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STUDY OF PROBLEMS RELATED WITH THE ESTABLISHMENT OF
MOTOR-VEHICLE INDUSTRIES IN DEVELOPING COUNTRIES

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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

1. Purpose of the study

In view of the major role played by the motor-vehicle industry in the economy of industrialized countries and of the international level at which most motor-vehicle enterprises operate, a study of the problems posed by the introduction and development of these industries in developing countries has a dual purpose:

- (a) it must consider to what extent a country in the process of industrialization should begin manufacturing motor vehicles and in what way it should set about doing so;
- (b) it should give light on the technical and economic considerations by which a major international manufacturer should be guided when planning to establish a plant abroad.

These problems have so far received little attention; when they have been tackled it has generally resulted in a sharp conflict between the two parties involved, between the interests of the developing countries on one hand and those of the world's major manufacturers on the other. The former, with an excessive sense of economic nationalism, insist on placing the motor-vehicle industry at the top of their list of industrial priorities because it is flattering to their national pride; the manufacturers, meanwhile, do their best to discourage such initiatives since they have to amortize their plant in their own country and are little inclined to turn over the manufacturing process to newly emerging countries. In the absence of an objective analysis of the problems involved and in view of the fact that, so far, the developing countries have been either unwilling or unable to join forces against the major international manufacturers, the solutions adopted have proved anti-economic, to the eventual detriment of both the developing countries and the manufacturers themselves.

It is therefore hoped that this study of the problems posed by the establishment of motor-vehicle industries in developing countries will show the way to the economic solutions that will conform best with the interests of both developing country and motor-vehicle manufacturers. It will also try to propose solutions that meet the long-term interests of both.

/It is

It is undeniable that if an objective and strictly analytical economic study of these problems can provide an indication of the best course to follow in future it must be of considerable interest, not only to the manufacturers themselves, but also to all those who are responsible for the industrialization of the developing countries.

2. A few preliminary definitions

It would be well at this point to define some of the terms currently employed in the motor industry.

Motor-vehicle industry - The motor-vehicle industry is that which is responsible for the manufacture and assembly of:

- passenger cars
- industrial vehicles, including commercial cars, vans, lorries, buses and coaches
- agricultural tractors

The definition is thus fairly comprehensive, comprising as it does a variety of types of products which are only homogeneous in the sense that they involve similar manufacturing techniques.

Built-up vehicle - Vehicle completely assembled

SKD - "Semi knocked down"

This term is used to designate the first break-down stage of a vehicle into the sub-units that, when assembled, comprise the complete vehicle.

CKD - "Completely knocked down"

This term is used to describe a further stage in the fragmentation of a vehicle in which each sub-unit is broken down into its various constituent parts.

CKD kit - A CKD kit consists of all the parts that, when assembled, make up a complete vehicle.

CKD packing list - The CKD packing list is a list of all the parts comprising a vehicle, together with their price in absolute terms or as a percentage of the total.

Units - Body parts ready for assembly.

Local integration percentage (or national content of a vehicle) - The ratio of the value (or weight) of the parts manufactured within the country to the total value (or weight) of the kit.

Packing - The process of grouping together the manufactured parts that go to make up the SKD or CKD kits.

/II. ATTITUDE

II. ATTITUDE OF DEVELOPING COUNTRIES TOWARDS THE PROBLEM OF MOTOR-VEHICLE INDUSTRIES

It is of course rather arbitrary to group all the developing countries under a single heading. No attempt will be made here to define what constitutes a developing country; the study refers essentially to all countries engaged in a process of industrialization which are to be considered as possessing a sufficiently large market to warrant the establishment of a motor industry under favourable conditions. It can therefore be said that, apart from mainland China and India, the study covers all the developing countries in the world.

This chapter deals with each of the following points in turn:

- the economic arguments employed to justify establishing motor-vehicle industries in developing countries
- the contradictory objectives pursued by the developing countries
- the solutions that are usually adopted
- the consequences of establishing these industries.

1. Economic arguments employed by developing countries to justify the establishment of domestic motor-vehicle industries

(a) Saving in foreign currency

Generally speaking, developing countries suffer from a shortage of foreign exchange: since motor-vehicles account for a large portion of their total imports,^{1/} a special effort should be made in this sector.

(b) The motor-vehicle industry is a basic industry

The motor-vehicle industry plays an important role in metal-transforming industries.

An analysis of intersectoral trade reveals that this sector is an important client of the steel, glass and textile industries. In France, for example, its share of the markets of other industries is as follows:

steel	8.4 per cent
glass	6.6 per cent
aluminium	8.9 per cent
semi aluminium product	28.0 per cent
semi copper products	5.8 per cent
rubber	24.0 per cent
textiles	5.3 per cent

^{1/} Often around 10 per cent.

/In 1959

In 1959, the consumption of the French motor-vehicle industry was as follows:

rolled steel	1,435,000 tons
iron	277,000 tons
cast steel	23,000 tons
iron products	1,735,000 tons
copper and copper products	17,000 tons
aluminium and light alloys	41,200 tons
zamak (foundry)	1,500 tons
lead	4,500 tons
rubber (natural and synthetic)	222,000 tons
safety glass	2,345,000 square metres
paints and solvents	20,500 tons
textiles	27,000 tons
plastics	10,000 tons
electricity	1,500,000 kWh
gas	154,000,000 cubic metres

Quite apart from its importance from the point of view of manufacturing, the motor-vehicle industry also promotes the development of foundries (cast iron, steel and light metals) and ironworks whose potential markets are not necessarily restricted to the motor industry. Foundries and ironworks are "basic" activities that are indispensable for any country engaged in the process of industrialization.

(c) The motor-vehicle industry employs a large volume of labour

The motor-vehicle industry undoubtedly generates employment. In France, for example, employment figures for 1961 were as follows:

manufacture of motor-vehicles	169,500 employees
manufacture of parts and components	75,000 employees
manufacture of tyres	28,000 employees

Average figures for this sector are as follows:

investment per person employed	80,000 francs
value added per person employed	30,000 francs
turnover per person employed	60,000 francs

/(d) From

(d) From the point of view of quality of labour, the motor-vehicle industry has the advantage:

- of promoting the training of qualified labour specialized in skills which are not restricted to that industry alone (lathe-operators, fitters, braziers, adjusters, electricians, etc.).
- of introducing, through the concept of "quality", a new mentality within the industry, which can thus be considered a valuable stimulant to progress.

2. Contradictory objectives pursued by the developing countries

Developing countries want:

- (a) to be able to offer consumers a complete range of vehicles at the lowest possible prices
- (b) to manufacture the most modern vehicles locally
- (c) to market the latest vehicles put out each year by the major manufacturers
- (d) to establish a domestic motor-vehicle industry in the shortest possible time
- (e) to achieve the highest possible national content

Quite clearly a choice has to be made among such contradictory objectives. It is well known that, according to the cost-volume ratio which exists in the motor-vehicle industry, as the number of models on the market increases the sales of each diminish, and by consequence manufacturing costs rise.

For the same reason, the production of new models every year is obviously incompatible with low prices. Furthermore, in such a limited market, any part that is manufactured locally as a replacement for a mass-produced imported part is bound to raise the production costs of the vehicle. Consequently, the greater the degree of national content the higher the manufacturing costs of the vehicle.

Also, a too fast industrialization can lead to higher costs.

The task of the governments of developing countries that have to reconcile these conflicting objectives is not made any easier by the fact that:

/(a) they

- (a) they do not have enough available information for making the correct choice;
- (b) they are subject to internal pressure, in so far as any restrictions regarding the range of vehicles on the market or the availability of new models are bound to be very unpopular;
- (c) they are subject to external pressure, in so far as every country strongly supports its own manufacturers and takes steps not to be eliminated from the market.

3. The solutions that are usually adopted

In the past, developing countries have all adopted roughly similar solutions. They have:

- (a) maintained a fairly wide range of vehicles composed of the most recent models available;
- (b) eliminated imports of built-up vehicles and insisted on a degree of national content in all vehicles (both passenger and commercial);
- (c) obliged manufacturers to achieve extremely high levels of national content (in many cases more than 90 per cent) within time-limits that vary from country to country but are nearly always very short;
- (d) allowed manufacturers freedom of choice as to the parts to be produced locally in compliance with national content requirements.

4. Results obtained

There is much to criticize about the results obtained.

(a) Increase in production costs

As was foreseen by the manufacturers themselves, costs have proved to be considerably higher than in the industrialized countries, as can be seen from the following figures based on a comparison with a medium-sized European vehicle:

/Country

Country	Annual output	National content	Index price France = base 100)
Argentina	20,000	85%	297
Brazil	12,000	92%	210
Mexico	6,000	25%	147

Note: These index prices were calculated at the official rate of exchange - a rather unsatisfactory method; it would be better to use the method based on salary scales which was adopted by Mr. Fourastié to compare prices over a period of time.

The table shows that the cost of motor vehicles in two countries with relatively large markets is in one case double and in the other three times the French price. Thus, these countries have set up national industries that are not competitive and are therefore incapable of exporting, which means that the outlook for their future development is particularly bleak.

(b) Dissatisfaction of consumers

From the consumer's point of view, the price of these products is extremely high - though this second result seems less important than the first except where the vehicles are not luxury items, but production goods that assure useful services to the economy of the country. A further source of dissatisfaction is the limited range of vehicles on the market which can to a certain extent hinder economic development if it affects industrial vehicles, because it will oblige to use vehicles for purposes they were not designed to serve.

(c) Setting up of trusts

In order to promote the development of local industries, a government frequently grants a motor-vehicle manufacturer a de facto trust, since on such a small market there is rarely enough room for several manufacturers of the same product. The presence of these generally poorly controlled trusts, with their invariable insistence on large profits, boosts prices still further.

/5. Conclusion

5. Conclusion

In conclusion, it may be useful to point out the main reasons for the failure of the policies adopted so far. There are at least three:

- (a) developing countries are not acquainted with the technical and economic laws governing the motor-vehicle industry;
- (b) they have so far attempted to find strictly national solutions to their industrialization problems;
- (c) they have not yet developed sufficient economic know-how to back up their industrialization policy properly.

This study will endeavour to point out the technical and economic laws governing production in the motor-vehicle industry and to set out basic economic guidelines for countries engaged in a process of industrialization.

It will only be possible to start thinking about solving the problem of establishing motor-vehicle industries in developing countries when these two aspects have been satisfactorily dealt with.

III. ATTITUDE OF MANUFACTURERS TOWARDS NATIONAL CONTENT REQUIREMENTS OF DEVELOPING COUNTRIES

International motor-vehicle manufacturers did not come up against the problem of incorporating locally manufactured parts in their products until after the Second World War. In recent years, all developing countries threatened to ban these large enterprises forever from their markets unless they start manufacturing locally. Assembly lines had, it is true, made an appearance in developing countries earlier than this: Ford, for example, set up a motor-vehicle assembly plant in Mexico as early as 1925 without being pressed into doing so by local legislation, and there have been other cases too. However, until the last world war, only assembly work had been involved, and this because it was found that the savings in transportation and related costs that could be achieved by substituting SKD kits for built-up vehicles was greater than the extra expense of assembling them in another country.

The desire of developing countries to start their economic growth by setting up new industries brought the motor-vehicle manufacturers a number of problems that they were not really prepared to solve, and it is no

/exaggeration to

exaggeration to say that they were somewhat surprised by the determination of certain countries to be motor-vehicle manufacturers as soon as possible. For the most part, therefore, they dealt with the problems one by one and then only because of pressure from their competitors.

In the past, these manufacturers have always been inclined to discourage this policy of developing countries by every possible means; what follows is an analysis of the arguments that they have used to justify their action.^{2/}

The reasons the manufacturers choose to adopt such a negative attitude are as follows:

- the need to amortize the parent company's own plant
- increased production costs
- reticence to take investment risks in developing countries
- lower quality
- organizational complications

1. The need to amortize the parent company's own plant

The motor-vehicle industry has become a mass production industry in which the cost-volume ratio has a particularly important role. The manufacturers consider that the more they can increase their output the lower the cost will be. Consequently, when the government policy of a developing country obliges them to cut down their volume of production, the cost is affected and their ability to compete on the major markets of developed countries suffers accordingly. They therefore fear that any concessions to developing countries will eventually handicap them in front of their competitors in the bigger markets and, above all, in their own national market.

Observation: It is essentially for this reason that manufacturers prefer national content in developing countries to be restricted to parts which they themselves have to acquire from outside sources rather than those produced by them.

^{2/} In this context, mention should perhaps be made of the powerful restraint constituted by the "homologation" procedure under which every licensed manufacturer in a developing country undertakes by contract to submit locally made parts for homologation: this means that he must send every new part made in the country for examination by the parent company which then only authorizes that part to be assembled on condition its standard of quality is identical to that of the original part: the parent company is sole judge and is entitled under the terms of the contract to veto the use of any given part.

2. Increased production costs

Splitting up the manufacturing process means losing the advantages of mass production. Any attempt to manufacture parts in a developing country which can only produce a limited volume is bound to lead to higher production costs than in the parent company's own highly automated factories.

As higher costs are reflected entirely in the sales price, the market suffers because of an extremely high elasticity of demand/price for motor-vehicles. Manufacturing in developing countries therefore tends to spoil the market - sometimes very seriously.

3. Investment risks in developing countries

The setting up of manufacturing units in developing countries frequently involves the parent company in helping to finance the investment. Although this is not an obligation, there are two reasons for doing so:

- (a) developing countries with limited financial resources request partial financing from abroad;
- (b) the parent company is anxious not to relinquish control of operations in developing countries and insists at least on membership of the board of directors of the local manufacturing companies.

Naturally, the need to invest in developing countries under these conditions acts as a powerful restraint in the development of local motor-vehicle industries. Manufacturers usually have other uses for their financial resources and prefer to use them, as far as possible, to the fierce competition of the major world markets; moreover, the risk attached to investing in developing countries is well known, especially for companies that are not able to insure against such risks (in France, for example).

/4. Lower

4. Lower quality

Experience shows that, particularly during the initial stages of industrialization, it is difficult to achieve high standards of quality in developing countries. There are a good many reasons for this, including:

- inadequately trained labour
- use of less automated production techniques than in the most developed countries
- poor organization
- lack of precision
- negligence.

Even when the standard of quality required by the manufacturer has been met, it continues to fluctuate for these same reasons which are but the reflection of the countries' lack of industrial experience. The manufacturers, on the other hand, pay the utmost attention to quality, especially in the case of parts where a quality defect might actually endanger people's personal safety.

Leaving aside parts affecting physical safety, any quality defects are very bad for trade. The motor-vehicle industry is a highly competitive sector in which a company's good name is an important capital asset. Its reputation in a country can very quickly be ruined; it may then take years of work to restore a public image that has been damaged by a few commercial policy errors.

5. Organizational complications

Setting up the kind of organization that is needed to meet the problems posed by manufacturing abroad is an expensive business. Competent people have to be found both at the technical and at the commercial and financial levels. There are two main groups of organizational complications:

(a) Packing

The parent factory is responsible for packing the parts that have to be sent abroad. However, the contents of the various kits vary from country to country and are constantly changing even within a single country according to the national content percentage. The CKD departments that deal with these problems in the parent factory always require a large staff.

/(b) New

(b) New models or modifications

The fact that models are modified each year or even changed altogether causes serious problems both for the parent company and for the factory abroad: modifications that may be economically feasible for the former are rarely so in the developing country where amortization is already seriously affecting production costs. Every time a model is changed, it has to be decided whether the factories abroad should take it or not. If, for economic reasons, it is decided to continue manufacturing a model abroad that has been abandoned by the parent company, the latter is obliged to continue making certain parts or sub-units on a small scale, so as not to cut off the supplies of the factories abroad. When a parent factory is involved in supplying several such foreign factories, each of which is assembling models with different characteristics and is at a different stage of national content, it is easy to imagine the complications the operation entails.

6. Conclusions

The reasons for the major manufacturers' attitude can be summed up as follows:

- (a) Manufacturing in developing countries increases the production costs of motor-vehicles and should therefore be avoided.
Manufacturers are constantly asserting that there is no point in producing motor-vehicles in developing countries that are bound to be expensive, when they could be obtained far more cheaply directly from the developed countries. This approach precludes any attempt by developing countries to develop their economy.
- (b) The decision to manufacture in developing countries involves major financial risks that cannot be taken lightly.
- (c) Manufacturing in developing countries complicates the organization of the parent plants.

By way of explanation of the manufacturers' attitude, it should be recalled that markets in developing countries are minute in comparison with those of developed countries. This alone could explain their lack of interest in manufacturing problems of developing countries.

IV. LAWS GOVERNING THE PHENOMENA DESCRIBED EARLIER

In order to clear up the contradictions shown in the preceding chapters and to assess the extent to which the motor-vehicle industry can play a part in the economic development of developing countries, it is necessary to consider the laws governing the phenomena discussed earlier, namely:

- The laws governing the economic development of the developing countries;
and

- The laws governing production economics in the motor-vehicle industry;
and then to identify the areas of compatibility common to both the motor-vehicle industry and the developing countries, from which the requirements for establishing a motor-vehicle industry in a developing country can be drawn.

1. The structure of development in the developing countries

This section will discuss a development model based on the work of a number of economists, for example W.W. Rostow in "Stages of economic growth", which was developed and described by Mr. O. Gelinier, the Director of CEGOS, in 1963.^{3/} The model is based on the following considerations:

1.1 The five sectors of production

The sectors of production can be broken down into five major categories:

- (a) Agriculture
- (b) Mining
- (c) First generation industries

These are simple, light industries whose output has what may be termed a "critical mass" of virtually zero,^{4/} for example, the textile, made-up textile goods, footwear, and food preserving industries.

^{3/} O. Gelinier, Fonctions et Tâches de Direction Générale.

^{4/} That is, industries in which there is no significant correlation between constant volume.

(d) Second

(d) Second generation industries

These are more developed industries whose output has a high critical mass, i.e. in which the possibilities of mass production involve sizable reductions in unit cost prices. They include, in particular, the steel, motor-vehicle, railway equipment, shipbuilding, machine-tool (at least simple machine tools), and modern food industries, etc.

(e) Third generation industries

These are highly technological industries characterized by a large research critical mass. They include the electronics and aircraft industries, the manufacture of complex equipment, modern heavy armaments, etc.

1.2 The three levels of development

Countries can be broken down into three categories, according to their level of development:

(a) Developed countries

These are countries with a high standard of living, i.e. a per capita income of over 800 dollars per year, a high level of education, and a diversified economy comprising, in particular, third generation industries.

(b) Under-developed countries

These are countries with a low per capita income (less than 200 dollars per year), a population without sufficient education to engage in productive activities, and a non-diversified economy, generally limited to the first two sectors of production mentioned above.^{5/}

(c) Countries in a transitional stage

These are the countries falling between the two other groups, and are normally termed developing or industrializing countries. Per capita incomes range between 150 and 600 dollars per year, the population is partially educated, and the economy is beginning to diversify, with first generation and second generation industries developing.

1.3 Laws governing the development of the five sectors of production

The characteristics of the development of the five major sectors of production can be summed up as follows:

^{5/} The sectors classified by Colin Clark as making up the primary sector.

/(a) Agriculture

(a) Agriculture

The introduction of mechanization to agriculture, together with the great strides made in improving cultivation techniques and in genetics, have increased agricultural productivity considerably since the beginning of the twentieth century, at a much faster pace than could have been expected.

As a result, the countries most able to make efficient use of technological progress have increased their productivity the most and, contrary to certain now outdated models, it has been the developed countries which have become the major exporters of agricultural commodities. The developing countries - at least those situated in tropical zones - have, however, retained a comparative advantage in respect of certain crops (coffee, cocoa, tropical fruits, etc.).

The rapid development of agricultural production in the developed countries is a relatively new factor which fundamentally alters the traditional basis for relations between developed and developing countries.

(b) Mining

Mining, which hitherto constituted a large source of revenue and foreign exchange for the developing countries, is losing importance and will continue to do so in the future. Admittedly, petroleum is for the moment in a different situation, and overshadows the development of the mining sector as a whole, with the result that the developing countries that are not petroleum exporters are suffering the consequences of market forces that are increasingly unfavourable to them.

(c) First generation industries

As defined above, these are industries with simple techniques. In high-income countries, their characteristic feature is that the factor labour accounts for a large part of production costs.

In general, they have the following features:

- (i) The gross value added contains a large proportion of labour costs;
- (ii) The techniques used are simple;
- (iii) There is no significant correlation between cost and volume, and they are within the capacity of the under-developed countries.

Naturally enough, the developing countries set up first generation

/industries since

industries since they are the kind most accessible to them; the developed countries, in many cases, have tended to move this kind of industry to the developing countries, one notable example being the cotton industry. The only obstacle to this trend is the political instability characteristic of most of the third world.

(d) Second generation industries

The major feature of the development of these industries is that the critical mass of production has gradually risen as a result of technological progress in the mechanization of operations, with a consequent reduction in production costs and with machines replacing men.

Most branches of the motor-vehicle industry have moved from the first generation (around 1920-1930) to the second generation. For example, the engine blocks formerly machined on general-purpose machines are now machined on transfer machines which are completely automated production lines. Similarly, bodywork has changed from being completely handworked wood to steel pressings produced on completely automated presses. At present, only assembly remains a manual operation.

(e) Third generation industries

The main characteristic of the development of these industries is the steady rise in the critical mass of research. Since, by definition, these are industries using rapidly changing technologies, factories must have highly qualified staffs available at all levels, and be situated reasonably close to planning offices and research centres.

1.4 A development model for the under-developed countries

The following paragraphs are designed to provide, not a complete theory of development, but simply a number of conditions that must be fulfilled if development is to take root and thrive.

(a) The need to invest

Development, like growth, cannot take place and continue without investment. A very rough correlation can be made between investment and the growth rate of national income, as follows:

$$I/C = \frac{1}{3}$$

$$C = \frac{1}{3} (I - 5)$$

where C = growth rate of national income,
and I = ratio of investment to income.

If the investment ratio is 20 per cent, the growth rate of national income is 5 per cent per year. For a country to be able to develop and "take off", as it were, it must achieve a high investment ratio (above 15 per cent of national income) and maintain it steadily over a long period.

(b) The need to export

All the countries in the developing stage increase their imports of both raw materials and capital and manufactured goods. To ensure that these imports are not hampered, the amount of foreign exchange earned by exports must increase at the same pace.

(c) The need to industrialize

At present, the developing countries cannot increase their export earnings either from agricultural exports, because of the factors mentioned above, or from raw material exports, with the exception of petroleum and certain materials that are in a privileged position because they are in short supply.

The increase has to come, then, from exports of manufactures by first or second generation industries - third generation industries being by definition beyond the capabilities of such countries.

Note: In certain countries, for example Mexico and Spain, increases may come from tourism or the sale of services (insurance, banking or a specially favourable taxation system), but this is the exception rather than the rule.

(d) The need to organize exports of manufactures

An under-developed country can organize its development either in terms of economic dependence on another country or group of countries, or by placing the highest priority on retaining the maximum possible economic and political independence. Clearly, a different strategy is required for each of these alternatives.

/Autonomous development

Autonomous development

This type of strategy will aim at exporting manufactures on a world-wide scale that will initially be produced by first generation industries and then subsequently, once exports have achieved a sufficiently strong position, by second generation industries. Exports have to be on a world-wide scale since a large volume of foreign exchange is needed for development, especially if a country is large in terms of area and population. This is a difficult strategy to implement, for it involves conquering the major world markets and requires a great deal of dynamism and export know-how. The economic development of Japan is far and away the best illustration of this type of strategy.

Integrated development

This strategy is less difficult to follow and involves a more moderate approach to economic nationalism. It consists in integrating the economy of a developing country, in part at least, into the economy of one or several other countries, and amounts to the mutual economic integration of two or more countries. Under the colonial system, such integration was based on the exchange of manufactures for raw materials but now the question is to exchange manufactures for manufactures. However, unlike trade between the developed countries, trade between developing countries or between a developing country and a developed country would take place in unfinished manufactures or what may be termed complementary goods.

Thus there can be specialization in which each trading partner produces manufactures under normal competitive conditions, those of the developing countries coming from first or second generation industry and those of the developed countries from third generation industry.

Hence, an under-developed country has to choose between the "hard" way to develop, i.e. by violently opposing other countries, or the easy way by harmonizing its development policy with that of other countries.

2. Laws of industrial economics governing the motor-vehicle industry

This section will discuss those laws which are of relevance to the establishment of a motor-vehicle industry in a developing country.

The following points will be covered:

- Structure
- Materials used and production techniques
- Investment
- Employment
- Cost-volume ratio
- Critical mass

2.1 Structure

Vehicle manufacturers have different policies as regards to the integration of their production. Some are highly integrated, while others are less so. The trend is clearly towards giving up a high degree of vertical integration in favour of subcontractors,^{6/} with the manufacturer concentrating on distribution, and, as regards production, on specific parts and the operations of assembly and finishing.

This trend towards specialization is due to the fact that manufacturers cannot deal with all the technical problems involved in the production of motor vehicles. As a result of the movement towards specialization stimulated by technological progress, manufacturers naturally tend to concentrate their resources on the areas they consider essential for their survival (marketing, model design, manufacture of parts which no other producer is interested in making).

The following three sections describe characteristic structures in France, the United Kingdom and the United States.

(a) France

In France, the following items are normally produced by industries complementary to the motor-vehicle industry:

^{6/} This does not exclude ownership of some part of the capital of subcontractors.

/- Electrical equipment:

- Electrical equipment:

Starters	Horns
Dynamos	Coils
Distributors	Regulators
Batteries	Cables
Spark plugs	Lamps
Windshield wipers	Headlights and sidelights

- Shock-absorbers
- Radiators
- Coil springs
- Tyres
- Clutches and brake linings
- Locks
- Window glass
- Tools
- Dashboard instruments and equipment
- Filters
- Carburettors
- Bearings
- Steering wheels
- Dashboards

Other items are normally produced by the manufacturers, for example:

Engines
Gear-box
Suspension
Steering gear
Front axle
Rear axle
Bodywork
Assembly and finishing of bodywork

/The parts

The parts made by outside suppliers represent an average of 35 to 40 per cent of the production cost of the vehicle.

(b) United Kingdom

The United Kingdom motor-vehicle industry is less integrated than its French counterpart. One major difference is that certain manufacturers do not have plants producing bodywork, with the result that the value of parts made by outside producers represents approximately 75 per cent of final production costs. With other manufacturers, this proportion ranges between 50 and 60 per cent.

In contrast to the situation in France, the following items are often produced by associated industries:

Bodywork (Pressed Steel Co.)

Engine parts (Hepworth and Grandage, for example)

Steering gears (Burman and Sons, Cam Gears, Alford and Alder Ltd., Adamant Engineering Co.)

Transmission shafts (Hardy Spier Ltd.)

(c) United States

The United States is always an interesting case, in view of its role as the trailblazer of the industry. The United States motor-vehicle industry (manufacturers) is very concentrated, but manufacturers do a great deal of subcontracting. There are at least 6,000 regular suppliers of parts for passenger cars and lorries, without counting those producing such items as nuts, bolts, washers, etc.

The figures for Chrysler Motors and the Ford Motor Company are as follows:

Chrysler: This company had 1,540 suppliers before the war and now has over 10,000, mainly small enterprises.

Ford: The figure is roughly the same for Ford, with the following breakdown:

Enterprises with less than 100 employees	75 per cent
Enterprises with 100-500 employees	16 per cent
Enterprises with 500-1,000 employees	4 per cent
Enterprises with over 1,000 employees	<u>5 per cent</u>
<u>Total</u>	100 per cent

/In value

In value, as in the United Kingdom, outside suppliers account for 65 to 70 per cent of the production cost of vehicles.

In conclusion, there is a marked trend towards decentralization, with subcontractors becoming increasingly specialized. Notable is the fact that many subcontractors are small enterprises (75 per cent of Ford's suppliers employ less than 100 workers).

2.2 Materials used and production techniques

The motor-vehicle industry uses a very large number of materials and production techniques:

(a) Materials

A European-type medium-size passenger car contains the following:

Forged steel	72.00 kg
Steel bars	43.00 kg
Grey iron	72.00 kg
Malleable iron	10.00 kg
Zinc	2.92 kg
Aluminium	13.30 kg
Bronze	1.25 kg
Steel sheet	374.00 kg
Rubber (excluding tyres)	22.00 kg
Paint	4.92 kg
Glass	1.74 m ²
Paper board	7.30 kg
Electrical wiring	90.00 m
Textiles	7.50 m ²
Cotton, wool	4.5 kg

Note: These data refer only to parts produced by the manufacturer.

(b) Production techniques

An attempt has been made to classify all the parts making up a vehicle by the different techniques used. The following are the major divisions:

Casting:

Iron
Steel
Aluminium
Special metals

/Forging

Forging:

Machining
Heat treatment
Pressing
Other techniques

The head of other techniques is unfortunately difficult to describe in detail for it includes all the production techniques used by all the associated industries, for example, those producing clutches, brake linings, electrical components, plastic mouldings, batteries, window-glass, etc.

The table on the following pages lists the main parts of a passenger car under the major divisions described above.

(c) Share of each major process in final cost

Considering the processes at present used by vehicle manufacturers in France, and the value added by each process - which is the most interesting factor from the economic standpoint - the share of each major process in the value added in production is as follows:

Casting	9 per cent
Forging	3 per cent
Sheet metal working	20 per cent
Machining	43 per cent
Assembly	25 per cent

As might be expected, machining accounts for the lion's share. The figures cover gross value added at factor cost, with depreciation estimated at the following proportions of gross value added:

Metal transforming	33 per cent
Sheet metal working	56 per cent

/Passenger cars

Passenger car Parts or components	Percentage of production cost	Casting					Machining						Pressing			Shaping	Other processes	Remarks	
		Iron		Steel	Aluminum	Special metal	Forging	Drilling, boring, tapping, milling	Turning	Cutting	Truing	Riveting	Heat processing	80 T press	80-300 T press				Over 300 T press
		Grey	Improved																
Engine																			
-Engine block																			
Crankcase and bearing caps	1.49	X					X											Centrifuged casting	
Cylinder sleeves	0.43		X					X		X		X							
Oil sump	0.10												X						
Bearings	1.12					X											X		
Other parts	0.12																		
-Moving parts																			
Crankshaft	1.10			X				X		X		X						Leblon lathe	
Flywheel	0.43	X		X			X	X				X							
Ring gear	0.97			X			X	X				X							
Piston rods	0.70					X	X	X				X					X		
Half-bearings	0.36					X											X		
Pistons	0.08										X	X					X		
Gudgeon pins	0.05		X									X							
Piston rings	0.03		X									X							
Compression rings	0.20		X									X							
Other parts	0.22											X							
-Cylinder head																			
Cylinder head	1.34				X		X							X					
Oil filler cap	0.01												X						
Cover	0.09												X						
Other parts	0.22																		
-Timing																			
Valves	0.24					X				X		X						Cold-drawn	
Springs	0.03																X		
Timing plate	0.36											X							
Camshaft	0.40	X							X	X	X	X							
Gears	0.40					X	X	X	X		X	X							
Tappets	0.02					X	X					X							
Rocker-arm pins	0.05					X	X		X			X				X			
Pulleys	0.09												X						
Rocker arms	0.19	X					X	X											
Other parts	0.40																		
-Air intake																			
Induction pipe	0.28				X		X												
Carburettor	0.92				X		X												
Carburettor control	0.09																X		
Air filter	0.81											X					X		
Other parts	0.07																		
Exhaust																			
Exhaust manifold	0.43	X					X												
Other parts	0.08																		
-Lubrication																			
Oil pump	0.26				X		X		X	X		X						Powder sintering	
Control shaft	0.04							X	X	X		X							
Pump gear	0.07								X			X							
Oil gauge contact	0.06																X		
Other parts	0.41												X						
Cooling																			
Water pump	0.27				X		X												
Bearing	0.09							X	X								X		
Impeller	0.05							X		X							X		
Other parts	0.41																		
Fuel supply																			
Fuel pump	0.21				X		X					X							
Other parts	0.03																		
Labour for assembly																			
Total	16.29																		
Transmission, steering and suspension																			
Clutch																			
Gear box																			
Transmission case	9.37				X		X	X	X	X	X							Shaving	
Gearing	1.51						X				X	X					X		
Housing	0.32																X		
Steering gear	0.28																X		

Passenger car Parts or components	Percentage of production cost	Casting					Machining					Pressing			Shaping	Other processes	Remarks		
		Iron		Steel	Aluminum	Special metal	Forging	Drilling, boring, tapping, milling	Turning	Cutting	Truing	Riveting	Heat processing	80 t press				80-300 t press	Over 300 t press
		Grey	Improved																
<u>Front axle</u>																			
Steering linkage	4.93																		
Steering swivel						X	X	X				X	X	X					
<u>Back axle</u>	4.52					X	X	X				X	X						
Differential																			
Other parts																	Rolled		
<u>Shock absorbers</u>	1.80																X		
<u>Suspension</u>																			
Springs	0.78																X		
Torsion bar	0.18																X		
Joints	0.70																X		
Other parts	1.00																X		
<u>Labour for assembly</u>	1.05																		
<u>Total</u>	26.45																		
<u>Electrical system</u>																			
Sparking plugs	0.52																X		
Dynamo	1.00																X		
Starter	1.29																X		
Battery	1.03																X		
Regulator	0.19																X		
Coil	0.19																X		
Dashboard	0.98																X		
Windscreen-wiper	0.96																X		
Headlights and sidelights	1.78																X		
Horn	0.35																X		
Switches	0.58																X		
Cables	3.50																X		
Lamps	0.27																X		
Turn indicators	0.10																X		
Other parts	1.00																X		
<u>Total</u>	13.74																		
<u>Miscellaneous</u>																			
Radiator	1.98																X		
Crank axle	0.42			X		X	X									X	X		
<u>Controls</u>																			
Cables	0.13																X		
Master brake cylinder	0.18	X					X	X									X		
Oil tank	0.05																X		
Brake distributor	0.13				X												X		
Tubing	0.25											X				X	X		
Other parts	0.42															X	X		
<u>Tyres</u>	4.50																X		
<u>Tools</u>	0.50					X													
<u>Total</u>	8.56																		
<u>Bodywork</u>																			
Panels	16.00																		
Glass	2.20											X	X	X			X		
Locks	1.56							X									X		
Fuel tank	0.70												X				X		
Silencer	0.24											X					X		
Trim	5.34																X		
Carpeting	0.40																X		
Wheels	1.52															X	X		
Seat frames	1.45															X	X		
Bumpers	3.25																X		
Rubber parts	1.30												X				X		
Nuts and bolts	0.70																X		
Other parts	0.30										X						X		
<u>Total</u>	34.96																		

2.3 Investment

The motor-vehicle industry requires a large amount of investment. However, the major production sectors account for different shares of the total. It is difficult - and not really relevant to the present study - to analyse the investment capital of the major manufacturers, since the data available represent only book values and it is known that, owing to the high degree of competition prevailing in the industry, book amortization is extremely rapid. The financial committee of General Motors in the United States, for example, will only authorize investment in equipment if it can be written off in under three years.

The following sections consider the amount of investment required for a motor-vehicle plant with an annual capacity of 50,000 to 60,000 units per year (i.e. roughly 200 units per day), with the value of materials being calculated f.o.b. French ports.

(a) Investment in the motor-vehicle plant (manufacturer)

(In French francs)

	<u>Investment</u>	<u>Working capital</u>	<u>Total</u>
Casting	13 000 000	1 500 000	14 500 000
Machining	50 000 000	5 000 000	55 000 000
Gears	25 000 000	1 000 000	26 000 000
Sheet metal working	75 000 000	10 000 000	85 000 000
Assembly	<u>22 000 000</u>	<u>10 000 000</u>	<u>32 000 000</u>
	185 000 000	27 500 000	212 500 000

Note: The figure for working capital is very approximate and will certainly vary depending on the number of models produced, the time taken to receive supplies, and the way in which production series are initiated.

This gives a rough figure of 210 to 220 million francs for a plant capable of producing 60,000 units per year, at the level of integration currently prevailing among French manufacturers.

/(b) Investment

(b) Investment in complementary industries

The amount of investment required in complementary industries is appreciably higher than that required for manufacturers, and can be estimated as follows:

Investment	300,000,000 French francs
Working Capital	140,000,000 French francs

Thus, the amount of investment required to establish a motor-vehicle industry in a given country, with a capacity of 60,000 units per year and national content at 100 per cent, can be estimated at approximately 650,000,000 French francs.

2.4 Employment

In this connexion, it is only possible to give precise data for manufacturers, and the following figures relate to a plant with a capacity of 60,000 vehicles per year:

	Total investment (<u>French francs</u>)	Workers employed	Investment per worker (<u>French francs</u>)
Casting	14,500,000	260	55,000
Machining	55,000,000	450	120,000
Gears	26,000,000	350	75,000
Sheet metal work	85,000,000	600	130,000
Assembly	<u>32,000,000</u>	<u>500</u>	64,000
<u>Total</u>	212,500,000	2,160	

The above table does not include administrative staff, since the studies on which it is based refer only to production staff. Total investment per person employed may be estimated as follows:^{2/}

^{2/} On the assumption that the plant would employ a minimum of 500 persons in its administrative and auxiliary services.

/Process

Process	Investment per person employed	
	Excluding working capital	Including working capital
Casting	35,000	45,000
Machining	90,000	100,000
Gears	57,000	59,000
Sheet metal working	100,000	112,000
Assembly	<u>35,000</u>	<u>51,000</u>
<u>Average</u>	68,000	79,000

- Note:
1. The figures for investment in sheet metal working may appear unusually low. The study on which these figures are based took the least intensive capital alternative possible, and for that reason was particularly original.
 2. The figures given are higher than those prevalent among the major manufacturers with production runs of between 500,000 and 1 million vehicles per year.
 3. Unfortunately it is not possible to give precise figures for investment in a plant with a smaller capacity, say 10,000 units per year, which is a common size in developing countries, although for assembly alone a plant of such size would require investment of the order of 100 to 120 million francs (ratio of production runs 1:6; ratio of investment 1:2).

2.5 Cost-volume ratio

There is a high correlation between cost and volume in the motor-vehicle industry, although it varies for each production process. Unfortunately, only a few points at best can be placed on the curves showing the fall in the cost price of a part in relation to increases in production runs, for generally the necessary studies are lacking, and the curves have to be interpolated. What are needed are special engineering studies to show which machinery is most appropriate for different runs and quantifying the corresponding production costs, but these would unfortunately be very costly to undertake.

/The figures

The figures given below are very approximate and were obtained by extrapolating the figures for selected parts to all the similar parts in a vehicle.

(a) Effect on costs of length of production runs

The cost of bodywork elements, produced using the methods of the major manufacturers, is the item most affected by short production runs. Two alternatives were considered:

Vehicles wholly manufactured in developing countries; and

Vehicles for which all parts are locally manufactured, except the bodywork.

In figure 1, annual production runs have been placed on the abscissa, and the increase in cost over the c.i.f. price of imported vehicles on the ordinate.

Note: The figures given assume that a single model is being manufactured with a fairly long life, say seven or eight years.

Figure 1 gives the following figures for a run of 25,000 vehicles per year, a run which is often within the capacity of the developing countries but which is often not achieved because no attempt is made to restrict the number of models manufactured:

Increase in cost price	All local	All local manufacture
at a production run of	manufacture	except bodywork
25,000 vehicles per year	+ 85%	+ 45%
(one model)		

In actual fact, even in the best of cases, manufacturers in the developing countries virtually never achieve production runs of more than 12,500 vehicles per year. At this level, the figures would be as follows:

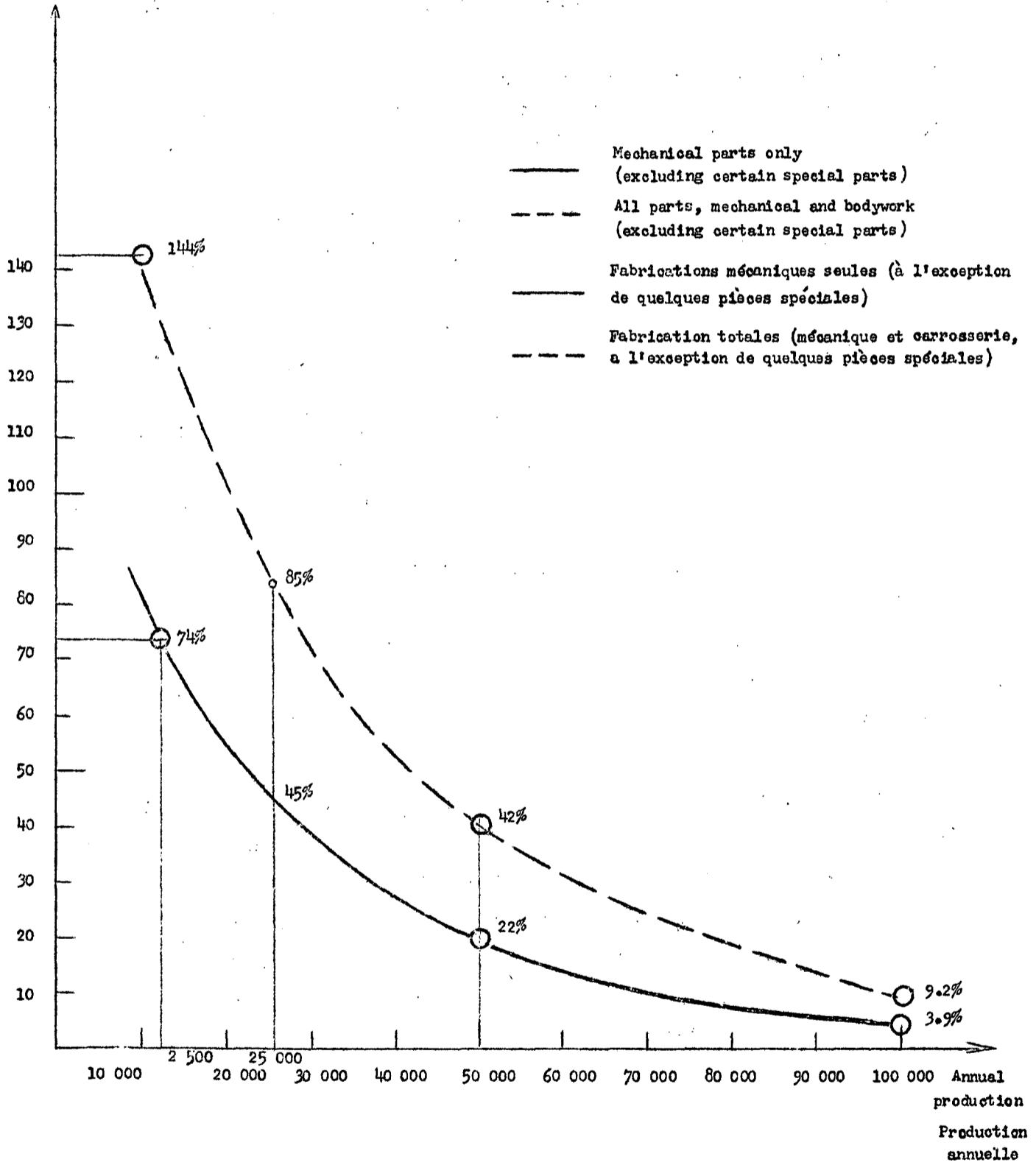
Increase in cost price	All local	All local manufacture
at a production run of	manufacture	except bodywork
12,500 vehicles per year	+ 144%	+ 74%
(one model)		

/Figure 1

Figure 1
Graphique 1

Increase in costs
(percentage)
Pourcentage
d'augmentation
des coûts

PASSENGER CAR: VARIATION IN COSTS IN TERMS OF LENGTH OF PRODUCTION RUN
AUTOMOBILE DE PASSAGERS VARIATION DES COÛTS EN FONCTION DES CADENCES



/(b) Increase in

(b) Increase in costs resulting from increases in national content

This section shows how the cost of manufacturing a vehicle rises as the proportion of national content rises, in developing countries. First, an estimate was made of the minimum curve, assuming that the first parts to be produced locally would be those for which the cost rise is relatively smallest, and that there would be a gradual progression to the parts for which the cost rise is highest.

The increase in the cost price of vehicles relative to the c.i.f. price is placed on the ordinate of the figure below, which contains four curves corresponding to different production runs, namely:

50,000 vehicles per year

25,000 vehicles per year

12,500 vehicles per year

8,000 vehicles per year

The curve showing increases at a production run of 8,000 units per year has three distinct phases:

The first phase (up to approximately t # 30%), where the cost increases more than proportionally to the level of national content;

The second phase (between t # 30% and t # 75%) where the increase is roughly proportional;

The third phase (above t # 75%) where the curve clearly becomes exponential.

Note: In this figure, as in all the others presented here, the relative position of the curves is what is important; the level on the ordinate depends on the total cost of transporting vehicles or parts between the exporting plant and the country concerned.

2.6 Critical mass

The preceding section described the main cost-volume relations in the motor-vehicle industry. Clearly, small production runs of the kind considered affect production costs in differing degrees, depending on the part concerned.

/It may

It may be assumed that the parts most affected by small production runs have a significant weight on the right hand side of the curves in figure 2.

This phenomenon can also be expressed as follows:

The critical mass of production is not identical for all the parts making up a vehicle. This is a fundamental point which warrants further discussion.

(a) Definition of the critical mass of production

This can be defined as follows:

In a given economic space, the critical mass of production is the minimum level or run of production which must be achieved in order not to be at a cost disadvantage in front of other enterprises.

The concept of the critical mass of production is linked to the cost-volume ratio. In figures representing the cost-volume ratio, the critical mass of production corresponds to the point on the abscissa after which the cost curve virtually ceases to incline downwards. Given the same production techniques, any enterprise that has achieved the critical mass of production is not at a disadvantage in front of its competitors as regards of production costs. In contrast, any enterprise that has passed beyond the critical mass does not have any significant advantage in front of its competitors as regards of production costs.

In the motor-vehicle industry, as in many other industries with autonomous plants or workshops, the critical mass of the industry as a whole is obviously determined by the plant (or the workshop) having the largest critical mass.

In the motor-vehicle industry, the plants with the highest critical mass of production are the pressing and engine machining shops. All the other plants have a lower critical mass, and for some, namely those whose cost-volume curve has zero elasticity (a horizontal line on the figure), the notion of critical mass has no significance.

(b) The size of the critical mass of production in different branches

It was noted above that the critical mass of production reflected the level of technology. The effect of technological progress is generally to raise the critical mass of production, although in some cases it may tend to lower it.^{8/}

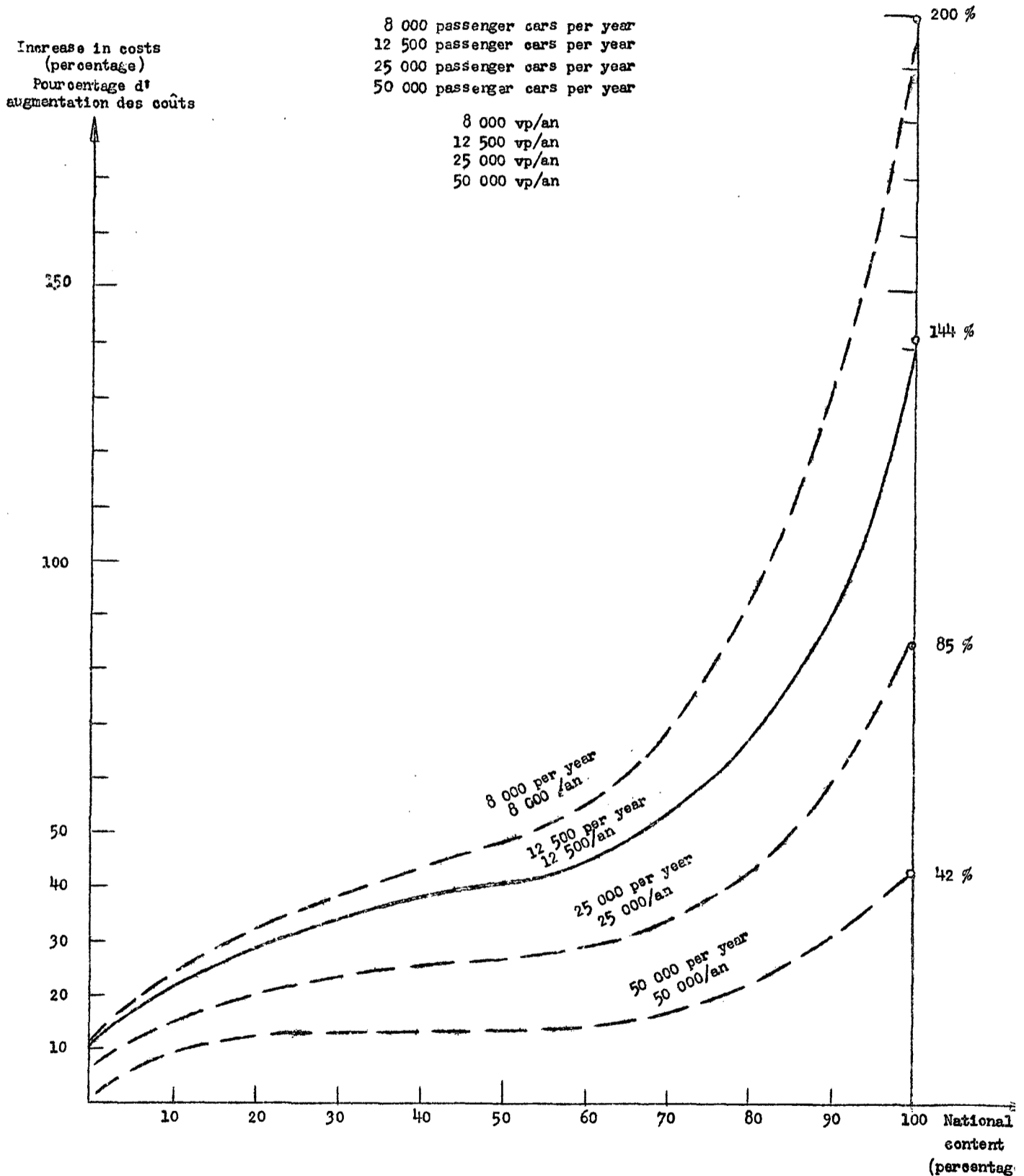
^{8/} This is the case, for example, of nitrogen production.

INCREASE IN COSTS RESULTING FROM INCREASES IN LOCAL CONTENT AT PRODUCTION RUNS OF:

ACCROISSEMENT DES COUTS ENTRAINES PAR L'INTEGRATION NATIONALE
POUR DES CADENCES DE PRODUCTION DE L'ORDRE DE:

8 000 passenger cars per year
12 500 passenger cars per year
25 000 passenger cars per year
50 000 passenger cars per year

8 000 vp/an
12 500 vp/an
25 000 vp/an
50 000 vp/an



Notes: The figure is based on the assumption of increases in national content in the most rational order (i.e. in order of increasing cost)

Remarque: L'hypothèse adoptée est celle d'une intégration locale, réalisée dans l'ordre le plus rationnel (étapes classées par ordre de coûts croissants)

Percentage
d' intégrati
locale

/Thus the

Thus, the relative importance of the critical mass of production must be assessed against the background of the technology currently being used by the major manufacturers, which has been developed and adapted for very large production runs. Hence, there are no data available to indicate what costs might be in small production runs, for example, one hundred times smaller than those of the major manufacturers.

The following sections will suggest orders of magnitude for the critical mass of production in a number of branches, based on the data available. It should be noted that the concept of the critical mass is simple when a plant produces only one item, for example, transfer machines machining cylinder blocks. It is much more difficult to apply to a plant producing a wide variety of items, for example a foundry. Decreasing production costs in a foundry depends on two factors: the volume and the homogeneity of production.

(i) Foundry (cast iron and steel). The concept of the critical mass is extremely difficult to apply to foundry activities. The more specialized the foundry, the lower its critical mass. As the volume of production rises, the degree of mechanization of operations and handling also rises.

The main sections to be considered are the following:

Cupolas: In a foundry operating for the motor-vehicle industry, the largest part is the cylinder block. A minimum of two cupolas is required, each with a capacity of 2.5 tons per hour (ϕ 650) operating seven hours per day.

Moulding and core-making: Cores can be made by hand in small foundries, or by machine if justified by the scale of production.

Pattern-making: Pattern-making may be subcontracted or the foundry may purchase patterns from manufacturers.

Testing: Machines are needed to check the seal of engine blocks and cylinder heads.

Heat treatment: Only a few parts require heat treatment after coming out of the foundry. The size of furnaces can quite easily be adapted to the volume and size of the parts to be treated.

/Handling:

Handling: When production is on a large scale, very substantial savings can be made by means of mechanization. Whatever the scale, however, either motorized or hand-drawn carts will be needed.

In brief, it is very difficult to determine the critical mass of a foundry. With respect to the motor-vehicle industry, a minimum figure could be roughly 400 tons per year for a foundry producing engine blocks and other parts for passenger cars.

(ii) Manufacture of cylinder blocks. Once the cylinder block leaves the foundry, there are three main ways of machining it:

- On general-purpose machines;
- On specialized machines; or
- On transfer machines.

The selection of the machine depends on the length of the production run. The general-purpose machine is for small runs and the transfer machine is only suitable for mass production. Figure 3 shows what happens to machining costs in each case.

Taking account of the cost of the unmachined block, the production cost of a cylinder block is halved if machining is automated rather than performed on general-purpose machines. Given the slant of the curves showing the cost-volume ratio, it would appear that the critical mass of a machining plant is roughly 500 units per day or 125,000 per year.

Note: Production costs in a plant in a developing country producing fifteen to twenty engines per day would be approximately 200 per cent higher than if the engines were imported.

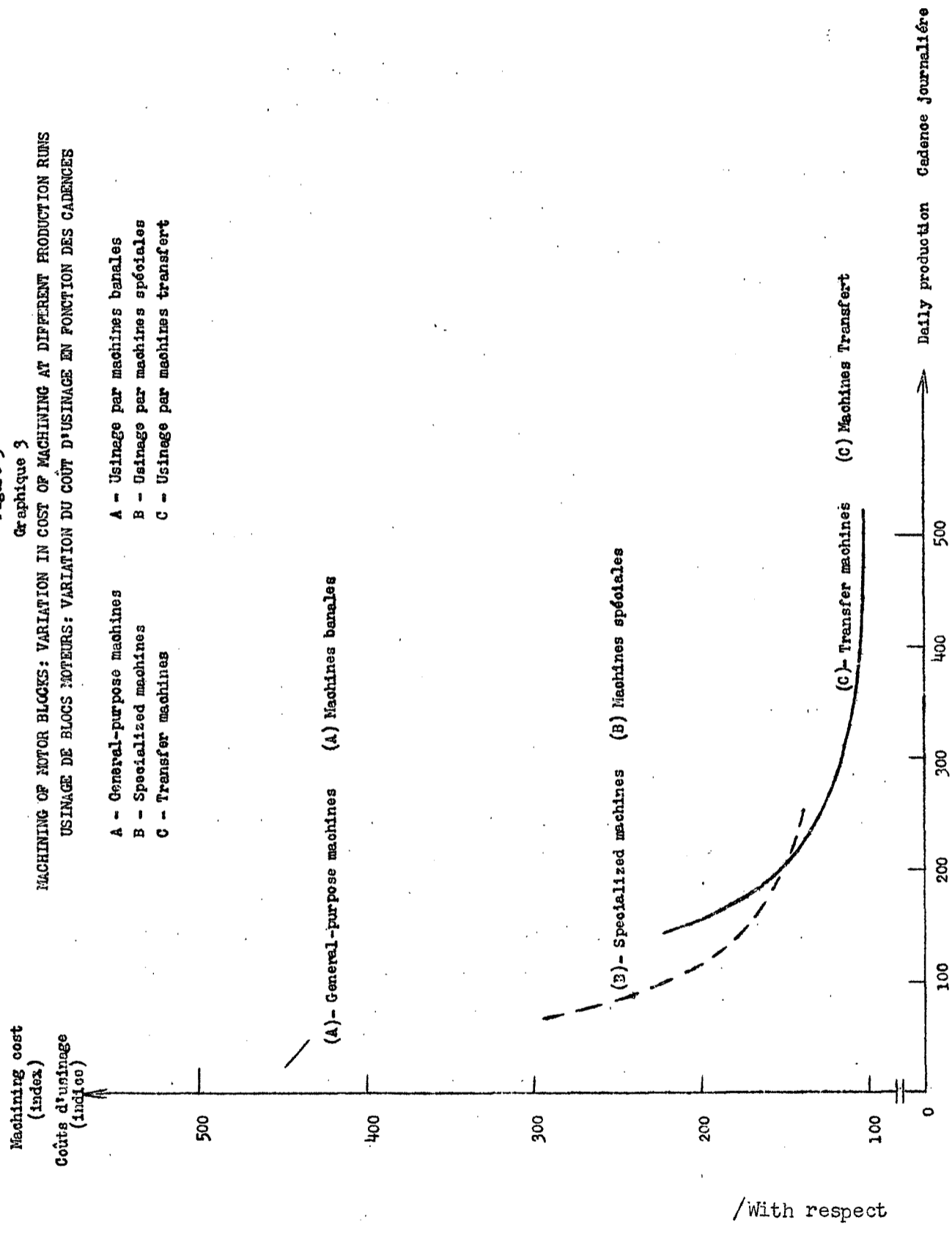
(iii) Manufacture of bodywork. In this respect, a number of different processes are possible, depending on the length of the production run:

- (a) Manufacture entirely by hand with mallet and hammer;
- (b) Manufacture entirely by hand with mallet and hammer on forms;
- (c) Manufacture by machine limited to pressing operations, all other operations (cutting, flanging, etc.) being done by hand;
- (d) Combination of pressing with other operations (use of multi-purpose machinery);
- (e) Complete manufacture on presses with automated handling of parts between machines.

/Figure 3

Figure 3
Graphique 3
MACHINING OF MOTOR BLOCKS: VARIATION IN COST OF MACHINING AT DIFFERENT PRODUCTION RUNS
USINAGE DE BLOCS MOTEURS: VARIATION DU CÔT D'USINAGE EN FONCTION DES CADENCES

- A - General-purpose machines A - Usinage par machines banales
- B - Specialized machines B - Usinage par machines spéciales
- C - Transfer machines C - Usinage par machines transfert



/With respect

With respect to tooling, elements can be made of steel, Zamak or plastic, the economic data being as follows:

<u>Material of pressing tool</u>	<u>Life</u>	<u>Cost ratio</u>
Steel	1 - 200,000 parts	100
Zamak	3 - 15,000 parts	30
Plastic	3 - 15,000 parts	25

Note: Unfortunately, technicians do not all agree on the possibility of using tools made of Zamak or plastic. The processes listed above are viable within the following limits:

- (a) 1 to a few dozen parts;
- (b) 10 to a few hundred parts
- (c) Up to 20,000 parts;
- (d) Up to 500,000 parts;
- (e) More than 500,000 parts.

Clearly production costs are not the same in all cases. Mass production as in process (e) requires an extremely large amount of investment, 30 or 40 million francs being needed per model for the pressing tools alone.

The critical mass of bodywork manufacture can be estimated at between 150,000 and 200,000 vehicles per year (see figure 4).

Note: If tools made of Zamak or plastic yielded satisfactory results, this figure would be very considerably less.

(iv) Moving parts. Without specific engineering studies, it is clearly impossible to make an exact evaluation of the critical mass of production for each part. As production runs become larger, increased specialization becomes possible, and machining operations can be automated. The following sections consider the manufacture of pistons and piston rods.

/Figure 4

Figure 4

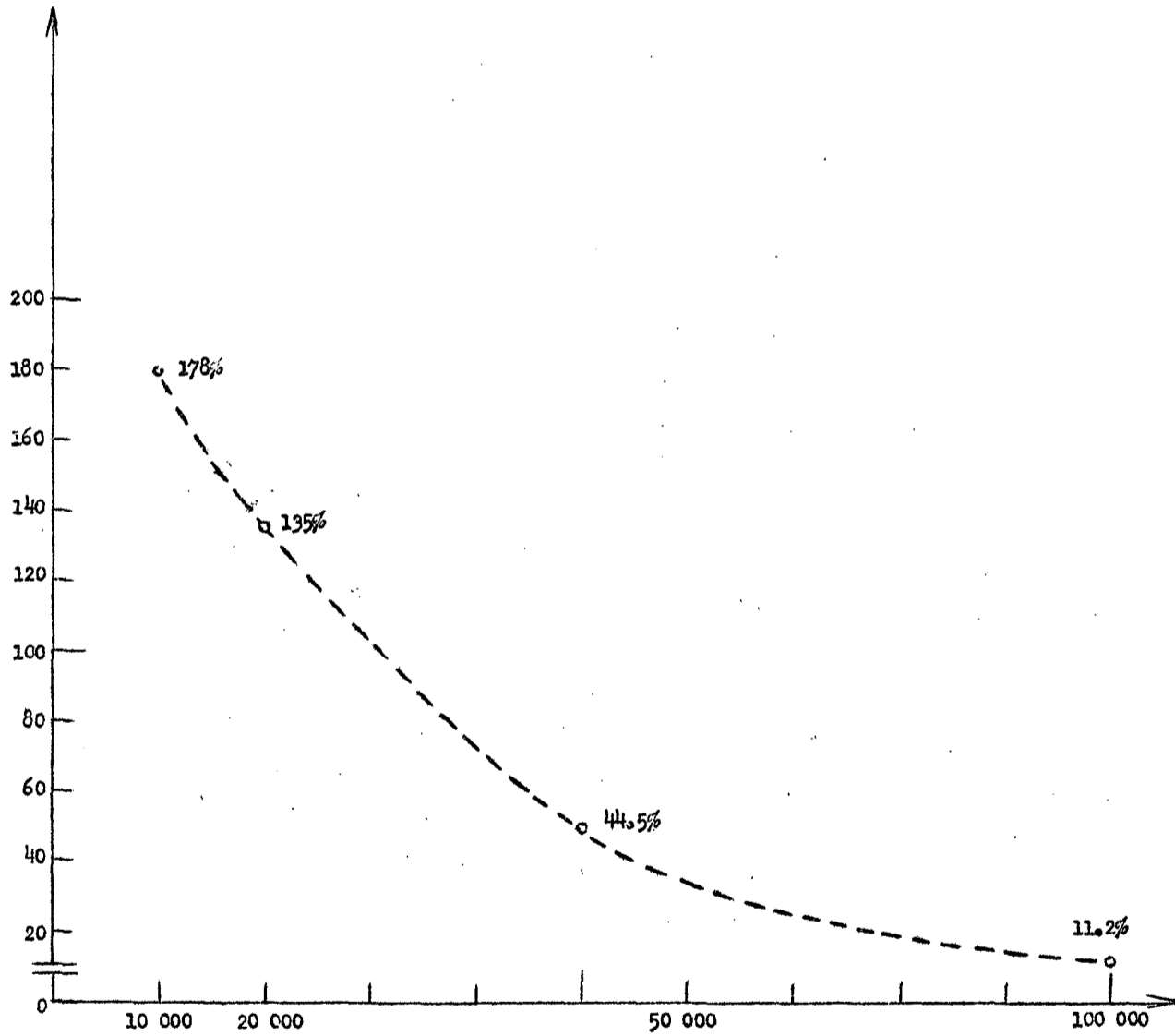
Graphique 4

THIS FIGURE PRESENTS A ROUGH IDEA OF COST-VOLUME RATIOS IN THE MANUFACTURE OF BODYWORK USING TRADITIONAL METHODS

A TITRE SEULEMENT INDICATIF NOUS PRESENTONS LA COURBE SUIVANTE, FIGURANT LES RELATIONS COUTS-VOLUMES DANS LE DOMAINE DES FABRICATIONS DE CARROSSERIES REALISEES AVEC LES TECHNIQUES TRADITIONNELLES

Increase in costs
(percentage)

% d'augmentation
des couts



(Base 100 = import cost of bodywork parts)

(Base 100 = prix d'importation des elements de carrosserie)

Annual production
Production annuelle

/(a) Pistons

(a) Pistons

Two methods of manufacture were considered:

Manufacture by standard machines; and

Manufacture by specialized machines.

The figures obtained are shown in figure 5, which takes the import cost of a piston in a developing country as base 100.

It can thus be estimated that the critical mass of production for pistons is roughly 1,000 units per day. Assuming that 20 per cent of production would be for replacement, this would correspond to an output of 200 vehicles per day, or 50,000 per year.

(b) Piston rods

The figures also cover manufacture on standard machines and on specialized machines, and are given in figure 6.

The critical mass here is between 1,500 and 1,600 piston rods per day, enough to equip 400 vehicles per day or 100,000 per year.

The two examples above are given purely for purposes of illustration. In many branches of the metal-machining branch, the critical mass is at present between 50,000 and 70,000 vehicles per year. It is hardly surprising, moreover, that this level is so high since manufacturers have done all they can to take advantage of increases in production volume to raise productivity and thus reduce final costs.

(v) Other items. A rough idea of the critical mass of production of a number of other parts is given below:

Tyres: To achieve a competitive cost level, a plant must have a minimum capacity of 1,000 tyres per day. This requires a market of 20,000 vehicles per year, allowing for the first set and replacements.

Batteries: This branch has a relatively low production minimum, something of the order of 20,000 batteries per year.

Seat frames: A plant making seat frames should have a production capacity of 50 seats per day, corresponding to 30,000 vehicles per year.

/Figure 5

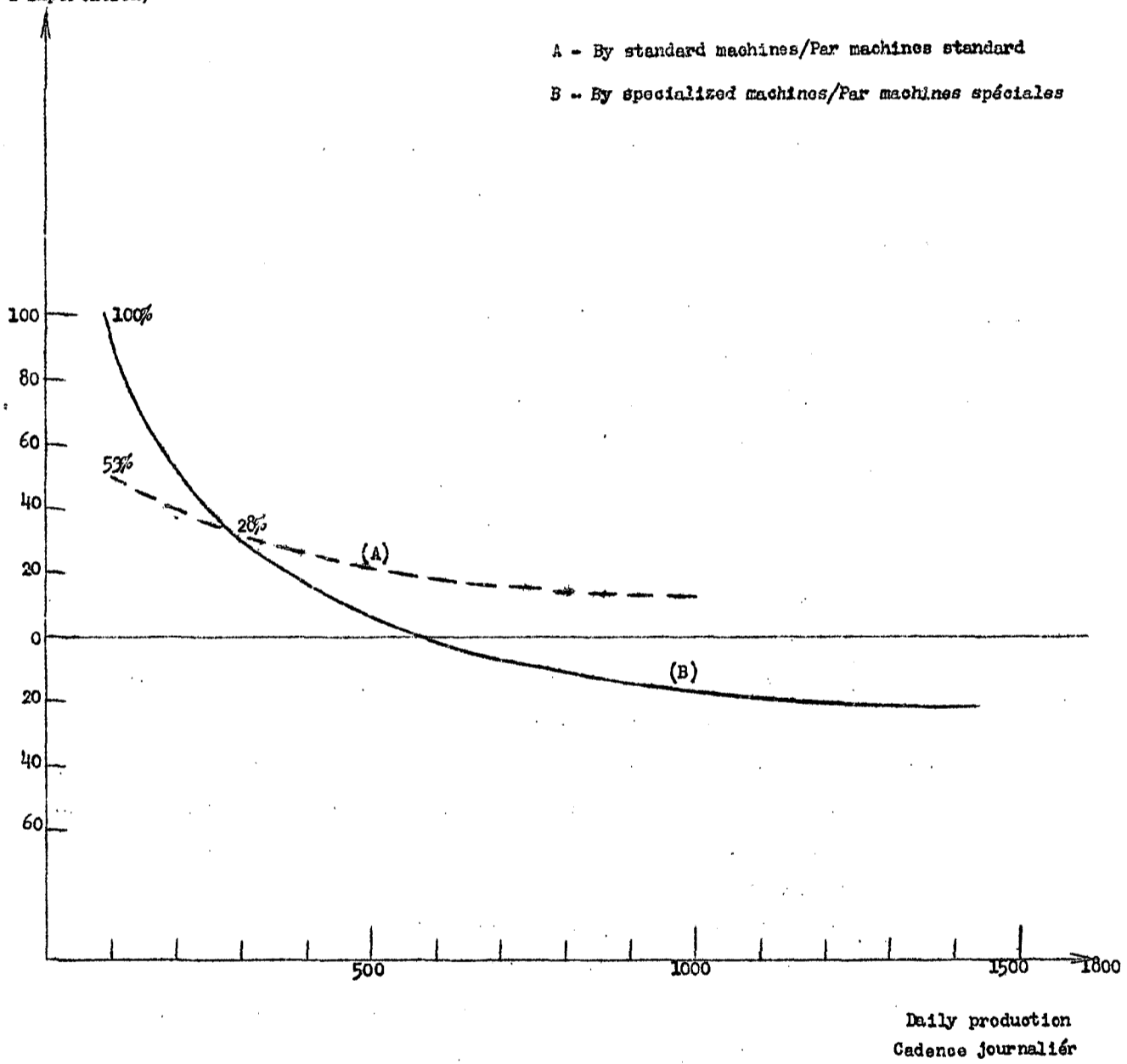
Figure 5

Graphique 5

MANUFACTURE OF PISTONS
FABRICATION DE PISTONS

Percentage
increase in costs
(over import cost)
% d'augmentation des
coûts (par rapport au
prix d'importation)

A - By standard machines/Par machines standard
B - By specialized machines/Par machines spéciales

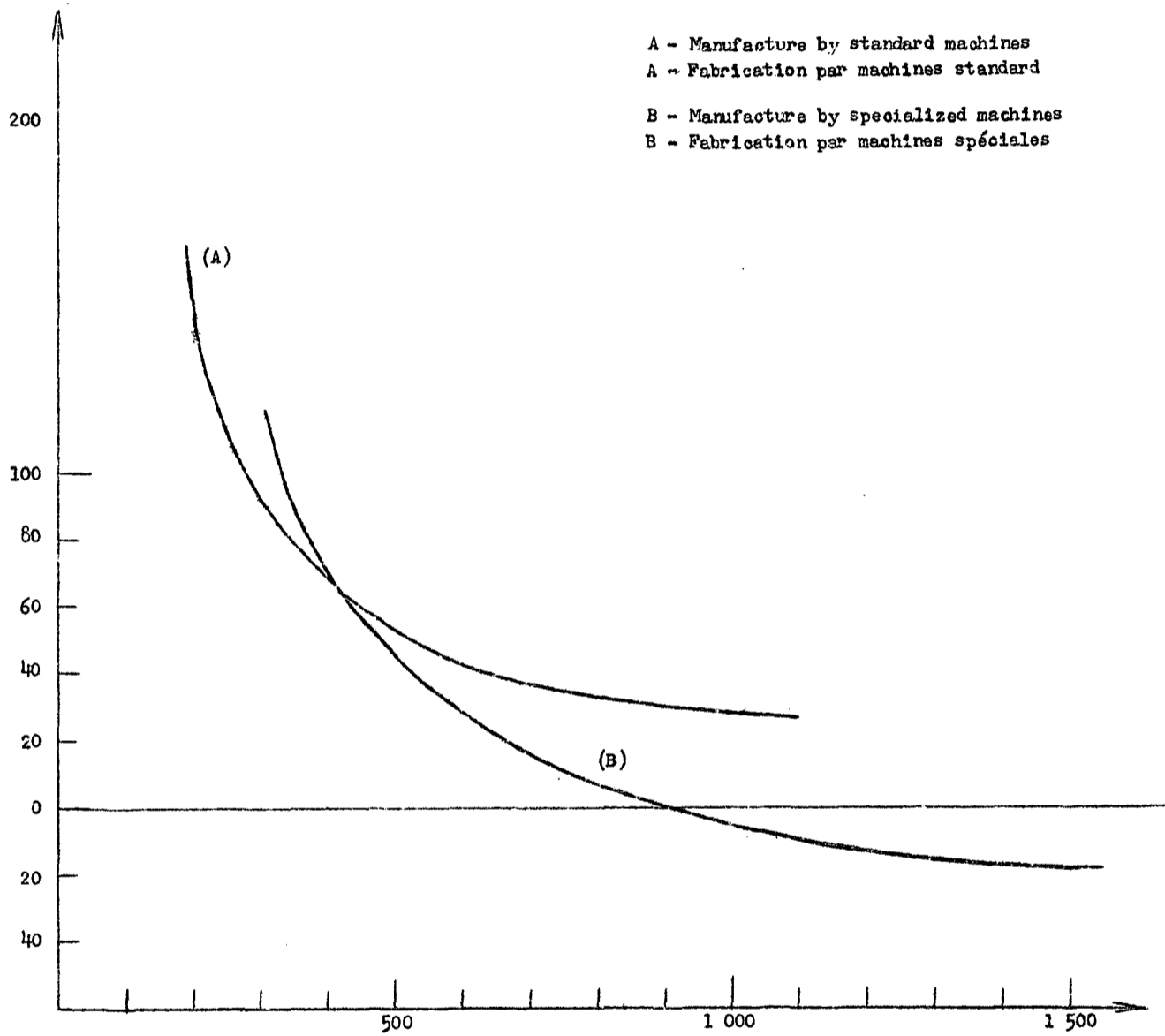


/Figure 6

Figure 6
Graphique 6

Percentage increase in costs (over import cost)
Pourcentage d'augmentation des coûts (par rapport au prix d'importation)

MANUFACTURE OF PISTON RODS
FABRICATION DE CORPS DE BIELLES



A - Manufacture by standard machines
A - Fabrication par machines standard
B - Manufacture by specialized machines
B - Fabrication par machines spéciales

Daily output (number of units)
Cadence journalière (nombre de pièces)

/Radiators

Radiators: A plant making radiators must have a minimum output of 40 to 50 radiators per day, or 10,000 to 12,500 per year. Bearing in mind replacement needs, a plant of this size could operate reasonably with a market of 10,000 vehicles per year.

Shock-absorbers: The critical mass of production here is around 160 to 200 per day, or 40,000 to 50,000 per year. Again bearing in mind replacements, this kind of capacity could be justified with a market of 10,000 vehicles per year.

Wheels: A plant making wheels should have a production capacity of at least 150,000 wheels per year, which assumes a market of 30,000 vehicles per year.

Suspension springs: Here the critical mass is an output of 400 to 500 units per day, corresponding to a minimum of 30,000 vehicles per year.

Electrical equipment:

- (a) Sparking plugs: For complete manufacture, critical mass is about 2,000 per day, or 500,000 per year.
- (b) Coils: About 100 to 200 per day, or 25,000 to 50,000 per year.
- (c) Horns: About 100 to 200 per day, or 25,000 to 50,000 per year.
- (d) Dynamos: About 100 to 200 per day, or 25,000 to 50,000 per year.
- (e) Starters: Somewhat higher - about 300 per day or 75,000 per year.
- (f) Windshield wipers: About 400 to 500 per day, or a market of 50,000 to 60,000 vehicles per year.
- (g) Headlamps: About 400 to 500 per day, or a market of 50,000 to 60,000 vehicles per year.

V. BYPASSING CURRENT CONTRADICTIONS

In most cases, the mistakes that have been made in connexion with the setting up of motor-vehicle industries stem partly from the difficulty for developing countries to plan and organize their development properly and partly from the indifference shown by the majority of major manufacturers towards the new problems posed by the countries of the third world.

This indifference can be explained easily enough by the comparative size of the motor-vehicle markets in developed and in developing countries.

The preceding chapters have endeavoured to clarify the problems posed so as to pave the way towards organizing the production of motor vehicles in developing countries as rationally as possible.

The rest of this study draws attention, first, to the various solutions that could be accepted within a framework of national self-sufficiency, and the limitations they comprise, and, finally, to the tremendous advantage of multinational solutions which, though highly promising, have so far been virtually overlooked.

Before turning to the solutions, however, it may be useful to recall some of the "golden rules" of industrialization in developing countries on which all the subsequent arguments are based.

1. A few "golden rules" for industrialization in developing countries

If they wish to set their economic development on a firm and healthy basis, developing countries must logically abide by the following rules:

1.1. Rule 1: reject any industrialization on a non-competitive basis.

Important though it is that this principle be strictly adhered to, it is bound to have to be adapted somewhat to circumstances. By accepting the establishment of non-competitive industries, a country automatically leaves its development open to structural inflation which is all the more serious because it has no remedy. A new industry may, and should, only be uncompetitive during the initial years of its existence, after which it must be able to fend for itself. Protectionism, especially in the form of tariff barriers, can only be justified if a country has this purpose in mind.

Although it is difficult to fix a definite period during which a protectionist policy can be followed, a minimum of five years and a maximum

/of ten

of ten would seem reasonable. This however is a matter for the general development planning of the country and there can be no hard and fast rules. The fundamental issue is that any new industry must become competitive within a reasonable period.

It should be remembered that undeveloped countries already benefit from a kind geographical advantage which allows their industries to operate with higher production costs than those of developed countries; the margin between the production costs corresponds to transport and related costs.

N.B. It would be a serious mistake to judge the advisability of establishing industries in developing countries on the basis of international dumping prices.

This principle of competitiveness is disregarded by most developing countries, which is tantamount to economic suicide for them since development can only come about through exports and, as has been already pointed out, this means, above all, exports of manufactured products.

1.2 Rule 2: expand exports as much as possible.

In the foregoing outline of the growth of developing countries, emphasis has been placed on the fundamental importance of exports. If their economies are to get off the ground, these countries must find large-scale and reliable outlets for their exports. This implies efficient organization and the kind of guarantees afforded either by the large number of clients involved - so that temporary fluctuations in individual sales cancel each other out - or by the adoption of a policy giving certain outlets a structural character.

1.3 Rule 3: keep salaries at an advantageous level for production.

Because they are arriving rather late on a world market which has already been mostly taken over by the industrialized countries and are moreover bringing a number of handicaps with them, developing countries should on no account fail to take advantage of their access to cheaper labour than that of industrialized countries. Every country should ensure that wages and salaries keep in line with its level of development. Allowing them, for the sake of political advantage, to increase faster than the economic development warrants can have far-reaching consequences for the country's future.

/1.4 Rule 4

1.4 Rule 4: harmonize the development of the various sectors.

It is both difficult and expensive to promote uneven development. Every industry needs others above and below it and it is no satisfactory solution for a few sectors to shoot ahead of the others. What the developing countries must do is make economic calculations (which is the true meaning of a Plan) so as to establish each year how best to allocate available investment resources to the various sectors of the economy. At the national level, they have to be able to estimate the marginal effectiveness of investment in the various sectors so as to reach a point where it is equal in every case.

This effectiveness should be calculated in terms of the value added (directly and indirectly) by each unit of investment allocated to a sector. N.B. It should be pointed out that this is the only way of deciding to what extent a country should insist on national content in the motor-vehicle industry. Only the planner himself can answer this question since he is the only person to have an over-all picture of all the sectors of the economy.

1.5 Rule 5: attract foreign investment.

Because they are usually short of capital or, if not, are not always able to recognize all the investment possibilities that exist, developing countries would be very well advised to try to attract international investment, as has frequently been pointed out to them by the international agencies set up to advise them.

Although obvious, it is often not fully appreciated that when a country turns down an offer of investment from a foreign industrial enterprise, such as a motor-vehicle manufacturer, that capital is not diverted to another sector of the economy but is purely and simply lost for the country.

Clearly, the best way of attracting foreign investment is to create an appropriate climate of confidence. A foreign investor does not judge a country by its legislation but by its behaviour, and no investment policy, however attractive, will be effective so long as the country's behaviour is unreliable.

1.6 Rule 6: adopt a set of rules and stand by them.

In many developing countries, there are no clearly defined sets of rules. They should therefore indicate once and for all whether they intend to develop

/a "laissez-faire"

a "laissez-faire" or a planned economy. In the case of a "laissez-faire" economy, the most important point is the maintenance of a competitive climate.

Under the more usual planned economy, the respective share of the public and private sector must be firmly established. The Plan must decide upon the specific objectives of each branch and stipulate the means of achieving them (price, customs duties, investment financing, taxation, etc.).

In any case, unless the Plan is based upon a serious study of the situation, it will be both unrealistic and unobjective and will consequently be ineffectual or even damaging to the economy.

Once the rules have been decided upon, it is absolutely vital that they be adhered to since a valid industrialization policy can only operate in a climate of stability and continuity.

2. The limitations to any solution based on national self-sufficiency

As regards the limitations inherent in any solution based on national self-sufficiency, the various suggestions that appear below are designed to make it as easy as possible for a developing country to develop its motor-vehicle industry. Far from being mutually exclusive, these proposals will give the best results if they can be combined.

2.1 Drastic reduction in the number of models to be manufactured

It can be clearly seen from figure 2 of paragraph 2.5 of Chapter IV, that it would be very much to the advantage of a country with a limited market to cut down drastically the number of models it plans to produce. For example, if a country with a market of 25,000 vehicles per year accepts a price increase of 20 per cent on motor vehicles, it can achieve the following degrees of integration:

- 15 per cent if it shares the market among three models
- 50 per cent if it shares the market between two models
- 65 per cent if it only places one model on the market.

A country wishing to industrialize therefore has to take these facts into consideration. The best solution is clearly to concentrate on producing a very limited number of models (one or two) and making up the rest of the range with as few imports as possible.

From the point of view of the countries concerned, however, there are two obstacles to such radical solutions:

/- a disinclination

- a disinclination to possess too small a range of vehicles
- the difficulty of resisting the pressure of industrialized countries and refusing their vehicles. (In practice, this second obstacle would seem easier to overcome than the first.)

2.2 Freeze on new models

Increases in production costs can be kept down by "freezing" the number of models produced so that the equipment can be amortized over a longer period. Here too, there are difficulties from the points of view of both developing country and manufacturer:

- consumers find it hard to accept that they should be deprived of access to new models;
- manufacturers supplying more or less complete CKD kits do not wish to continue indefinitely turning out parts that no longer correspond to the models they are currently producing; when they do accept to do so, the cost is very high.

Despite these objections, a freeze of this nature is to be recommended. The difficulties from the point of view of the manufacturers should not be exaggerated, especially during the initial years following a change in the parent company's models; it is up to them to organize themselves so as to be able to supply spare parts for the vehicles they have put into circulation.

2.3 Use of second-hand machines and tools

Because amortization costs are largely responsible for the high production costs of developing countries, it is important to consider the advantages that may accrue from using second-hand equipment.

This is a delicate problem that has already given rise to a great deal of controversy and it would be a mistake to rush into generalizations about it. It is, however, a fact that developing countries have not given the matter sufficient thought, since, in such a highly competitive sphere as the motor-vehicle industry, equipment is very often replaced before it has been technically amortized; developing countries would therefore be very well advised to try to obtain this equipment.

On the other hand, second-hand machine-tools may easily involve relatively high maintenance costs which might offset part or all of the advantage of a low purchase price.

/This is

This is a matter that must be looked into carefully at the time of buying. Tools, especially dies, stamps or casting moulds, would obviously have to be adapted to the machines they are destined for. Here again, it is impossible to make generalizations.

Finally, it should be noted that, if it did prove possible to use second-hand equipment, particularly pressing tools, production costs in developing countries would be reduced - provided of course that proper thought was given to the matter at the time of purchase. Using second-hand pressing tools, on the other hand, implies that the model being manufactured has already been on the market for several years, and this leads to the problem already mentioned in respect of a freeze on new models.

2.4 Production of special models

Another solution would be to design more simplified and stripped-down versions of motor vehicles than those produced in industrialized countries so as to reduce production cost to a more reasonable level. These could be along the lines of the Willys Jeep, with its fairly basic bodywork design; this solution has already been adopted in certain countries.^{9/} Two difficulties, however, would first have to be overcome:

- (a) the cost of designing special models (manufacturers so far seem to have decided that the planning and research needed could not normally be amortized);
- (b) the reticence of consumers (developing countries are apparently not prepared to accept such discriminatory solutions).

2.5 Modified production techniques

This area remains relatively unexplored and indeed, as far as mechanical parts are concerned, it does not seem very promising unless the entire concept of the motor vehicle is revised. As regards sheet metal work, however, there has hardly been any suggestion that developing countries should manufacture motor-vehicle bodies any differently from the methods employed in mass production factories and yet various new solutions could probably be found, such as using Zamak or plastic tools or making

^{9/} Argentina's Estanciera

/certain parts

certain parts in plastic.^{10/} To simplify matters, it would most likely be necessary to modify the body designs.

It is therefore impossible to reach any definite conclusion on this point: quite clearly, very little research has been carried out into techniques that industrialized countries rarely, or never, use and that involve a smaller capital outlay. Although the most that has been done so far is to contemplate using forty- or fifty-year-old techniques, modern scientific manufacturing methods could probably be found that would be more accessible to developing countries than those employed by the highly industrialized ones. The United Nations has in fact shown that research of this kind would be of considerable value for the countries of the third world and would therefore be prepared to support such efforts.

2.6 Conclusion

The above suggestions, which are designed for a framework of national self-sufficiency, would involve developing countries in manufacturing either outdated vehicles or vehicles that corresponded exclusively to their specific requirements, i.e. that were neither comfortable nor aesthetic. A more or less acceptable solution (and probably one of the best) would be to produce a vehicle that had already been discontinued by a rich country, freeze the model for a fairly long time - thereby accentuating its out-of-date character - and manufacture it with second-hand equipment.

A solution such as this, which in any case would not be perfect because production costs would probably still be much higher than in industrialized countries, would mean many sacrifices for consumers in developing countries; above all they would have to be prepared to pay at least as much for outdated vehicles as for recent models, and probably more.

^{10/} A move is being made in this direction in Mexico (Diesel Nacional).

/The same

The same difficulties apply to highly simplified and stripped-down vehicles.

If it were felt that it was too much to ask consumers to accept such sacrifices, then the only solution would be to develop new technologies. This too, however, has very doubtful prospects and would probably still mean that consumers had to accept a number of sacrifices as regards the quality or the appearance and comfort of the vehicles.

These then are the limitations to the various solutions based on national self-sufficiency. There is clearly very little room for manoeuvre since they come up against psychological obstacles whose repercussions can only really be assessed by the Governments of the countries concerned. Experience shows that few Governments are prepared to face up to the difficulties that such radical solutions are bound to bring in their wake.

3. Organization of production on a multinational basis: A new and promising solution

It is obvious that the proliferation of national motor-vehicle industries based on national self-sufficiency and stifled by inadequate markets cannot ever be a very satisfactory solution. By way of example, the figures for the passenger car markets of a few countries in 1965 were as follows:

Venezuela	42,000
Mexico	58,000
Morocco	125,000
Tunisia	3,000
Algeria	8,000

Many developing countries have such small domestic markets that there is possibility of no room for national self-sufficiency; others, such as Venezuela and Mexico, have large enough markets to support viable solutions of this kind provided they apply the methods set out in item 2 of this chapter, which they are not at all prepared to do.

/Since for

Since for one reason or another, there is no place for absolute national self-sufficiency on a satisfactory basis in the motor-vehicle industry of developing countries, it is necessary to investigate the possibility of organizing production on a multinational basis, examining first the advantages of specialization and then the way in which it could be organized; finally, an attempt will be made to assess the obstacles to solutions of this nature.

3.1 Advantages of specialization

Specialization is the only way of resolving the contradictions that have been inherent in the current efforts of developing countries to establishing national motor-vehicle industries. With specialization it should be possible

- to install units of production with a critical mass which can operate at competitive prices;
- to enable developing countries to export industrial products, which is of fundamental importance for their economic development;
- to give developing countries a normal range of vehicles;
- to apply industrial techniques to up-to-date vehicles and not simply to old models, as would be the case with any solution based on national self-sufficiency.

As can be seen, there are considerable advantages to be obtained from specialization.

For a developing country, the choice therefore lies between setting up a self-sufficient motor-vehicle industry in the appalling conditions that have been described above so as to promote employment, and going in for specialization with its two-fold advantage of providing the same amount of employment and establishing competitive, and therefore healthy, industries.

The most important thing for a country is not so much to manufacture vehicles independently as to establish industries capable of promoting employment and fostering exports.

Ultimately then, the choice lies between economic suicide, on one hand, and, on the other, normal and healthy development.

/3.2 Organization

3.2 Organization of specialization

A. Types of specialization

Specialization can mean two things:

- specialization by model of vehicle
- specialization by product.

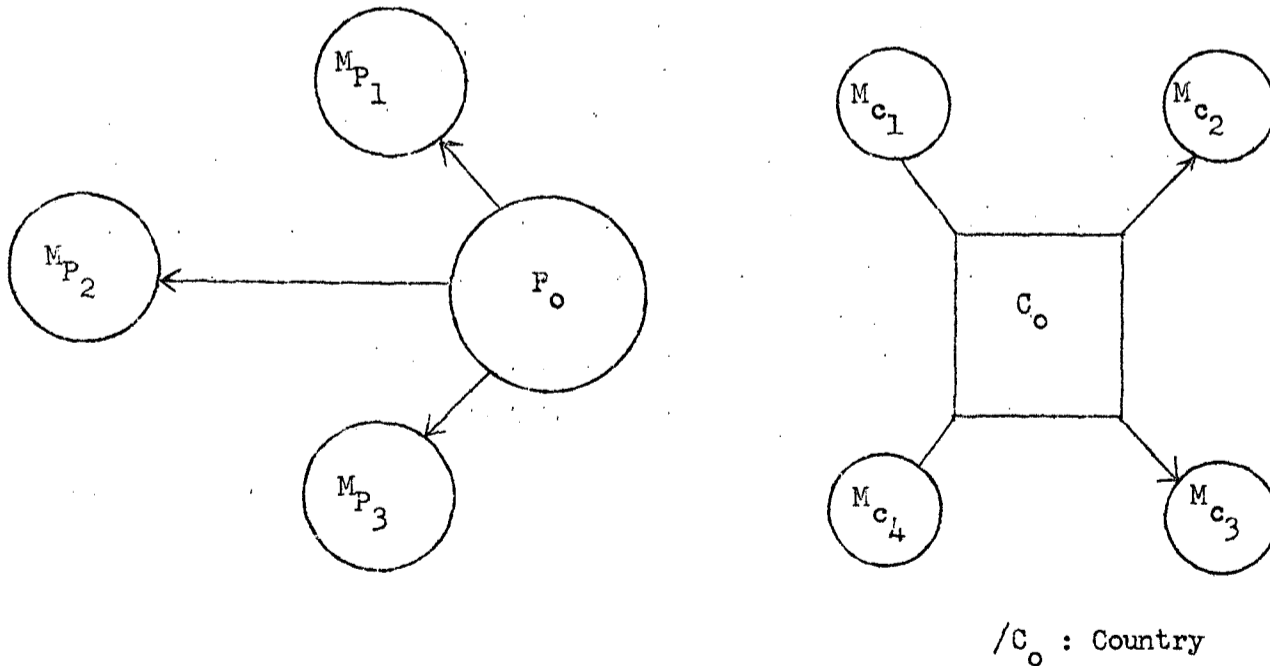
(a) Specialization by model: This means that a country concentrates all its industrial capacity on a single model, so that the production rate can reach a point of critical mass, and then exports this vehicle in exchange for a whole range of other vehicles.

This can be done either on a small or on a large scale, and therefore implies the adoption of a world strategy for motor-vehicle manufacturers.

There are three possibilities:

- Limited strategy: The export market of a country specializing in the production of a given model can be restricted to a specific geographical area, the size of which is determined by the number of vehicles to be exported annually and by the size of the markets of the peripheral countries.

This kind of strategy can be illustrated as follows:

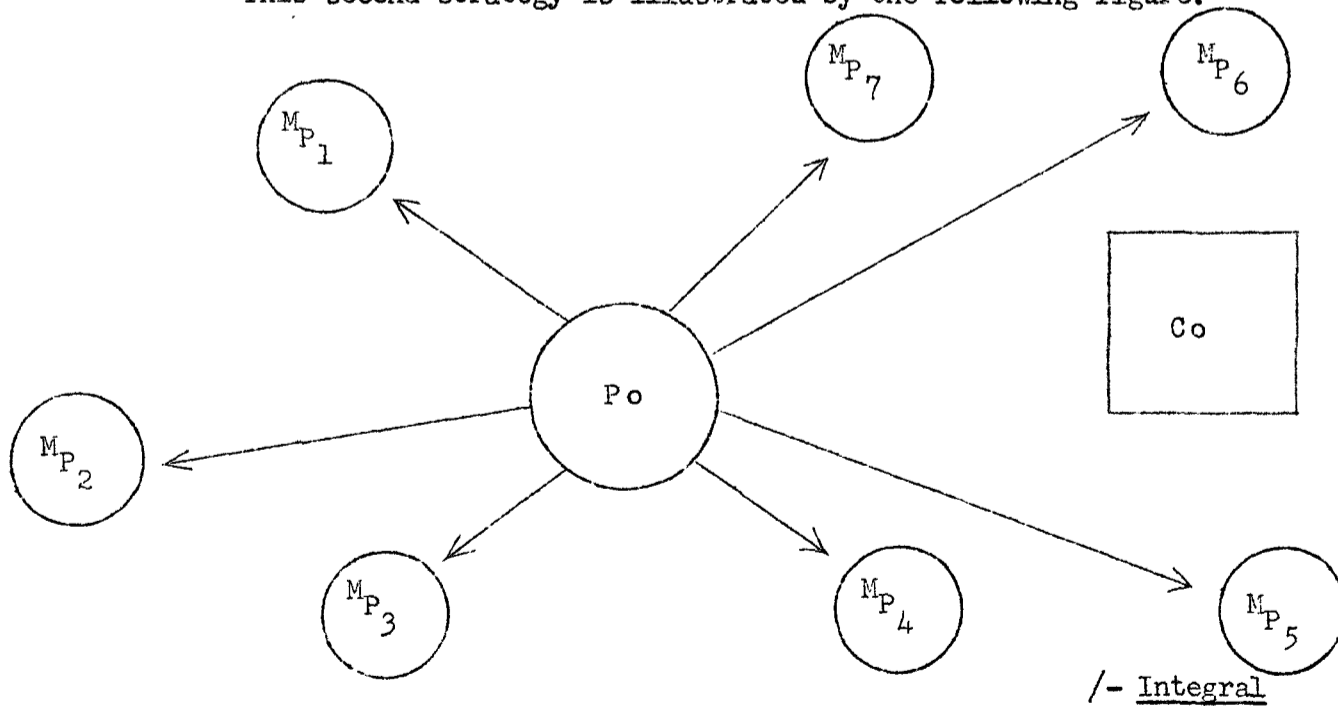


- C_o : Country of origin (parent company)
- $M_{c_1} - M_{c_2}$: Geographical area exploited by the parent company with model M
- $M_{c_3} - M_{c_4}$: Geographical area exploited by the parent company with model M
- P_o : Country locally specialized in production of model M
- $M_{P_1} - M_{P_2} - M_{P_3}$: Geographical area exploited by P_o with the same model M

-- Partial world strategy: According to this solution, the parent company (C_o) turns over production of the model (M) entirely to country P_o which then exports it throughout the world. Thus there is an agreement as to "range" between P_o and C_o . This strategy would be advisable in the event of a parent company's choosing to discontinue production of a vehicle which it considers outdated on the national market but which still has interesting prospects in other countries. The manufacturing equipment should then be transferred to country P_o which would then take over the entire world market.

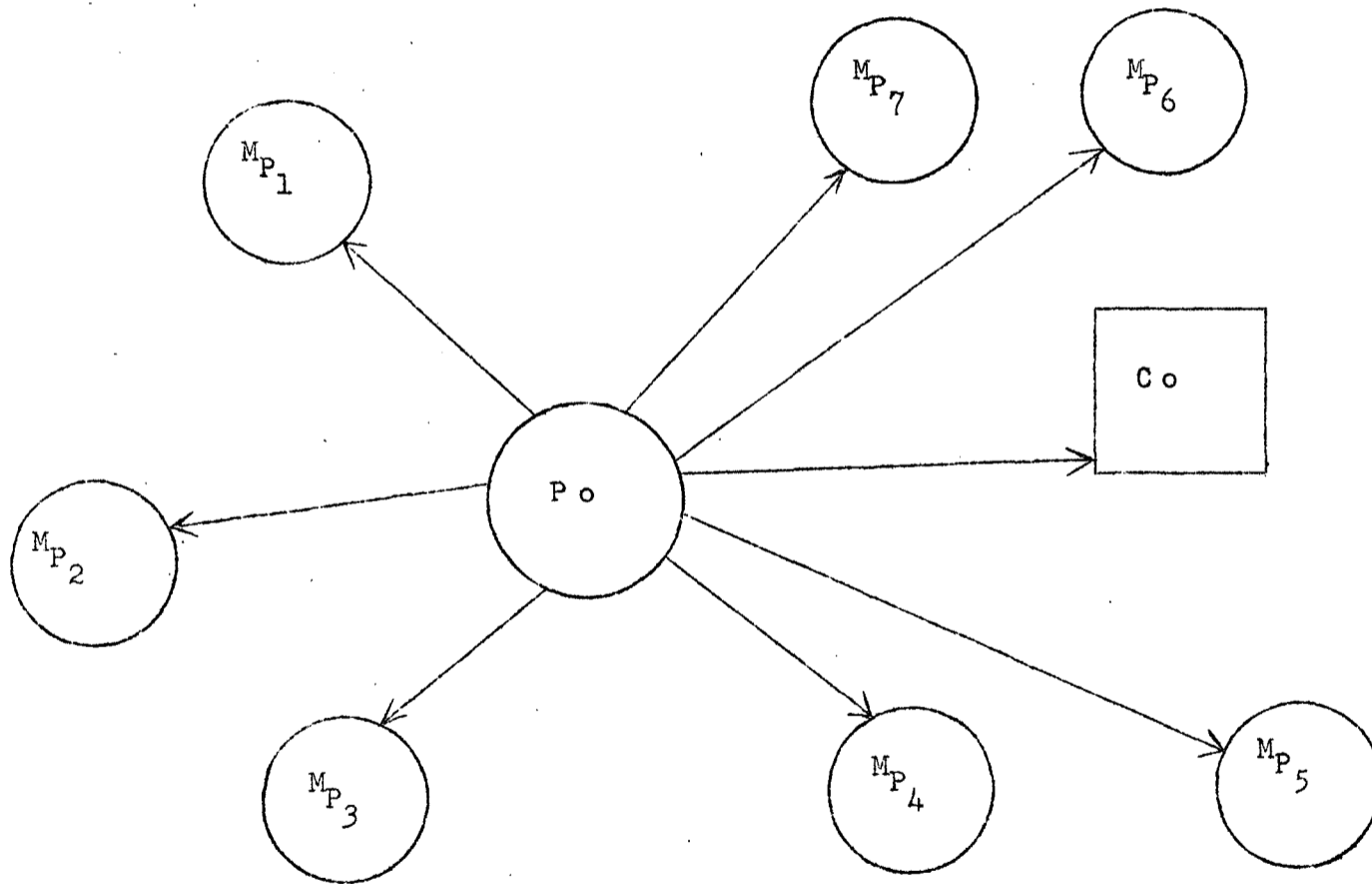
Observation: P_o would only supply C_o with spare parts for maintaining vehicles of this type already in use.

This second strategy is illustrated by the following figure:



- Integral world strategy: The third strategy would involve specializing country P_o in the manufacture of a model designed for export not only to the various world markets but to the domestic market of the parent company as well. Similar solutions have already been adopted in industries other than the motor-vehicle industry. It is to be recommended when it is less expensive to manufacture the vehicle in P_o than in C_o , i.e. when the difference in production costs is greater than the transport and related costs between P_o and C_o .

This situation is illustrated as follows:



/This strategy

This strategy corresponds to the pattern of development of sectors and countries described in item 1 of chapter IV. It renders the manufacturer in the advanced country responsible for designing the model and for making decisions as to methods employed, organization of sales and financial holding while leaving the actual manufacturing of the model to the developing country.

These then are the kinds of specialization strategies that could be followed as regards the model of vehicle. Naturally, the outline given here is merely theoretical and all the necessary calculations (transport costs, customs duties, etc.) would have to be made so as to assess the advantage or otherwise of applying the strategies proposed in each case.

(b) Specialization by product: If this solution were adopted, each country would specialize in producing one or more parts, one becoming a mass producer of pistons, another of dynamos and starters, a third of gear-boxes, and so on. From the point of view of a developing country, it is a simpler solution than the preceding one since, instead of manufacturing all the parts of a vehicle, it would only have to make a few of them. Here too, specialization can take the form of a limited strategy or an integral world strategy. In exchange for exports of its motor-vehicle parts, each country would receive the built-up vehicles it required.

Thus, if a developing country adopted one of these strategies, it would be paying for its imports of built-up vehicles with exports either of a specific type of vehicle or of certain mass-produced parts.

B. Role of developing countries

Developing countries are not as a rule sufficiently aware of the problems facing the motor-vehicle industry to be able to develop multinational solutions themselves. Even if they were, they would still find it very difficult to organize the fairly complex exchange system between the countries.

/A developing

A developing country should perhaps set about solving its problems in the following manner:

(a) Attitude towards the manufacturers

No attempt will be made here to enumerate the reciprocal obligations and duties of manufacturer and developing country. What follows is merely a guide as to the general attitude for a developing country to adopt in its negotiations with the manufacturer.

Rather than expect a manufacturer to develop a more or less fully integrated motor-vehicle industry on its territory, a developing country should encourage a system of compensation restricted to the metal-transforming industries. For reasons that have already been explained in previous chapters, the fundamental objective for a country in process of industrialization is clearly to promote national industries that are both competitive and able to export. In developing countries, most manufacturing branches in the motor-vehicle industry can only be competitive if they are also capable of exporting.

The obvious course for a developing country to follow is to ask the large manufacturers, who provide a natural outlet for their exports, to purchase a given product manufactured under normal conditions, as regards both quality and price. Consequently, developing countries must entirely revise their past definition of national content percentage. Rather than define it as the ratio between the value of the locally manufactured parts and that of the complete vehicle, it should be expressed as follows:

$$t = \frac{\text{value of parts purchased by the manufacturer in the country}}{\text{value of the manufacturer's sales in the country}}$$

Like the national content percentage, this ratio would evolve, so that when its value is equal to 1 the developing country and manufacturer will have reached a compensation point strictly limited to the metal-transforming industries.

/(b) Attitude

(b) Attitude towards the other developing countries

Every advantage is to be gained from countries getting together and agreeing on the best way of synchronizing their decisions in matters of industrialization. Negotiations with major manufacturers may go no further than has been suggested in the previous paragraph. The solutions arrived at, however, will be all the more satisfactory if multinational agreements can be reached involving at least two and preferably more countries. A manufacturer who undertook to purchase parts from a country in exchange for motor-vehicle sales would obviously have to be able to use them within a reasonable radius; any agreement that could be reached between several countries would therefore greatly assist the manufacturer in this direction. Unfortunately, it is well known that countries have tremendous difficulty harmonizing their economic policies.

(c) Role of the manufacturers

It would appear that the manufacturers' role should be to enlighten the developing countries and point out how their problems could be solved. This they could do in three ways:

- (i) Direct action vis-a-vis the developing countries: Nobody is better placed than the manufacturers themselves to discover the most satisfactory economic solutions both for themselves and for the developing countries. Thus, by starting on a small scale and dealing with these countries two by two at first, they could for instance suggest to two neighbouring countries that they specialize in making certain parts which they could trade on a compensation basis. Many countries, and particularly the members of the Latin American Free Trade Association, would be very interested in this kind of approach.
- (ii) Joint action on the part of the manufacturers: It would apparently also be to the manufacturers' advantage to act in concert. The number of manufacturers interested in a given group of countries is generally very limited; there are even fewer (usually less than five or six) that have already established themselves in several peripheral countries. Therefore, taking the problem on a regional basis, the few manufacturers involved in a limited
/group of

group of countries would probably have to consult one another so as to agree on a joint strategy entitling the submission of specific proposals to the countries concerned. In the long run, we do not see any advantage for the manufacturers in developing countries if these countries are subject to contradictory pressures. This is an approach that should be looked into more deeply, though with considerable caution, since the fierce competition that exists between the various manufacturers and the instability of many developing countries do not leave a great deal of room for optimism.

- (iii) Action vis-a-vis international agencies: Direct action in front of the developing countries can be paralleled with an approach to international agencies. Manufacturers would do well to co-operate with agencies responsible for advising developing countries so as to help them develop proposals for harmonizing policies which they could suggest to these countries.

While partial agreements within a limited geographical area are feasible, the more comprehensive type of agreement is still kind of utopic. It would be a mistake to try to do too much too quickly. It would already be a major step if agreements could be reached between just two or three countries.

3.3 Obstacles to the organization of production on a multinational basis

This study is not concerned with possible economic obstacles, since there can be no real economic argument against economically valid solutions; it must be remembered that the strategies outlined above can only be adopted if calculations as to transport costs, the cost of intermediate stocks and customs duties indicate that such solutions are feasible. Obstacles from the point of view of customs tariffs, too, can be left to one side since these can be settled by careful negotiation and are therefore more apparent than real.

/The real

The real difficulties arise from the inevitable fact that, as far as the manufacturers ultimately responsible for co-ordinating these operations are concerned, the outcome of a multinational system of production is unforeseeable. Production in a developing country is far more unpredictable and more easily upset than in a developed country.

Political risks are especially serious and difficult to assess, which means that the "integral world strategies" outlined above are perhaps somewhat premature at this stage.^{11/} On the other hand, because of their limited geographical scope, "partial world strategies" are definitely feasible. The best solution, therefore, would appear to be for the manufacturers, developing countries and international agencies assisting them, to look into this possibility carefully and attempt to bring about a certain number of initial achievements that will enable the developing countries to get themselves out of the route that they have been in for such a long time.

^{11/} They could however be contemplated for the developing countries in Europe (Spain, Portugal, Greece).

