 1 000 units produced per year)
A+3
A+2
A+1
A
Costo del vehículo para 1 000 unidades anuales en condiciones actuales de integración y tributación
Cost of vehicle per 1 000 units produced per year under present conditions of taxation and integration
% PAIS DE ORIGEN
% Integración Nacional
National integration