Technology and emplyment: The case of Turkish manufacturing industry

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TECHNOLOGY AND EMPLOYMENT

THE CASE OF TURKISH MANUFACTURING INDUSTRY

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ABBREVIATIONS

AID : Agency for International Development
EEC : European Economic Community
FFYDP : First Five-Year Development Plan of Turkey(1963-76) (The First Plan)
GNP : Gross National Product
GDP : Gross Domestic Product
ILO : United Nations, International Labour Office
NPC : National Productivity Center of Turkey (MPM)
OECD : Organization for Economic Cooperation and Development
R and D: Research and Development
SEE : State Economic Enterprises
SFYDP : Second Five-Year Development Plan of Turkey(1968-72) (The Second Plan)
SIS : State Institute of Statistics of Turkey (DIE)
T.C. : Turkish Republic
TFYDP : Third Five-Year Development Plan of Turkey (1973-77) (The Third Plan)
TL : Turkish Lira
TUSIAD : Turkish Industrialists' and Businessmen's Association
TUBITAK: Scientific and Technical Research Council of Turkey
UDC : Underdeveloped Country
UNCTAD : United Nations Conference on Trade and Development
Union of Chambers- Union of Chambers of Industry, Commerce and Commodity Exchanges of Turkey

INTRODUCTION

In a number of underdeveloped countries, increasing unemployment and a rapid industrial growth have occured simultaneously, during the last two decades.[1] Notwithstanding the efforts made in the rural sector to offer more employment, it has been realized that there are limits to the expansion of agriculture and these limits have become more severe as the available spare land has dwindled.[2] It has been therefore argued that it is the industrial sector and manufacturing sector in particular, that will create a sustained growth of employment. The simultaneous growth of industry and open urban unemployment, however, has directed the attention of development economists more than ever during the last fifteen years, towards the possibilities of creating more employment opportunities than at the present, in the growing industrial sector. When the pattern of industrial growth that has taken place in a number of underdeveloped countries has been reviewed, one of the leading solutions to the problem has been found in the field of technology.

More specifically, it has been suggested that for the manufacturing sector, to be able to absorb a larger portion of the increasing labour force, the average level of employment it creates per unit of investment must be higher-given the assumption that the present saving/investment capacity of the industrializing countries can not be increased to a sufficient level to absorb the present unemployed labour force.[3] This suggestion, however, involves an inherent contradiction with some of the "modernization ideals" which have been widely adopted at various levels and within varying contexts, by many industrializing countries.

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1. For a review of some examples from Latin America, see, ILO, Towards Full Employment, Geneva (1970).
2. ibid. Also, see, A.C.Kelly, G.J.Williamson and R.J.Cheetham, "Biased Technological Progress and Labour Force Growth in a Dualistic Economy", Quarterly Journal of Economics , LXXXVI (August 1972), pp.426-47
3. For references to various authors, see Chapters 2 and 3.

G. Myrdal notes that among the prominent components of the "modernization ideals" are, development, rise of productivity and rise of levels of living.[4] These ideals stress the significant difference in initial conditions of development in the newly industrializing countries as compared with the Western countries in their early stages of development since the Industrial Revolution. As D.S.Landes says : "The term 'industrial revolution'... usually refers to that complex of technological innovations which, by substituting machines for human skill and inanimate power for human and animal force, brings about a shift from handicraft to manufacture and, so doing, gives birth to a modern economy. In this sense, the industrial revolution has transformed a number of countries, though in an unequal degree ; other societies are in throes of change ; the turn of still others is yet to come".[5]

The level of productivity has been usually taken as an indication of economic development, and higher output per head of population or the labour force, is a commonly shared goal of development planning-which has been adopted as an instrument of economic development, in most of the underdeveloped countries.[6] The theoretical and emprical investigations of the last two decades have shown that the explanations of the changes in productivity primarily lie in the technological field. The rate of technical advance is defined by reference to the rate at which unit costs of production fall when factor prices are constant.[7] An abstract definition of technology consists of (i) the efficiency in transforming a given combination of inputs into output; (ii) technologically determined economies of scale; (iii) capital intensity ; and, (iv) the ease with which capital is substituted with labour- which implies a presumed relationship between capital intensity and factor prices within a neo-classical framework.[8] An

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4. To these, G.K.Mydral adds, 'rationality', 'planning for development', 'social and economic equalization', 'improved institutions and attitudes', 'national consolidation', 'national independence', 'political democracy' and 'social discipline. See, Asian Drama, <u>An Inquiry Into The Proverty of Nations</u>, A Twentieth Century Fund Study(1968), Part 1 and Ch.2
5. D.S.Landes, <u>The Unbound Prometheus</u>, Cambridge U.P.,(1970), p.1
6. see, G.K.Mydral, op.cit., pp.58-59.
7. W.E.G. Salter, <u>Productivity and Technical Change</u>, Cambridge U.P. (1968) Chapter 3.
8. see, M.Brown, <u>On the Theory and Measurement of Technological Change</u>, Cambridge U.P.(1968), pp.12-26

analysis of the relationship between employment and technical change is in fact an analysis of these elements of technology in relation to employment. Since investment in technology involves the total capital costs arising in innovating new methods and processes, a reduction in the level of investments per employee means a negative association between the elements of an abstrack technology and employment measured in natural quantity.[9]

An analysis of technical change in relation to the increase in productivity in underdeveloped economies cannot be made in isolation from the production conditions in these countries.[10] Together with low output per worker and low income per head of population, a set of conditions in the field of production characterize the level of underdevelopment, which are in turn among the causes of low labour productivity and low income per head. Various authors have agreed upon the following conditions of production to this respect :[11]

small industrial sector
little capital per worker
low labour utilisation :
    low participation
    short duration
    low efficiency
primitive and crude techniques
absence of economies of scale
absence of specialisation
scarcity of products requiring much capital
small savings per head of the bulk of the population
concentration of exports on a few primary products

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9. Alternative measures of capital and labour, are discussed in Chapter 2.
10. In fact, an analysis of technical change in relation to the increase in productivity cannot be made in isolation from the movements of economic variables-like investments,output,demand,income,distribution,employment and market structure. Because intentive activity is induced by economic factors and innovation-the use of new knowledge for production purposes-affects the pattern of behaviour of the economic variables.
11. see, P.Streeten, The Frontiers of Development Studies, Macmillan (1972), pp.34-37 ; and, G.K.Mydral, op.cit., pp.1861-1864.

inadequate social and physical infrastructure
low volume of intrenational trade per head
low output per acre, particularly of protein foods
little enterprise

For development to occur, these conditions should improve. However, this arbitrary grouping broadly indicates that some of the components of the production conditions that must be improved as a precondition of 'modernization' and 'development' may tend to diverge from the employment maximization criterion which has been summarized earlier.

However, two points should be made clear at this stage :

First, it is possible to state that the main aim of economic activity in underdeveloped countries is to increase per capita income and to raise the standard of living within a foreseeble time dimension. Creation of employment opportunities may be the only mechanism by which arrise in the standard of living can be achieved in those countries which are typically suffering from chronic unemployment. If this case and the above-mentioned divergence are relevant then some components of the "modernization ideals" which have been pointed earlier are contradictory to each other. Consequently, an alternative definition of economic development consider the possibility of sacrife of a certain proportion of the rate of productivity rise in order to create higher levels of employment ; otherwise the element of a rise in the levels of living should be excluded from the definition of development. In both cases, the time preference on the maximization of either of these two factors, is an important determinant.

Second, is there an obvious conflict in reality, between a grossly defined increase in productivity and employment ? This question will be attempted to be made clear in the course of the present research.

The present thesis is an enquiry into the relationship between employment and technical change in Turkish Manufacturing Industry. In the course of our enquiry we deal with such questions as following :

- What is the impact of productivity growth upon the rate of growth of industrial employment ?
- Are factors such as large scale production, factor price ratios, distribution of productivity gains, long-term trend of investment involving

embodied technology, and capital efficiency, significant productivity determinants acting on concert with the level of capital-intensity ?

- What differences exist in relation to above-mentioned questions among manufacturing subsectors, individual investment projects and establishments with different size ?
- Is there any relationship between the possible trends and the sources of technology in terms of domestic scientific and technological capabilities and transfer of technology from advanced industrial nations ?
- What policy recommendations can be made in relation to the Turkish case, in order to alleviate unemployment without necessarily contradicting with the 'modernization ideals' ?

This thesis consists of four parts and fifteen chapters distributed to each part. The order of these is as follows ;

Part One : Deals with a discussion of the basic concepts and a review of literature to draw a general fframework of analysis for the rest of the thesis.

Chapter 1, discusses the meaning and the components of technical change.

Chapter 2, discusses the different concepts of 'choice of techniques' and their importance from the viewpoint of employment

Chapter 3, analyses the content and the possible censequences of alternative definitions of "appropriate technology" in relation to employment.

Chapter 4, attempts to determine the factors leading to technological dependence of the underdeveloped countries and its impact on the pattern of present technical change.

Chapter 5, is an attempt to give a brief summary of the alternative channels of transfer of technology and their desiratum from the point of view of the underdeveloped countries.

Part Two : Examines the relationship between employment and technology in Turkish Manufacturing Industry.

Chapter 6, provides a brief review of the present development of the manufacturing industry and increasing unemployment in Turkey.

Chapter 7, studies the present capital-intensive bias in the manufacturing sector and its implications in relation to the levels of employment and productivity.

Chapter 8, enlargens the analysis made in the previous chapter, by the size of establishments, in manufacturing subsectors and as total manufacturing activity.

Chapter 9, is an attempt to determine the present R and D capacity and organization in Turkey.

Chapter 10, examines the relative weight of alternative sources of technical change, in the manufacturing sector.

Chapter 11, attempts to evaluate the influence of foreign capital investments on technology and employment.

Part Three: Is an attempt to test some of the conclusions of Part II, with a case study in the iron and steel industry.

Chapter 12, discusses the relative importance of the iron and steel industry in the Turkish industrial development.

Chapter 13, gives a brief outline of the alternative technologies available for integrated iron and steel plants.

Chapter 14, studies transfer of technology in the case of Ereğli Iron and Steel Plant.

Part Four: discusses the possible policy recommendations in relation to technology that may increase the present employment absorbtion capacity of the manufacturing sector.

Chapter 15, also reviews the present policies in the development plans, on science, technology and employment.

PART I

BASIC CONCEPTS
AND
THEORETICAL FRAMEWORK

CHAPTER 1

THE MEANING AND THE COMPONENTS OF TECHNICAL CHANGE

The concept of technology has become one of the core of discussions besetting economic development since it has been distinguished as a major factor of production besides the classical production factors of labour and capital. In the developed market economies, with the possibility of recources fully employed, productivity has become the centreplace of economic development, as the new economic problem has become one of increasing the yield of economic resources.[1] As far as the underdeveloped countries (UDC's) are concerned, the choice of an appropriate technology as well as the problem of increasing the yield of economic resources, has been the major source of controversy for well over two decades. However, the exposition of the problem in this way is merely rising more questions than it answers. One of the basic reasonsfor this is the lack of clear definitions on the meaning and components of technical change. This Chapter, therefore, is an attempt to define - or possibly to redefine - the meaning and the components of technical change.

1.1 THE MEANING OF TECHNOLOGICAL PROGRESS

The concepts of "technological progress" and "technical change" are usually taken as synonimous. However, "technology is the sum of all the new methods of production and application of materials, machines and structures".[2] It is a code of doing things. When the new body of knowledge involved in technological progress is applied in the field of production, it becomes "technical change". In other words a technique is the applied part of the technology.

1. see, W.E.G.Salter, Productivity and Technical Change, Cambridge U.P. (1961), p.1
2. C.L.Boltz, Technology and Economic Development, The Economic Research Foundation, Istanbul (1970), p.51

C.L.Boltz, referring to the conference organized by the International Labour Organization at Geneva in 1962 says that technical change was defined as: "Technical innovations, whether they arise individually or in groups, present themselves as mechanization, automation, acceptance of new working procedures and processes, and employment of new equipment and new methods in business organization".[3] In the sense that all technology tends to take the place of manual energy, the terms in this definition can be accepted-mechanization, automation, new processes, new equipment. But it is hardly enough in this present context, for it omits all mention of science or research. It is not a full enough definition to consider here in relation to economic development.

Engineers would identify technology by the nature of the physical and chemical transformations involved or the equipment producing them. In this sense there are many technologies and it is their sum that we are concerned with. Economists would not need to know about physics and chemistry or even engineering. They would identify technologies by the production factors and the outputs.

According to R.Solow, "technical change...(is)... a shorthand expression for <u>any kind of shift</u> in the production function. Thus slow downs, speedups, improvements in the education of labour force, and all sorts of things will appear as 'technical change' ".[4] This neo-classical definition is, in fact, an extension of "the residual" into the sphere of production functions. What is "the residual" ?

The contribution to economic growth of technical change has been given increasing attention during the post-World War II period, particularly since the appearence of an article by Moses Abramowitz.[5] In this article, he suggested that the entire increase in net product <u>per capita</u> was associated with the increase in something other than the inputs of physical capital stock and the services of labour. This "increase in something" was later called "the residual". There has been quite a number of discussions on the components of "the residual" and a variety of approaches have produced diversified results on the basis

3. ibid., pp.50-51
4. R.Solow, "Technical Change and Aggregate Production Function", <u>Review of Economics and Statistics</u> (August 1957), pp.312-20
5. M.Abramowitz, "Resource and Output Trends in the United States Since 1870", <u>Papers and Proceedings of American Economic Association,</u> vol.46 (may 1956), pp.5-23

of different bodies of data, covering different time periods. However, the common result of these studies has been that the contribution to economic growth of variable technologies is as equally important as the traditional labour and capital factors.[6]

E.Denison clarifies the components of the residual and tentatively quantifies their effect on economic growth, in his remarkable book.[7] The following sources of growth are distinguished : labour input, broken down into the components employment, hours of work, age-sex composition and education ; capital input, broken down into dwellings, international assets, non-residential structures and equipment, and inventories; improved allocation of resources, broken down into contraction of agricultural inputs, contraction of non-agricultural self-employment and reduction of international trade barries ; scale economies ; two special items relating to the capital stock, reduction in its age, and improved balance in its composition ; advances in knowledge and finally,a residual item.

E. Denison's study attempts for allocating growth quantitively between sources in terms of what were the soruces of the differences in the growth rates achieved over the period 1950-62 in the United States, Belgium, Denmark, France, Germany, the Netherlands, Norway, the United Kingdom and Italy ; and what were the sources of the differences between those countries in the level of income in 1960 ? The comparisons of these levels very greatly added to the statistical difficulties of the exercise, and Denison warns that they are less firmly based than the comparisons of growth rates.

Embodied and Disembodied Technology

Disembodied technology applies equally and alike to all resources of men and machines in current use. Such technical progress repre-

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6. For a review of literature, see, C.Kennedy and A.P.Thirlwall,"A Survey of Applied Economics: Technical Progress"The Economic Journal, (March 1972), pp.11-72
7. E.F.Denison, assisted by J.P.Pouillier, Why Growth Rates Differ:Postwar Experience in Nine Western Countries, Washington D.C.;The Brookings Institution, (1967). see, also, the review " Whay Growth Rates Differ", by R.C.D.Matthews, The Economic Journal, (June 1969)

sents technical know-how falling like a "manna from heaven".[8] It arises mainly as a consequence of progress in administration and organization. It is a form of technical change which is independent of the investments and capital stock. The basic assumption on the nature of capital input is that it is homogeneous.

Embodied technical progress applies not to the whole range of available resources, but only to certain tranches of capital equipment, usually machines produced and installed currently, together with the associated labour input. Capital is no longer assumed to be homogeneous. On the contrary, capital becomes essentially a mixed stock of different 'vintages'. Machines of one vintage are different in kind from those of another ; because of embodied technical progress, new machines are more productive than older (if otherwise similar) machines. Further, labour may be treated in a similar way by giving up the assumption of a homogeneous labour force and by taking men of different 'vintages', distinguished by age and training. Men of the current vintage, e.g. those recently trained, are then more productive than those of earlier vintages.

1.2 THE COMPONENTS OF TECHNOLOGICAL PROGRESS

Estimation of technical change through the movements of partial or total factor productivity has been quite common.[9]

8. R.G.D. Allen, Macro-Economic Theory, New York (1967), St.Martin's Press, pp. 236-37.
9. The early attempts to measure technical progress were simply dealing with the partial productivity-usually labour."In spite of the widely held impression to the contrary, such measurements (may) not be used to determine the efficiency of the workman himself, that is to say,high degree of skill or the application with which he works. On the contrary, much of the significance of such measurements consist in relating production to that factor in production which is least likely to change but which is probably most sensitive to any alteration in any other factor". See,O.E.E.C., Measurement of Productivity, Technical Assistance Mission no's 7,10,11 ; Paris, p.15. Estimation of the residual through the movements of total factor productivity can be various. For example,B.L. Lave says that between 1909-1949, employed capital per man-hour in the private, non-farm sector of the USA rose by 31.5 percent.This increase in capital should have given rise to an increase in per capita output about 10 percent. The data showed that output per man-hour rose 104.6 percent

However, an interpretive analysis of how technical change leads to a shift productivity requires understanding of the content of technical change. This has been made by defining the components of an "abstract technology", in the neo-classical world.

An Abstract Technology

M.Brown defines a technological change in terms of changes in the characteristics of an abstract technology. This definition is based on the production function which expresses the way in which outputs are produced by inputs and the way inputs co-operate with each other in varying proportions to produce any given output. These relations between outputs and inputs themselves are determined by the technology that rules at any given time. There are four characteristics of the production function which are called, taken together, an abstract technology.[10] Once these characteristics are identified, it is relatively easy to define a technological change.

a. The Efficiency of a Technology : for given inputs, and given the other characteristics of an abstract technology, the efficiency characteristics determines the output that results. If it is large, than output is large, irrespective of the plant and equipment and the labour employed, etc. One can think of the efficiency characteristics as a scale transformation of inputs into output.

b. Economies of Scale : for a given proportional increase in all inputs, if output is increased by a larger proportion, the firm enjoys increasing returns (or economies of scale) ; if output is increased by the same proportion, there are constant returns to scale ; and if output is increased by a smaller proportion, decreasing returns result (or diseconomies of scale). Economies of scale can be taken in two categories : first, those arising from the general development of industry ; and secondly, those dependent on the resources of the individual houses of business engaged

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over that period. See, B.L.Lave, Technological Change:Its Conception and Measurement, Prentice-Hall (1966), p.4

10. M.Brown, On the Theory and Measurement of Technical Change, Cambridge U.P., (1968) pp.12-22

in it, on their organization and the efficiency of their management. We may call the former external economies, and the latter internal economies.[11] If a single firm encounters increasing returns as it expands its own scale we say that it has internal economies of scale, while if it encounters decreasing returns we say it has internal diseconomies of scale. Within the present study, this distinction will be kept in mind while dealing with micro and macro economic variables.

c. The Capital Intensity of a Technology : This is the quantity of capital relative to the quantity of labour used in the production process. Since the transfer of technologies from capital-rich countries to capital-poor ones is one of the basic discussions that this thesis deals with, the capital-intensity characteristic of a technology is a crucial one. However, when we talk about the capital-intensity characteristic of a technology, we are concerned with the technological requirements of the production process, not the effects of relative factor supplies. The effects of relative factor supplies reflected by the relative factor prices may have an influence on the adoption of alternative production functions with varying capital-intensities. The capital/labour ratio is taken as an exogenous variable for an entrepreneur who may be facing with alternative factor scarcities or abudance. For example, given the relative dearth of labour input, entrepreneurs may wish to emloy more highly mechanized techniques, which simply means the adoption of higher capital/labour ratios.

d. The Ease With Which Capital Is Substituted For Labour :This is known as the elasticity of substitution which is defined as "the proportional change in the relative factor inputs to a proportional change in the relative factor price ratio". According to A.Marshall, every agent of production, land, machinery, skilled labour, etc., tends to be applied in production as far as it profitably can be. If employers, and other business men, think that they can get a better result by using a little more of any one agent they will do so.[12] The elasticity of substitution developed by J.R.Hicks, tells us how rapidly diminishing returns set in to one factor of production when its price falls relative to another factor price.[13]

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11. see, "Long-run Variations in Output", in Positive Economics, by R.G. Lipsey, London (1964), pp. 191-194.
12. A.Marshall, Principles of Economics, p.521 ; ref. made by M.Brown op. cit., pp.17-18
13. J.R.Hicks, The Theory of Wages, pp.119-35. 233-46 ; ref.made by M.Brown, ibid.

The elasticity of substitution can take on any value between zero and infinity, always being positive. If it is equal to one, it is called unitary elasticity, if less than one, it is inelastic, and, if greater than one, it is elastic.

The elasticity of substition has a high analytical value, particularly in a quantitative approach. However, it assumes a continuous substitution between the two factors of production is possible in establishing a static equilibrium. The dynamic nature of technical change creates an important drawback in dealing with the theory of production. For example, so long as the plant is in existence, the possibility of economising by changing the method of production is small ; but as the plant comes to be renewed it will be in entrepreneur's interest to make a radical change. In the pre-investment stage, however, there may only be fixed-factor-ratios as available alternatives. On the other hand, "certain adjustments to changing conditions take long periods of time to work themselves out, particularly when capital equipment is involved. While static equilibrium analysis tells us the equilibrium which would be reached if no further changes occured, in fact, change is continuous... continuous disturbance and slow adjustment are essential features of technical change...The 'once-over' analysis of comperative statics is only appropriate to changes in technique which are sufficiently great to displace completely all pre-existing methods before they themselves are displaced".[14] As far as the UDC's are concerned, most of the industries are transplanted for the first time and the question is mostly limited to the pre-investment stage of erecting a plant.

A Neutral Technical Change

According to E.Mansfield, a neutral technical change saves both labour and capital, but at the same proportion. For example, the assembly line principle saved both labour and capital ; but since it saved labour at a higher percentage than it saved capital, it was a labour-saving, or, capital-intensive technical progress.[15]

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14. W.E.G.Salter, Productivity and Technical Change, Cambridge U.P.(1961), p.5
15. E.Mansfield, The Economies of Technological Change, New York (1968) pp.20-21

In the neo-classical terminology, a neutral change is one which produces a variation in the production relation, itself, but does not affect the marginal rate of substitution of labour for capital. A non-neutral technological change alters the production function and can be either labour-saving (capital-using) or capital-saving (labour-using). If the production function is altered such that the marginal product of capital rises relative to the marginal product of labour for each combination of capital and labour, there is said to occur a capital-using (labour-saving) technological change. A capital-saving change occurs when the marginal rate of substitution of labour for capital is lowered at every combination of capital and labour. These are definitions developed by J.R. Hicks.[16] In terms of the abstract technology, variations in the efficiency of a technology and economies of scale produce neutral technological changes.[17]

The Harrod-neutral technical change assumes a constant capital/output ratio while the capital/labour ratios may be altered by technical change.[18] This definition of neutrality will be left out ; since the Hicksian approach suits the purposes of the present study.

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16. see, W.E.G. Salter, op.cit., pp. 32-34
17. M.Brown, op.cit., p.21
18. see, C.Kennedy, "Harrod on Neutrality", <u>Economic Journal</u>, vol.72 (March 1962),pp.249-350. According to R.F.Harrod, neutrality implies output (Q) and capital (C) grow at the same warranted rate, where labour (L) and capital are homogenous and substitutable continuously. A production function $Q=f(C,L)$ shifts over time as a result of an all round increase in the efficiency of labour : $Q'=f(C,zL)$; labour and capital are measured in natural units (e.g.machine hour and labour hour) and z is the rate at which the efficiency of labour increases as a function of time : $z=z(t)$.If(z) is greater than 1 as time goes on, and its rate of increase is positive : $z'(t)>0$. If the rate of technical progress is m, it increases as e^{mt}, where $\bar{L}=e^{mt}.L$; $\bar{L}$ is the measured efficiency units of labour instead of natural units. By substituting this into the production function we get $Q'=f(C,\bar{L})$.

    In fact this is a lasour-augmenting technical change at a rate m. if population naturally increases at a rate n, overall rate of economic growth will be m+n, in a Harrod-Domar growth model.

    Apparently, this rules out the incresae in the efficiency of capital. In Hicksian case, efficiency increases at the same rate for both labour and capital. Accordingly, $Q'=f(zC,zL)$ which is equal to $Q'=z^x f(C,L)$: x represents the returns to scale. If the efficiency of either factor

1.3 IS TECHNICAL CHANGE "A MANNA FROM HEAVEN" ?

Neo-classical production theory treats changes in technology as exogenous to the firm and the economy. New methods of production and processes come into existence outside the economic system. Each factor of production is homogenous as far as its technological characteristics are concerned ; for example, all vintages of capital share equally in progress. Neoclassical theory thus treats technology as " a manna from heaven ".[19]

Contrary to this assumption, new technologies are created somewhere either within outside of a particular sphere of production. Some recent studies on the sources of invention indicate that of patented inventions over 60 percent were made within profit making firms. Although the great majority of the existing firms are not directly engaged in research and development activities, they are usually engaged in improving their organizational efficiency, learning process, etc.[20] K.Arrow postulates that productivity per worker is determined by accumulated gross investment ; the production of new knowledge and the transmission and application of that knowledge are treated as by-products in the production and adaption of new goods.[21] K.Shell concludes that technological progress is related to gross investment both as a by-product of capital goods production and as a vehicle for embodying new techniques in the new capital equipment ; and, the rate of production of technical knowledge can be increased by increasing the allocation of resources devoted to inventive activity.[22] J.Schmookler studied the relationship between patents and capital formations and production in petroleum refining and building indus-

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increases faster, it is a biased technical change in Hicksian sense. When marginal efficiency of both factors increase at the same rate, their marginal productivities are expected to increase at the same rate in a perfectly competitive world, leaving the pattern of distribution of net output between labour and capital unchanged.

19. see, C.Kennedy and A.P.Thirlwall, op.cit., pp.17-19
20. B.Ustunel, op.cit., pp.2-3 Refers to J.Schmookler, et.al.
21. K.Arrow, "The Economic Implications of Learning by Doing", Review of Economic Studies, (June 1962), pp.157-173
22. K.Shell, "Towards a Theory of Inventive Activity and Capital Accumulation", "American Economic Review", (May 1966), pp.62-63

tries.[23] He reached the conclusion that the basic inventions which establish new industries are induced by economic sources like those which appear to operate in already established industries. C.Kennedy points out that under certain assumptions, labour-saving innovations were induced by historically rising wage-rental ratios.[24] According to H.J.Habakkuk relative ffactor scarcities stimulated mechanisation in USA in the nineteenth century.[25]

According to J.Schumpeter, the agent of change is the entrepreneur who is "essentially putting productive resources to uses hitherto untried in pratice,and withdrawing them from the uses they served so far.[26] Aided by the elasticity of the cash and credit system, he acquires an entrepreneurial profit which is the primary source of investments. Schumpeter also applies the term 'innovator' to the entrepreneur, suggesting a kind of differentiation from inventors in the technical fields. A.P.Usher shows that inventions which open up a new practical use may involve a large degree of novelty of both engineers and technicians and the administrative staff of an enterprise in production stage, although the beginnings of commercial application may precede the full accomplishment of invention.[27]

Technical change is somewhat exogenous to an UDC, whose productivity can be increased by the mere transfer of techniques already known in the developed countries. However, this does not imply that the flow of inventions to these countries are automatic sources of gain or 'a manna from heaven' that every country linked to the transfer mechanisms can easily enjoy. A detailed account of this phenomenon will be given in the following chapters.

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23. J.Schmookler, "Economic Sources of Inventive Activity", Journal of Economic History, (March 1962), pp. 1-20
24. C.Kennedy, "Induced Bias in Innovation and the Theory of Distribution", Economic Journal, LXXIV (Sept.1964), pp. 541-47.
25. H.J.Habakkuk, American and British Technology in the Nineteenth Century: The Search for Labour-Saving Inventions, Cambridge U.P. (1962)
26. J.Schumpeter, "The Instability of Capitalism" (1928) in The Economics of Technological Change, N.Rosenberg(ed),Penguin (1971),pp.31-32,35-36
27. A.P.Usher, "Technical Change and Capital Formation", in The Economics of Technological Change, ibid., pp.47,55

1.4 THE ELEMENTS OF TECHNICAL KNOWLEDGE IN THE TRANSFER OF TECHNOLOGY

The transfer of technology may be from one country to another and from one enterprise to another, between the developed and the developing countries and among developing countries themselves. Technology transfer can be either the transfer of basic scientific knowledge to technology or the adaptation of an existing technology to a new use. In either case the components of technological progress is the subject matter of the transfer.

The transfer of technology from advanced to developing countries is a consequence of attempts to industrialise on the base of a pre-existent economic structure which is incapable of generating the skills required to originate, introduce or operate the technologies required to meet growing consumer demands. C.Cooper and F.Sercovitch define transfer as follows :

"The transfer of technology from advanced to underdeveloped countries may be taken to cover the transfer of those elements of technical knowledge which are normally required in setting up and in operating new production facilities and which are characteristically in very short supply (and often totally absent in the developing countries)".[28]

The authors distinguish the following elements of technical knowledge, as precise categories to be included in the concept of transfer of technology :

A. for feasibility studies and market surveys prior to investment.

B. for determining the range of technologies which may be available to manufacture the product in question, and for choosing the most appropriate technique.

C. for engineering design of new production facilities, involving both plant design and selection of machinery.

28. C.Cooper and F.Sercovitch, "The Channels and Mechanisms For The Transfer of Technology From Developed to Developing Countries",UNCTAD, Trade and Development Board, TD/B/AC.11/5 (27th April 1971), pp.6-7

D. for plant construction and installation of equipment.

E. for the process technology proper.

F. for management and operation of production facilities.

G. for marketing.

H. for improving the efficiency of established process by minor innovations.

Most of these 'elements' are self-explanatory. The process technology section, however, needs some discussions. If refers to technical knowledge actually 'embodied' in the production process. For example, the chemical and engineering knowledge needed to 'invent' a petroleum cracking plant is process technology ; so is the engineering knowledge used in making a piece of textile machinery, or even the unsystematised mechanical knowledge required to build a hand-loom in an artisanal work-shop.

There are many sources of process technology. A production process may be the outcome of many years of research and development work, or it may result from the mechanical ingenuity of an individual craftsman. New process technologies may evolve from old through successive minor modifications.

Process technology is sometimes patented. Nearly all industrial patents apply to process technology rather than to other elements of technical knowledge. In addition, however, a considerable amount of unpatented technological knowledge is kept secret. We shall refer to patented and secret process technology together as proprietary process technology. It is estimated that about half of all industrially exploited inventions in this class of technology are unpatented but secret. All other process technology will be called non-proprietary process technology.[29]

29. Ibid.,

G.R.Hall and R.E.Johnson further distinguish among types of information that may be involved in the process of transfer of technology, as general, system-specific, and firm-specific technologies.[30]

General Technology refers to information common to an industry,profession or trade. At one extreme this category includes such basic skills as arithmetic, and at the other such specialized skills as blueprint reading, tool design, and computer programming. The same general knowledge is possessed by all firms in an industry and hence is the ticket of admission to the industry.

System-specific technology refers to the information possessed by a firm or individuals within a firm that differentiates each firm from its rivals, and gives a firm its competitive edge. Some of this specific information will have been acquired through engaging in certain tasks of projects. It comprises indigenous procedures connected with a particular system, solutions to unique problems or requirements, and experiences unlike those encountered with other systems. System-specific technology is when a firm,in manufacturing an item, acquires information that is peculiar to that item. Were any other firm to manufacture that item, it too would probably obtain the same technology.

Firm-specific knowledge differs from system-specific knowledge in that it cannot be attributed to any specific item the firm produces. Firm-specific knowledge results from the firm's overall activities. Some organizations possess technical knowledge that goes beyond the general information possessed by the industry as a whole ; another firm manufacturing the same products would not necessarily acquire this same technology. For example, a firm may have special capabilities in thinwall casting or metallurgical techniques not possessed by other firms, and not necessarily attributable to any specific item the firm has produced.

1.5 SUMMARY

The lack of clear definitions on the meaning and components of technical change has been a common difficulty in most of discussions on technical change and economic development.

30. G.R.Hall and R.E.Johnson,"Transfers of United States Aerospace Technology to Japan",in the Technology Factor in International Trade, ed.by R.Vernon, National Bureau of Economic Research,New York(1970),pp.308-309

A neo-classical definition of technical change is"any kind of shift in the production function". This definition is an extension of"the residual" to the neo-classical world of production. "The residual" is the "entire increase in net product per capita associated with the increase in something other than the inputs of physical capital stock and the services of labour." The components of "the residual" has been variously defined. E.Denison distinguished the components of technological progress as follows : labour input (including employment, hours of work, age-sex composition and education) ; capital input (broken down into dwellings, international assets, non-residential structures, equipment and inventories) ; improved allocation of resources both in national economy and along the frontiers ; scale economies ; advances in knowledge ; a residual ; etc.

Disembodied technology applies equally and like to all resources of men and machines in current use.Such technical progress represents technical know-how falling like a "manna from heaven".Embodied technical progress applies not to the whole range of available resources, but only to certain tranches of capital equipment. Capital is no longer assumed to be homogenous but it becomes essentially a mixed stock of different vintages.

An abstract technology changes as a consequence of the change of its four basic components ; namely, first, its efficiency(i.e., for given inputs and other characteristics of a production function, the scale transformation into output) ; second, economies of scale (i.e., for a given proportional increase in all inputs, output is increased by a larger proportion) ; third, capital-intensity (capid i.e., capital/labour ratio); fourth, elasticity of substitution (i.e., the easewith which capital is substituted for labour).

If a change in technology saved both labour and capital at the same proportion,it is called neutral technical change.The Hicksian neutrality involves constant marjinal rate of substitution between labour and capital as output shifts. If the marjinal product of capital rises relative to the marginal product of labour, this is a capital using(labour-saving) technical change, and vice versa.

Technical change is not "a manna from heaven".They are originated mostly by the profit making firms, who are usually engaged in some sort of innovative activity.The creation and application of new technologies are closely connected with investment activity and mostly take the form of embodied technology. Technical change is also induced by economic factors

The transfer of technology from advanced to underdeveloped countries may be taken to cover the transfer of those elements of technical knowledge which are normally required in setting up and in operating new production facilities and which are characteristally in very short supply, in the underdeveloped countries.

CHAPTER 2

THE MEANING OF CHOICE OF TECHNIQUES

The choice of technology is one of the key instruments of a development strategy. However, the concept of "choice of techniques"is variously understood. The following reasons for this situation can be cited :

a. The meaning of the question depends in the first place upon the objectives in determining the choice ;

b. Secondly, confusion arises out of a frequent failure to differentiate between the choice of technique for a specific production process and the choice of technique for the economy as a whole ;

c. Thirdly, there are difficulties in measuring capital-intensity ;

d. Fourthly, the non-linearity between an economic optimum and technical optimum, raises the question how to reconcile an engineering process with specific economic policies ;

e. Fifthly, in determining what is "appropriate", there is a great divergence between the basic theoretical guidelines and economic practice.

The issue of an "appropriate technology" will be the subject matter of the next Chapter. The first four of the above reasons will be discussed below.

2.1 THE DIFFERENCES IN OBJECTIVES

A private investor is basically interested with the profitability of a specific investment project. But a government is interested more with the contribution of a project to the economy as a whole. A government may wish either to maximize current consumption or to maximize the rate of growth of output. Some writers on the choice of techniques have seen the problem entirely in these terms : they have suggested that the use of labour-intensive techniques will maximize current consumption, whereas the use of capital-intensive techniques, by shifting the distribution of income towards profits, which are assumed to be reinvested, will produce the maximum rate of growth of output.[1]

The objective of reducing unemployement, accompanied by an adjustment in the distribution of income, may precede the objective of maximizing output in a given span of time. Balance of payments difficulties may lead governments to choose export-oriented technologies which may be beyond the technological capabilities of an UDC. Import-substitution objective may leaddto the adoption of an extensive industrialization strategy-i.e. the establishment of all branches manufacturing mostly at a high degree of technical sophistication which does not suit the factor and resource endowment of the country. Political exigencies rather than economic calculations may lie at the root of investment decisions. Under whatever motives these decisions are taken, the different economic effects of different choice of techniques will prevail.

The Conflict Between Employment and Output Growth.

Underlying theoretical arguments on "choice of techniques" in "labour abundant" economies stems from the neo-classical theory of production. The argument is that since labour in underdeveloped countries is cheaper than it is in developed countries, then the farmer should adopt techniques which economize on the use of the relatively more expensive factor, capital.

In practice, however, "technical progress take a form which involves increasing labour productivity, so that the rate of growth of employment is less than the rate of growth of output. This phenomenon-output increasing faster than employment-has been observed in many developing countries."[2]

The precise form that technical progress takes will affect the terms of any conflict between output and employment. If technical progress is disembodied, affecting existing capital equipment unrelated to the rate of investment, and if it increases the labour productivity associated with techniques of varying capital-intensity to the same extent, then the technique which maximizes the rate of

1. see. e.g., A.K.Sen, Choice of Techniques, Oxford (1968), c.h.2
2. see, F.Stewart and P.P.Streeten, "Conflicts Between Output and Employment Objectives, in Third World Employment, ed.by R.Jolly, E.de Kadt, H.Singer and F.Wilson (Penguin 1973), pp. 381-82

growth of output will be the same as the technique which maximizes the rate of growth of employment, though the latter will be lower than the former. If technical progress is embodied, affecting only new investment, the greater the rate of investment, the greater the increase in labour productivity. Hence for any increase in growth rate, resulting from an increase in the investment ratio, there will be a less than proportionate increase in the rate of growth of employment. Similarly, if labour productivity is positively related to the scale of production, measures which speeded up the growth of output will increase the growth of employment less than proportionately. Relationship of this type have been observed for underdeveloped countries, though the relationship appears less strong than for developed countries.[2]

According to W.Galenson and H.Leibenstein, investmentin those industries where marginal per capita investment quotient is higher will lead to a higher rate of economic growth. The marginal reinvestment quotient is equal to marginal output per worker minus consumption per worker They, advocating the maximization of reinvestment quotient, say :

> "Our thesis, baldly, is that successful economic development under present Conditions particularly in the face of gross backwardness, hinges largely upon the introduction of modern technology upon as large a scale as possible."[3]

The suggestion to introduce modern technology "upon as large a scale as possible" may involve a higher investment per worker and contradict to the objective of employment maximization. In fact, if the use of modern technology does not require a higher investment per worker than an old technology, and, if large scale production can be realized by the repetitivee installation of plants, then maximization of reinvestment criteria may not necessarily conflict with the employment maximization objective. This latter one may lead to enjoy the benefits of economies of scale without necessarily altering the capital-intensity and the marginal contribution of each factor of production to final output. However,Galenson and Leibenstein point out that the maximization of the marginal per capita investment quotient requires the maximization of ; (a) the amount of capital per worker ; and, (b) the quality of labour force, i.e.its skill, knowledge, energy and adaptability. The ratio is determined principally by factors like gross productivity per worker, wage goods consumed per worker,

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3. W.Galenson and H.Leibenstein,"Investment Criteria, Productivity and Economic Development,"Quarthly Journal of Economics (August 1955),p.370. J.Robinson discusses the maximization of a"potential technical surplus",

replacement and repair of capital, improvements in health, energy and discipline of the labour force, declines in mortality and direction of investment.

If the maximization of the reinvestment quotient requires higher investment per man, then the maximization of employment is left to the future. For maximizing employment in the future, the following conditions must be fulfilled :

i. the whole wages bill must be spent on consumption ;

ii. since the potential surplus can partly be consumed by the capitalist, all enterprises are state-owned and the whole surplus is reinvested by state ;

iii. the consumption of the unemployed worker who now gets a job, is not released but consumed by other people on whom this person, when unemployed was living ;

and,

iv. installed plant and equipment operates at full-capacity.[4]

If these conditions are not satisfied, the maximization of reinvestment quotient criterion may lead to lower levels of surplus than expected and this may hinder the alleviation of the unemployment problem in the long-run. However, the risk of postponing the objective of reducing unemployment to the future is ultimately taken by social decisions.

The emprical evidence on the relationship between the reinvestment quotient and capital-intensity, however, shows varying results. For example, it has been found in the Indian textile industry that there is "no definite relationship between these two variables. A comparison of the output per worker with the size of plant and the size of plant with capital-intensity has led to this result.[5] The maximum capital-intensity seems to be in the medium size of plant (250-499 people employed) and to be lower both for smaller and larger plants than this. Since wages vary between different sizes of plant, and are in most cases higher in larger plants, in pratice any definite relationship between technique and surplus is eliminated. A study for Argentina has shown that the difference between the

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which is equal to productivity per worker minus consumption per workers family to keep him in the work force. see, Accumulation of Capital, Mac Millan (3rd Edition) (1969), Ch.8

4. Points ii and iii are pointed out by A.K.Sen, Choice of Techniques, op.cit., pp.97-98

5. A.S.Bhalla, "Galenson-Leibenstein Criterion of Growth Reconsidered:

average productivity of production workers in Argentina and in the United States is least when capital-intensity is greatest.[6] The variable used in this case to measure capital-intensity is the share of wages and salaries as a percentage of value-added. As the share of wages and salaries in industries rises (i.e. capital-intensity falls), the avarage productivity of Argentinian workers falls compared with United States workers. As for the production as a large a scale as possible, A.D.Hirschman discusses that productivity differentials between developed and underdeveloped countries are likely to be least in large-scale operations ; this is the result of the fact that capital-intensity tends to involve operations which are machine-paced and can therefore be less influenced by the quality of the labour force.[7] However, Hirschman defines capital-intensity as capital-output ratio while the relative prices in which relative productivity must be measured, are not qualified as in relation to competitive distortions, in the two countries in question. Given these limitations of his study, its conclusion is that there may be some tendency for the reinvestment quotient to be highest in the most capital-intensive industries.

The Time Preference Problem

When there is a conflict between present employment and future employment, a society faces the problem of inter-temporal trade-off. The present competitive distortions and structural imbalances led some authors to consider this problem as a matter of public policy.[8] Connected with this is the argument that the rate of discount is politically determined and that the rate of discount between present employment and future employment of any society may be an outcome of the political progress.[9] When the politically deter-

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Some Implicit Assumptions", Economia Internazionale (1964), p.248

6. C.Diaz-Alejandro, "Labour Productivity and Other Characteristics of Cement Plants : An International Comparisons", in Development and Planning ed. by J.N.Bhagwati and R.S.Eckaus, London (1972), pp.283-315
7. A.O.Hirschman, The Strategy of Economic Development, Yale(1970),p.152
8. see, J.Tinbergen and H.Bos, Mathematical Models of Economic Growth, New York (1962), p.41
9. A.K.Sen, "The Role of Policy Makers in Project Formulation and Evaluation", Industrialization and Productivity Bulletin (13), pp. 41-43

mined rate of discount is given, there may not be much room for a wider spectrum of choice between existing alternatives.

The adoption of labour-using production methods may decrease the reinvestment quotient when governments cannot generate savings and the lower income groups tend to have a higher propensity to consume. The choice in favour of present employment may therefore mean to limit the scope of investible funds within a foreseeble future. The one reservation to this point is that the government may be able to distribute consumption over time to some extent through fiscal policy.

The problem would be easier if capital goods last for only one period ; but, capital input lasts a long time and involves the selection of a rate of discount by the private or public sector. The uneven time pattern of capital costs when discounted at the chosen rate of discount may no longer lead to a unique solution for the choice of technique. A particular rate of discount or profit could lead to both capital-intensive and labour-intensive techniques giving identical present values of the future discounted stream of net income. "This problem of reswitching robs the neo-classical approach of its satisfactory simplicity in purely theoretical terms... Its solution demands a much more realistic approach which pays close attention both to detailed technical information and to the political and social dimension of choosing techniques."[10]

A Theoretical Model of Choice of Techniques

The conflict between employment and output objectives can be made clear with the aid of a theoretical model shown by Figure 2.1

In Figure 2.1

q - output per unit of labour
k - capital per unit of labour
f - the relationship between q and k.

The assumptions of the model are as follows :

1. the capital input is measured in terms of its cost price which is assumed to reflect the efficiency of it ;
2. there exists a continuous possibility of substitution between labour and capital along f ;
3. the model refers to the pre-investment stage of a project ;
4. there are constant returns to scale ;

10. R.B.Sutcliffe, Industry Underdevelopment, London(1971)p.170.

5. the marginal product per labourer is positive increasing at a decreasing rate as k increases

In this neo-classical model, if one approaches to the origin on the horizontal axis, current employment levels are increased relative to capital.

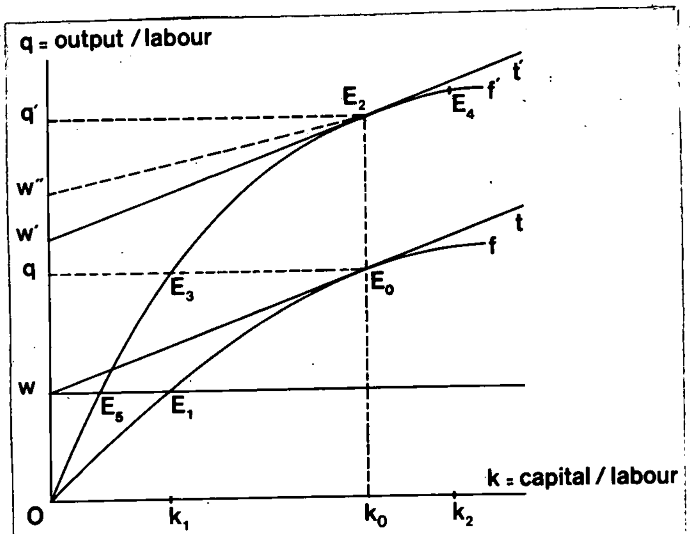

Figure 2.1 A Model of Choice Techniques.

In the neo-classical world, the limit to employment is set by real wages paid to the labourers. Say, we face a given capital-inten_ sity ko, with the corresponding wage rate ow which is obtained by drawing a tangent to f at point Eo. The reinvestment quotient is the level of output per man at ko level of capital-intensity (oq) minus ow. The rate of growth that can be achieved at this level of reinvestment quotient can be determined by the productivity of capital (i.e., the capital/output ratio in a Harrod/Domar model). In a labour-abundant economy the wage rates may be represented by the function $w\bar{w}$: in this case, the wage rates may not set the limit to employment and ko could represent the minimum cost situation. If the capital-intensity kl has been chosen along f, the output per labourer would be equal to the consumption of that labourer.This may be the case when extremely simple or outmoded capital is employed in production. Apparently there can be no motive to choose kl instead of ko, apart from the socially determined decisions to invest at kl.

Let us assume that the state of knowledge leads to a shift from f to f'.If ko remains constant(Hicksian neutral),the new level of output per labourer will be q'. A neutral technical change is expected to leave the factor-price frontier unchanged. But the absolute level of the share of each factor of production increases at the same rate. The tangent to point E2(w't') is expected to be parallel to w t. This implies that

$w'q'/oq'$ is equal to wq/oq. If the labour-abundance gives a wage function like $w\bar{w}$, the "magical wand" shift of f to f' may still make f' a desirable state of knowledge : f' represent the modern technology. If a shift on to f' requires the adoption of a more capital-intensive process, say E4, it may be desirable to stay on f, to maximize immediate employment. If a shift on to f requires a shift to E3 or E5, from Eo, then the adoption of modern techniques may not conflict with the immediate employment objective.

Other Objectives

One of the major arguments in favour of the use of capital-intensive techniques is the effect which they have on the quality of output. If the industrial production of underdeveloped countries must compete either in export or domestic markets with the products of developed countries then quality must be both high and consistent.

This implies the use of techniques of production similar to those in use in the industrialized countries. However, the assumption that the use of capital-intensive techniques as such improve the quality of products must be qualified. There are some products which will be marketed only because they are produced by traditional methods. In fact, if domestic markets are highly protected, and if no great reliance is placed on the expansion of exports, then quality differences may be much less significant. This is most true in countries where consumer taste can be brought under close government control and where the demonstariton effect can be tempered.[11] For example, Japanese industrialists, relying on export markets in engineering goods, have been scrupulous about quality control while Indian practice has in this respect been very lax.[12] Such laxness may be generally more harmful in the producer-goods industries since it may force low-quality production throughhout the rest of the economy.

11. R.B. Sutcliffe, op.cit., p.185
12. J. Baranson, Manufacturing Problems in India : The Cummins Diesel Experience, Syracuse (1967), pp.79

2.2 THE CHOICE OF A SPECIFIC PROJECT AND THE CHOICE FOR INDUSTRY AS A WHOLE

The question of choosing a technique from a range of available techniques to produce a particular product must be distinguished from the question of what products to produce. In other words, the choice of industry and the choice of a specific project are two different questions. A country may, for example, use the most capital-intensive techniques available to produce everything which is made domestically, and yet it may at the same time specialize in those industries which are in any case more labour-intensive than most others. At this level the question therefore is not only about choosing a technique from a range of available techniques to produce a particular product ; it is also a question about choosing what products to produce.

The tendency, for the choice of industries for underdeveloped countries is to list as "favourable" those industries which have low capital-labour ratios. The decision about the choice of industry is probably of more strategic significance in determining the level of employment and the rate of growth, than the choice of capital-intensity within industries. However, there is no clear-cut ranking of industries, as usually thought, by the capital-intensity criterion. For example, contrary to the common belief, machinery production is one of the more labour-intensive branches in most economies. In the U.S. the capital-labour ratio in the machine-building branches is very low.[13] The very low capital-labour ratio found for the Japanese machinery industry in 1951 is shown in Table 2.1.; of twenty-one branches, only seven had lower capital-labour ratios. The foundation of the misconception of the branch's capital intensity lies in the confusion between the direct and total input structure. While some branches which produce important inputs to the machine branch, particularly metals, are themselves very capital-intensive, the machinery branch not a heavy user of capital, also offers the advantage that small-scale production may be relatively efficient.[14] Alternative discussions may be offered for the other industries, which focuses our attention on the inter-industry dependence as a determinant of choice between industries.

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13. see, W.W.Leontief, Input-Output Economics, Oxford U.P. (1966), pp.129-33
14. H.Pack and M.Todaro, op.cit. p.399

TABLE 2.1 : CAPITAL-LABOUR RATIOS IN JAPANESE MANUFACTURING - 1951

Petroleum Products	1.200	Metal Mining	0.172
Coal Products	0.682	Fishing	0.170
Non-ferrous Metal	0.363	Machinery and Electrical equipment	0.161
Chemicals	0.338		
Iron and steel	0.337	Apparels	0.132
Non-metalic mineral products	0.298	Textiles	0.131
Non-metalic Minerals	0.199	Paper	0.120
Processed Foods	0.193	Rubber	0.119
Grain Mill Products	0.193	Lumber and Wood	0.111
Shipbuilding	0.174	Printing	0.093
Transport equipment	0.174	Leather	0.068

Source: Reference made to Institute for Social and Economic Research, Osaka University (mimeo), by H.Pack and M.Todaro, in"Technological Transfer, Labour Absorption, and Economic Development", Oxford Economic Papers, vol.21, no.3, pp.395-403

Most underdeveloped countries, partly through import-substitution policy, partly because of the role of given channells of transfer of technology, have followed a pattern of wholesale adoption of the more advanced industrial technologies, in the most of the manufacturing branches. A further account of this situation will be given in the consequent Chapters.

The choice within an industry is more related to the choice of a specific project, a particular product or the size of an establishment. How wide is the spectrum of choice in reality is the issue that goes beyond the assumptions of theoretical interest. The difficulty is related to the lack of direct knowledge of the different techniques available for particular industries. The figures given in Table 2.2 provide some rough estimates of the ratio of the highest to lowest capital-intensity and technological flexibility by manufacturing sectors. The first column show these ratios for seven regions of the United States, in 1954 ; the second column shows the ratios of highest to lowest average capital-intensity among four countries (the United States, Mexico, Colombia and India) in 1945/50. On the face of it a high ratio would be some indication of technological flexibility, since it seems to imply that there is a wide range of techniques in use. R.B.Sutcliffe, who arranged this table says that among many possible reservations about the value of these figures the most significant is that, since they all encompass a major category of industrial production, they must reflect not only differences in capital-intensity in the production of specific items, but also differences in the composition of output whithin these major categories between different areas. It is quite possible, therefore, that a high ratio of the highest to lowest capital-intensity in use in a particular manufacturing sector is consistent with the use of identical techniques of production for every item in different areas, but indicates a major contrast between areas in the composition of output within each manufacturing category. Also, because of factor intensity reversal with different relative factor prices, the exclusive use of capital-intensive methods in one country does not mean that labour-intensive techniques are unavailable or not efficient in another country. Conclusions about technological flexibility therefore must be exceptionally tentative. The same caution must be exercised in international comparison as those of the second column.[15]

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15. see, R.B.Sutcliffe, op.cit., p.147

Table 2.2 : RATIO OF THE HIGHEST TO LOWEST CAPITAL-INTENSITY AND TECHNOLOGICAL FLEXIBILITY OF MANUFACTURING SECTORS

	Ratio of the highest to lowest capital-intensity		Rough estimate of the degree of technological flexibility of manufacturing sector.
	USA(a) 1954	Mexico, Colombia, India, US 1945/54	
Food manufactures(excluding baverages)	1.87	2.8 --- 10.3[b]	flexible
Beverages	-	3.0	-
Tobacco	9.13	6.2	very flexible-flexible (d)
Textile manufacture	5.72	4.8	flexible
Footwear, other wearing apparel and made-up textiles	3.57	---	flexible
Wood and Cork (excluding furniture)	8.41	---	flexible
Furniture and fixtures	2.18	---	not very flex.
Paper and paper products	2.15	2.1	flexible
Printing, publishing, etc.	1.95	1.5	inflexible
Leather and leather goods	10.74	---	-(e)
Rubber products	4.63	2.1	flexible
Chemicals and chemical products	4.60	---	-
Products of Potreleum and Coal	2.65	---	inflexible
Non-metalic mineral products	2.01	---	-(f)
Basic metal industries	1.93	---	not very flex.
Metal products	1.59	5.9[c]	-(g)
Machinery	2.42	---	-
Electrical machinery, apparuts, appliances, supplies	1.85	---	-
Transport equipment	2.37	---	-
Miscallaneous manufacturing	2.02	---	-

(a) for seven regions of the United States ; (b) the lowest figure for starch-making, and the highest figure for sugar refining ; (c) iron and steel only ; (d) tobacco manufactures ; (e) leather goods are technologically flexible ; (f) production of bricks, roofing tiles and some other building materials said to be technologically flexible ; (g) calculation from Dutch data suggest only moderate flexibility in metal facing and turning; Japanese data suggest iron and steel products technologically flexible ;

Source : R.B.Sutcliffe, op.cit., pp.149-155

The American data suggest that the most technologically flexible categories of manufacturing production are leather goods, tobacco, wood and cork (excluding furniture), textile manufacture, rubber products and chemicals and chemical products; the least flexible categories are metal products, electrical machinery, apparatus, appliances and supplies, food manufactures (excluding beverages), basic metal industries, printing and publishing ; while footwear, other wearing apparel and made-up textiles, furniture and fixtures, paper and paper products, products of petroleum and coal, machinery, non-metallic mineral products and transport equipment all occupy an intermediate position. The international comparisons given in the second column of Table 2.2, gives the impression that the sectors of metal products, food manufactures, tobacco and textile manufacture have a highly flexible technology, along the frontiers; the least flexible categories are printing and publishing, paper and paper products rubber products while beverages an intermediate position.

Particularly that latter data gives some hints about the possibilites of a wide spectrum of choice in the transfer process. In other words, there is a wide orange of different techniques of production available, measured by their capital-intensity, and that these techniques will be economically efficient at some factor-price ratio. As for a specific project, however, a technologically flexible sector may not inevitally present techniques available to it - which are, for instance, particularly labour-intensive.

2.3 THE DIFFICULTIES IN MEASURING CAPITAL-INTENSITY

In determining capital-intensity, the problem of measuring capital-stock has been a major source of contreversy.[16] The consequent confusion in relation to the meaning of choice of techniques is of great practical importance.

The cost price of capital investment is mostly taken as the concept to be measured as "capital stock". However, the use of capital measurement in value terms have certain disadvantages as not reflecting the real productive capacity of production. One of its causes is the existance of competitive distortions that may lead to variations in valuation in different industries and different countries, at different times. The

16. see, J.Robinson, ob.cit., pp.117-123

problem is aggravated by the combination of capital equipment of different vintages. Also the book-value of capital equipment already in use may not reflect its efficiency for the same reason. The use of depreciation, on the basis of assumed standard rates, is not very much helpful to determine its technical properties.

R.G.D.Allen differentiates three "capital" concepts.[17] The first one is based on the assumption of "capital" as a homogenous commodity. However, this assumption can be abandoned by considering "capital-stock" as a collection of machines of different ages or "vintages", which is the second concept. Thirdly, a widely adopted approach is to abandon the concept of a capital stock and to work only with net investment. The last one is relevant since "the choice of techniques described by the production function only applies to entrepreneurs who are considering investment, either new investment or replacement investment".[18] However, since the choice between alternative techniques can only take place prior to the act of investment, the use of net investment as a measurement of capital stock may not only be limited within the sphere of production function that an endrepreneur faces.

Alternatively, some proxy measures have been employed to quantify capital. Among these have been the amount of horse-power per worker and the consumption of electricity per worker. However, these tend to reflect the mechanical efficiency of the machines rather than the value of installed capital which is determined economically. The value of installed capital (or capital costs) involve a combination of the actual costs of capital equipment and its running costs. Since the determination of these is a rather complex process, the use of those proxy measures of horse-power employed, or the amount of electricity used, may be prefferred as easier to quantify. When a specific investment into a particular technology is in question, the distribution of the value-added between wage bill and profit can be more indicative. In this case, the lower the rate of profit, then the higher the degree of mechanization.[19] However, even this method does

17. R.G.D.Allen, Macro-Economic Theory:A Mathematical Treatment, op.cit. pp. 33-34
18. W.E.G. Salter, op.cit., p.17
19. J.Robinson, op.cit., pp.132-133

not take account of distortions which may be introduced by differing degrees of competition.[20] Also, while the use of electricity decreases as capital equipment is used more intensely, the pattern of distribution of the net output between labour and capital may not change which is deficient of reflecting the efficiency property as related to intensive use of capital. This problem may arise particularly when the machinery and equipment is used more than one shift a day.

The measurement of labour input is usually in terms of workers, work-hours or its cost. The wage payments may vary considerably between the day and night shifts. The increase in the need for wage-labour may be higher than the need for salaried personnel at the night shift. The use of the wage bill for quantifying labour will tend to reduce the capital-labour ratio when there is shift-working. Also the measurement of labour in terms of workers, will tend to give a lower capital-intensity in cases where capital equipment is used for more than one shift each day. On the other hand the skill and competence of the labour over the machinery employed will affect the efficiency of both capital and labour in practice.

The problems of measuring capital-intensity indicates the need for caution in interpreting the results of emprical evidence. Also the use of different measurements presents alternative meanings to the concept of "the choice of techniques". This problem will be further considered in the following chapters.

2.4 THE DIVERGENCE BETWEEN AN ECONOMIC OPTIMUM AND A TECHNICAL OPTIMUM

If a technologically efficient method of production (i.e.- it may produce the highest physical output per unit of input) is also economically efficient (i.e.- it may satisfy the minimum cost condition per unit of output), it may be ideal to employ it in the production process. However, such an optimum is only of theoretical interest. In reality, there is usually a discrepancy between an economic optimum and a technical optimum. The existence of competitive distortions and structucal imbalances are accounted as the major reasons of this situation.

20. G.Harcourt, "Some Cambridge Controversies in Capital Theory", Journal of Economic Literature, (June 1969)

21. A.Sen, Employment, Technology and Development, Oxford (1975)pp. 13-16

A.Sen explains "technical efficiency" as follows :[21] Suppose we are producing a certain bundle of goods x, using a certain bundle of inputs y, through a combination of techniques A. It may be possible that by using another combination of techniques B to get more of some output and no less of any other output and use up no more of any input. This means that by shifting from A to B we get something for nothing, and if B is available when we choose A, we are being "technically inefficient" ; or, what we may call "away from a technical optimum". We are technically inefficient also if some available combination C can produce no less of any output while using less of some input and no more of any other input. If these are no such "superior" technological possibilitees compared with A, than A can be described as technically efficient.

A narrowly defined economic optimum is the one which is cost-minimizing and profit-maximizing. Consider the case where a fund of knowledge has been transformed into techniques of production. In other words, knowledge is in the form of technical facts and relationships that is translated into the field of production : the properties of steels and alloys, the means of transforming one type of motion into another, the thermal content of different fuels, and so on. Engineers and applied scientist have the task of translating such knowledge, some old and som new, into feasible techniques of production. The difficulty is that costs impinge upon this process at two points. First a choice must be made as to which of the countless methods that are technically feasible in principle are commercially promising to be worth developing in detail. Even at this early stage costs, and through them factor prices, intrude to some extent. A method, rejected on the grounds that it is commercially impracticable, may have been regarded as promising if factor prices were different. Secondly, in even the simplest designing process there are numerous alternatives which must be decided on the basis of cost : whether a machine should be powered by electricity or diesel power, whether control should be automatic or manual, whether bearings should be bronze or steel, or whether the flow of materials should be mechanised or not. Thus, the range of techniques available to the individual businessman is very often limited by the range of equipment produced by machine-manufacturers. Again, costs and factor prices influence the range of equipment to be designed and marketed.[22]

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21. A.Sen, Employment, Technology and Development, Oxford (1975), pp.13-16
22. W.E.G. Salter, passim., pp.13-14

For the profit-maximizing firm, the price behaviour in relation to the product of a particular technique will play an important role in determining economic efficiency. For the purpose of simplicity, however, we shall avoid from discusing this issue in this chapter.

A final remark on economic efficiency is again made by A.Sen. "The concept of economic efficiency (as opposed to technical efficiency" is a bit closer to policy prescriptions. This is the notion of Pareto optimality familiar in welfare economics. A situation x is Pareto-superior to another y if someone is better off at x than at y and everyone is at least as well of at x as y ... But as soon as we shift our attention from the strange World of Robinson Crusoe, economic efficiency ceases to be a complete criterion for action. Situation x may make person A better off and person B worse off compared with situation y, but both x and y would be economically efficient in this two alternative choice. The concept of economic efficiency gears itself to individual welfare and makes pronouncements only on those choices in which no inter-personal conflicts arise."[23] Thus our attention is once more directed to the differences in objectives in choice of techniques. In real policy debates, differenees in objectives go much beyond the criterion on economic efficiency, as inter-personal and inter-class conflicts of interest have to be faced.

2.5 SUMMARY AND CONCLUSIONS

The meaning of the concept of "choice of techniques" is variously understood in the current literature. Five major reasons can be accounted for this confusion.

Firstly, there are differences in objectives of the decision-makers who decide which technique to adopt. Basically, the objectives of maximizing current output, employment, consumption, the policies of industrialization under import substitution strategy, the objective of adjustment in the distribution of income, tend to conflict with each other. The conflict between employment and output is one of the crucial issues for the purposes of this study. A successful economic development is usually attributed to the use of modern technology upon as large a scale as possible. This strategy assumes the maximization of the amount of capital per worker-whose reciprocal is minimum

23. A.Sen, Employment,Technology and Development, op.cit., pp.15-16

employment with given investible funds at present-that is supposedly maximizing the marginal per capita investment quotient. However, a number of emprical evidence shows that the assumptions of such a strategy may not necessarily prove valid. The problem of inter-temporal trade-off between various objectives can be made clear with the aid of models based on neo-classical production theory. In practive however, the problem is much more complex.

Secondly, the problem of choosing a specific project and the choice of an industry must not be confused. While the latter one is a matter of deciding on sectoral priorities by low capital-labour ratios, in underdeveloped countries, the choice of a specific technique in a given industry and with a given spectrum of choice is rather related to determine economic efficiency at some factor-price ratio.

Thirdly, the differing concepts and methods of capital-intensity requires particularly the emprical results to be interpreted cautiously. The concept of 'capital' is variously defined as homogeneous or as a collection of different vintages ; or as the accounting value, the net investment, 'capital costs', and so on Alternatively, some proxy measures of capital such as the horse power employed or the consumption of electricity per worker and the relative share of profit in net output, are used. The labour input is defined by the number of workers, the work-hours, and so on.

The fourth source of confusion in defining the concept of "choice of techniques" is related to the divergence between an economic optimum and a technical optimum. A technical optimum is understood purely in engineering terms, as the one producing the highest physical output per unit of input. An economic optimum, however, considers the factor prices as determining the costs of production in selecting out of a bundle of technically feasible processes.

A fifth factor determining the meaning of "choice of techniques" is the meaning of an "appropriate technology", which is the subject matter of the next Chapter.

CHAPTER 3

THE CONCEPT OF AN "APPROPRIATE TECHNOLOGY"

The choice of an "appropriate technology"for underdeveloped countries has been a major source of controversy among development economists for more than two decades. One fundamental issue around which the controversy centres is whether or not the availablle technology currently being produced in the advenced Western countries is appropriate for adoption in underdeveloped ëconomies. "Specifically, it is often argued that given the relative abundance of manpower, poor countries may be undermining their own self-interest by indiscriminate adoption of the labour-saving equipment which has emerged as the natural response of developed countries to their own labour scarcities. The economic rationale usually provided for this argument is the textbook dictum that static efficiency requires the equilibration of marginal rates of factor substitution and the (implicit) wage-rental ratio."[1] However, for the sake of theoretical simplicity the arguments about the choice of technology are often over-simplified by a number of assumptions which are in practice seldom fulfilled. Consequently, the question of "what is appropriate?" needs to be discussed beforehand.

3.1 THE CRITERIA FOR "THE APPROPRIATE" CHOICE

The Agent of Choice

The criteria used in choosing which techniques to adopt, is closely connected with the question of who makes the choice. Categorically, there are three agents in the economy who may act under different motives in determining the choice of techniques.[2] Firstly, the indigenous private

1. H.Pack and M.Todaro, op.cit. p.395
2. R.B. Sutcliffe, passim., pp.159-160

investors make a choice. The expected profit earnings of a particular investment govern their decision under the restraints of the relative prices of the factors of production in relation to their productivity; other costs, most notably raw material costs.; the availability of investible funds, and so on. The second agent of choice consists of the foreign investors. Foreign investors most often raise capital for new investment out of retained earnings or in the capital markets of the developed countries. The cost of capital to the foreign investor tends to be lower than its cost for an investor raising capital in the comparatively capital-scarce underdeveloped countries. What, therefore, may seem economically irrational-capital-intensive investments in capital-scarce countries - may from the point of view of the foreign investor be completely rational. In assessing investment patterns, therefore, it is necessary to take account not only of the people by whom the choice of technology is made, but also the prices which govern that choice.

Thirdly, the choice is made also by governments or planning authorities in underdeveloped countries. When industrial technology must be choosen for those industrial investments actually undertaken by the state, they are at liberty to incorporate in their choice considerations about social costs and benefits of different technologies, which a private investor, concerned largely with minimizing private cost, cannot be expected to take into account. However, the governments or planning authorities may have the power to influence the cost of factors of production to the investor by means of taxes, subsidies and other measures of economic control. If the government maintains complete control over the choice of technology, as it would if all industrial investment were done by the state, the behaviour of the private investors as discussed earlier, would be irrelevant.

The Problem of Alternative Objectives : A Numerical Example

The concept of "appropriate technology" is variously understood under different objectives that are discussed in the previous Chapter. The final decision on which technology is appropriate-is a common-place of the interaction of these objectives and a number of technico-economic variables which act as a restraint on choico of techniques. We can illustrate this case by the aid of a hypothetical example.

Assume :

c - cost price of capital input
L - number of employees
W - wage rate per employee
W.L - total wage fund
Q - value of total output at unitary price
t - technology
C/Q - capital/output ratio
C/L - capital intensity
Q/L - labour productivity
S/C - rate of profit
S - surplus (or profit)
q - reinvestment quotient

Also assume that there three techniques of production t_1, t_2 and t_3, all of which equally produce the same quantitiy of output Q, at a similar quality (column 5, in Table 3.1). Labour and capital are homogenous; labour is measured in numbers and capital in value terms.

Table 3.1 : A NUMERICAL EXAMPLE OF THE IMPLICATIONS OF DIFFERENT TECHNIQUES

	(1) C	(2) L	(3) W	(4) WL	(5) Q	(6) C/Q	(7) C/L	(8) Q/L	(9) S	(10) S/C	(11) q
t_1 :	300	50	1	50	100	3	6	2	50	1/6	1
t_2 - a :	150	25	1	25	100	1.5	6	4	75	3/6	3
- b :	150	25	2	50	100	1.5	6	4	50	2/6	2
t_3 - a :	300	25	1	25	100	3	12	4	75	1/4	3
- b :	300	25	2	50	100	3	12	4	50	1/6	2

For a proponent of the factor proportions hypothesis, both t_1 and t_2 are equally desirable compared to t_3, since they have a smaller capital-intensity (see, colums 1,2 and 7). However, t_2 represents a superior technique of production by reducing the capital and labour requirements fifty percent, to produce the same quantitiy of output. Consequently the capital/labour ratio is halved in the case of technique t_2 as compared to t_1 (column 6). Also the labour productivity is doubled by the adoption of t_2 instead of t_1 (column 8).

If wage rates remain the same with the use of either technology, i.e. the case of t_1 and t_2-a ; the profit rate triples if t_2-a is used instead of t_1 (see column 10) ; and the reinvestment quotient is equally dripled(see, column 11). However, if the factors of production are rewarded proportionate to their efficiency, these ratios will differ. Assume that the wage rates are doubled with the adoption of t_2 (the case of t_2 - b in the table) while the price of capital is halved due to its capital-augmenting nature -i.e. its supply increased in efficiency terms. In this case, t_2 - b may render a profit rate and a reinvestment quotient lower than in the case of t_2 - a, but still higher than in the case of t_1.

The capital-intensity characteristics of t_1 and t_2 do not lend themselves for a choice between these two, along the lines suggested by the factor proportions hypothesis. However, the argument in favour of t_2 intdead of t_1 is not for using a technique with a given capital-intensity but for using <u>modern</u> technique. "Modern" in this sense connotes techniques which are first of all mechanized and possess the advantages of the influence of machine-paced operations on the productivity of labour, techniques giving a high and consistent quality of output (contrary to the assumption that both t_1 and t_2 produce similar products) and techniques which may possess a higher growth potential by increasing the reinvestment quotient.

The technique t_2 represent typically a neutral change. Alternatively, assume that the price of capital input has increased proportionate to its efficiency while it still saves labour by fifty percent- the case of technique t_3. If the price of labour is not altered by the use of t_3 (the case of t_3 - a), the level of surplus (column 9) and the reinvestment quotient (column 11) are the same as in the case of t_2 - a. However the rate of profit is lower in this case due to the higher capital costs. If the wage rate is doubled (t_3 - b), the rate of profit is lower than the alternatives presented by t_2. When both capital costs and labour costs increase proportionately, as in the case of t_3 - b, the only argument in favour of t_3 can be a higher reinvestment quotient which certainly contradicts to the employment objective. The adoption of a technique like t_2 could allow same level ofemployment as in the case of t_1 to be created by the repetitive installment of technique t_2, which would double the output and surplus levels.

Although the oversimplicity of this example is apparent, it still casts hight upon the fact that even when the objectives of choosing a particular production technique is socially determined,there may not necessarily exist an alternative which is clearly the most "appropriate" for that given objective.

Arguments in Favour of Using More Capital-Intensive or More Labour-Intensive Techniques of Production

a) The imperfect substitutability between the factors of production :

One of the leading ussamptions of choice between alternative capital-intensities has been that there is a continuous spectrum of techniques out of which economically more efficient combinations of capital and labour can be selected. A consequent argument is that in underdeveloped countries where the relative abundance of manpower is prevailing, the use of the capital-saving equipment is "appropriate". However, it is quite possible that, even if the factors of production could have been rewarded in relation to their relative scarcity, they may not have been combined without limit ; i.e. with decreasing but always positive marginal returns to labour and capital.[3]

If the technical substitutability of the factors of production is limited, there may be a choice between techniques with discrete capital/labour ratios. However, only a few industries are "technologically flexible" in the sense that they have available to them a range of potentially efficient techniques of different capital-intensity. In many industries, the technology currently available for most industrial activities is of one kind- and that is capital-intensive. In the process of transferring techniques to the underdeveloped countries, the new equipment tends to be considerably more capital-intensive than the latter."Thus, although the new equipment may provide some range of alternative factor intensities, e.g. Japanese equipment may be somewhat more labour-using than American equipment of the same vintage - both are likely to be labour-saving vis-à-vis the existing twenty-year-old equipment from these same countries".[4] The importation process determines the range of technical choice, dictated largely by the history of technological progress in developed countries as well as the speed and direction which this process will take

3. see, R.S.Eckaus,"The Factor Proportions Problem in Underdeveloped Areas" American Economic Review (1955),p.565. Also, see, P.Streeten, The Frontiers of Development Studies,Mc.Millan(1972),pp.324-25 and 336-38

4. H.Pack and M.Todaro, op.cit. p.396

in the future. In fact, the capital intensity of output fell steadily in many developed countries, viewed within a historical perspective.[5] The same tendency has been observed in theearly years of Japanese industrialization while a contrary development has taken place in India.[6] One of the explanations of the Indian case, is that the investment in power and capital-goods industries has been given priority. However, in India, the most labour-intensive available techniques in particular industries, have been also adopted. If in these more labour-intensive industries the most modern techniques are employed, then the prior establishment of highly capital-intensive projects may be found to have been necessary.[7] This latter case indicates that there may not be the possibility of perfect substitutability between the factors of production when inter-industry linkages determine the capital-intensity in one industry with respect to another.

b) Externalities and Linkages

One of the leading arguments in favour of adopting capital-intensive techniques is that the use of such a technique in one industry may lead to higher employment in other industries. The investible surplus created in the capital-intensive industry may be reinvested in a labour-using industry or process. Also the final goods demand due to higher wage rates realized in the capital-intensive industry and the intermediary goods demand created by the capital-intensive itself may encourage the development of labour-using methods of production.

A.O.Hirschman points out that two inducement mechanisons may be at work within the directly productive activities :(i) the input provision, derived demand, or backward linkage effects -i.e. every nonprimary economic activity will induce attempts to supply through domestic production of the inputs needed in that activity ;(ii) the output utilization or forward linkage effects -i.e. every activity that does not by its nature cater exclusively to final demands, will induce attempts to utilize

5. see, P.Anderson,"The Apparent Decline in Capital-Output Ratios", Quarterly Journal of Economics (1961)
6. J.C.H.Fei and G.Ranis, The Development of Labour Surplus Economy: Theory and Policy, Illinois (1964), pp.125-134
7. R.B.Sutcliffe, passim., p.186

its outputs as inputs in some new activities.[8] The adjustment period induced by backward and forward linkages may face with unavoidable unused capacity and inefficiency ; this is the case if an industrialization stratgy tie-up an economy's capital funds in indivisible manufacturing units that tend to be more capital-intensive. If long-run costs are declining, it pays to build a plant larger than the optimum determined by a constant present demand, for the unit costs of production of the optimum plant would be higher than the unit costs of the same output produced by the larger plant.[9]

As a special case, however, negative externalities create a strong argument against the use of capital-intensive techniques in underdeveloped countries. The basic explanation of the manufacturing sector that the technological advance in large establishments may have had an adverse effect on the growth of small-scale traditional industries. The extent to which an exchange economy develops and the replacement of the traditional types of goods by a modern equivalent, may determine the possible negative externalities of the modern industries- which are supposedly capital-inten_sive - on the traditional manufacturing sector. The replacement of charcoal by electricity and gas, of bicycles and carts by cars and buses, of local beverages by coca-cola and other drinks, of nylon products by other textile goods, etc. are given as familiar examples.[10] Some of these examples, however, are difficult to consider as representing negative externalities since they represent the so-called "progress" of a society. On the other hand, there are a number of sectors in which the appearance of advanced industrial methods is seriously handicapped by the possibility of competition from independent, small-scale producers. Examples are the manufacture of furniture, shoes, apparel, bricks, ceramics, cigars, baskets, some metalworking, as well as large parts of the food-processing and construction industries.[11] Now all these activities stand today a high fairly good chance of being "left alone" for a considerable length of time because there exists the investment outlets for industrial processes which are entirely outside the technological and capital capabilities of the local

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8. A.O. Hirschman, op.cit., p.100
9. P.Streeten (1972), op.cit., pp.96-98
10. T.Oshima, "Growth and Unemployment in Singapore", Malayan Economic Review, vol.12, no.2 (October 1967).
11. A.O.Hirschman, op.cit. p.129

handicraft and small workshop industries. These are the process characteristic, for instance, of chemicals, potroleum refining, basic iron and steel, cement, pulp and paper, but also of many modern consumer goods, from radios and hight bulbs to toothpaste and aspirin.[12] The most efficient use of capital in underdeveloped countries is in these industries that open up new product horizons for the economy and these industries are likely to be more capital-intensive than others with which the country can dispense in the short run because the needs served by them are satisfied by existing handicraft and cottage industries.

c) The quality and composition of output :

An important assumption in favour of capital-intensive techniques of production is that the quality of the output produced by capital-intensive techniques is higher than that of labour-intensive techniques. This assumption may not be true for some of the products of the local handicraft and small workshop (as discussed in the earlier section). The demand for specialized goods which fall into the province of small rather than large establishments -e.g. craft goods requiring artisanal skills - may not come into competition with large establishments that protect their dominance in terms of low and high quality like iron and steel, petrochemicals, synthetic textile products, etc. For this latter category of industrial products, the argument is not for quality in a crude sense which is important but for the guarantee of standartization and consistency in the quality of output.

The importance of quality depends on the requirements of the markets. The market demand determines beforehand what products to produce, the techniques of producing them and the allocation of investment between sectors. If different consumption goods require different proportions of labour and capital, the level of employment can be raised without varying the techniques of producing any product by enlarging the share of labour-intensive products at the expense of capital-intensive products.[13] If there are opportunities for international trade on favourable terms, this is an obvious solution. If, however, a changing composition involves

12. ibid.

13. F.Stewart and P.P.Streeten,"Conflicts Between Output and Employment", in Third World Employment, op.cit. p.383

changing the products consumed at home, the question is whether, with a proper system of weighting, losses in consumers welfare would arise. If the labour-intensive products are also those those largely demanded by the poor, a fall in output would lead to the conclusion that the weights derived from a more equal income distirbution might show a rise. "If a product is wanted (a) because others buy it or (b) because it was bought in the past or (c) wants are created through advertising, and if these features are peculiar to the capital-intensive products, its elimination may lead to smaller welfare losses (in cases (b) and (c) after a time) than the expenditure valves would indicate or it may lead to welfare gains."[14]

The import-substitution policies pursued by a large number of underdeveloped countries has promoted the development of those industries with high capital-intensity coefficients. In fact, the import coefficient tends to rise in these countries because of the well-known tendency for income-elasticities of demand to be high for motor cars, other consumer durables, and foreign travel, even where the income distribution is constant. The expansion of television and other advertising media also creates still stronger tastes for imported consumer goods.[15] However, the import-substitution policies tend to alter the composition of output in the capital-intensive direction not only in the consumers goods industries but also in production goods and intermediary goods industries. While the newly emerging industries of this sort tend, by the nature of their technical structure, to be more capital-intensive, there may be a spectnum of choice for alternative projects involving both different products and related capital-intensities.

In many underdeveloped countries where the primary goods exports present limits in foreign exchange earning capacity, the export of secondary products is the only way to increase foreign exchange earnings. This necessarily implies the changing of the quality and composition of output. According to the "product cycle" theory, underdeveloped countries may enter the production and export of a product, when the technical specifications of the new product become more "standardized".[16] When a product

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14. ibid.

15. D.Seers, "A Step Towards a Political Economy of Development", in <u>Third World Employment</u>, op.cit., p.402

16. see, R.Vernon, "International Trade and International-Investment in the Product Cycle", Quarterly <u>Journal of Economics</u>, vol.80(1966), pp.190-207; also, W.Gruber, D.Mehta and R.Vernon, "The Rand D Factor in International

is standardized, it can easily be transplanted to new enuironments because its production process is stable and well-established, the sequence of operations is strictly specified and leaves comparatively little room for mistakes. We shall avoid any discussion of the implications of the"product cycle" theory in this Chapter. What we would like to conclude here is that the technical specifications of the different are also determinant on deciding about the product-mix.

d) The Improvement of the Domestic Industrial Skills :

The possibility of improving the skill endowment which is inherently backward in underdeveloped countries, is usually considered in connection with the adoption of more capital-intensive or modern techniques of production. One of the explanations of this tendency lies in the field of the quality of output :

> "Since machine-paced operations are typically more capital-intensive than operator-paced ones,our argument qualifies the advice to adopt labour-intensive processes usually given to capital-poor and labour-rich countries.This advice rests on the assumption that the productivity of labour in underdeveloped countries will not deteriorate relative to developed countries as technology becomes more labour-intensive. But since the scope for poor performance becomes wider when more labour-intensive processes are used in this assumption may be untenable."[17]

In fact, quality and precision requirements place absolute limits on the technical feasibility of substituting human skills for machine capabilities. A dilemma is often posed by the playoff between machine sophistication and the human skill requirement : sophisticated equipment requiring minimal operator's skills; usually requires high levels of planning, coordination, and maintenance skills. Simpler equipment places a heavier burden upon supervisony and operating skills to adjust tolerances,pace the feeding of materials, and control quality and specifications of finished

Trade and International Investment of United States Industries", Journal of Political Economy, vol.75 (1967) pp.20-37

17. A.D.Hirschman, op.cit., p.146

parts.[18]

D.Granick has examined the proposition that the heavy investments in new palnt in the metal-fabricating industries during the early 1930's in the Russian Economy, were justified by exigencies of the quality of the existing labour supply, by on-the-job training with its"investment in human capital", or by the creation of a superior technological-organizational system of production. The proposition has been unreservedly rejected with regard to the first and third items, and qualifiedly rejected with regard to the second.[19] It is interesting in this example that the managers faced a real problem in their need to incorporate a vast army of the rural unskilled into the metal-fabricating labour force. "Presumably it was somewhat easier to do this in factories organized along lines of mass production and extreme division of labour. But the gain here was not nearly as great as had been hoped, and Soviet experience demonstrated that these same groups could also be effectively employed in the pre-existing factories."[20] In fact no real effort was made to incorporate the very large numbers of metalworking handicraftmen into the factory work force, despite the fact that these skilled workmen were most wastefully employed.

As to prime reliance on-the-job training of the new labour force, this appears to have been more a result of the fact that the vocational educational system was unable to cope with the rush of trainees than of a deliberate decision on the part of the authorities. As for the underdeveloped countries of today, some examples of on-the-job training indicate that, a large scale reliance upon this method has been directed towards the more intensive use of existing plant and equipment. This has been carried out in the first place by increasing the number of workers operating with given capital equipment at any moment of time and secondly, by increasing the number of work shifts employed.[21] In fact, in various examples, the low level of literacy among machine laboures led to difficulties in handling blue-prints related to the machine-paced operations ; but once a routine was stabilized, the operation was handled with reasonable efficiency.[22] The shortages of foreman, production control managers, shop managers, the deficiencies in the experience and know-how in setting up and

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18. J.Baranson, op.cit.p.14

19. D.Granick, Soviet Metal-Fabricating, The University of Wisconsin (1967), pp.119 - 121

20. ibid.

21. ibid

22. J.Baranson,op.cit., pp.80-81

coordinating segments of industrial operations and in industrial management led to considerable inefficiencies during the process of adjustment to local conditions.

The traditional industries and small establishments may have various advantages in a gradual transformation of the domestic skill-endowment of the underdeveloped countries. They can economize scarce managerial skills, provide immediate executive experience on expatriate managers and technicians that the machine-paced operations usually require.[23] On the other hand, the necessary education and training will have do differ from the conventional methods and curricula in those improved traditional industries and modern industries. The sophistication that might be adopted by the manpower and educational strategy will determine the relative weight of all types of training including on-the-job training, technical and vocational training, formal education and the like.

e) Economies of Scale

It is often assumed that labour-intensive operations tend to be small scale and capital-intensive operations large scale. It is true that many small-scale operations, especially household industries, are labour-intensive. Also the industrial activities which tend in most countries to be on a very large scale-oil refining, iron and steel production, petrochemicals and so on - tend to be highly capital-intensive. In the steel industry the level of output desired to a great extent determines the techniques which can be used.[24] But the proposition as it stands is a gross over-simplification. First of all, the growth of output may lead to a reduction in the use of raw materials, power, labour and capital, while capital labour ratio remains constant as production expands. The determinant factor, in this case, is the market size which may allow the advantages of division of labour also to be enjoyed. Secondly, even if in practice there tends to be some association between scale and capital-intensity it does not present any uniformity.

23. see, K.Marsden, "Progressive Technologies for Developing Countries", in Third World Employment, op.cit., pp.327-328

24. see, C.Pratten, R.M.Dean and A.Silberstune, Economies of Large-Scale Production in British Industry, Cambridge (1965), pp.12-14

G.Ranis suggests that a study of four industries (textiles, light engineering, plastics, leather and leather goods) in Pakistan indicates that the total plough-back of profits in relation to capital stock seems to be maximized in the medium scales for all industries, rather than in the largest and most capital-intensive enterprises.[25] J.C.Sandesara concludes from a study of the whole industrial sector in India that the labour-intensive technology has lower wage per worker; but has higher output per unit of capital than capital-intensive technology.[26] In Japan, however, there is a fairly close relationship between size of enterprise and degree of capital-intensity.[27] But in all these cases size of plant is being measured by the number of workers while economies of scale relate to the size of output and not to the number of workers.

An important assumption in discussions on economies of scale is that there is a large enough market to realize the expected returns from investing in a particular technology. However, the smaller the level of demand for industrial products, the problem of excess capacity will arise with a consequent diseconomies of scale. Alternatively the faster the rate of growth of demand, than the more desirable will large-scale plants become, in spite of the disadvantage of excess capacity.

f. A limiting factor : imperfect markets

The imperfections in the markets tend to induce the adoption of capital-intensive techniques of production. On the other hand, the industries where new techniques have clustered may have monopolistic tendencies. A large modern enterprise can take over a competitor in the national economy due to its advantages in technology, management, access to markets and the huge capital outlays needed to enter into the industry.

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25. G.Ranis, "Investment Criteria, Productivity and Economic Development: An Emprical Comment", Quarterly Journal of Economics (May 1962), p.302
26. J.C.Sandesara, "Scale and Technology in Indian Industry", Bulletin of the Oxford University Institute of Economics and Statistics, (August 1966), pp.194-195
27. see, also for further discussion, R.B. Sutcliffe, passim., pp. 207 - 209

C.P.Kindleberger says : "A given investment may introduce a monopoly advantage but destroy an old monopoly, a large foreign firm competing with and putting out of business small but non-competitive enterprises, settled into a rut of low volume and high mark-ups."[28] Also, the newly emerging industries mostly erected as a result of import-substitution strategy tend to be the sole producer of a particular good that was previously obtained from abroad.

In either case, (i) under monopolistic product markets, adoption of capital-intensive technologies (or modern high-cost methods) can be possible as long as the costs can be passed on to the consumers ; and, (ii) when possibilities of import substitution are exhausted, the protected industries with a monopoly advantage in the domestic economy may face a disadvantage in competing on world markets. In the latter case a tendency to use low-cost methods may develop. The tendency to maintain the value of existing capital may be replaced by the use of economic methods before the marginal revenue falls below the operating costs of marginal operating capacity and below the total cost of marginal new capacity.[29]

Apparently, the criteria for "the appropriate choice" may go beyond what has been discussed so far, when imperfect markets tend to limit the relevance of other criteria.

3.2 WHAT SORT OF A TECHNOLOGY ?

So far it has been discussed that the concept of "appropriate technology" is variously understood in relation to the objectives in mind. There are powerful arguments favouring the use of both labour-intensive and capital-intensive techniques in underdeveloped countries. The arguments in both directions suggest the possibilities of following solutions :

a. the choice of a particular objective instead of others, and concentrating on producing methods suitable for that objective ;

b. a mixture of widely differing types of industrial techniques or "technological pluralism" ;

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28. C.P.Kindleberger,"Restrictions on Direct Investments in Host Countries", in Development a 12d Planning, op.cit., pp. 208-209

29. see, W.E.G.Salter, op.cit., pp.90-94; and, O.Lange and F.M.Taylor, On The Economic Theory of Socialism, Mc.Graw Hill, New York(1964) pp.50 - 61

c. the development of an "intermediate technology", involving generating a domestic machine-producing capacity, among other things ;

Given the fact that there is an inevitable conflict between a number of objectives discussed in the last chapter, these alternatives may present some kind of compromise as well as outlets.

a. The Choice of a Particular Objective Instead of Others

The urgent need to eliminate the increasing volume of open unemployment in a great number of underdeveloped countries has led many of the discussions to concentrate on the objective of maximizing employment. Assuming that there is an obvious conflict between employment and output objectives, any attempt of increasing employment by adopting techniques with lower capital/labour coefficients means reducing the growth of output in the immediate fiture. According to F.Stewart and P.P.Streeten, apart from simply maximizing output, going for the capital-intensive technique and ignoring the employment implications, three possibilities are open:[30]

1. First, there is what we might describe as the Gandhi solution of adopting the hand technique despite, e.g., halving output.

2. Second, there is the "Nkrumah" solution of introducing the modern factories and 'employing' the additional, e.g. 900 workers in some minor and possibly completely useless capacity in the modern factory. Problems here are first that the extra workers might reduce output as a result of getting in each other's way and diverting administrative personnel (though probably output would not be reduced by as much as if the Ghandi salution were adopted and administrative difficulties might also be less).Secondly, if the modern factories also pay relatively high wages as they generally do, the wage cost may be exarbitant. This has implications for savings and also for the viability of the enterprise if it is in private ownership. The Gandhi solution would probably allow lower wages per head. Thirdly, in a mixed economy it may not be possible to get employers to take on such useless labour. Voluntary agreements to increase employment by as little as 10 per cent have been notoriously short lived.

3. A third solution is to adopt the modern methods and to use some of the extra output to employ the non-employed on public works, etc. The difficulty here is that if any equipment is involved in public works, employing workers on them will again divert capital equipment from other parts of the economy

30.F.Stewart and P.P.Streeten, op.cit., pp.370-371 where the impact on output might have been bigger in fact we are back at the initial problem.

The existence of scarce resources creates the problem of diverting investments into any of these categories easily. If however, "the non-employed can make their own tools from local materials that are not scarce, and if their employment does not require the diversion of scarce administrative personnel, their employment will increase current output."[31]

The cases where priority is given to the maximization of output has already been discussed in the Second Chapter. Other objectives will not be discussed beyond the scope of discussions carried out so far; since the problem of unemployment occupies a leading place for the purposes of this thesis.

b. Technological Pluralism

The term 'technological pluralism' defines the spectrum of techniques of production where high productivity islands (with modern, capital-intensive methods endowed with highly sophisticated machinery and skills) coexist with traditional methods and process (e.g.using hand workers with rather limited division of labour and specialization) under a sort of division of labour and integration.

This concept mainly stems from the technological dualism prevailing in underdeveloped countries : there are sharp technical and managerial differences among the modern capital - intensive industries and the traditional industries. The modern industries have reached a level of high technical competence and a high access into the technology markets compared with the inefficient traditional industries which are mostly lacking not only the capacity to search for more economic alternatives but also the capacity to grow into production units that are capable to survive in the face of competition from the modern sectors. 'Technological pluralism' involves the possibility of a successful integration and division of labour between these two forms of industrial organization.

The traditional industries may comprise the small-scale, home-

31. ibid.

based organizations (the so-called domestic system) as well as a throughgoing capitalist organization except that the workers may provide their own equipment and work at their own homes.[32] As in many cases observed in early Industrial Revolution, these industries include the capitalistic organization with cooperation based on a higher division of labour as powered equipment begin to show itself.[33] In this case a fairly matured relationship between employee and hire wage-earners and the subordination of domestic handicraftsman, working in their homes to a capital holder on the so-called "putting-out system" emerges.[34] This system generally face with certain difficulties in the process of modernization. The new mechanical equipment is expensive and beyond the resources of the domestic producer. Contrarily, the traditional industries possess certain advantages over the factory system: because of their low fixed capital costs, they may be in a better position than the factories to cut their costs in small markets or during a depression by small-scale output.[35] Since they can buy and operate their equipment in smaller units than the modern capital-intensive factories, their capital requirements can be raised more readily. However, they may lack control over the quality of the product and over the performance of the worker ; inferior workmanship and of embezzlement of raw materials are their common problem.

Is it possible to organize the modern (capital-intensive)and traditional (labour-intensive) sectors under an efficient system of production ? An often quoted example of this is the use of small work shops in Japan as adjuncts to modern industrial complexes.[36] These small work shops could function effectively because they were able to convert techniques to meet the manufacturing specifications of the modern industrial complexes and where necessary, adapt materials to meet standards. To be effective, such organizations must be able to coordinate their activities and schedule

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32. see, M.Dobb, Studies in the Development of Capitalism, London(1947) pp.138-9 and 142-4; D.Landes, The Unbound Prometheus, Cambridge(1970), pp.44,54 and 118-90; and T.S.Ashton, The Industrial Revolution 1760-1830 Oxford (1968) p.41

33. ibid

34. ibid

35. H.J.Habakkuk, op.cit., pp.144-45

36. J.Baranson, op.cit.,p.68; also S.Broadbridge, Industrial Dualism in Japan, London (1966), p.19.

production in relation to the larger industrial complex. In Japan, technological pluralism operated under the subcontracting system. Thus the large-scale, highly capital-intensive industries using the more sophisticated modern technology alongside an enormous number of small-scale labour-intensive plants could coexist.[37]

However, Japan had an abundence of the experienced engineering and technical skills necessary to convert techniques to local equipment and materials.[38] There was also a much higher level of machine labour and skills and factory discipline developed in Japan over the past century, than in many of today's underdeveloped nations. Therefore, the Japanese experience may not be succesfully applied by many of the underdeveloped countries today. Many of the endurdeveloped countries have based, on the other hand, their industrialization strategy on high knowledge-organization-technology levels during the last two decades. The question of where and how will the small-scale labour-intensive plants be placed in this strategy needs to be answered.

c. Intermediate Technology.

The most convincing objection to development based on capital-intensive technologies has been that underdeveloped countries simply to not dispose of sufficient capital and cannot conceivably hope to attract enough foreign aid. "If a capital intensive technology is chosen then a country can only afford to equip a very small proportion of its labour force with the means of increasing output. One would therefore create small islandsof high productivity whilst leaving large parts of the economy untouched. It is this which has led the search for what is sometimes described as an 'intermediate technology'-neither so advanced that it is beyond the means of underdeveloped countries, nor so primitive as that originally prevailing.[39]

There are two aspects of intermediate technology as defined

37. see, T.Ando,"Interrelation Between Large and Small Industrial Enterprises in Japan", <u>Bulletin of Industrialization and Productivity(U.N.), No.2</u>
38. J.Baranson, op.cit., p.68
39. see, W.Elkan, op.cit. pp.88-89.

as above : (a) the selection of labour-using production techniques among those which are already available mostly from advanced countries -i.e. technology suppliers ; and (b) the development of new machines that would be more labour-using as well as efficient in economic sense.

The general view of the selection of labour-using production techniques out of a given spectrum is not too different from what has been discussed in the last Chapter and in the first section of this Chapter: the choice in the labour-intensive direction by suitable criteria, tends to satisfy the desire for intermediate technology. A more specific issue that must be added to the present discussion is related to the importation of used equipment from advanced industrial nations. Two underlying assumptions behind this suggestion are : first, the older equipment tends to be more labour-using, and second, the cost price of the older equipment is expected to be lower. In fact, there are a number of examples of the use of imported old equipment. Second-hand textile machinery was imported from Great Britain by the Japanese, in the early Twentieth Century.[40] The purchase of cheap foreign machinery from the depression affected Western factories was observed in Brazil, Peru, Mexico and Puerto Rico, during 1930's.[41]

However, the importation of old equipment has been attacked from various points of view. It is said: "Even the extreme assumption that all gross investment is satisfied by the continuous importation of used equipment, will still imply an increasing divergence between output and employment growth rates since the limited supply of older equipment forces a Switch to used equipment of a later vintage with its bower labour coefficient. This switching is required even existing factor prices would lead firms to choose the purchase of more equipment of older vintage. Consequently, given the present abundance of labour and the prospective rapid increase in the potential industrial labour force, it follows that regardless of whether the used equipment is actually economically more efficient in terms of static unit costs than the modern capital-intensive equipment, the prospects for significant long-run labour absorption in the industrial sector become rather dubious."[42] On the other hand, imported second hand machinery has inherently a shorter span of life-time, high maintenance and repair requirements and high wastage of raw material and energy inputs. When such drawbacks

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40. see, I.Asahi, The Secret of Japan's Trade Expansion, The International Association of Japan, Tokyo (1934).
41. see, for a number of references, R.B.Sutcliffe, op.cit., p.187
42. H.Pack and M.Todaro, op.cit., p.396.

are discounted against such equipment's expected cheapness, its effective cost may prove rather high. Altohugh an old equipment may tend to have a 'standardized' technique (with an ability to adjust the manufacturing process at short notice and labour-skill adaptation), concentrating on new equipment amounts to a substitution of capital for the skilled labour which otherwise would have been necessary to provide the additional maintenance required by the old equipment.[43]

As far as the development of new machines is concerned, much attention has been given by economists - though not much yet by engineers- to the question of adapting modern technology to countries where labour is cheap and plentiful and where the introduction of certain labour-saving innovations may not be justified. The search for evidence of such adaptation apparently has been somewhat disappointing. "Because the returns to such effort appear more risky and uncertain than the returns to such perfecting machinery for the main machine-using countries of the world. Furthermore there is a 'market' in the latter whilst the former can only demonstrate a 'need'".[44] However, some attempts at designing equipment specifically for underdeveloped countries have been made such as at the Philips Pilot Plant in Utrecht and under the aegis of the Intermediary Technology Group in London. The Japanese have also developed a hand power-tiller for agriculture.[45] Perhaps even more significant have been the instances of adaptation in the underdeveloped countries themselves. It is often argued that the underdeveloped countries should produce their own machinery, copying initially the earlier more labour-intensive designs of the Western Countries. This would provide the possibility of eliminating much of the conflict between output and employment growth while avoiding the important difficulty of designing new labour-using machinery.[46] This could also be a major source of external economies to the non-capital goods sector, especially in providing skilled workers to the other sectors. Against the possibility that such capital goods designs may not be included in the current machinery catalogues, it has been suggested that "they have to be dug out of the archives of patent offices and long-established machinery manufacturers".[47] However, it is not certain that

43. D.Granick, op.cit., p.193
44. W.Elkan, p.89 op.cit.
45. ibid.
46. H.Pack and M.Todaro, op.cit., p.397
47. K.Marsden, op.cit., p.334

such efforts may rendera lower-cost capital equipment compared with the alternatives of present vintage ; and a higher productivity compared with the capital equipment of an older vintage.

The development of intermediate technology does not mean a return to an outdated system, something that is a mere second best ;"it is not concerned with keeping alive activities which lack essential viability: it is concerned with creating a new viability."[48] In this sense, it requires research and development. Tho whole of the underdeveloped world constitutes a market which is large enough to justify the production of new types of industrial machines. However, there is no such demand as clearly manifested as to start the research and development activity to the extend required to test the possible success of creating such a new way out. There is neither any certainty that all underdeveloped countries will require the same kinds of new techniques. The regionally integrated groups of underdeveloped countries or those that have potentially large enough domestic markets, may have more realistical opportunies to initiate the search for intermediate technologies.

Lastly, 'intermediate technology' is not simply an extention of the factor proportions hypothesis. When it is consired in such a narrow may, it concentrates on the relative 'scarcity' and 'abundance' of the factors of labour and capital. However, underdeveloped countries often lack critical material resources, essential industrial capabilities, or the human resources to organize, manage and control production. Recommendations for the redesign of technological transplants represent an alternative adjustment to factor scarcities.[49] On the other hand, the conversion of manufacturing techniques to the conditions prevailing in underdeveloped countries generally requires the very engineering capabilities and industrial organization underdeveloped economies are trying to acquire. The quality and precision requirements place absolute limits on the technical feasibility of substituting human skills for machine capabilities. Also, labour is usually overpriced in underdeveloped countries which sets another limitation of substitution between labour and capital. Consequently, the search for intermediate technologies may not simply take the relative abundance of labour and scarcity of ca-

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48. E.F.Schumacher, "Industrialization Through Intermediate Technology" in <u>Industrialization in Developing Countries</u>, ed.by. R.Robinson, Cambridge (1965), p.97.

49. J.Baranson, op.cit., pp.13-16

pital as the starting point. The resource and skill endowment, market size and alternatives of scale economics and the dynamic linkage and externality factors should also be inclued in the definition of intermediate technology.

3.3 SUMMARY AND CONCLUSIONS

The concept of an 'appropriate technology' is understood differently in the present literature. One of the basic causes of this is the differences in the objectives of those who make the'choice'. While the costs of production with a given technology is determinant on the choice between alternatives, these 'costs' are weighted variously by private indigenous and foreign investors, and by the governments.

In fact,there are strong arguments in favour of using either capital-intensive or labour-intensive techniques of production. Firstly, the lack of a perfect substitutability between labour and capital inputs, may limit the choice to alternative discrete capital/labour ratios, that may tend to be capital-intensive particularly for a technologically dependent economy.Secondly,viewed macroeconomically,adopting capital-intensive industries may generate the development of labour-intensive industries,while the latter one is affective on generating demand and income distribution; thus the existence of externalities and linkages may tend to favour either techniques within a given prespective of inter-temporal trade-off.Thirdly,many underdeveloped countries face the need to change the compositions of output to meet the changing demand in both domestic and export markets; the new product-mix with higher quality specifications may be altered by modern capital-intensive methods of production vis-à-vis traditional production techniques;however,for some specialized products,traditional industries may fall into the province of demand-generating methods and processes.Fourthly,the adoption of capital-using,modern capital equipment might serve to improve the quality of labour force;however the scope for poor performance in relation to output is not eliminated at least for a period of adjustment to new processes and skills;there is,also,room fora balanced growth of the quality of work force in the traditional industries with inherent labour-intensive bias.Fifthly,capital-intensive industries are seen as essential to enjoy the advantages of economies of scale;however the smaller the level of demand for industrial products,the problem of excess capacity may lead to diseconomies of scale.Sixthly,the criteria defined so far may have a limited relevance when imperfect-markets tend to induce the adoption of 'inefficient' techniques of production.

The divergant concepts of 'appropriate technology' seems to present three answers for the question of what sort of a technology is needed by the underdeveloped countries. Firstly, the choice of a particular objective instead of others, and concentrating on methods and processes suitable for that objective, seems to be what is going on in practice against the basic policy guidelines suggested by the factor proportions hypothesis. Secondly, technological pluralism can present a solution where highly modern (capital-using) production techniques may coexist with traditional methods and process under a sort of division of labour and integration. Thirdly, the intermediate technology alternative presents the possibilities of ; the selection of labour-using production techniques among those which are already available from advanced countries ; and, the development of new machines that would be more labour-using as well as efficient in economic sense.

CHAPTER 4

THE ESSENCE OF TECHNOLOGICAL DEPENDENCE

There are national differences in scientific and technical potential of both the advanced and underdeveloped countries. This is the fact the term 'technological gap' refers to, which is basically resulting from the differing speeds and affectiveness with which these countries appeared to be developing and exploiting their scientific and technological capabilities. The consequence of technological gaps between nations is technological dependence. Technological dependence actually shows up in the form of transfer of technology which, in the case of underdeveloped countries, results primarily from the limited capability in these countries to provide the elements of technical knowledge necessary for initiating and operating new forms of production.

This Chapter aims to give a general view of technological gaps as a source of technological dependence. It is not an attempt to draw any conclusions to guide the practice of innovation and technology transfer.

4.1 TECHNOLOGICAL GAPS BETWEEN ADVANCED INDUSTRIAL NATIONS

The gap in creating and exploiting the new methods of production and process is great between the developed and underdeveloped countries. The ninety eight percent of world expenditure on technical progress takes place within advanced countries and only two percent within underdeveloped countries.[1] However, an important points is that the gaps in technology between the advanced industrial nations are considerable and a greater proportion of technological transfers takes place between the advanced industrial countries[2] which is mainly stemming from the different nature of

1. see, C.Cooper, et.al., "Technology For the Second Development Decade", (mimeo), Institute of Development Studies, Brighton (1969)
2. see, C.Freeman, C.H.G. Oldham, and E.Turkcan, "The transfer of Technology to Developing Countries", UNCTAD 2nd World Conference, (1968).

the gaps in technology between these countries.

Investment In Generating Technology

An O.E.C.D. report on the technology of the member countries says that in 1964, the United States devoted 3.4 percent of its G.N.P.on research and development (R and D), the economically advanced European O.E.C.D. countries together 1.5 percent, the European Economic Community 1.3 per cent, Canada 1.1 percent and Japan 1.4 percent.[3] The report states that the combined efforts of the four Western European countries (U.K., France, Germany and Netherlands) do show some closing of the expenditure gap between 1958 and 1964, the U.S.index of Gross National Expenditure on R and D as a percentage of G.N.P. rising by a quarter and the 'European' index rising well over 40 percent.

In fact there has been an increasing importance attached on R and D. Table 4.1 indicates that, in U.S.A., expenditures in this field increased 14 times in fourty years as percentage of G.N.P. The rate of increase has been much faster since the Second World War. Although the patents bought during this period do not increase at the same rate, it is quite possible that quite a number of original inventions may not have been officially registered. The importance attached to R and D in a number of other advanced countries can be observed particularly in the so-called 'research-intensive' industries. These industries are ; aircraft, vehicles, electromics, electrical machinery, machinery, instruments and chemicals. A higher proportions of the R and D expenditures are diverted to this field. Table 4.2 indicates that 41.3 percent of the gross national expenditures on R and D are devoted to the science-based industries in the U.K., as the US. 46.4 percent, Germany 39.7 percent, Japan and France 33.7 percent, Belgium 40.9 p.c. and Netherlands 35.7 p.c.

These industries are the ones which need heavy capital and maintenance expenditures in order to perpetuate production and realize new products and process. Also a highly qualified body of scientists are necessary to carry ont the research works. For example, 62.6 p.c. of the R and D

3. O.E.C.D., Gaps in Technology, Third Ministerial Meeting on Science of Countries, (11-12 March 1968), p.14

T A B L E : 4.1

THE GROWTH OF R AND D EXPENDITURES IN THE AMERICAN ECONOMY

Selected Years 1921 - 1961[a]

Year	Total R and D Expenditures	Per Cent of G.N.P.	Per Cent of R and D Expenditures Federally Financed
1961	14,740	2.8	65
1960	13,890	2.8	65
1959	12,680	2.6	66
1958	11,130	2.5	64
1957	10,100	2.3	63
1956	8,670	2.1	59
1955	6,390	1.6	57
1954	5,620	1.5	55
1953	5,150	1.4	53
1940	570	0.6	21
1931	300	0.4	13
1921	150	0.2	17

a. 1921 - 1940 - estimated from partial data.

SOURCE : R.R. Nelson, M.J. Peck, E.D. Kalachek, op.cit., p. 46

T A B L E : 4.2

THE R AND D EFFORT IN SCIENCE-BASED INDUSTRIES

In Percentages

	U.S.	U.K.	Germany	France c, d	Japan	Italy	Canada	Nether-lands	Sweden	Belgium	Norway	Austria
R and D perfomed in science-based industries as percentage of gross national expenditure of R and D	46.4	41.3	39.7	33.7	33.7	28.7	24.6	39.7	33.6	40.9	16.8	23.2
Individual science-based industries as a percentage of total industrial R and D expenditures												
Aircraft	38.3	29.0		24.6			16.9		19.8	1.5		
Electrical a	24.8	24.5	31.2	28.6	30.3	25.7	29.1		24.3	20.3	22.0	18.6
Chemical b	13.0	14.4	34.7	19.4	27.3	28.1	23.6		9.9	43.8	21.3	24.0
Total	76.1	67.9	65.9	72.6	57.6	53.8	69.6	64.4	54.0	69.6	43.3	42.6
Percentage of each industry's activity financed by government												
Aircraft	90.4	84.3		78.3			46.1		69.7			
Electrical a	61.8	36.0	4.0	29.9	0.3		22.6		56.6	2.8	9.7	
Chemical b	15.9			2.8	0.1	0.3	1.9		2.4	3.4	4.7	

a- including electronics
b- including petroleum refining and drugs
c- includes depreciation, excludes capital expenditure
d- 1964
e- five large companies including food and drink industry

O.E.C.D., Gaps in Technology, Third Ministerial Meeting on Science of O.E.C.D.Countries, (11th and 12th March 1968) p.14

personnel of the total industries was employed in this sector at 1927, against 85.2 percent in 1957.[4] The research-intensive industries have immediate effects on a set of other industries. Solid state physics, for example, influences progress in a number of applied research fields such as electronics and communication. Atomic and molecular physics is another example. The instrinsic importance of fundamental research in generating new goods and process as well as new industries caused a great importance to be atteched by the governments into this field. For instance 90.4 percent of the aircraft industry, 61.8 percent of the electrical industry and 15.9 p.c. of the chemicals industry is financed by the government in the U.S.A. Similar figures are presented for other advanced nations at the bottom of Table 4.2.

R and D and Growth

There is now a growing tendency to assume that investment in R and D is one of the main dereminants of growth in Western Countries. The increasing productivity experienced in these econcmies particularly since the Second World War is roughly parallel to the increasing R and D expenditures of the same period. E.Mansfield suggests that the rate of increase of output per man-hour in the post-war period seems higher than that before.[5] On the other hand it has been pointed out that industries that have high growth rates have high R and D rates. Could the low-growth industries become high-growth industries by rising their R and D rates ? B.R.Williams says that this hypothesis is almost certainly untrue : the high growth industries have high R and D rates because in these industries R and D is profitable ; R and D are needed to create new industries and sustain industrial growth in rich countries and this also made a larger education sector necessary.[6] E.F.Denison, by a different route, appears to arrive at similar doubts about R and D economics. For the United States, of the annual per caput measured growth rate of 1.7 from 1929-1957, he estimates only one-twelfth can be attributed to organised R and D.[7]

4. R.R.Nelson, M.J.Pack and E.D. Kalachek, Technology, Economik Growth and Public Policy, Brookings Institution, Washington (1967), p.50
5. E.Mansfield, op.cit., pp.36-37
6. R.B.Williams, op.cit., pp.120-121
7. ibid.

B.R.Williams perpetuates that looked at internationally there is no sign of growth rates are increasing functions of R and Drrates. For 30 years, R and D in the United States has been growing by 12 percent a year in real terms, without any significant changes in the trend rates of growth of total output per head.

The capacity to turn inventions into innovation undoubtedly plays an important role on the relationship between R and D growth. In other words, performance in orginating innovations differs from performance in diffusing innovations. According to the OECD survey, higher growth rates were achieved in those countries where performance in diffusing technological innovations was more successful. The survey says:"Indicators show that the United States has the highest level of diffusion of new products and process, but that other Member countries have sometimes had higher rates of increase in the diffusion of new production process over the past 10 to 15 years. However, rates of increase in diffusion have been much higher in Japan than in European Member countries, whose rates of increase have been closer to that of the US than to that of Japan. It is therefore safe to conclude that as a corrolasy of hihg rates of economic growth and investment in Japan and Europe, new products and processes (including those originating in the US) have been effectively diffused throughout most of the economies of the industrially advanced Member countries."[8]

In fact, most of the studies attempting to measure the contribution of technical progress to growth, tend to measure the relative weight of the factors of production as wall as technical progress, in total growth of national output. Table 4.3 shows that although more than fifty per cent of the rate of growth of GDP in nine European Countries and Canada (14.3 p.c. in Canada) is contributed by technical progress, overall growth rate is determined by the combined effect of increase in labour, capital and technical progress.Thus, both investment in humans and capacity to invest in capital formation tends to be a precondition for the realization of the contribution made by technical progress to growth rate. In other words 'abstract technology' becomes visible in terms of growth affect, only if the complementary production factors are realized - they may or may not involve 'embodied' technology.

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8. "Technological Gaps : Their Nature, Causes and Effects", <u>OECD Observer</u>, No. 33 (April 1968), p.23

TABLE 4.3 PERCENTAGE CONTRIBUTION OF INCREASE IN LABOUR AND CAPITAL, AND TECHNICAL PROGRESS TO RATE OF GROWTH OF GROSS DOMESTIC PRODUCT IN NINE EUROPEAN COUNTRIES AND CANADA (1949 - 1959 PERIOD)

Countries	rate of growth of G D P =	Contribution of production factors to GNP growth labour +	capital +	technical progress	Percentage share of the contribution made by technical progress to GNP growth
	(1)	(2)	(3)	(4)	(5)
West Germany	7.4	1.1	1.8	4.5	60.1
Italy	5.9	0.8	1.0	4.1	69.3
Yugoslavia	5.5	0.8	1.5	3.2	58.0
Holland	4.8	0.8	1.4	2.6	54.1
France	4.5	0.1	1.0	3.4	75.5
Canada	4.2	1.5	2.1	0.6	14.3
Norway	3.4	0.2	1.4	1.8	53.0
Sweden	3.4	0.3	0.6	2.5	73.5
Belgium	3.0	0.2	0.8	2.0	66.6
United Kingdom	2.4	0.4	0.9	1.1	51.6

Source : Reference made to ECE, Some Factors in Economic Growth in Europe During the 1950's, (Part II), Geneva (1964), Table 18 ; by E.Türkcan, İktisadi Kalkınmada Bilim ve Teknoloji, Faculty of "Political Sciences publication, Ankara(May 1972), Appendix II.A.Table 2

Since no western country, apart from the USA, generates more than about 10 % of the world's new technology, most countries growth depends to a large extent on the importation and diffusion of new technology. In fact, international technology-transfers have increased more rapidly than both economic growth and international trade. The methods of obtaining foreign technology may have varied considerably from country to country. At the two extremes, Canada has relied mainly on direct foreign investment, and Japan on licencing agreements coupled with a large indigenous effort of absorptive R and D. The main technology producing country (i.e.the USA) has not grown as rapidly as countries that have imported US technology. Although the level of use of advanced technology is higher in the USA, thereby reflecting higher living standards, the rate of increase in use of advanced technology has been higher in many other OECD countries, and very high in Japan. The case of Japan as effectively using the technologies originated elsewhere is indicative of the case of underdeveloped countries, most of which are technologically dependent to a great extent. In the advanced industrial countries, the problems in relation to R and D and growth, were seen as essentially intra-organizational problems, and the outcome of the research concern has been a growingbody of literature centering on the management of organizations to secure more effective transfer of results from research to profitable application.[9] In the underdeveloped countries, on the other hand, increasing volumes of domestic and international resources have been devoted to R and D (but still insignificant) activities. The results of these activities have been very mixed ; also, there is the widespread experience of research output in a host of institutions throughout the underdeveloped world.[10] The use of the techniques originated in the advanced industrial nations, namely the transfer of technology, is necessary for rapid industrialization in underdeveloped countries because they have limited technical knowledge and equally a limited capacity to use such knowledge. The relationship between technology transfer and growth is the subject matter of the Second Part of this thesis. However, as an <u>apriori</u> argument, we can state that the causes of technological gaps also determine the capacity to turn inventions into innovation.

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9. see,"Applied Scientific Research Corporation of Thailand Outline and Status Report on Research Programme 55" joint research programme of the Science Policy Research Unit of University of Sussex and the Applied Scientific Research Corporation of Thailand into "The Transfer of Technology to Manufacturing Industry in Thailand",(April 1972), p.3

10. ibid.

The Causes of Technological Gaps.

The OECD sector studies indicate that the term "technological gap" symbolises a complex of differences in contemporary social, economic and industrial development ; there is no single or simple cause. Some factors affecting the position are :[11]

a) scientific and technological capability - clearly a prerequisite, but not a sufficient basis for success in originating innovations and in research-intensive industry ;

b) the market is a very important factor conditioning the realisation of scientific and technological potential ;

c) the size and homogeneity of the US market helps American firms to commercialize discoveries; fragmentation of the European market makes the realisation of its potential very difficult ;

d) a broader European market in and of itself, however, would not solve the problem. One reason is that many firms are of inadequate size, though small firms can be competitive by exploiting technological opportunities ;

e) the scale of government procurement of technologically sophisticated products and of related government financed R and D, and the conditions under which such government support is given are both important ;

f) the educational system of a country is considered to be of vital importance ;

g) while social and economic environment, and government policies to make it conducive to innovation, can facilitate decisions to innovate, they cannot take the place of the decisions of management ;

h) in the techniques of management, including the management of research, and of combined technological and market forecasting, the United States appears to have a clear head ;

i) to sum up, then, the problem is not only one of the magnitude of scientific and technological resources in Europe and Japan, but the effectiveness with which these resources are deployed and utilised.

11. OECD (April 1968), op.cit., p.26

The gaps in technology between advanced industrialized countries, however, is the source of technological exchange between these countries. The study made by Freeman-Oldham-Turkcan shows that the payments of the underdeveloped countries for 'patents, licencies, royalties and know-how' accounted for about 10 percent of total international payments in 1966. The 90 percent of these payments took place between the advanced countries themselves.[12]

This leads to the conclusion that among the causes of technological gaps, the possibility of maximizing the benefits of technological dependence should be considered. The differences in the performance of different industrial sectors sheds some light upon the form that this dependence can take among the advanced industrial nations.[13]

Electronic Computers

In the early stages of the development of the computer industry a number of European Member countries, together with the US, made important contributions to the development of basic computer technology. In the 1960's, however, a major gap has developed between the USA and other OECD countries in originating innovations, and this is reflected in the very strong position of US based firms on the US and world markets.

Semi-conductors

From the outset, US firms have had a very strong lead in invention and originating innovations, which is reflected by the position US based firms on world markets.

Pharmaceutical Products

There are no general and deep-rooted differneces amongst the OECD countries in inventive capacities. Furthermore, no country has an overwhelwing lead in originating innovations. Nonethelles, US firms have had the strongest performance, followed by Swiss and by Germen firms. This position is reflected in shares of world markets.

Plastics

No important gap exist amongst the OECD countries in inven-

12. Oldham, Freeman, Turkcan, op.cit.

13. OECD(April 1968), passim, p.23

tion, originating innovations or the production of bulk Plastics. US based firms have a clear lead over the past ten years in originating innovations in 'specialised plastics' used for defence and space purposes.

Iron and Steel.

There are no fundamental disparities between countries with regard to the availability of technological know-how in the iron and steel sector. Differences exist, for economic, technical and other reasons, in the rate of application of a new technology. Eventual convergence towards a standard appears to be the rule.

Machine Tools.

There exists no major technological gap between the OECD countries machine-tool industries in general, despite marked differences between firms or countries in the technical performance of specific machine-tools. A gap which has existed for numerically controlled machine-tools - due to their earlier development and industrial use in the US - is now shrinking. It may, however, widen again if numerically controlled machining is only hesitantly accepted in Europe and Japan.

Non-ferrous Metals.

No gap exists in aluminium, copper and nickel production, where a number of Member countries have originated significant innovations. Amongts the newer metals, no gap exists in invention, nor in originating innovation related to germanium. However, US based firms have a clear lead in originating innovations related to tantalum and - to a lesser extent - titanium.

Scientific Instruments.

Within this highly diversfield sector, no overall gaps have been identified. Firms based in countries such as Germany. Japan, the Netherlands, the UK and the US all have a strong performance in originating innovations in specific instrument groups. US firms have a clear lead in electronic test and measuring instruments, but firms based in Europe and Japan also have originated significant innovations in such groups as nuclear, biomedical, and process control instruments.

MAN-Made Fibres.

The scientific and technological potentials of Member countries are being effectively utilised at the present time and are likely to be effectively utilised in the foreseeable future. It is not possible to say that there are at present any technological gaps that need to be bridged or closed, but it is important that in the future no barriers should be raised to impede the free operation of patents and licensing systems. Differences between national industries mainly result from the size of the market and the greater or lesser degree of integration of firms.

4.2 TECHNOLOGICAL DEPENDENCE OF UNDERDEVELOPED COUNTRIES ON ADVANCED INDUSTRIAL NATIONS

Technological Gaps Between Underdeveloped Countries and Advanced Industrial Nations.

Investment in generating technology is rather limited in the underdeveloped countries. The OECD pilot teams' studies have shown that stocks of scientific personnel in Greece, Portugal, Spain and Turkey, and in Yugoslavia are much smaller than in the more industrialised countries.[14] The expenditure on R and D has been a relatively small proportion of GNP (About 0.2 to 0.4 percent) and that the proportion of the population engaged in such activities was particularly small (averaging about 2.07 Rand D personnel per 10.000 of population). This indicates that the industrialized countries devote proportionately between 4 and 10 times as much of the national resources to R and D activities as the 'developing' member countries ; much of the effort of the latter is concentrated in the agricultural sector.[15]

14. OECD (April 1968), op.cit. p.25

15. ibid.

The figures in Table 4.4 give a global view of the technological gaps between underdeveloped countries and advanced market economies by 1974. The scientist-engineer personnel per 10.000 of population in developed capitalist countries, is much higher than the total scientist-engineer personnel employed in Latin America, Asia and Africa. The situation is not much different for the number of technicians employed per 10.000 of population in these countries. The gap is greater for the R and D personnel employed in scientific and technical activities. The number of R and D personnel per 10.000 population, working as scientist-engineer, is 10.4 in the advanced market economies, 1.2 in Latin America,1.6 in Asia and 0.4 in Africa ; the number of technicians engaged in R and D activity is 8.2 in advanced market economies, 1.4 in Latin America, 0.6 in Asia and 0.4 in Africa.

TABLE 4.4 : NUMBER OF R AND D PERSONNEL PER 10 THOUSAND OF POPULATION

	Developed capitalist countries	Latin America	Asia	Africa
Scientist-engineer	112.0	69.0	22.0	5.8
Technician	142.3	72.2	23.4	8.3
R and D personnel :				
Scientist-engineer	10.4	1.2	1.6	0.4
Technician	8.2	1.4	0.6	0.4

Source : reference made to J. Quartim, "Un Impossible Transfert", L'Economiste du tiers monde (November-December 1976), p.37, in Cumhuriyet (15th March 1977)

The table is also indicative of the great differences in the technological capabilities between underdeveloped countries themselves.

Lack of An Endogenous Process of Technical Change

The limited capability of underdeveloped countries to supply the elements of technical knowledge for initiating and operating new forms of production, leads to the transfer of these elements from advanced industrial nations. It is not simply the fact that the elements of technical knowledge cannot be provided from within the underdeveloped country. Perhaps more important is the fact that technological capability is so limited that management and control of the process is usually precluded even when these elements are received from other nations.

The point is clearly made by C.Cooper and E.Sercovitch:[16] "In the more advanced countries technological change has been generated 'endogenously' for the most part and even where the technologies have been 'imported' from other countries they have rapidly become integrated into an internal process of technological advance. Each round of technological change to some extent laid a foundation for further advance. Technological advances in one part of the system often created demand conditions which stimulated further technological changes in supplier or customer sectors. Perhaps more fundamentally each 'round' of technological change resulted in a new differentiation of technical - and sometimes scientific - skills in the economy. These new, specialised skills provide factor inputs which are needed to sustain further technological advance. This cumulative, endogenous process is not found to anything like the same extent in the developing countries ... In developing countries, industrialisation has in most cases, been a reponse to domestic demands for consumer goods which were previously imported from advanced countries. Naturally enough, it has been based on importation (or transfer) of technologies and production skills already existent in the advanced countries... Industrialisation in developing countries has not generally resulted in an endegenous process of technological advance. Nearly all new technologies used in these economies have been introduced from outside. In this sense technological change is an 'exogenous factor' in the developing countries and economies."

The economic organisation of the underdeveloped countries simply did not generate the ability to create new technologies, nor skills required to operate them. Dependence on external technologies is just as much a consequence of the very limited differentation of technical skills

16. C.M.Cooper and F.Sercovitch (27 April 1971), pp.6-7

in the underdeveloped economy as a result of transfering technologies.

The leading growth sectors of the advanced industrial economies are heavily dependent on scientific and technical knowledge, particularly in science-based industries. Emprical investigations of recent years on the sources of economic growth of the West has led a number of economists to develop a "dynamic theory of the firm" in which inventions and continuous changes of technical conditions can be taken as an integral part of a firm's activities.[17] In the field of "growth and technical change" some of the new approaches try to internalize technical progress and construct more dynamic models.[18] The striking feature of these studies have shown itself particularly in the field of international trade." In all these discussions as to whether trade is an 'engine' of growth for importing or exporting countries, or whether the 'engine' of growth is essentially a domestic product and foreign trade can only make some contribution, underscertain conditions, to the performance of this engine as a transmission mechanism or conveyor for the strategic inputs for growth, one important element seems to have been continuously disregarded by the traditional approaches : the role of knowledge (K), organizational capacity (O) and technology (T) in trade and growth ... Changes in KOT factors... -will for several reasons increase not only domestic output and level of income but also the trading capacity of a nation These 'induced' changes in a country's capacity to export, import and transplant new technologies may, in turn, accelerate the economic growth and also lead to new developments in KOT."[19] It is important to recognise that the exogenous nature of technology in the underdeveloped economies does not simply result from the convenience of using a technique already extant but also from the inducement mechanism of demand-generated growth that has already developed. The advancing technological basis of production is very different in the underdeveloped countries in this sense that the present growth has been the result of assimilating the industrial structure of the developed economies which in turn has been the source of demand for new 'exogenous technology'.

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17. For a review of these developments see, B.Ustunel's recent review article, op.cit ; and, also, Kennedy-Thirlwall, op.cit.

18. ibid.

19. B.Ustunel, op.cit., pp.12 - 13

Adaptive Research

An important question in relation to 'exogenous technology' is whether reliance on external sources of technology has contributed to the differentiation of technical skills which are a prior requirement of an endegenous process of technological change. In other words, the question is related to the relevance to the underdeveloped countries of innovation and technology transfer which concentrade on the process of R and D which are primarily concerned with the needs of the advanced industrial nations. It has been already suggested in the Third Chapter that the novelty of the exogenous technology may not necessarily be the 'appropriate' alternative.

There has been frequent reference to the need in underdeveloped countries for types of technological change that are 'adaptive' - directed at making more 'appropriate' the technological alternatives introduced from the industrialsed societes. We have discussed in the earlier chapter the alternatives open to the sort of technology that underdeveloped countries need. What follows from the earlier discussions is that the adaptive type of innovation is likely to draw mainly on available knowledge and technique, also involving some minor alternations in the inherent design. This sort of adaptive research is related to the modification of the processes before they are installed, and the redesign of products prior to innovation. However, a case of non-need for this sort of research arises when the choice of a particular objective in ffavour of totally 'western equipment', is made vis-à-vis those suiting the factor/resource endowment of the underdeveloped country.

In recent years, increasing, but still insignificant, resources have been devoted to scientific and technological activities in underdeveloped countries in the hope that developmental benefits will accrue.[20] International agencies like UNESCO and UNIDO have attempted to build or promote specialised and multi-purpose governmental research institutes-e.g. in Thailand and in other South East Asian countries. The belief that indigenous science leads to successful technology transfer and thus to development has been shared by a number of governments in underdeveloped count=

20. see, "Applied Scientific Research Corporation of Thailand...", op.cit.p.1

ries.

What will the actual shape of inventive activities and related institutionalisation in underdeveloped countries reminds to be answered. However, the problem on this issue is identified by E.Turkcan as "the lack of demand for research" in industry.[21] Science and technology policy can do little in this situation. One might just as well carry on promoting research despite the fact that it does not relate to anything in the productive sector. The present is hopless, "but in the future,as industrialisation gains momentum (as in the case of Turkey)... real industrial research demand will appear and universities will reorganise their research and educational activities in line with new situations... If there were any demand for research the superstructure would rationalise itself in one way or another".[22] Consequently, the alternative question is "what sort of a technology for underdeveloped countries ?" which has been the subject matter of the previous Chapter.

4.3 SUMMARY

The existence of technological gaps between nations create the need for technological dependence or transfer of technology.

The major proportion of the world expenditure on technical progress takes place within advanced countries. A higher proportion of the R and D expenditures are made into the field of research-intensive industries - such as aircraft, vehicles, electronics, electrical machinery, instruments and chemicals. These industries require highly qualified R and D personnel, heavy capital and maintenance costs and financial support of the governments.

Technical progress has been a source of economic growth.However, the issue of the extent to which R and D expenditures are related to economic growth remains unsolved. The capacity to turn inventions into innovation is determinant on economic growth. The causes of technological gaps

21. E.Turkcan, "The Limits of Science Policy in a Developing Country : The Turkish Case", A study based on the experience of the Scientific and Technical Research Council of Turkey, (January 1974)
22. Ibid.

also affect this capacity. Among these causes are, the scientific and technological capability, the size and conditions of the national markets as well as the firms, the scale of government involvement, the educational system, the techniques of management and the social and economic environment in general.

The limited technological capabilities of the underdeveloped countries to provide the elements of technical knowledge for initiating and operating new plants is the source of their dependence on transfer of technology. Consequently, contrary to the endogenous, internalized process of technological change in advanced countries, technical progress is an exogenous phenomenon to the underdeveloped countries. This exogeneity leads to the question of the relevance of the transfered technology to the needs of the underdeveloped countries. However, since the concept of 'appropriate technology' is variously understood, there is no clear-out answer of this question. Some of the arguments are in favour of 'adaptive research' in underdeveloped countries to modify the imported Western technology according to the requirements of these countries. Cantrarily, there is a lack of demand for research-including the 'adaptive' one - in most of the underdeveloped countries. This leads us back to the question of 'what sort of a technology for underdeveloped countries ? " which has been the subject matter of the earlier Chapter.

CHAPTER 5

CHANNELS OF TRANSBER OF TECHNOLOGY

The underdeveloped economies can benefit from importing industrial technology. The pattern of the international diffusion of technology and the successful application of the imported inventions, have an imported influence an the growth in manufacturing industry. The range of alternatives through which the elements of technical change can be introduced to an underdeveloped economy is quite large. However ;

> "If the concept of technology transfer is explicitely limited to the elements of technical knowledge which are needed to set up particular new production facilities - rather than new production facilities in general - the analysis is more manageable. This makes it possible to distinguish the 'transfer technology' from the wider concept of 'supply of technical information'... This has the advantage, that it helps to sort out a particularly intractable and heterogenous group of 'mechanisms'... The category includes such things as exchanges of books, learned journals, trade journals and sales literature; informal personal contacts, (etc.)..."[1]

In this Chapter, the channels of transfer of technology will be taken as they are used to transfer elements of technical knowledge which are needed to set up and operate specific new production facilities. This is because it is analytically useful to separate the problem of technology transfer from the wider issue.

1. see, C.Cooper and F.Sercovitch, "The Mechanisms For Transfer of Technology From Advanced to Developing Countries", Science Policy Research Unit and Institute of Development Studies, University of Sussex (4th November 1970), p.8

5.1 DETERMINANTS OF TRANSFER OF TECHNOLOGY TO UNDERDEVELOPED COUNTRIES

Classification of Transfer Mechanisms

Cooper and Sercovitch make a distinction between two broad groups of transfer mechanisms :[2]

a. Direct Transfers - these are the mechanisms that are used when receiptent enterprises are in direct contact with suppliers of technical knowledge. They include such things as direct contracting of individual experts and consultant companies, engaging engineering design and plant construction enterprises, training nationals for specific production projects, technical information activities - also in relation to specific projects, and transfer of the process technology embodied in capital goods by importation of equipment.

b. Indirect Transfers - these are the mechanisms that come into play when an advanced company enterprise plays an intermediary role in the transfer process.

Nearly all technology transfers are indirect either in totality or in part. Cooper and Sercovitch distinguish three main reasons for this :[3] (i) deficiencies in the capacity to use technical knowledge in underdeveloped countries, (ii) the role of proprietary process technology in the transfer process; (iii) the role of trade-marks, brand names and the like in transfer process.

Enterprises in underdeveloped countries enter contractual arrangements with enterprises in the advanced country because although they may be able to obtain direct access to some of the elements of technical knowledge needed for the new investment project, they may not have the capacity to use this knowledge effectively. For example, the construction phase of the new project may involve complex management techniques which the receiving enterprise simply cannot cope with ; the operation of the plant may give rise to similar problems. Advanced country enterprises often possess a high degree of corporate skills in mobilising technical knowledge.

2. ibid., pp.11-21
3. ibid.

The process technologies are mostly in proprietory Character. In the transfer of technology large multinational firms tend to have an exclusive control over new technology. However, although they have been responsible for most important innovations in such areas as commercial EDP computers, pharmaceuticals, plastics and nuclear energy, small firms give the examples of important and profitable innovations in sophisticated, fast-moving technologies (e.g. xerography, instant photography, advanced electronic components, large and small computers).[4] In either case, the company which owns the proprietary technology may be unwilling to release it unless the supplier is able to control the whole transfer operation. One reason for this is that the supplying company normally has an interest in the efficiency of the new project, since the returns to be obtained through transferring the technology, depend on the commercial efficiency of the receipent enterprise (e.g. royalties linked to net sales, dividends or profits from sales of intermediate goods to the licencee). However, proprietary technology is only a part of the technical knowledge required. The multinational firm which must be seen not only as a source of technological innovation but also as a source of entrepreneur-ship,[5] may act as an agent to commercialize the non-proprietary technology required for the efficient use of the proprietary technology. This latter case is particularly important as the deficiencies in the capacity to use technical knowledge raise barriers to the application of non-proprietary technology and technical cooperation with supplier and consulting firms may be needed.[6] Usually, the company which owns the process technology takes on the 'intermediary' role and controls other parts of the transfer as well. This tendency is reflected in the variety of elements of know-how that are usually covered by contractual agreements which involve patented processes.

Lastly, the market for the products which are to be manufactured with transferred technology is well-established. Moreover, this market is often conditioned to the brand-names and trade-marks of specific foreign suppliers. The importance which receipent enterprises place on the

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4. see, K.Pavitt, "The Multinational Enterprise and The Transfer of Technology", in The Multinational Enterprise, ed.by. J.H. Dunning, G.Allen Unwin, London (1971), p.62
5. ibid.
6. see, S.Rottenberg, How US Firms Promote Technical Change in Latin America, National Planning Association (1957), pp. 58-60

use of brand-names and trade-marks leads them into indirect transfer agreements even when the technologies required to make the product are simple,well-established and available through direct transfer mechanisms.[7]

Motivations To Transfer Technology To Underdeveloped Countries

The 'intermediary' enterprises which typify indirect transfers, usually possess the 'corporate skills' and 'technology' which are supported by marketing advantages, management and organisation. These distinctive capabilities lead the 'intermediary' enterprise to dominate the transfer phenomenon. "An enterprise which has a degree of monoply power may seek to widen its markets to exploit its advantages fully. Sometimes scale factors may oblige the enterprise to sell internationally.For example the fixed costs of R and D in parts of the electronics capital goods industry are so high that producers must control substantial parts of the world market to amortise them. But whatever the incentives may be to sell the product internationally,it does not necessarily follow that the enterprise has to transfer its technology in order to do so. After all one option open to the enterprise - which presumably has numerous advantages - is to export its products".[8]

There are a number of possible arguments which account for international scales of operation."The classical and neo-classical explanations for the existance of trade between countries are one set of arguments - and so are the neo-Marxist arguments about the falling rate of profit and the shortage of investment outlets in relation to the domestic markets of the advanced industrialised countries."[9] We are not concerned about these contraversises in order to limit the scope of this particular study. However, two points need to be emphasized here. First, if a technology-supplier is forced to develop international markets in order to cover high fixed-costs in its headquarters, this might influence its bargaing position vis-à-vis governments and technology receivers. Seccndly, for the same reason, there will be a preferance for those mechanisms which give a

7. C.Cooper and F.Sercovitch, op.cit.
8. ibid, p.32
9. see,"The Transfer of Technology to Latin America"(Summary) by the Science Policy Research Unit of The University of Sussex, (15 February 1972), p.12

high absolute return cash-flow or high absolute volume of profits as well as a reasonable rate of return over mechanisms which might have high rates of return but small absolute amounts of profits. Such preferences may also influence the proportion of the reinvestible surplus generated by the new production unit.[10]

Why do enterprises choose to transfer rather that to export? There are two arguments which come up frequently in the current literature : (i) international differences in relative factor prices - and particularly in wage rates relative to the price of capital-account for the decision to transfer technology ; (ii) transfer takes place because of restrictions on trade imposed by the governments of the underdeveloped countries.[11] These two arguments are usually referred as the <u>cost-reduction</u> hypothesis and the <u>tariff-jumping</u> hypothesis.

The cost-reduction hypothesis predicts that a company will choose to produce abroad rather than export if the unit costs of production are lowerin the foreign country than at home. Transfers of technology of this kind are expected to contribute to the growth of manufacturing exports that from underdeveloped countries (trade-creating). Some explanations of this case are made by the product-cyle theory. Successive stages of standardization, argues R.Vernon, characterize the product cycle.[12] He says : "The early producers of a new product intended for the United States market are attracted to a United States location by forces which are far stronger than relative factor-cost and transport considerations." In the early stages of introduction of a new product, producers were usually confronted with a number of critical, albeit transitory, conditions. For one thing, the product itself may be quite unstandardized for a time ;its inputs, its processing, and its final specifications may cover a wide range. At this stage, the producers are particularly concerned with the degree of freedom in changing their inputs ; the price elasticity of demand for the output of individual firms is comparatively low due to the high degree of product differentiation or the existence of monopoly ; and, there is a need for effective communication on the part of the producer with customers, suppliers, and even competitors. The product matures as, firstly, some set of product standards opens up technical possibilities for achieving econo-

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10. ibid.
11. see, C.Cooper and F.Sercovitch, op.cit., p.33
12. R.Vernon,"International Investment and International Trade in The Product Cycle",<u>Quarterly Journal of Economics</u>,vol.80(May 1966)pp.190-207

mies of scale through mass output, and encourages long-term commitments to some given processes and some fixed set of facilities. Second, concern about production cost begins to take the place of concern about product characteristics. At this stage, there is likely to be considerable shift in the location of production facilities. Although the first mass market may be located in the U.S., some demand for the product begins almost at once to appear elsewhere. This, under production cost differences mainly arising from differences due to scale and labour costs, may lead to a shift to an advanced country. While the international firm begin servicing third-country markets from the new location, the products becomes more standardized. At an advanced stage in the standardization of some products, the underdeveloped countries may offer competitive advantages as a production location.

The hypothesis suggested by the product cycle theory is that the United States exporting high-income and labour-saving products in the early stages of their existence, and importing them later on. This conclusion is in line with implications of so-called "Leontief Paradox" which criticised the comparative cost theory by establishing the fact that the ratio of capital to labour in United States exports was lower, not higher, than the like ratio in the United States production which had been displaced by competitive imports.[13]

Tariff-jumping transfers take place when the technology-owner sees a threat to its exports market because the government raises tariffs or other import restrictions against his product. It may prove to be more profitable to produce in the protected market rather than to export it. Technology transfers of this kind may take place even if the unit cost of production in the tariff-protected economy are higher than in the home-economy of the technology supplier. These transfers are essentially import-substituting and to that extent trade-destroying. And because of

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13. see, W.W. Leontief, " Domestic Production and Foreign Trade:The American Capital Position Re-examined", Proceedings of the American Philosophical Society Vol.97 (September 1953); also, see, W.H.Gruber, D.Mehta and R.Vernon,"The R and D Factor in International Trade and International Investment of United States Industries",The Journal of Political Economy, No.1 (1967),pp. 20-37 ; for a literature survey, see, B.Ustunel, passim.

the high unit costs of production that are involved they are unlikely to contribute to growth of exports from underdeveloped countries."The evidence is that a large proportion of technology transfers are in fact a response to this protection of foreign markets rather than to factor price differences *per se* ... This factor accounts for many United States transfers (by direct investments and licence agreements) to Europe and Canada. Protection has probably been an important factor in technology transfers to Japan. More particularly, in the case of developing countries, there are numerous references to protection as a factor in stimulating transfers".[14] The intermediary enterprise transfers technology where this is the most effective means for exploiting its 'quasi-monopolistic' advantages in the international market. It is very likely that the market conditions which result from protection in the underdeveloped countries, actually reinforce its monopolistic advantages.

Alternative Contractual Agreements and Involvement of Underdeveloped Countries Governments in Determining Different Channels.

Basically, there are three different types of contractual agreements between the intermediary companies involved in the transfer process and the underdeveloped countries receving technology ;wholly-owned subsidiaries, joint ventures and licencing agreements.

The intermediary companies that act as technology diffusers on an international plane work under a set of constraints. The risks, for example, that are external to the firm like inflation and devaluation, changing and unpredictable legislation and nationalization are among these.[15] The governments in underdeveloped countries tend to pursue the double policy objective of encouraging a greater inflow of foreign technology while, at the same time, obtaining from this transfer a more substantial contribution to the country's development program. However, the examples on this issue indicate that the policies of the host country governments do not emphasize on technology *per se* ; rather, the economic implications of a new investment in a given span of time tend to dominate their decision.

14. C.Cooper and F.Sercovitch, op.cit., p.34
15. For a further account of the risks involved, see, A.Maddison,"Foreign Skills and Technical Assistance in Economic Development", OECD Development Center, Paris (1968), pp.32-36

As G.M.Meier suggests : "the experience of the past two decades has made it increasingly evident that policies of the capital receiving countries are more decisive in determining the quantity and quality of the private capital inflow than are the measures taken by the capital-exporting countries to encourage and protect foreign investment ... Controls exercised by the host country over the conditions of entry of foreign capital, the operation of foreign enterprises, and the remittance of profits and repatriation of capital are of crucial importance in determining the flow and contribution of external private capital."[16] Thus, the host government involvement may force the multinational to use certain mechanisms in the transfer instead of others. Before going into a discussion of the host government policies, let us draw a general picture of alternative contractual agreements.

P.Streeten, in a discussion of the features which distinguish modern private foreign investment from that in the last century, says that whereas in the ninneteenth century 70 p.c. of world foreign investment took the form of bonds and only 30 p.c. that of equity, today bond investment is small and, regarding trade credits, majority is in direct equity; one of the causes of this is that a result of the more rapid spread of knowledge, types of technological knowledge are nowadays more widespread and standardized then they were in the nineteenth century.[17] It is sometimes cheaper to hire foreign engineers and to borrow capital at fixed interest rates than to invite equity investment. In those areas where hired skills plus fixed interest borrowing can achive the same results more cheaply than foreign equity investment, the latter puts an excess burden on the host country. There are other industries in which technical and managerial know-how is not so readily available and where high returns are justified. The standardized technologies are more likely to be known by local producers and there is more likely to be prospective competition from new entrants. In such cases, the monopoly gains of innovating a new technology viadirect investments may not be possible for the technology suppliers. However, given the deficiencies in the capacity to use technical knowledge in underdeveloped

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16. see, G.M.Meier, "Private Foreign Investment", In <u>International Investment</u>, ed.by J.H.Dunning (Penguin 1972), p.412-13
17. P.Streeten, "New Approaches to Private Investment in Less Developed Countries", in <u>International Investment</u>, ed. by J.H.Dunning, op.cit. pp. 436-37

countries, it would, for instance be possible to offer a management contract to a foreign investor who may also be permitted to hold a substantial minority of shares. The foreign investor would construct and manage the plant and would receive management fee. This fee can take the form of a percentage both of profits and of foreign exchange savings realized.[18]

The Wholly-Owned Subsidiaries in underdeveloped countries are almost totally controlled by their parent multinational company". "The whole transfer of technology is dominated by the parent company and the only substantial negotiation is that which takes place between the parent company and the government of the developing country."[19] The wholly-owned subsidiary of a multinational is a useful mechanism of transfer of technology in many cases. When, for instance, the technological capabilities of an underdeveloped country is extremely limited, investments by foreign companies may be the only means of transferring technology. However, a number of transfers particularly in consumer goods industries may be intended to reap advantages conferred by an international brand-name in a market which is supplied already with the product. It is also more difficult for governments to control the monopolistic practices that unique possesion of a differentiated technology or product permits, in the case of wholly-owned subsidiaries. This does not mean that local participation or ownership is a guarantee against such practices.[20]

Both the investment goods needed in the pre-operation stage of a new technology and the shortages of intermediary goods in the operation stage, in the host country, which may lead to strong input dependence on the supplying companies, give a strong saying to the suppliers on the type of contractual agreements. Supplying companies tend to favour wholly-owned subsidiaries because of the real or imagined difficulties of finding a suitable counterpart company in the developing country, and because of the disagreements that often arise between supplier and receipment companies on management decisions and methods.[21]

Many countries have attempted to secure local equity participation from the very beginning of the investment by excluding the fore-

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18. ibid.
19. C.Cooper and F.Sercovitch, op.cit., p.22
20. ibid
21. C.Freeman, C.H.G. Oldham and E.Turkcan, op.cit.

ign investor in certain industries unless the investment is in the form of a joint international business venture. Apart from the shortages of managerial and technical skills in the host country an important factor that may lead to the establishment of joint ventures is the lumpiness of investment due to (i) the inseperability of different stages of the production process, and, (ii) technical scale factors. The lumpiness of investment may require an equity commitment which is large in relation to the resources available to the supplier. However, a joint venture will not be attractive to the foreign investor when the foreign enterprise has adequate capital and does not need local equity capital, there is no need to have a local partner to supply local knowledge, or when the participation of a local partner would affect the freedom of operation of an internationally integrated company. On the other hand, even if the foreign investor is willing to invest in a joint venture, the foreign investment will be lost if domestic investors do not respond.[22] Contrarily, the joint venture may present an attractive opportunity for investment and the it may simply lead to credit creation from domestic sources.

It is possible to acquire foreign know-how, managerial talent and training facilities without enduring the costs of foreign financial involvement. To this end, contractual devices involving engineering and construction agreements, technical services agreement, management contracts or licence or franchise arrangements may be superior to the equity joint venture.

To the extent that the foreign firms view pure licencing as a risk-hedging and profit-maximizing device, there may be rather lower incentives to commit equity. This may be particularly true in industries where the weight or volume of the products militate against export but manufacturing techniques constitute a profitable export.[23] The licence agreement gives the licencee access to proprietary process technology. The licence agreement is a contract "under which the licencee is granted certain rights to manufacture and sell products utilizing inventions, process techniques and other industrial property rights of the licensor."[24] The

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22. G.M.Meier, op.cit., p.432

23. A.P.Mc Dermott, "Licencing is Middle Route", International Commerce, (December 1968), p.6

24. Reference made to U.N.Report of Secretary General, "The Role of Patents in the Transfer of Technology", by C.Cooper and F.Sercovitch, passim., p.23

licence agreement is different from the sales contract. The sales contract involves an outright sale whereas the licence agreement gives "merely temporary outhorisation" to use proprietary technology. This way of using proprietary technology may involve, however, the equity participation of the licensar as a payment for the technology. The licensor exercise control over the licencee in a number of ways. For example, when brand-names are exchanged, licensors sometimes appoint quality control experts and or control marketing through a seperate wholly-owned subsidiary or a joint venture. Also, the licence agreement may include provision for training, for engineering design, machinery supply, plant construction and so on.

An important channel of transfer of technology is the turnkey agreement in which the technology supplier carries out the full range of technical and managerial operations needed to establish an enterprise and turns over the management of the enterprise in full operating condition to the local owner.[25] Where proprietary technology is involved, the turnkey agreement is in fact an extreme from of licencing agreement. However, turnkey agreements also involve non-proprietary process technology. The advantage of the turnkey agreement is that all the skills required to marshall and organise market consultants, engineering designers, machinery suppliers, plant constructors, etc. are provided by the supplier. The leading disadvantage of this sort of an agreement is that it does not help to develop the local technological infrastructure.

The extent to which alternative channels through which technology is transferred can be roughly depicted by the figures related to the advanced western world. Between the mid-fifties and the mid-sixties, "the pattern of outflows of US technology through licencing and foreign investment changed significantly, with a relatively larger portion going to Western Europe and, within this proportion, larger share being transferred through direct foreign investment rather than through licencing agreements between independent firms. Between 1957 and 1965, the annual rate of increase of outflows of US technology to Europe was 18 %, and the proportion of the total accounted for by foreign investment as against licencing increased from about 44% to 70%. This shift of emphasis was much less

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25. C.Cooper and F.Sercovitch, op.cit., p.25-27

pronounced for US technology outflows to Canada and Japan".[26] However, the changing pattern of alternative mechanisms need not necessarily to follow the same course for the underdeveloped countries. The emprical evidence on this issue is rather scare to draw any comments.

Receipent Government Policies and Monopolistic Technology Markets

Among the receipent government policies to affect foreign technology inflow, the tax concessions represent the major legislative effort. These concessions take three principal forms : relief from income and other taxes to new technologies (which is, in practice, to new investments and necessary industries), partial or complete exemption from duties on the importation of essential equipment and materials, and liberal depreciation allowances in the calculation of company taxes. However, some emprical studies conclude that for many countries the tax system is relatively unimportant in inducing investment, and that tax relief seems to be of only secondary importance in creating conditions conducive to industrial growth.[27] Given the low utility of tax incentives, the cost of tax concessions may commonly outweigh the advantages of related technology transfer. It is usually argued that, "when confronting large foreign enterprises and competing among themselves for the short supply of foreign capital, small countries might well be providing more by way of inducement than is necessary - especially when the concessions do not affect the total of investment forthcoming, but only its intercountry allocation."[28] Added to these are the government expenditures on public utilities, labour training and developing industrial sites, and the use of foreign exchange controls to promote exports, the high tariff protection as a part of the import-substitution policies, which make the long-term costs of inducement legislation quite complicated to estimate (we shall come to this point in the latter part of this Chapter, in an evaluation of the costs and benefits of the transfer process). The legislation on the transfer of 'invisible rights' is usually an integral part of the legislation concerning the industrial priorities, investment, imports and exports, foreign capital, and so on, in underdeveloped countries.

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26. K.Pavitt, op.cit. p.66
27. see, J.Heller and K.M.Kaufman, Tax Incentives For Industry In Less Developed Countries, Harward Law School (1963)
28. G.M.Meier, op.cit., p.425

In fact, the receipent government policies reflect the quasi-monopsonistic powers of the government vis-à-vis the quasi-monopolistic powers of the technology supplying company. As C.V.Vaitsos suggests, it is usually assumed that the allocation of resources and distribution of returns are associated with the market mechanism and price system ; and, also, (a) goods, services and factors of production are 'individually owned' (by persons or firms) and (b) the parties participating in an exchange are able to assess the values of economic units transacted. However, "the market within which technology is being commercialized violates both (of the latter) assumptions related to the price system, as it is traditionally defined. Consequently, technology commercialization can best be described through other mechanisms, and one that appears most appropriate is that of bargaining. Policy makers, therefore, who concentrate on the 'price mechanisms'... in order to maximize their country's interests when technology is being purchased, are misorienting themselves completely."[29] C.M.Cooper says that neither the government nor the technology supplier will look upon the negotiation as being about the "price for technology".[30] For each of them the object is to fix terms on which a particular production activity is to be set up in the country. The negotiation is about such matters as the terms on which the technology supplier is allowed to set up a wholly-owned subsidiary or a joint-venture with a local company. It involves such familiar questions as repatriation facilities or licencing or royalty fees, or the regime of profit tax under which the new venture will operate. "Sometimes, where the government has a strong bargaining position and where there is a competent local company, the government may try to convince the technology supplier to provide the production technology on a licence agreement without equity participation".[31] However, the receipent government is usually at a disadvantage since it is impossible

29. C.V. Vaitsos, "Bargaining and The Distribution of Returns in the Purchase of Technology by Developing Countries", Bulletin of the Institute of Development Studies, vol.3, no.1, 1970, p.16-17

30. C.M. Cooper, "The Choice Between Alternative Mechanisms For Setting Up An Oil Refinery In A Developing Country" Science Policy Research Unit and Institute of Development Studies, Universtiy of Sussex (mimeo) p.2

31. ibid.

for it to know with any pecision what is actually going to be purchased.

The technology suppliers tend to use their quasi-monopolistic advantages in many ways. Since the negotiation between technology suppliers and receivers take the form of determining the type of contractual agreement in most cases, the supplier may use its advantage on this issue. On the other hand, what has recently come out clearly from a number of emprical studies is that, fearing encroachment by new competition, they have sought protection through restrictive business practices. For this, first, export cartels have sought to prevent enterprises in non-industrialized areas from entering certain markets. Second, industrial technology suppliers have sought to prevent technology receivers from producing potentially competitive exportables. "These restrictions impede the non-commodity based income growth of certain developing countries. This is particularly pertinent in the case of the most advanced of the underdeveloped countries, some twenty of which account for nearly 85 percent of all Third World non-commodity exports."[32] The restrictive clauses are often imposed on underdeveloped countries' local enterprises. By transferring capital through direct foreign investment, multinationals maintain direct decision-making control over their affiliates, and consequently more direct control over markets, trade patterns, and product cycles. Direct foreign investment may be the best means of preserving a monopoly of knowledge in a foreign market.[33]

The recent emprical evidence on the quasi-monopolistic advantages of the technology suppliers has been emphasized by many authors.[34] The idea is that since licencing system opens the way to independent development to many potential competitors, it is of course to some extent ceasing to satisfy the large monopolies, in which the bulk of scientific and technological progress is concentrated. It is argued, for instance, that "the current aim of experienced U.S. firms operating internationally is to use licencing, along with exporting and foreign investment is a tool for expanding a firm's world commercial potential."[35] The passimistic

32. see, UN Economic Commission to Africa,"Industrial Growth in Developing Africa from 1950 to 1968 and Prospects for 1980",Economic Bulletin for Africa, 10 (1970)

33. see, P.O.Brien,"Trade Patterns and Technology",Journal of World Trade Law, 5 (November - December 1971), p.665

34. see.e.g.C.V.Vaitsos,"Transfer of Resources and Preservation of Monopoly Rents",Economic Development Report No.168,presented at the D.A.S. Conference, Dubrovnik, Yugoslavia (June 1970)

view on this issue is that the patent and licencing system can no longer play an important role in the dissemination of new technology than it played in the past. That which can be patented is only a part of the sum total of the technological know-how and experience needed for the application of technical inventions. Since the object is becoming, not "mere return", but the "extraction of maximum income, fully realizing the potential inherent in the firm's know-how and experience".[36] However, the earlier discussions have shown that there are 'motivations' to transfer technology to underdeveloped countries and the relevant question in relation to the quasi-monopolistic supply markets in the extent to which the transferable technology is 'appropriate'. Therefore, we can conclude that the assumption that 'the patent and licencing system can no longer play an importent role in the dissomination of technology' is only of an extreme one.

C.Vaitsos distinguishes three main sources of monopoly power : technology and technological dependence, receipent's ignorance and host government's policies and others.[37]

A major vehicle for technology importation, particularly in underdeveloped countries, has been their dependence an importation of intermediate and capital goods. In some cases, the utilization of a particular form of know-how determines quite uniquely the sources of supply of the products and capital goods which will be used in a given production process. In others, where technological factors are not restrictive contractual requirements included in the agreements of technology purchase (tie-in clauses) explicitely specify the source of supply of imports. These procedures render the market for intermediate products and capital goods heavily monopolistic. Industrialized countries, having realized the monopoly implications and the restrictive business practices that result from tie-in clauses, have explicitely legislated against them. Underdeveloped countries, however, have still to show in their legal system an awarences and control of the economic implications resulting from tie-in arrangements.

35. see, International Commerce, vol.74, No.52 (December 1968), p.7

36. S.E.Rolfe, <u>The International Corporation</u>, Paris(1969),pp.54,60

37. see, C.V.Vaitsos, (paper presented at Dubrovnik Conferemne),op.cit. pp.12-30

Another aspect of the monopoly power stemming from technological dependence is that the buyer doesn't possess the information about the knowledge he is going to purchase. Since they do not know the properties of the market for technology importation they pay monopoly prices for it. A similar case exists for small and medium-sized manufacturing companies in industrialized countries. However, technical information services are set up which help to reduce such practices.[38] The need for such institutionalizations still remains to be recognized in underdeveloped countries.

The relative bargaining power is the factor that determines the height of monopoly prices. In fact, the receipents ignorance is one of the causes of its relative weakness in bargaining. It is interesting that due to the considerable lag that usually exists between the first commercial usage of a technological discovery and its transfer to an underdeveloped country, she finds herself buying technology not from its 'originator' but someone who copies it. To this, we must add, the origins of monopoly referring to properties related to the receipent of foreign resources rather than to the properties of technology and capital markets, or the motives of the supplier.

The policies of the host government can prove to be another major source of monopoly gains. The inefficiencies caused by import-substitution policies has been paid considerable attention in the present literature. One of the consequences of excessively high effective protection offered by the tariff structures in underdeveloped countries could result in high profits by the efficient producers. The consequent high profits may lead the efficient foreign producer to overinvoice his importations of intermediate products and capital goods so as to implicitely repatriate his high profits. The overvalued exchange rates can make the overpricing less painless for the underdeveloped country, althougn this would lead to higher equity interest in terms of local currency. The economic costs for the local producer would clearly have been much higher, in face of overpricing of intermediate products, if the exchange rate was 'Properly valued' or undervalued. If, on the other hand, the tax jurisdictions allow

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38. see, J. Janetzky, "Netherlands Industrial Consulting Service", Industrial Research and Development News, vo.VI ; and, R.E.Mc.Burney, "The Technical Information Service of the National Research Council of Canada" "Industrial Research and Development News" (1970)

only a percentage of the accrued profits to be repatriated to the parent corporation or have upper limits on rates of payments of interest charges or royalties, the monopoly gains will be obviously understated via excessive pricing.*

5.2 COSTS AND BENEFITS OF TECHNOLOGY TRANSFER THROUGH ALTERNATIVE CHANNELS

G.R.Hall and R.E.Johnson indicate that regardless of whether economic, political, social or some mixture of factors lead a firm or a government to consider substituting an importation of technology for an importation of products, the costs of transfer are a factor in the decision and its outcome ; these costs depend upon the amount of technology transferred and the process of acquisition.[39] The costs of technology transfer are determinant as compared with the benefits of the transfer phenomenon. H.Johnson, talking about the multinational enterprise,which is essentially the corporation operating outside its own national sphere or on a trans-national basis, emphasizes the benefits from local operations of foreign enterprises as consisting in receipt of a "package" of advanced technology, cheap capital, superior managerial ability, and superior knowledge of foreign markets for both final products, and capital goods, intermediate inputs, and raw materials.[40]

Costs of Technology Transfer

The type of the transfer naturally affects its costs. If a firm or a country already possesses the general technology required to manufacture the product in question, transfer is likely to be relatively inexpensive. Transfers involving substantial amounts of general technology can be extremely expensive. Even if the transplantation is limited to system-specific technology, transfer is not an all-or-nothing matter. The ability to import components, parts, and materials provides considerable

39. G.R.Hall and R.E.Johnson, op.cit., pp.354-58

40. H. Johnson, "Economic Benefits of the Multinational Enterprise", in Nationalism and the Multinational Enterprise, edited by H.R. Hahlo, J.G.Smith and R.W. Wright, Oceana Publications N.Y. (1973), p.168

flexibility in the extent of transfer. Transfer entails not only a movement of ideas in the form of blue-prints, drawings, and other data, but a movement of material and men. Put differently, a transfer of manufacturing technology for a sophisticated product usually involves a transfer of rights and data, a technical assistance program, and material support.[41]

Cost of transfer of technology are both direct and indirect. Direct costs include licencing fees, royalty payments, technical assistance payments, costs of buying machinery, components and intermediate materials and profits on equity investments. These are easier to estimate. Indirect costs occur because of transfer princing, restrictive clauses, tie-in agreements, inefficiencies in transplantation, external diseconomies, lack of support for local R and D, and so on. In many cases these two categories of costs arise together and it is difficult to estimate each one seperately. Ultimately, the foreign exchange equivalent of direct and some of indirect costs are important to determine. The other indirect costs are closely related to the concept of "appropriate" technology.

It is often difficult to determine the foreign exchange burdens resulting from particular transfers. The problem is further complicated, because the supplier and receipent may have considerable freedom to shift the burden of payment from one heading to another depending on which means of payment are most advantageous from the point of view of repatriation and tax laws. Royalty payments are oftan preferred because they areeeasy to repatriate. Normally royalty payments are controlled by governments but where there is no control they can be very high.[42] Royalty rates are generally linked to the ex-factory value of sales or the volume of production. In the 1950's, e.g., India and Japan paid royalty rates ranging up to 10-15 % ; in more recent years, the rates have ranged between 5-7 %.[43] While underdeveloped countries appear to have received better terms in recent years, much depends on the total content of agreements. The concern of governments in underdeveloped countries with excessive rates of royalty is apt to have encouraged transmitting companies to claim higher technical fees for designs, specifications, drawings, etc.; thus, it is

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41. G.R.Hall and R.E.Johnson, op.cit.
42. see, C.Cooper and F.Sercovitch, passim., p.42
43. ref. made to Foreign Collaboration in Indian Industry-Survey Report, Reserve Bank of India, Bombay(1968); and, R.H.Patil, "Foreign Collaboration in Japanese Industry", Reserve Bank of India Bulletin (February 1970); by S.S.Tarapore, in Finance And Development, vol.9, No.2 (June 1972)

possible that an agreement with a lower royalty rate may involve a larger total outgo in terms of foreign exchange.[44] Again, the scaling-down of royalty rates may be parallel with a scaling-down of the sophistication of technology ; however, this possibility is unlikely to be general experience, as countries in the process of development would insist on importing progressively more technology.

The duration of agreements to import technology is effective on costs. The receipment countries tend to seek short-terms agreements since they need to be renewed only if the transmission process is found to be satisfactory. In the 1950s it was not uncommon to find agreements for the transmission of fairly rudimentary technology to underdeveloped countries with a duration of 20 years or more.In more recent years, a 10 years' duration seems to be practice.[45] This sort of practices tend to raise indirect costs of transfer particularly in those industries where flow of new inventions is rapid -e.g. chemicals,electronics, etc. The monopoly gains stemming from technical dependence and receipents ignorance will show up in the agreements. These gains are relevant to buying of machinery and component, too. Particularly, if, non-technical dependence is unavoidable, it is often observed that the similar machinery is obtained at surprisingly different prices from different sources.[46] The 'overpricing' of import of semi-finished goods and materials is another aspect of this problem which has been discussed earlier, in this Chapter.

The repatriation of profits has been among the chief concerns of the discussionsoon the costs of transfer of technology. It is often suggested that there is a need to reduce costs of foreign investment to the host country, without reducing its benefits. A high share of equity investment imposes two kinds of burden on the host country. First, a high share of the increase in production, which the investment makes possible, must return to the foreign investor in the form of profits. Secondly,these resources must be transferred through additional foreign exchange earnings or foreign exchange savings. The risks such as expropriation without ade-

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44. ibid
45. ibid
46. ibid

quate compensation, restriction on repatriation profits and capital or devaluation are often cited as factors which make it necessary to earn high rates of profits to compensate for these risks. Hihg profits also impose a heavy balance of payments burden, tending to lead to restrictions on remittances and repatriation, and onse again strengthen the demand for higher profits to compensate for the risk of the imposition of such restrictions.

Among the indirect costs of technology transfer, the failure to achive a considerable change in the product-mix of the total exports, has an indicative character. The reasons for this failure are manifold. Among these are, the inadequate capacity to assimilate industrial technologies in underdeveloped countries, the inefficiencies induced by highly protective import-substitution policies, the lack of export-marketing skills, the extensive industrialization policies leading to 'inappropriate' choice by definition, the restrictive practices of the intermediate companies which act within a global strategy, and so on. The process of development of non-competitive industries has been discussed by many authors.[47] The wider scope of this literature prevents us from going into further discussion on this issue.

The restrictive clauses of technical collaboration agreements are frequently mentioned as cost raising factors in the transfer process. These restrictions may take the form of tie-in clauses which require purchase of raw materials and equipment from a source approved by the foreign collaborator or stipulations on production patterns, exports, and sales procedures.[48] As for exports, however, the costs of production in licences companies (and also in wholly-owned subsidiaries) are so high that they cannot export even where there are no restrictive clauses in the agreement.[49] This may indicate that the tariff-jumping hypothesis may be more relevant in most cases than the cost-reduction hypothesis, in the transfer process.

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47. see, e.g., J.Baranson, Manufacturing Problems In India : The Cumins Diesel Experience. Syracuse U.P., N.Y.(1967) ; and, I.Little, T.Scitovsky and M.Scott, Industry and Trade In Some Developing Countries. O.E.C.D. Development Centre, (1971) Oxford.
48. For further references on this issue, see, S.S.Tarapore, op.cit.
49. Cooper and Sercovitch, passim., p.45

The indirect costs such as negative externalities on the traditional local enterprises, diseconomies of scale, etc. has been the subject matter of the previous Chapter and, therefore we shall not repeat the same arguments here.

Benefits of Technology Transfer

The desire to achieve a shift in the total factor productivity, resource use, and resource allocation is the reàson d'etrè of the desire for new knowledge. More specifically, the expected overall benefits to national economic development is the basic source of demand for transfer of technology to those technologically backward countries.

Thus, the transfer of technology is expected ; (a) to involve the factors of production and resources hitherto unused, in the production process ; and, to shift those which are already in use, to marginally more productive areas ; (b) to create new areas of production so as to alter the old product-mix ; (c) to alleviate the balance - of-payments difficulties by reducing import-dependence and by increasing export potentials ; (d) to lead an expansion of employment as well as production ; (e) to help developing an indigenous scientific and technical substructure ;(f) to make demand-generating affects by opening up new employment opportunities, (g) to help in establishing contacts with overseas banks, capital markets, markets for products, sales organisations and other institutions and to open a previously closed society to world-wide influences[50] ; (h) in appropriate forms and with appropriate safeguards, it can contribute to the growth of local entrepreneurship, by subcontracting, by the encouragement of indigenous workshops and other ancillary enterprises; (i) to contribute indirectly to filling the savings and the foreign exchange gaps by contributing to tax revenue ; and so on.

Here, we shall not go into further discussion of most of these benefits since they have been considered in detail in the previous chapters. It has been apparent that a clear formulation of the costs and benefits is an essential prerequisite to the proper appraisal of the value of technology transfer.

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50. Emphasized by P.Streeten, op.cit., p.445

As a conclusive remark, we can apply to the words of P.Streeten :[51] The organizational structure and motivation of the international corporation, with subsidiaries and branches in many countries, which can militate against the interest of development in a particular country, is for the same reason capable of responding more effectively to technological, political and economic changes in switching to new products, closing down inefficient lines, cutting costs by shifting to new sources of supply, etc. The pressure for greater local participation in ownership and control may impede or even prevent these operations in much the same way in which nationalism and autarky prevent the most efficient international specialization. It ignores nationalistic aims, and, in seeking profits wherever they arise, transcends national boundries. It is this dilemma between, on the one hand, international allocation in the service of efficiency and, on the other greater local participation and commitment, which must be resolved.

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51. ibid

P A R T II

TECHNOLOGY AND EMPLOYMENT IN TURKISH MANUFACTURING INDUSTRY

CHAPTER 6

AN OVERVIEW OF GROWTH OF INDUSTRY AND INCREASING UNEMPLOYMENT IN TURKEY

Turkey has experienced a rapid industrial growth for more than two decades and, by most counts, appears destined to continue this growth. However, even with such a performance, rising open urban unemployment continues. The multiplicity of possible explanations of this phenomena in the present literature has been discussed in the first part of this study. The consequent chapters will attempt to shed some light on this issue in view of the Turkish experience. This Chapter aims to give an overview of the growth of Turkish industrial development and the statistical deliniation of the problem of unemployment will be attempted to be made as an introduction.

6.1 INDUSTRIAL DEVELOPMENT OF THE TURKISH ECONOMY

Overall Growth Performance

Turkey went through a considerable economic growth during the last quarter of country. This growth took place in two different periods : the first period (1950-1962) is characterized by liberal economic policies ; the second (1963-1975) by indicative planning. Gross National Products increased by 6.6 p.c. on the average during this period. The average rate of increase of GNP was 6.3 in the pre-plan years and 6.9 in the planned years. (Table 6.1)

The planned period of economic development has emphasized on the need for industrial progress to achieve a 'structural change' in the Turkish Economy. The Second Five Year Development Plan (SFYDP) (1968-1972) states :[1]

> "The Second Plan aims at achieving a 7 per cent rate of growth per annum in the economy, and also establishes as a target the realisation of radical changes to ensure and maintain this growth rate. The modernisation of economic activities as a whole, depends upon the use of modern technology and know-how in agriculture instead of traditional methods, on the one hand, and upon achievemnt of a rapid increase in the relative share of the industrial sector in GNP, on the other. For this purpose, the output of the industrial sector, which will become the leading sector of the economy during the second Plan Period, will mark an increase of 12 per cent, and its relative share in GNP will increase from 16.3 per cent in 1967 to 20.5 per cent in 1972. To achieve this increase, it is considered imperative to expand the general employment opportunities ; to transfer surplus man-power from the agricultural sector into non agricultural activities ; to utilise trained manpower more effectively ; to gradually reduce the dependence of the Turkish economy on

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1. Second Five Year Development Plan 1968-1972, Republic of Turkey Prime Ministry State Planning Organization, pp.3-4

TABLE 6.1

THE GROWTH PERFORMANCE OF THE TURKISH ECONOMY IN 1950-1975

(1968 Producers Prices, Yearly % changes)

	Agriculture	Industry	Construction	Gross National Product
1950-1962	5,2	8,3	7,4	6,3
1960	2,3	0,4	4,6	3,4
1	- 4,9	11,7	- 1,6	2,0
2	5,0	3,5	0,8	6,2
3	9,6	12,0	9,4	9,7
4	- 0,4	11,2	11,1	4,1
5	- 3,9	9,5	3,5	3,1
6	10,7	15,2	13,9	12,0
7	0,1	8,2	2,9	4,2
8	1,5	11,1	11,1	6,7
9	1,2	12,0	2,8	5,4
1970	4,0	2,2	8,3	5,6
1	13,3	10,4	- 4,3	10,7
2	- 0,2	11,7	7,2	7,6
3	9,9	13,4	9,8	5,5
4	10,3	8,6	7,7	7,4
1975	8,9	9,2	9,6	7,9
1963-1975	3,5	10,4	7,2	6,9
1950-1975	4,3	9,3	7,3	6,6

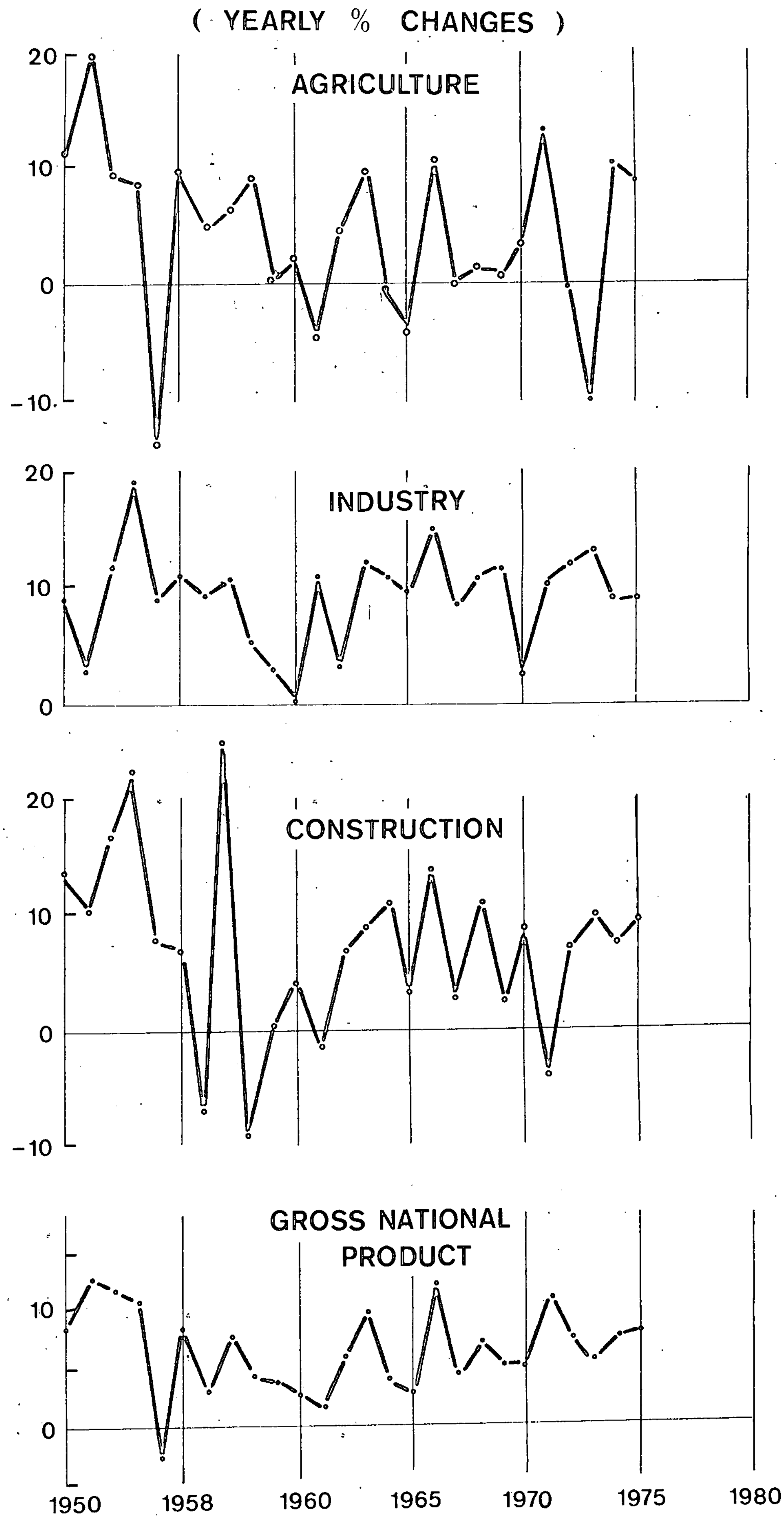
Source : DIE, Türkiye Milli Geliri ve Harcamaları , Tables 10,18 foreign resources ; to alleviate the problems in the balance of payments ; and above all to accelerate the rate of industrial activity in order to attain rapid development, and to promote urbanisation parallel with the efforts towards industrialisation."

The annual average rate of growth of of the Turkish economy has been close to the planned rate of 7 per cent since this rate was set as an explicit growth target in 1962, though with rather wide annual swings due, mainly, to changes in agricultural production, in particular cereals, but also at times to difficulties in keeping domestic industry supplied with needed imports. (See Graph 6.1) The performance of the economy was markedly better than during the 1950's when sharp fluctuations was observed in the growth pattern of the economy as compared to the plan period.

Looking at two successive five-year periods (1963-1967 and 1968-1972) which correspond to the first two Five Year Plans, it seems that the average growth of GNP was 6.7 percent during the first and 7.1 percent during the second. (Table 6.2) As we move to growth rates by sectors, there is more deviation in the direction growth rate of GNP that the growth rates remained below the targets in industry and construction and to a lesser extend in agriculture while it exceeded planned rates in services, housing and during the Second Plan period in transportation.

During the planned period the variations in weather conditions went on influencing the agricultural production and since agricultural output still accounts for more than twenty percent of GNP, swings of 20 per cent in the cereal harvest, which occur not infrequently from one year to the next, can produce a change of several percentage points in the overall GNP figure.[2] Big annual changes in the level of production of the primary sector (and the development of farmers' incomes) were bound to influence industrial output. The processing of agricultural products (e.g. sugar beet, olives, tobacco, wool and cotton) plays a large role in Turkish industrial structure and the swings in the purchasing power of farmers affect demand for industrial products. Industrial production was also affected by recurrent periods of stringency in making imports of needed supplies, including spare parts, and by credit restrictions imposed to dampen

2. see, Turkey , OECD Economic Surveys (November 1974), pp.14-16


(YEARLY % CHANGES)
AGRICULTURE
INDUSTRY
CONSTRUCTION
GROSS NATIONAL PRODUCT
20
10
0
-10
1950
1958
1960
1965
1970
1975
1980

GRAPH 6.1

the over-heating of the economy at times.

TABLE 6.2 PLANNED AND ACTUAL SECTORAL GROWTH RATES (%)

	1st Plan 1963-1967		2nd Plan 1968-1972		3rd Plan 1973-977	
	Target	Actual	Target	Actual	Target	Actual 1/
Sectoral growth rates						
Agriculture	4.2	3.7	4.1	3.6	3.7	3.1
Industry	12.3	10.6	12.0	9.9	11.2	10.4
Construction	10.7	8.0	7.2	5.0	11.9	9.0
Transport	10.5	7.8	7.2	8.8	8.2	9.9
Housing	n.a.	3.5	5.9	6.8	5.0	6.5
Services	6.2	7.5	6.3	7.7	7.1	8.2
GNP(at market prices)	7.0	6.7	7.0	7.1	7.9	6.9

1/ 1973-1975 actual averages

Source : First, Second and Third Plan documents and tables, and 1976 Annual Program

TABLE 6.3 PERCENTAGE DISTRIBUTION OF GNP BY SECTORS(AT 1968 FACTOR PRICES)

	1950	1960	1965	1970	1975
1. Agriculture	45.5	40.9	34.0	30.0	21.8
2. Industry	10.7	15.3	18.4	19.6	20.7
a. mining	1.4	1.9	1.8	1.7	1.7
b. manufacturing	8.8	12.6	15.6	16.7	17.6
c. electricity, gas and water	0.5	0.8	1.0	1.2	1.4
3. Construction	4.2	5.2	6.0	7.3	5.9
4. Others	39.6	38.6	41.6	43.1	51.6
5. Total	100.0	100.0	100.0	100.0	100.0

Source : National Income and Expenditure of Turkey 1948-1972 , Republic of Turkey Prime Ministry State Institute of Statistics (1973) ; and, T.C. Resmî Gazete 11 Aralık 1976.

As the fastest growing sector of the economy the share of industry in GNP has risen to 20.7 p.c. in 1975 from 15.3 p.c. in 1960, while the share of agriculture has decreased from 40.9 p.c. to 21.8 in the same period. (see, Table 6.3) This so-called structural change has been accompanied by the rising share of construction and services sectors from 43.8 p.c. to 57.5, in this period. The manufacturing output has reached to a level of 17.6 p.c. of the GNP in 1975, against 12.6 p.c. in 1960. An arbitrary criterion for 'industrialization' is that about a minimum of 25 % of GDP must be created in the industrial sector and of this at least 60 % should be in manufacturing, and at least one-tenth of the total population of the country should be employed in industry.[3] These proportions were,

3. There are numerous other criteria for 'industrialisation' ; for a thorough discussion of these, see, R.B.Sutcliffe, Industry and Underdevelopment , op.cit. Chapter 2

respectively, 23.6 %, 85.1 % and 5.4 %, in Turkey, in 1975.[4] By this token, the structural change resulting from the overall growth of the economy has remained far behind the stage that a country can be called as 'industrialised'.

The appreciable increases in annual growth rates has not led to equally high increase in per capita income though. Since the net annual average increase of population was 2.49 % during 1962-72 period, the per capita income growth remained around 4 % on average. The international comparisons presented in Table 6.4 indicates this dilemma. The average annual rates of growth of GDP (at a market prices) between 1964-1974 is given in the first column of the table : Turkey occupies the fifth place among 22 countries as a rapidly growing economy, following Spain, Japan, Portugal and Greece. The second column shows the average annual rate of growth of GDP per head of total population : Turkey is at the eleventh place in ranking from the highest per capita growth rate to the lowest. This is not surprising because the net average annual increase of population is the highest in Turkey compared to the OECD countries.[5] However, Turkey still occupies the fifth place by the annual rates of growth of GDP per head of occupied population, in the last column. This is because of the high proportion of the dependent population, since only about 38 % of the total population is in civilian employment.

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4. Total population was 38,270 thousand by mid-1974 and civilian population employed by industrial sector was 2,090 thousand, by 1973.

5. see, Turkey , OECD Economic Surveys (November 1974) 'Basic Statistics : International Comparisons'.

TABLE 6.4 ANNUAL RATES OF GROWTH OF GROSS DOMESTIC PRODUCT AT MARKET PRICES 1964 - 1974 (at constant prices)

%

Country	Total	Per head of total population	Per head of occupied population
1 Germany	4.0	3.3	4.2
2 France	5.3	4.4	4.5
3 Italy	4.7	4.0	4.8
4 Netherlands	5.0	3.8	4.4
5 Belgium	4.7	4.3	4.2
6 Luxembourg	3.7	2.9	2.5
7 United Kingdom	2.5	2.1	2.4
8 Ireland	3.9	3.2	4.1
9 Denmark	3.8	3.1	2.9
10 Greece	6.5	5.9	7.0
11 Turkey	6.4	3.8	5.0
12 Norway	4.5	3.8	3.4
13 Sweden	3.5	2.9	2.7
14 Switzerland	.	.	.
15 Austria	5.0	4.6	6.0
16 Portugal (a)	6.7	7.2	7.3
17 Finland	5.1	4.8	4.8
18 Spain	10.4	9.2	9.2
19 USSR	.	.	.
20 USA	3.7	2.6	1.6
21 Canada	5.2	3.6	2.0
22 Japan	8.6	7.3	7.4

(a) 1963-1973

Source : Eurostat, Basic Statistics of the Community 1975-76, p.23

Growth of Manufacturing Industry

Since the adoption of development programmes in 1963, industrialization has been the key factor in the growth strategy and investment in manufacturing increased more than twice in ten years, measured in constant 1975 prices ; from 1.4 billion dollars in 1963 to 311 billion dollars in 1975.[6] The share of investment in manufacturing industry, in total investments has been 19.5 % on average during the FFYDP period (1963-67), 27.5 % during the SFYDP period (1968-72), 29.1 % in 1973, 30.3 % in 1974 and 28.5 % in 1975.[7]

More than fifty per cent of total investments was made in the intermediary goods industries throughout the planned period ; the investment goods industries received about 13 p.c. of total investments. Although consumers goods industries received the second largest share (between 23 and 28.7 p.c.), the proportion of consumers goods output has decreased in the total manufacturing output (Table 6.6). The capital goods industries have set themselves as high-growth sectors whilst the heavy investments made in the intermediate goods industries account for this qualitative change in the manufacturing sector. However, Turkey's industrial output still consists predominantly of consumer goods.

TABLE 6.5 THE BREAKDOWN OF INDUSTRIAL PRODUCTION (%)

	1962	1967	1972	1973	1974	1975	1976
Consumer goods	62.3	52.9	46.6	53.5	47.4	51.4	48.9
Intermediate goods	27.8	35.4	39.4	32.5	39.3	34.3	35.8
Investment goods	9.9	11.7	14.0	14.0	13.2	14.2	15.3
	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : TFYDP , document, Table:8 ; and, annual programs

6. spo
7. 1971 Program, Table 29 ; TFYDP document, Table 24 ; 1973 Program , Table 41 ; 1974 Program , Table 52 ; 1975 Program , Table 66 ; and 1976 Program , Table : 74

6.2 INCREASING SURPLUS MANPOWER

Increase In Employment Lags Behind Output Growth

The rapid industrial development has not led to equally rapid employment expansion in the Turkish economy, since the lunching of the development plans in 1963. We can have a general view of this pattern of development with the aid of Table 6.7. The average annual rate of increase in total employment has been 2.1 % during 1963-1972, whilst the GNP increased at a 6.8 % rate during the same period. In all sectors of the economy the rate of growth of employment remained behind the rate of increase in output. This, however, is not surprising, since the economy realized appreciable increases in productivity, in all sec-

TABLE 6.6 ANNUAL AVERAGE RATE OF INCREASE OF GROSS NATIONAL PRODUCT AND EMPLOYMENT BY SECTORS /1963-1972

SECTORS	GROWTH RATE (%)	INCREASE IN EMPLOYMENT(%)
Agriculture	3.3	- 0.23
Industry	9.1	7.35
Services	7.7	
Construction	7.3	
Transport	7.5	5.95
Residence	7.9	
Others	7.8	
GNP and total employment	6.8	2.10

Source : TFYDP document, Tables : 2 and 63

tors, during this period. The fastest growing sector of the economy has been the industrial sector, which has also increased employment at the highest annual average rate compared to the other sectors and the economy's total increase in employment has been 7.35 % on average, annually, whilst the industrial output increased at a 9.1 % rate. The total employment in agriculture decreased during that period by 0.23 p.c., as agricultural output increased 3.3 p.c. annually, on average. Employment in other sectors has increased by 5.95 p.c. during this period, whilst output growth has changed between 7.3 p.c. and 7.9 p.c.

Many authors who have investigated the relative growth of output and employment in manufacturing have found similar trends. For example, W.Bear and M.E.A. Hervé studied this problem in selected countries and concluded that "in most countries the rate of growth of employment in the total manufacturing sector was substantially less than half of the growth rate of output ; not only did the industrial sector's rate of labour absorption fall behind the growth rate of the urban population in many countries, but it even fell behing the general growth rate of the population."[8] L.G.Reynolds' survey of the economic development of Puerto Rico indicated that even with a growth of real GNP per capita of 5.2 % annually during the 1950's, total employment fell between 1950 and 1960, with the most dramatic shrinkage in agriculture.[9] In the Turkish case, employment growth has similarly lagged behind the population growth and agricultural employment decreased ; however, industrial development presented the highest new employment opportunities.

Surplus Manpower

L.G.Reynolds postulates that "unless the labour demand curve moves to the right faster than the labour supply rises, surplus labour will increase over time".[10] Moreover this process of increasing labour surplus may be accentuated by high rates of population growth and policies which prematurely raise industrial wages, and induce workers to migrate to the cities.[11] According to A.Lewis, in a two sector economy, namely, a capitalist and a subsistence sector, if this wage phenomenon exists, a transfer of labour from the traditional agricultural to the industrial sector is induced.[12] The marginal productivity

8. W.Bear and M.E.A.Hervé, "Employment and Industrialization in Developing Countries", Quarterly Journal of Economics(80),(February 1966), pp. 88 - 107.
9. L.G.Reynolds, "Wages and Employment in the Labour-Surplus Economy" American Economic Review 55 , (March 1965), pp.19-39
10. ibid. p.21
11. For a review study, see, D.R.Miller, Essays on Labor Force and Employment in Turkey, collected essays of the CENTO symposium (Tehran, November 24-December 5, 1969) and NESA Seminar(Kathmandu, July 5-9, 1970) ;Part I/
12. W.A.Lewis, "Economic Development With Unlimited Supplies of Labour", Manchester School(May 1954);also, in Economics of Underdevelopment,

of labour in the subsistence sector is negligible, zero or even negative; however, the workers receive a subsistence income in terms of agricultural goods. In the capitalist sector, the wage rate which is measured in terms of industrial goods, is assumed to be higher than the average income in the subsistence sector. As the capitalist sector progressively expands, labour is drawn into this sector. This dual economy model simply explains the lure of the town as eventually creating the preconditions for rising urban unemployment, given the unlimited supply of unskilled labour. In fact, the Lewis model attempts to draw a comprehensive frame-work capitalistic accumulation which is not without critics.[13] This aspect of the model will be left out of the context of this Chapter. As for the drift of surplus labour from the subsistence sector to the industrial sector, the following criticisms can be cited :[14] in actual development, wages have risen dramatically long before the surplus labour from the subsistence sector has been absorbed in the industrial sector and the capacity of the industrial sector to absorb labour has turned out to have been rather small ; the disguised unemployment may not in fact be widespread in many of the densely populated areas and only if labour is redundant during peak periods of demand could the agricultural labour force be reduced without reducing agricultural output - however there is a possibility of maintaining agricultural output in the face of a falling labour force by a change in the organization or techniques of farming ; lastly, the seasonality in demand for labour in agriculture indicates that it may well be that labour cannot be spread at peak seasons and there is disguised unemployment at other times - consequently the surplus labour might not be very useful as a supply to urban industry where continuous operation may be essential.

The present conceptual difficulties and the lack of relevant statistical data on employment and unemployment issues cast doubts on the conclusions based on emprical material in this field. Let us exclude these drawbacks for the moment and have a look at the estimates

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edited by A.N.Agarwala and S.P.Singh (1963).

13. For a review of the Lewis model and its leading criticms, see, W.Elkan, Development Economics, Penguin (1973), pp. 65-73.

14. ibid.

of the State Planning Organisation of Turkey, on employment and surplus manpower, in Table 6.8.

The first row of Table 6.8 shows the annual supply of manpower in the Turkish economy during 1962-1977 period. The second row gives the total civilian population actually at work, by sectors. The third row assumes that the difference between the first and the second rows gives the surplus manpower in the non-agricultural sectors or 'open' unemployment. The fourth row shows the surplus manpower in agricultural sector, or, the 'disguised' unemployment.

The figures in Table 6.8 indicates, firstly, the proportion of civilian employment in agricultural sector in total employment, decreased from 76.9 % to 57.7 %, during 1962-1977 ; the ratio of employment in non-agricultural sectors (including industry, services and during 1962-72 period, the emigrant workers abroad) increased from 22.2 % to 41.3 %, by the end of 1977. Secondly, the share of unemployed population in the total supply of manpower, increased from 8.0 % in 1972, to 13.3 % in 1977. Thirdly, the ratio of 'open' unemployment increased from 1.8 % of the total manpower supply in 1962, to 8.7 % in 1977. Fourthly, the relative share of 'disguised' unemployed in total manpower supply was 6.2 % in 1962, which decreased to 4.6 % in 1977.

Deficiencies in SPO Estimates of Employment and Unemployment

The SPO estimates of employment and unemployment are surrounded by a host of still unresolved conceptual, measurement and methodological difficulties such as, for example, deficiencies in population and manpower data, occupational structure of the labour force, efficiency of the present techniques used, and so on. Consequently, employment forecasts are repudiated by the actual outturn events.[15] This leads to change

15. see, M. Celasun, "Prospective Growth of Nonagricultural Employment in Turkey, 1972 - 1982" in Essays on Labour Force and Employment in Turkey, op.cit., pp. 140-141

TABLE 6.7 EMPLOYMENT AND SURPLUS MANPOWER ESTIMATES (15 TO 64 AGE GROUP OF BOTH SEXES, IN THOUSANDS)

	1962(d)	1967(d)	1971(e)	1972(e)	1973(f)	1974	1975	1976	1977(h)
1.Total supply of manpower (a)	12,186	13,467	14,531	14,882	14,670	15,150	15,600	15,990	16,380
2.Total civilian employment demand (a)	11,951	12,937	13,830	14,132	13,946	14,088	14,319	14,621	14,897
a.agricultural sector	9,216	9,073	8,763	8,763	8,760	8,735	8,705	8,680	8,600
b.non-agricultural sectors	2,654	3,322	4,364	4,586	4,920	5,203	5,479	5,806	6,162
c.unknown (c)	81	338	133	133	130	130	130	130	130
d.emigrant workers abroad	-	204	570	650	136(g)	20(g)	5(g)	5(g)	5(g)
3.Surplus manpower in non-agricultural sector	235	530	701	750	724	1,062	1,281	1,396	1,438
4.Surplus manpower in agricultural sector (b)	750	910	860	850	840	800	750	710	700
5.Total surplus manpower	985	1,440	1,561	1,600	1,564	1,862	2,031	2,079	2,183
6.Ratio of surplus manpower (5/1)	8.0	10.7	10.7	10.7	10.7	12.3	13.0	13.0	13.3
7.Ratio of non-agricultural surplus manpower(3/2.b)	1.8	3.9	4.8	5.0	4.9	7.0	8.2	8.7	8.7
8.Ratio of agricultural surplus manpower (4/2.a)	6.2	6.8	5.9	5.7	5.8	5.3	5.1	5.7	4.6

(a)excluding those at military service;also excluding housewifes,students,prisoners;(b)by employment in most active agricultural season;(c)those employed at miscallaneous jobs in the tertiary sector;(d)based on the population censuses and realized production levels;(e) based on the net output elasticity of employment estimated from previous years' real figures;1972 figures represent the estimates from target growth rates of output in the Program;(f)different net output elasticity of employment used for the Third Plan estimates cause the downward shift as compared to 1972 figures;(g)total workers abroad have been excluded from the Third Plan estimates; (h) based on 1977 Program,net output targets.

Source: TFYDP document, Tables 508 and 511;1977 Annual Program, Table 220, Official Gazette , no.15786, 11th December 1976 in assumptions of forecasting at different periods of time. For example, in Table 6.8 , a comparison of the 1972 figures with 1973, indicates a relative decrease in 1973, in the amount of total supply of manpower, total civilian employment (except employment in non-agricultural sectors) and also in the surplus manpower estimates. This is because of ; (a) changes in supply of labour force due to the usage of different projections based on 1970 population census ; (b) different net output elasticities of employment used to estimate sectoral employment ; (c) exclusion of emigrant workers abroad from total civilian employment figures in Third Plan forecasting, although this category was included in the previous plan estimates.[16] The value of the estimates presented in Table 6.8 , to make inter-temporal comparisons is, therefore, rather limited.

Total supply of labour force is based on the Census of Population figures, whereas that proportion of the active population (15 to 64 age group of both sexes) which is either already working at a usual job or actually looking far a job, is assumed to be representing the total supply of labour force. This assumption, however, excludes the child labour (e.g. 7 to 14 age group) which tends to be employed at jobs that may actually create positive marginal productivity particularly in the agricultural sector, in the peak season as well as in the other seasons. Those at the military service, housewifes, students, prisoners and pensioners that fall into the 15 to 64 age group, are also excluded in the SPO estimates, but among these e.g. housewifes may be willing to be employed at productive works.

Total civilian employment includes, in fact, both the actually employed population and the vacancies in the non-agricultural sectors and the estimates of demand for agricultural sector. For the estimation of non-agricultural employment, however, the employment elasticities of the value added has been used since Second Plan preparation studies - e.g. if the value added rises 1 % in a given sector, employment increases by the estimated elasticity.[17] The major drawbacks of this approach are ;firstly, the condition of homogeneity iz assumed to hold for the labour force, which is measured simply by the numbers of participants whereas output increase may be related to changing technology which may necessarily require a shift

16. see, Y.Hamurdan, Türkiye'de İşgücünün Arzı, Talebi ve İşgücü Fazlası Tahminleri,(January 1972), Ankara, SPO publication no: 964-SPO 216

17. ibidb, p.7 ;and, Ad Hoc Committee Report on Employment-Labour Force, Ankara (1973), SPO pub.No. 1144-öik:137, p.11

in the quality of the labour force. Secondly, an implicit assumption since the Second Plan forecasting is that labour is treated in terms of full time equivalents and the surplus labour is then defined as 'unemployment'. The assumed use of full-time equiralents in the measurement of employment is quite arbitrary because recorded statistics do nod differentiate fully and partially employed labour. Partial employment is certainly a widespread case in the service sectors.[18]

The agricultural sector has been administratively defined by the plans ; population and labour force estimates of the districts with less than 10 thousand inhabitants has been assumed as agricultural population and labour force. However, there are those engaged in non-agricultural activities in these districts as well as the persons living in districts with more than 10 thousand population are usually engaged in non-agricultural activities. The labour force demand in the agricultural sector represents the peak season requirements of workeforce in this sector. However, this figure is not equal to the actually employed manpower. The difference between the actual employment and the estimated requirement of manpower in the peak season, has been taken as the 'disguised' unemployment. The concept of 'disguised' unemployment is defined in the Second Plan, as "the volume of unutilised manpower, during the July-August period when manpower demand is at a maximum in agriculture".[19] In fact, a different institution, State Institute of Statistics, estimates the open unemployment rate as 2-3 % on the basis of household surveys ; the general belief on this relatively low rate is that a considerable surplus population is absorbed in terms of disguised unemployed in the pural sector. The plans, however, emphasize that the important problem in the agricultural sector is not the 'disguised' unemployment but the 'structural' unemployment or seasonally unemployed population who can't be seperated from the agricultural activities at the peak season, given the present technological substructure.

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18. L.Celasun, op.cit.

19. SFYDP document, op.cit., p.133

Employment In Manufacturing

The problems besetting the measurement of employment makes it very difficult to go into an analysis of employmentissues in the manufacturing sector, too. There are inconsistensies between the official statistics available in this field. The FFYDP estimates employment in manufacturing 850 thousands in 1961, and 1,470 thousands in 1972.[20] The estimation based on the 1965 Census of Population is 961 thousands in 1965, though. The SFYDP estimates of manufacturing employment in 1972, is 1,919 thousands. However, the 1977 Annual Program's estimate of employment in manufacturing in 1973, is 1,484 thousands. Thus, varying scope and methodology of employment statistics lead to inconclusive results on the basis of the available data.

The Third Plan estimates of manufacturing employment during 1973-1977 indicate that, in 1977, it amounts to 1,808 thousands. The relative share of the employment in manufacturing remains around 30% of the total non-agricultural employment, during 1973-1977 period.[21] However, employmentoopportunites are expected the rise much faster in construction and transportation sectors in this period. The relative share of these sectors are 10.5 % and 11.5 % in 1977, in the total non-agricultural employment.

The State Institute of Statistics Yearbooks provide employment by manufacturing subsectors, by the number of insured persons. Since the coverage of social insurance is rather limited in practice contrary to legal provisions, the SIS figures grossly underestimate the level of employment in manufacturing sector. Also, the extending coverage through time may lead to overestimate the real rate of growth of employment. Assuming that the SIS statistics can be broadly indicative, Table 6.9 gives some idea about increase in employment in manufacturing subsectors, over 1963-1974 period. Accordingly, the leading employment growth sectors have been : electrical engineering, mechanical engineering, wood products(including furniture and others), metal goods, iron and steel, beverage,

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20. see, Table 6, p.55 in Türkiye'de İşgücünün Arzı, Talebi ve İşgücü Fazlası Tahminleri, by the SPO, op.cit.

21. estimates based on Table 221, in 1977 Program.

TABLE 6.8 EMPLOYMENT BY THE NUMBER OF INSURED PERSONS IN MANUFACTURING SECTOR

Manufacturing Subsectors		1963	1974	1974/63
Consumers	goods industries	212,133	340,837	160.6
	food	76,320	118,252	154.9
	beverage	4,822	13,473	279.4
	tobacco	30,499	53,206	174.4
	textile and clothing	100,492	155,906	155.1
Intermediary goods industries		80,010	207,312	259.1
	forest products	8,163	34,775	426.0
	Paper	7,969	11,911	149.4
	printing	7,097	15,433	217.4
	leather and fur	2,157	4,724	219.0
	rubber	6,624	10,525	158.8
	plastics			
	chemicals	13,942	36,903	264.6
	petro-chemicals	-	-	-
	fertilizer	-	-	-
	petroleum	1,593	4,208	264.1
	cement	...	...	...
	Earth Products	...	...	...
	Glass	...	...	...
	Ceramics	...	...	...
	Iron and steel	10,793	33,667	311.9
	non-ferrous metals	21,672	55,166	254.5
Investment	goods industries	67,242	228,383	339.6
	metal goods	17,433	56,886	326.3
	machinery	12,634	55,766	441.3
	electrical engineering	4,110	20,505	498.3
	electronical engineering	-	-	-
	highway transport equip.	30,489	83,701	274.5
	railway transport equip.			
	shipbuilding	-	-	-
	aeroplane maintenance	-	-	-
	small industries	-	-	-
	technological research	-	-	-
	other	2,567	11,525	448.9
Total		359,385	776,532	216.0

Source : SIS, 1975 Statistical Yearbook, (pub.no.750), pp.159-160 ; and 1971 Statistical Yearbook, (pub.no.670), p.172

transport equipment, chemicals and petroleum products. However, the level of employment was higher in the following sectors (from the highest level to the lowest) : textile and clothing, food, transport equipment, metal goods, machinery, tobacco, non-ferrous metals, chemicals, wood products and iron and steel. Apart from the technical structure of these sectors (which will be discussed in theo consequent chapters), the long-established history of these industries (excluding machinery and chemicals) is among the causes of such a high present employment level.

6.3 SUMMARY AND CONCLUSIONS

The GNP of Turkey increased at an average annual rate of 6.9 p.c. during 1963-1975 period. This growth was accompanied by 'structural change' - i.e. the share of industry in GNP increased to 20.7 p.c. from 15.3 p.c. during this period while the share of agriculture decreased from 40.9 p.c. to 21.8 p.c. Within the industrial sector, the manufacturing industry showed the most marked increase at an annual average rate of growth of 9.2 p.c.

However, the consequent appreciable increases in per capita income remained relatively moderate due to high net average annual increase population - which is about 2.49 p.c., the highest among OECD countries ; also a high dependency ratio reduces the productive employment of a larger proportion of the total population.

During the planned period of economic development, investment in manufacturing industry received incresingly higher shares in total investments which was about thirty percent on average during 1973-75. This practice has been a result of the import substitution policy pursued in all branches of manufacturing activity.

The rapid industrial development has not led to equally rapid expansion in employment. In fact, employment in industry has been the fastest compared to other sectors. However, since the labour demand has not increased faster than the labour supply, 'surplus' labour has risen over time.

The proportion of civilian employment in agricultural sector in total employment decreased from 76.9 p.c. to 57.7 p.c. during 1962-1972 while the ratio of non-agricultural employment increased from 22.2 p.c. to 41.3 p.c., during the same period. The share of unemployment in the total manpower supply increased from 8.0 p.c. to 13.3 p.c. and the 'non-agricultural' 'open' unemployment increased from 1.8 p.c. to 8.7 p.c. in the total supply of manpower, in the same period. The share of 'disguised' unemployed decreased from 6.2 p.c. to 4.6 p.c. through 1962-1977.

However, the employment-unemployment figures must be interpreted cautiously. The still unresolved conceptual, measurement and methodological difficulties are also besetting the data provided in the Turkish case. Changing scope and definitions in the basic statistics make intertemporal comparisons rather arbitrarily indicative of the employment trends.

Consequently, the guarded conclusion of this Chapter, is along the Neo-Malthusien lines that population grows fast enough to offset the contribution of economic growth in the direction of full-employment in Turkey and that economic growth is not fast enough to absorb increasing work force.

CHAPTER 7

CAPITAL-INTENSIVE INDUSTRIAL GROWTH AND IMPLICATIONS FOR LEVELS OF EMPLOYMENT

The Neo-Malthusian explanations of the phenomenon of industrial growth and rising non-agricultural unemployment in Turkey has been considered in the previous Chapter. This Chapter intends to test the hypothesis that one of the leading causes of this phenomenon is the strategy to maximize growth by rapid, capital-intensive industrialization, which is inherently labour-saving.

7.1 CAPITAL-INTENSIVE TREND OF INVESTMENTS IN MANUFACTURING INDUSTRY

Investment Policy In Manufacturing Industry

Investment in manufacturing has been based on an extensive industrialisation strategy in Turkey -i.e. no distinction has been made so as to specialize in some of the manufacturing branches and import substitution continued in many subsectors. The three plans commonly emphasized the target of lessening Turkish economy's dependence on external resources and encouraging industrial exports.[1] The combined result of extensive industrialisation and increased export potential of industrial goods would be that the visible trade gap would have decreased. The employment goal has been viewed as a consequence of these policies.[2] An example of the fact that Turkish development plans do not consider employment as an independent target, is given by the Second Plan :[3]

1. see, e.g., SFYDP document, pp.3-4
2. for a review of the major goals of the development plans, see, OECD Economic Surveys, Turkey, op.cit.
3. "Strategy and Objectives of the Second Five-Year Development Plan", SPO publication no.752, Ankara (1969), p.679

> "The general objectives of development planning require that the creation of employment for the existent ever growing manpower arising from the rapid increase in population, should be evaluated as a consequence of development and not as a selected target apart from the rapid development of the economy ....Employment will be raised to the highest possible level in proportion to the increasing opportunities to be created by the growing volume of economic and social activities dependent on the realization of the selected 7 per cent rate of growth".

In fact, this Nurksian approach towards employment was also followed, though implicitely, in the pre-plan years.

Capital-Intensive Trend of Investments

In order to test the hypothesis that capital-intensive bias in investments is among the major causes of relatively slow increase of employment than manufacturing industry's output, we have calculated the indices of employment and gross investments (at constant prices), during 1951-1970 period. These indices do not cover the 1970's, since the data obtained from the SIS do not include this period and the SPO figures which include this period show great variations from the SIS figures for the 1963-70 period. To provide some consistency of data over time, we have preferred to limit the time span of analysis, to 1951-70 period. The indices of employment and investment are presented in Table 7.1 -also, the last column of the table shows the indices of labour productivity over the same period.

The trend line of employment indices/investment indices (y) shows a clear decline over time : the regression equation of t (time) over y has a negative sign- $y_t = 191.49 - 7.99\ t$ (see, Graph 7.1). However, there is a positive correlation between the disturbance terms(D.W.=0.9224) which indicates that this trend is weakened by other factors. In fact, the data used for this analysis may be criticized from various view-points. Firstly, the level of additional employment in each year is affected positively by the new investments realized in that year and negatively by the amount of depreciation - at least theoretically. Therefore, the net investments should have been used in our analysis, instead of the gross investments. The dearth of consistent time-series data has prevented this. Secondly, the present investment figures involve not only the machinery and equipment of different vintages, but also the investments made into industrial construction -i.e. the investments made into machinery and equipment are assumed to require necessarily some complementary construction activities.[4]

The declining trend of employment/investment ratio must be interpreted cautiously for technological reasons, too. As it has been discussed in the first part of this thesis, technical advance may lead to save both labour and capital, and, the incerased efficiency of the capital goods may reflect in the prices of these goods. Thus, even though the rate of saving of both labour and capital are proportionately equal, and the price of capital equipment remains at the previous level, a decline in the employment/investment ratio is unavoidable. Consequently, the quasi-monopolistic 'rent' of the technology suppliers result in the direction of capital-intensive bias since capital goods are measured in terms of cost price.

However, if the prices of investments reflect their increased efficiency, there must be a correlation between the level of productivity and the volume of investments. We have regressed the productivity index on investment index, in order to test this hypothesis :

VA/L = index of labour productivity
I = index of gross investments
t = time

$$(VA/L)_t = 83.42 + 0.235\ It$$
$$(17.67)\quad(11.46)$$
$$R^2 = 0.885 \quad D.W.=0.585$$

The changes in productivity is explained by the level investments at a rate of 23.5 % - i.e. the marginal capital/output ratio is about

4. Many of the authors mentioned in the discussion on the measurement of capital-intensity (Ch.3) make the same assumption.

TABLE 7.1 : INDICES OF EMPLOYMENT, GROSS INVESTMENTS, EMPLOYMENT/ INVESTMENTS AND LABOUR PRODUCTIVITY

Years	Indices of Employment x	Indices of Investment xx	Employment Index / Investment Index	Indices of Labour Productivity
1951	85.84	40.18	213.64	72.75
1952	88.90	40.08	221.18	77.46
1953	92.46	75.24	122.89	87.67
1954	96.15	85.68	112.22	92.22
1955	100.00	100.00	100.00	100.00
1956	104.00	125.37	82.95	105.59
1957	108.16	77.16	140.18	111.80
1958	112.49	76.31	147.61	116.90
1959	116.99	63.82	183.31	115.43
1960	121.77	74.84	162.71	111.96
1961	126.64	77.43	163.55	118.94
1962	170.74	182.36	93.63	119.96
1963	135.48	279.17	48.53	133.42
1964	140.39	241.80	100.18	140.14
1965	145.47	225.78	64.43	148.09
1966	150.74	286.59	52.60	164.83
1967	156.20	360.65	43.31	175.85
1968	161.85	450.78	35.90	190.41
1969	167.71	550.43	30.47	205.31

(x) Annual average number of wage and salary earners.

(xx) Gross investments at constant prices

Source : see, Appendix B

4.3 , on average. These coefficients are affected by some other factors not included in this model : the disturbance terms have a systematic relationship over time (D.W. = 0.585).

Analysis by Subsectors

As a result of the extensive industrialisation strategy investments have been made in all branches of manufacturing activity in Turkey, during the planned period. This practice can be roughly observed with the aid of Table 7.2, which shows the distribution of manufacturing investments by subsectors, during the planned period (at constant prices). If capital-intensity has not been a limiting factor on the level of employment, the rate of growth of employment would have been the highest in those industries where a larger proportion of the investments are realized. The analysis of rank correlation between gross investments and employment (see, Table 7.3) indicate that the industries where employment growth has been faster during 1963-1974 period, are not necessarily the ones where higher volume of investments have been made. However, the investment figures are the ex post amounts for 1963-1972 period and the ex ante investments for 1973-1977 , which requires the conclusion drawn above, to be interpreted causiously. Also, the gross investment figures may not necessarily represent the existing capital stock during the period in question.

The combined emphasis of the three plans on manufacturing subsectors have been, from the highest priority to lowest, as follows : iron and steel, textile and clothing, non-ferrous metals, machinery, petroleum products, petro-chemicals, fertilizers, paper, metal goods and chemicals. However, out of these, only machinery, metal goods, iron and steel and petroleum products have been among the high employment growth industries.

TABLE 7.2 MANUFACTURING INVESTMENTS BY SECTORS[x] (AT 1971 PRICES, MILLIONS OF TL.)

Subsectors	FFYDP period (1)	SFYDP period (2)	TFYDP period (3)	% distribution (4)
Consumers Goods	5.257	7.093	14.520	16,56
Food	1.797	2.761	4.870	5,55
Beverage	309	631	500	0,57
Tobacco	279	200	400	0,46
Textile and Clothing	2.872	3.501	8.750	9,98
Intermediary Goods	10.914	27.690	53.880	61,43
Wood Products	261	733	1.250	1,42
Paper	443	2.690	4.250	4,85
Printing	358	419	350	0,40
Fur and leather	93	119	700	0,80
Rubber	710	257	700	0,80
Plastics	153	399	400	0,46
Chemicals	2.428	6.419	3.850	4,39
Petro-Chemicals	- (1)	- (1)	4.650	5,30
Petroleum Products	- (2)	3.476	6.750	7,70
Fertilizers	...(1)	...(1)	4.670	5,32
Cement	1.054	2.125	2.060	2,35
Earth Products			480	0,55
Glass	1.077	1.421	650	0,74
Ceramics			270	0,31
Iron and Steel		5.684	15.400	17,55
Non-Ferrous Metals	4.337	3.948	7.450	8,49
Investment Goods	2.593	5.831	19.300	22,01
Metal Goods	975	1.161	4.100	4,67
Machinery	329	1.587	6.700	7,65
Agricultural Machinery	100	307	1.550	1,77
Electrical Engineering		563	1.550	1,77
Electronical Engineering	457	147	1.500	1,77
Highway Vehicles			1.080	1,23
Railway Vehicles			300	0,34
Shipbuilding	602	1.833	1.020	1,16
Aeroplane repair and maintenance			1.500	1,71
Small Industries	130	223		
Manufacturing Total	18.764	40.614	87.700	100,00

(x) realized figures for FYDP and SFYDP periods, and TFYDP targets

(1) included in chemical goods investments

(2) included in mining sector

Source : TFYDP document, p.294

TABLE 7.3 ANALYSIS OF RANK CORRELATION BETWEEN GROSS INVESTMENTS AND EMPLOYMENT

	ranking from highest to lowest	
	% distribution of total gross investment 1977/63	Employment growth Index 1974/63
Food	6	15
Beverage	12	6
Tobacco	16	12
Textile and Clothing	2	14
Forest Products	14	3
Paper	7	16
Printing	17	11
Leather and fur	13	10
Rubber and Plastics	15	13
Chemicals	9	17
Petroleum	4	8
Iron and Steel	1	5
Non-Ferrous Metals	3	9
Metal Goods	8	4
Machinery	5	2
Electrical engineering	10	1
Transport Equipment	11	7

Source : Tables 6.8 and 7.2

rank correlation coefficient : + 0.042

7.2 RELATIONSHIP BETWEEN EMPLOYMENT, PRODUCTIVITY, WAGES, PRICES AND INVESTMENTS

A Further Distinction of the Factors Affecting Productivity Levels

It has been showed in the earlier section that the new investments may tend to raise productivity - not too strongly though. In other words new investments tend to involve 'embodied' techniques of production as a determinant of productivity growth. Given the problems of dealing with macro time series data whereas capital is treated as one homogenous stock and technology is not easily defined, the relatively smaller proportion of productivity growth explained by new investments leads to a need for further distinction of the factors affecting productivity levels. Among these are :

(a) wage/rental ratio : according to the induced innovation hypothesis if with a constant price level, money (and real) wage rates rise relative to interest rates, this is expected to make it profitable to use more capital-intensive methods of production (see, Appendix to Ch.3). Assuming homogenous labour input, productivity may rise as wage/rental ratio rises if further employment is explained by rising marginal productivity of labour, in the neo-classical world ; if further employment of labour leads to diminishing marginal productivity of labour relative to capital, a negative relationship between wage/rental ratio and productivity per unit of manpower used, is expected.

Table 7.3 gives the wage/rental ratio in the last column for the Turkish manufacturing industry, over 1955-1969 period. The 'rental' is measured in terms of what is left over value-added (gross output minus inputs other than labour and capital) ; this, consequently, involves the interest paid on capital and the entrepreneurial margin of 'innovating' new technology : the rent.

The regression equation of wage/rental ratio (VW) on productivity (VA/L) is :

$$(VA/L)_t = 306.56 + (-1.74)\,(vw)_t \qquad \text{period : 1955-1969}$$

$$t_1 = 6.22 \qquad t_2 = 11.06$$

$$R^2 = 0.47 \qquad D.W = 0.66$$

TABLE 7.4 INDICES OF GROSS INVESTMENTS, EMPLOYMENT, PRODUCTIVITY, PRICES AND WAGE-RENTAL RATIOS[x] IN TURKISH MANUFACTURING INDUSTRY (1955-100)

Years	Value-Added (VA) (1)	Employment (L) (2)	Productivity (VA/L) (3)	Investments (I) (4)	Gross Output (Q) (5)	Prices (P) (6)	Wages (W) (7)	Wages / Value-Added (VW) (8)
1951	62.19	85.84	72.75	40.18	-	81.48	-	-
1952	68.87	88.90	77.46	40.08	-	82.32	-	-
1953	81.06	92.46	87.67	75.24	-	84.00	-	-
1954	88.68	96.15	92.22	85.68	83.78	93.24	-	-
1955	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1956	109.81	104.00	105.59	125.37	101.84	116.76	110.16	100.32
1957	120.93	108.16	111.80	77.16	111.77	138.60	116.97	96.73
1958	131.50	112.49	116.90	76.21	124.46	159.60	134.41	102.21
1959	135.04	116.99	115.43	63.82	142.78	190.68	159.14	117.85
1960	136.33	121.77	111.96	74.84	147.47	200.76	166.79	122.34
1961	150.62	126.64	118.94	77.43	151.86	206.64	172.76	114.70
1962	156.82	170.74	119.96	182.36	156.54	218.40	184.35	117.54
1963	180.75	135.48	133.42	279.17	171.45	227.64	162.49	89.90
1964	196.72	140.39	140.14	241.80	202.78	225.90	200.60	101.97
1965	215.43	145.47	148.09	225.78	231.61	246.12	210.03	97.49
1966	248.46	150.74	164.83	286.59	263.42	257.88	223.66	90.02
1967	274.67	156.20	175.85	360.65	299.95	278.04	231.90	84.43
1968	308.18	161.85	190.41	450.78	325.38	286.44	258.18	83.78
1969	344.35	167.71	205.31	550.43	-	307.44	280.88	81.57
1970	353.15	173.93	203.05	-	-	327.60	298.45	84.51

(1) Value-added in manufacturing, at constant prices.
(2) Annual average number of wage and salary earners.
(3) Value-added per man, derived from first two columns.
(4) Gross, at constant prices.
(5) In terms of value, at constant prices.
(6) Wholesale price indices.
(7) Annual average of daily real wages.
(8) Derived from the first and the seventh columns.
X Changes in wages over value-added, assuming that interest on capital plus profit makes "the rent"

Source : see, Appendix 7.1

There is a negative relationship between these two variables but not a strong one since there is a strong positive correlation of disturbance terms. Thus, although a capital-intensive bias is among the major determinants of productivity changes, there are other factors affecting the changes in productivity.

In fact an increase in value-added per man employed affects more strongly the pattern of distribution of output between labour and capital :

$$(vw)_t = 139.28 + (-0.284)\ (VA/L)_t$$
$$t_1 = 14.96 \quad t_2 = -4.44$$
$$R^2 = 0.885 \quad D.W. = 0.43$$

(Since $R^2 = 0.885$ is greater than $R^2 = 0.47$)

(b) <u>economies of scale</u> : the level of output (Q) may affect the level of productivity (VA/L) in a positive way, but not necessarily creating a limiting affect on the level of employment. Because, the scale of output may be increased by the repetitive installation of relatively labour-intensive production methods.
The affect of scale economies has been found rather strong in the Turkish Manufacturing Industry :

$$(VA/L)_t = 66.11 + 0.328\ Qt \qquad \text{period : 1955-1968}$$
$$t_1 = 25.45 \quad t_2 = 24.49$$
$$R^2 = 0.98 \quad D.W. = 1.294$$

However the opposite relationship is also relevant that the adoption of methods of production which raise productivity is determinant on the level of total output :

$$Q_t = -194.20 + 2.99\ (VA/L)_t$$
$$t_1 = -12.47 \quad t_2 = 24.49$$
$$R^2 = 0.98 \quad D.W. = 1.256$$

(c) a demand-generated rise in productivity : the non-technological explanations of the level productivity and employment lie in the field of demand. If we take a demand-pull inflation for granted, rising prices may induce further investments for profitable opportunities and consequent rise in productivity. The regression of prices (p) on investments and productivity indicates to this direction :

$$I_t = -122.18 + 1.638\ P_t \qquad \text{Period : 1951-1969}$$
$$t_1 = 2.36 \quad t_2 = 6.28$$
$$R^2 = 0.689 \quad D.W. = 0.374$$

$$(VA/L)_t = 41.03 + 0.460\ P_t$$
$$t_1 = 4.97 \quad t_2 = 11.06$$
$$R^2 = 0.878 \quad D.W. = 0.31$$

However, the strong positive serial correlation between the disturbance terms indicate the fact that above relationships may not be as relavent as they appear in these equations.
Indeed, if there was not cost-push inflation and imperfect markets, a rise in productivity would lead to a decrease in the price level but it does not :

$$P_t = -55.88 + 1.91\ (VA/L)_t$$
$$t_1 = -2.47 \quad t_2 = 11.06$$
$$R^2 = 0.878 \quad D.W. = 0.29$$

(d) a lagged relationship between productivity and investment : the gestation period of investments may be an important determinant of the realization of productivity gains resulting from technical change in the embodied form. This possibility, which has been excluded in section 7.1, has been tested for lags from one to three years :

$$(VA/L)_t = 89.22 + 0.2440\ I_{t-1}$$
$$t_1 = 19.08 \quad t_2 = 12.01 \qquad R^2 = 0.89 \quad D.W. = 0.8138$$

$$(VA/L)_t = 89.70 + 0.2888\ I_{t-2}$$
$$t_1 = 16.64 \quad t_2 = 10.61 \qquad R^2 = 0.88 \quad D.W. = 1.1205$$

$$(VA/L)_t = 90.39 + 0.3388\, I_{t-3}$$

$$t_1 = 14.79 \quad t_2 = 9.53 \qquad R^2 = 0.86 \qquad D.W. = 1.108$$

The elimination of auto-correlation is observed due to two and three year lags : this leads investments to be a more important explanatory variable on productivity.

(e) institutionalisation in labour markets : a comparison of columns 3 and 7 indicate that the rate of increase in wage levels has been faster than the growth of productivity over 1955-1970 period. This has been even faster during the 1960's. An increasing industrial action following the legal recognition of strikes in the 1963 Labour Code has been one of the causes of secular wage increases since that time. Although the wage/rental ratio shows a declining trend during this period (see, graph 7.2), this phenomenon has induced a capital-intensive bias in investment decisions. Indeed, there is a stronger negative relationship between the level of productivity and wage/rental ratio, during the post-1962 period than the 1955-1968 period :

$$(VA/L)_t = 371.69 + (-2.24)\,(vw)_t \qquad \text{period : post-1962}$$

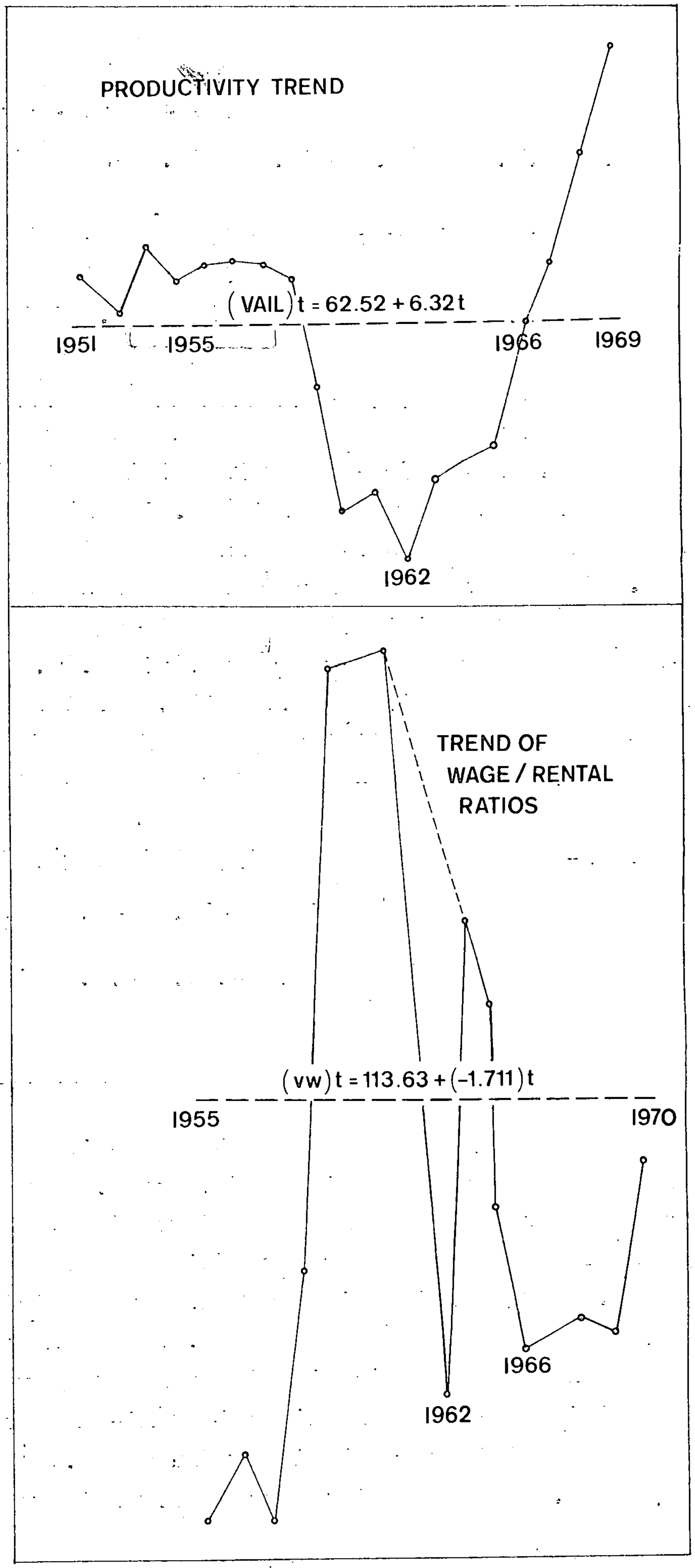
$$t_1 = 7.18 \quad t_2 = -4.03$$

$$R^2 = 0.699 \quad D.W. = 1.649$$

Conclusive Remarks

The capital-intensive trend of technical change over a period of more than 15 years, has been nourished by changing pattern of distribution of net output between labour and capital due economic and institutional factors, in the Turkish Manufacturing Industry. The sources of increase in productivity has been more diversified though. Economies of scale, pattern of demand growth, the length of gestation period (or, the 'imitation lag') have been also determinant on the level of productivity. Thus, while the capital-intensive bias has been a limiting factor on the level of employment, a grossly defined productivity increase possibly has not been in conflict with increase in employment.

This analysis has been based on time-series data which is strongly affected by random, cyclical, structural and institutional changes.


PRODUCTIVITY TREND
(VAIL)t = 62.52 + 6.32t
1951
1955
1966
1969
1962
TREND OF
WAGE / RENTAL
RATIOS
(vw)t = 113.63 + (-1.711)t
1955
1970
1962
1966

GRAPH 7.2

And, thus, it may not be suggestive enough on the prospective developments.

The cyclical fluctuation, wwhich has not been a matter of discussion so far, is strongly related with the productivity trend. For instance, the Turkish economy entered into a period of recession in 1955, which was recovered in the mid-1960's. The reasons of this recession were the exhaustion of erable lands, inflationary monetary policies, import bottlenecks (in raw materials, parts, transport equipment and rubber) and deficit financing. Consequently, capital accumulation slowed down and in industrial establishments an excess capacity of 40-48 % arose, in the late fifties.[5] The consequent productivity decline can be observed in Graph 7.2. Although the pattern of the changes in the level of employment shows a relatively stable development in this period, (column 2, in Table 7.4), the possibility of labour redundancy or 'disguised' unemployment, is obvious. The productivity growth speeded up as economy started expansion. Thus, there is a clear relationship between the productivity changes and cyclical fluctuations, in Turkish Manufacturing Industries.

7.3 RESULTS OF SURVEYS MADE BY OTHER AUTHORS

SPO Technical Manpower Survey (1967)

The conclusions of this survey are presented in the last four columns of Table 7.5. The first three columns of this table has been based on our calculations from the SIS data.

The SPO survey covered 2708 private and 1960 public enterprises.

Column 4 is based on Arrow-Chenery-Minhas-Solow model.[6] They showed that

5. see, document of IMP, Stabilization Program of The Turkish Government (July 1958), part II, p.6
6. K.Arrow, H.Chenery, B.Minhas, R.Solow, "Capital-Labour Substitution and Economic Efficiency", Review of Economics and Statistics (1961)

TABLE 7.5 PRODUCTIVITY, EASE OF FACTOR SUBSTITUTION AND ECONOMIES OF SCALE IN FOURTEEN TURKISH MANUFACTURING INDUSTRIES (1967)

Industries	(1) Productivity ('000 TL) (1)	(2) Share of Wages and Salaries in Value-Added (%)	(3) Avarage Output In Each Firm ('000 TL) (1)	(4) Elasticity of Substitution (A.C.M.S)	(5) Elasticity of Substitution (K atz)	(6) 'True' Verdoorn Coefficient	(7) Implied Value of Returns to Scale
Food	39.276	20.60	11,751.4	1.181 ns	0.595xx	0.212	2.098
Beverage-Tobacco	80.583	9.01	49,271.8	0.691 ns	0.689ns	0.179	2.356
Textiles	20.736	39.13	9,150.9	0.190nsx	0.048nsx	0.106	1.125
Wood Products	15.415	40.27	4,525.6	0.122nsx	-0.122nsx	0.205	1.224
Paper-Printing	72.457	40.46	7,830.9	0.796 ns	0.011nsx	0.325	1.489
Fur-Leather	19.564	50.48	2,946.0	0.721 ns	0.938ns	-0.099	0.385
Rubber Products	56.604	18.87	10,294.5	0.798 ns	0.687ns	0.047	1.177
Chemical Products	41.365	31.94	10,154.0	0.928 ns	0.811ns	0.121	2.779
Non-Metallic "(2)	25.373	38.75	397,701.8	1.685 ns	1.394ns	0.100	0.798
Basic Metals (3)	50.438	29.36	40,542.6	0.083 ns	-0.655nsx	0.298	1.219
Metal Products(4)	26.366	40.84	8,641.2	0.528 xx	0.242nsx	0.287	1.038
Machinery (5)	31.523	34.49	9,226.0	0.505 xx	0.168nsx	0.192	1.300
Electrical mach.	34.028	31.90	9,528.0	0.720 ns	0.566xx	0.102	1.307
Transport equipm.	16.300	73.48	18,410.2	0.886 ns	0.564xx	0.197	1.824

(1) Average Productivity of the total manufacturing industry is 41.13('000 TL)
Average Output in each firm in total " " is 12,398.9('000 TL)

(2) Except products of petroleum and coal

(3) Iron and Steel.

(4) Except machinery and transport equipment

(5) except electrical machinery

n.s. non-significantly different from 1 at a 5% or higher level of confidence.

n.s.x " " different from 0 at a 5% " " " " "

x.x significantly different from 1 and 0 at a 5% or " " " "

Source: SIS data evaluated by us ; the last four columns show the SPO estimates by M.Toruner, in SPO publication no:DPT 1138-SPD:245(November 1971)

Rank Correlation :

(I) Productivity on wage-rental ratio : $r_1 = -0.8494$

(II) Productivity on firm size : $r_{11} = 0.6208$

(III) Productivity on elasticity of substitution(Katz) : $r_{111} = 0.8138$

(IV) Productivity on the returns to scale : $r_{1V} = 0.2571$

(V) Elasticity of substitution on returns to scale : $r_V = -0.3532$

(VI) Elasticity of substitution on wage-rental ratio : $r_{V1} = -0.5844$

there is a linear relationship between the rate of productivity growth and the growth of real wages. Their regression model which is based on the CES production function can be written in linear form as follows :

$$\log (VA/L) = -(\log a + \quad \log W)$$

whereas is the elasticity of substitution between labour and capital. The assumptions of the model are ; (a) constant returns to scale ; (b) factors of production are rewarded by their marginal productivities.

<u>Column 5, 6 and 7</u> are calculated by Katz model.[7] J.M.Katz starts from the 'Verdoorn Coefficient' which refers to the assumption that there exists a stable long-run relation between productivity and the level of output.[8] The rate of output growth being the explanatory variable, the 'Verdoorn Law' gives us the scale coefficient explaining the productivity growth. Katz points out that the single regression of labour productivity on the output growth "does not allow a clear identification of any of the parameters of the production process, and also that it produces a systematically biased coefficient, the bias being due to the omission of several other terms that properly belong to the model". Thus, he expands the model as follows :

$$\log (VA/L) = z + \quad \log W + \quad \log M + b \log(VA) + \quad t + u$$

Where; = elasticity of factor substitution
M = the degree of imperfection
t = time
= an estimate of annual technical change
b = (1-) (V-1)/V, where, V = economies of scale. Katz calls this the 'true' Verdoorn coefficient.

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7. J.M.Katz, "Verdoorn Effects, Returns to Scale, and Elasticity of Factor Substitution" , <u>Oxford Economic Papers</u> (1970)

8. J.M.Katz, <u>Production Functions, Foreign Investments and Growth</u>, North Holland Pub.co. Amsterdam (1969), Ch.3

The Results of Table 7.5

The cross-section analysis in which each industry is treated as an observation reveals an important association between productivity movements and the other variables. Under the assumption that there is profit maximization and the factor proportions are being continuously adjusted at the margin to the ruling factor price ratios, the following results have been reached :

a) 12 industries out of 14 increasing returns to scale ; fur and leather, and the non-metallic products are not in this category. In metal products and textiles, scale coefficients are not significantly different from 1 at a 5% or higher level of confidence.

b) When the elasticity of substitution is near to zero, a smaller part of the observed changes in average labour productivity will be accounted for by changes in factor proportions ; this is the case for industries like textiles, wood products, basic metals, machinery, paper and printing and metal products. These are also the industries where the share of wages and salaries in the value-added is above the average of total manufacturing industry. This may indicate that the techniques of the labour-intensive industries are less sensitive to changes in the wage rate. All of these industries enjoy increasing returns to scale.

c) The level of productivity and the share of wages and salaries in value-added have an inverse correlation, as would be expected on the basis of the conventional theory ($r_1 = -0.849$). This may indicate the low productivities in labour-intensive industries. Also, it may mean that wages and salaries increase rapidly as mechanization increases.

d) Three of the industries, food, beverage-tobacco, and tronsport equipment, have both the coefficient of elasticity of substitution and returns to scale above the average for all manufacturing industries. This may indicate that scale economies may sometimes be more important in labour-intensive industries than in the capital-intensive ones.

e) When average output concentration in each firm is used as the scale variable instead of the total level of output in each industry, a stronger relationship is found between labour productivity and economies of scale ($r_{II} = 0,6208$ against $r_{IV} = 0.2571$) the "implied value of returns to scale" is determined by the level of ; but it is based on the familiar neo-classical assumptions.

f) SPO results and our calculations indicate a consistent relationship between productivity changes and wage-rental ratios : as the elasticity of substitution gets larger, productivity changes are more strongly influenced by it ($r_I = -0.8494$ and $r_{III} = 0.8138$).

g) The elasticity of substitution has an inverse correlation with returns to scale ($r_V = -0.3532$)

h) In the public enterprises scale coefficient is bigger than in the private enterprises, consistent with output and labour concentration.

Manufacturing Sectors	Elasticity of Substitution	'True' Verdoorn Coefficient	R^2	Number of Observations	Implied Value of Returns to Scale
T o t a l	0.449 (0.052) 8.606	0.183 (0.021) 8.870	0.633	563	1.49
P r i v a t e	0.453 (0.053) 8.424	0.230 (0.023) 9.841	0.685	466	1.72
P u b l i c	0.325 (0.134) 2.419	0.290 (0.047) 6.190	0.653	96	1.75
Average Number of Employees in Each Firm	Private : 82 Public : 652				
Average Level of Output in Each Firm (million T.L.)	Private : 7.2 Public : 69.8				

Ad Hoc Committee Report on Employment and Manpower

The Ad Hoc Committe Report of the SPO on employment and manpower evaluates the relationship between employment, productivity and output, during 1963-69 period.[9] The regression value-added, and productivity on employment is found :

$$L = 0.90 + 0.941\ (VA) - 1.153\ (VA/L)$$

This indicates that although there is a positive relationship between output increase and employment, a 1% increase in productivity leads to a reduction in employment of 1.153 %.

A similar analysis has been made between employment, investmants and real wages :

$$L = 4.528 + 0.331\ I - 0.194\ w \qquad (R^2 = 0.966)$$

Similarly, while a 1% increase in investments tend to rise employment by 0.33%, an equal rate of increase in wages tend to reduce employment by 0.194%.

NPC Study On State Economic Enterprises

National Productivity Center of Turkey used SIS data covering the 1948-1968 period, in State Economic Enterprises employing more than 10 employees or 10 HP capacity.[10] Some of the regression results of this study are as follows : (K denotes capital stock)

(1) $\ln L = -1.041 + 0.429 \ln\left(\frac{VA}{L}\right) + 0.156\ w + 0.10868 \ln K$

$t_1 = 0.0962 \qquad t_2 = 1.95758 \qquad t_3 = 0.83027$

$R^2 = 0.99383 \qquad F = 455 \qquad$ period : 1948-68

(2) $L = 44.077 - 0.0956\ w$ period : 1964-68

$t = -0.378$

(3) $L = 71.261 - 0.9889\ w$ period : 1968-72

$t = -2.56$

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9. SPO, <u>Ad Hoc Committee Report on Employment and Manpower</u> , publication No. 1144/137, Ankara (1973), pp.28-31

10. R.Hoşgör, <u>İktisadi Kamu Kuruluşlarında ve Büyük İmalat Sanayiinde Ücret-Fiat-Verimlilik-İstihdam İlişkileri</u> , NPC publication no.: 194, Ankara (1975)

$$(4) \quad W = 37.65 + 0.0739\,(VA/L) \qquad \text{period : 1964-68}$$
$$t = 2.331$$
$$(5) \quad W = 58.40 + 0.3384\,(VA/L) \qquad \text{period : 1968-72}$$
$$t = 2.65$$

The conclusions drawn from the first equation is strikingly contrary to what is found in the studies discussed so far. Because, firstly, increase in productivity does not conflict with increase in employment. Secondly, level of wages are also positively correlated with the level of employment. Thirdly, increase in capital stock leads to an increase in employment, as well - though at a 10 p.c. slower rate.

The second equation indicates, however, that an increase in real wages leads to a decrease in the level of employment during 1964-1968. The third equation carries out the same analysis for the 1968-72 period and draws similar conclusions.

The fourth and fifth equations indicate that there is a positive relationship between an increase in productivity and real wages, during 1964-68 period.

The differing coverage of this survey leads these conclusions not to be totally comparable with the previous ones.

7.4 SUMMARY AND CONCLUSION

A Nurksian attitude has been adopted towards employment by policy-makers during the last 25 years, in Turkey-i.e. creation of employment has been viewed as a consequence of output growth, not as an independent target. This has been accompanied by a capital-intensive trend in investments both at an aggregate level and by manufacturing subsectors.

Although 'embodied' technology has been possibly an important component of new stock of machinery and equipment, it has not been a too strong determinant of productivity changes.

In fact, the pattern of distribution of productivity gains, economies of scale, the volume of demand for output, the imitation lag, and fluctuations of cyclical, institutional and random character have been also determinant on the level of productivity. These, however, affected the level of productivity at various degrees viewed at an aggregate level and sectorwise.

The capital-intensive (productivity-raising) techniques of production had a limiting influence on the growth of the volume of employment ; in some cases, it had even a negative affect on the total employment level. This, however, may not be quite true in some sectors of the economy, particularly in the recent fifteen years - e.g. in some of the state economic enterprises. In any case, the Nurksian attitude towards employment created the possibility of labour redundancy and 'disguised' unemployment - the 'Nkrumah Solution'.

In those cases where capital-intensity has made a relatively minor affect on the level of productivity, than other factors, capital-intensive bias in investment decisions may not have been too detrimental on the growth of employment - assuming that a reasonably high level of capacity usage had existed.

The SIS had adopted in the Manufacturing Industry Surveys, the definition of manufacturing establishments as 'small' and 'large' by their employment level, until 1970. Accordingly, those establishments employing less than 10 persons were categorized as small and those employing 10 or more persons were categorized as large. In the 1970 Survey, the scope of large establishments was expanded by defining them as those employing 10 or more persons or using more than 50 horse power capacity. However, these definitions have been made for statistical and descriptive purposes ; they do not refer to homogenous technico-economic characteristics. A further qualification of these categories can be made as follows:[2]

Small establishments can be divided into workshops, handicrafts and cottage industries.

a. Workshops : They are operated with the labour of the workshop proprietor who is also the master workman, perhaps with the help of the members of this family, and perhaps with a few hired wage-workers. There may be both apprentices and journeyman in his predominantly artisanal activity without technical division of labour. Certain quality standards areeachieved by artisanal specialization, by using simple hand tools sometimes supplemented by mechanical energy. They may train young artisans. The workshop can be a seperate place or the home of the master workman. Production is to a large extent for marketing in regional and national markets and they generally produce consumer goods.

b. Handicrafts : They are similar to workshops. However artisanal skills dominate in quality, outlook and beauty of the product. In some developing countries they usually produce tourist goods.

c. Cottage industries : Production activity is usually performed when agricultural activities stagnate, by using the agricultural surplus. They produce low quality foodstuffs, confectionaries, etc., and sell in village markets, road sites or produce for self-consumption.

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2. Based on information supplied in, Pamuklu Tekstil Endüstrisinde Prodüktiviteyi Arttırma Semineri , NPC publication no.107, Ankara (1971),pp. 18-19. A similar classification is made by S.Rottenberg, Technical Cooperation in Latin America : How U.S. Business Firms Promote Technological Progress, National Planning Association (1957), pp.12-13

<u>Large establishments</u> involve the large and small factories.

d. <u>Large factories</u> : They are highly mechanized and employ mass production methods with a high division of labour and specialization at technical, managerial and administrative levels. Their products are specialized and standardized and the quality of their output is high and uniform. They produce for export markets as well as for national markets. They do negligable research but they are closely linked with the mechanisms of transfer of technology. They do industrial training and develop skills needed to use modern technologies. Capitalist employee-wage labour relations are predominant.

e. <u>Small factories</u> : They present a technical division of labour similar to but less sophisticated than those in large factories. Employees are wage-earners ; owners or partners do not actually join physical work but concentrate on production and management decisions. Work does not show an artisanal character and it is not seasonal but permenant. Despite the high level of technical division of labour, they use labour-intensive and sometimes old mechanical equipment. They may have poor repair and maintenance activities. Output quality is geared to the requirements of the domestic markets. Trial and error methods are extensively used in the production process.

These broad categories are difficult to define in quantitative terms though.

Distribution of Output, Value-added, Capital, Wages and Employment by Size of Establishments

The statistical significance of establishments of different size in the Turkish Manufacturing industry can be discussed with the aid of Table 8.1. The data presented in Table 8.1 refers to 1970. There are two groups of 'size' in this table : the first group is in terms of the number of employees, and the second group is in terms of the value of output.

Let us take the size of establishments by number of employees, first. The highest concentration of the number of establishments is observed in the less than 50 employee category. 75.9 % of the total manufacturing establishments are within this interval while their share in total output is 9.0%, in value-added 5.7%, in total capital stock

7.3 %, in total payments of wages and salaries 8.5 % , and in total employment 14.0 %. The 'small' establishments have a relatively smaller share within this category, compared to the 10-19 and 20-49 intervals. The concentration of establishments decrease as output, value-added, capital stock, wages and salaries and employment show a regular pattern of increase after the 200 employee interval. Particularly the 500 category produces the 66.8% of total output, 75.7 % of value-added, ppossesses the 65.1 % of the total stock of capital, and creates the 34.0 % of the total manufacturing employment. The relatively higher concentration of 'gross' output and 'net' output (value-added) compared to the concentration of labour indicates that the 500+ employee category is much more productive than the previous ones. Considering these characteristics a rather tentative conclusion that we can draw is that the examples of handicrafts, workshops and cottage industries can be found in the less than 50 employee category ; the large-scale modern factories may be within the 500+ employee interval ; and the establishments within the 50-500 employee interval may present characteristics of the small factories. However, this conclusion needs further evidence.

Secondly, if we take the size of establishments by the volume of output, the general trends of concentration of the number of establishments, output, value-added, capital stock, wages and salaries and employment do not change. The establishments with less than TL.5 millions value of output are 72.9 % of the total and the proportion of the establishments gets smaller as the size of establishment increase. In the less than TL.5 millions valueoof output category : 8.7 % of total output and 6.4 % of total value-added is created, 7.6 % of the capital stock is concentrated, 9.0 % of the wages and salaries are paid, and, 18.8 % of the total employment is realized. The category of TL.50+ millions value of output, creates the 61.0 % of total output, 71.1 % of total value-added, 61.0 % of total capital stock, 63.1 % of total wage fund and 44.3 % of total employment. The interval of TL.5-50 millions possesses a larger share of output, value-added, capital stock, wages and salaries and employment than the smaller establishments, but a smaller share than the larger establishments.

TABLE 8.1 DISTRIBUTION OF OUTPUT, VALUE-ADDED, CAPITAL, WAGES AND EMPLOYMENT BY SIZE OF ESTABLISHMENTS

Size of establishments by number of employees	number of establishments %	output %	Value-added %	Capital stock %	Wages and salaries %	Employment %
(1) 0-9	23.1	1.2	0.7	1.1	0.8	1.8
(2) 10-19	28.9	2.9	1.9	2.0	2.5	4.4
(3) 20-49	23.9	4.9	3.1	4.2	5.2	7.8
(4) 50-99	9.7	5.3	3.6	6.0	5.9	7.4
(5) 100-199	5.7	6.2	4.4	6.0	7.0	8.4
(6) 200-499	4.7	12.7	10.6	15.6	14.1	15.2
(7) 500-999	2.5	33.6	33.9	38.7	19.8	18.8
(8) 1000	1.5	33.2	41.8	26.4	44.7	36.2
total	100.0	100.0	100.0	100.0	100.0	100.0

Size of establishments by volume of output (million TL.)	number of establishments %	output %	Value-added %	Capital stock %	Wages and salaries %	Employment %
(1) 0.5	21.1	0.5	0.7	0.7	1.0	2.7
(2) 0.5-0.9	14.7	1.0	0.8	0.9	1.2	2.8
(3) 1 -4.9	37.1	7.2	4.9	6.0	6.8	13.3
(4) 5 -9.9	10.2	6.6	4.2	5.9	5.5	8.9
(5) 10-19.9	7.2	8.9	6.2	9.6	8.5	11.7
(6) 20-49.9	5.3	14.8	12.1	15.9	13.9	16.3
(7) 50-99.9	2.6	16.0	14.6	22.2	21.2	15.8
(8) 1000	1.8	45.0	56.5	38.8	41.9	28.5
total	100.0	100.0	100.0	100.0	100.0	100.0

Source : The data supplied by the 1970 Survey of Manufacturing Industry of the SIS, evaluated by the National Productivity Center of Turkey.

8.2 TECHNOLOGICAL LEVEL BY SIZE OF ESTABLISHMENTS

Total Manufacturing Sector by Establishment Size

Table 8.1 indicates that larger the establishments become, higher is the level of employment. However, this does not necessarily imply that these establishments possess a higher employment potential since a larger stock of capital is also located in them : the objective of employment maximization requires the creation of higher jobs per unit of capital investment. A further analysis of this problem will be made by the use of data presented in Table 8.2.

Table 8.2 shows, by the size of establishments, the number of employees per unit of value-added, the capital/output ratios, the ratio of capital-intensity, the average 'reinvestment quotient', and wages and salaries per employee.

capital-intensity : When we take the size of establishments by volume of output (Table 8.2/b), capital-intensity shows a secular trend of increase as the establishments get larger (see, also, Graph 8.1). In other words, in the larger establishments, a higher level of investment is required per unit of employment. If we take the size of establishments by the number of employees, the 0-9 and 1000^{+} employee categories deviate from this trend. In the 0-9 employee category, it is quite possible that the employment figures are underestimated due to the exclusion of the family members who are engaged in the manufacturing activity in cottage industries, handicrafts or workshops. In the 1000^{+} employee category, either the existence of overemployment (or disguised unemployment) which is an extensive practice particularly in the state economic enterprises, or the repetitive installation of relatively less capital-intensive plants, may account for this situation.

Number of employees per unit of value-added : This ratio decreases with the increase of establishment size (in terms of the volume of output-see, Table 8.2/b and Graph 8.2). This conflict between employment and output is not very clear when we take the establishment size by the level of employment : this ratio tends to increase up to the 50 employee size of establishments (Table 8.2/a). Given the tendency of increasing capital-

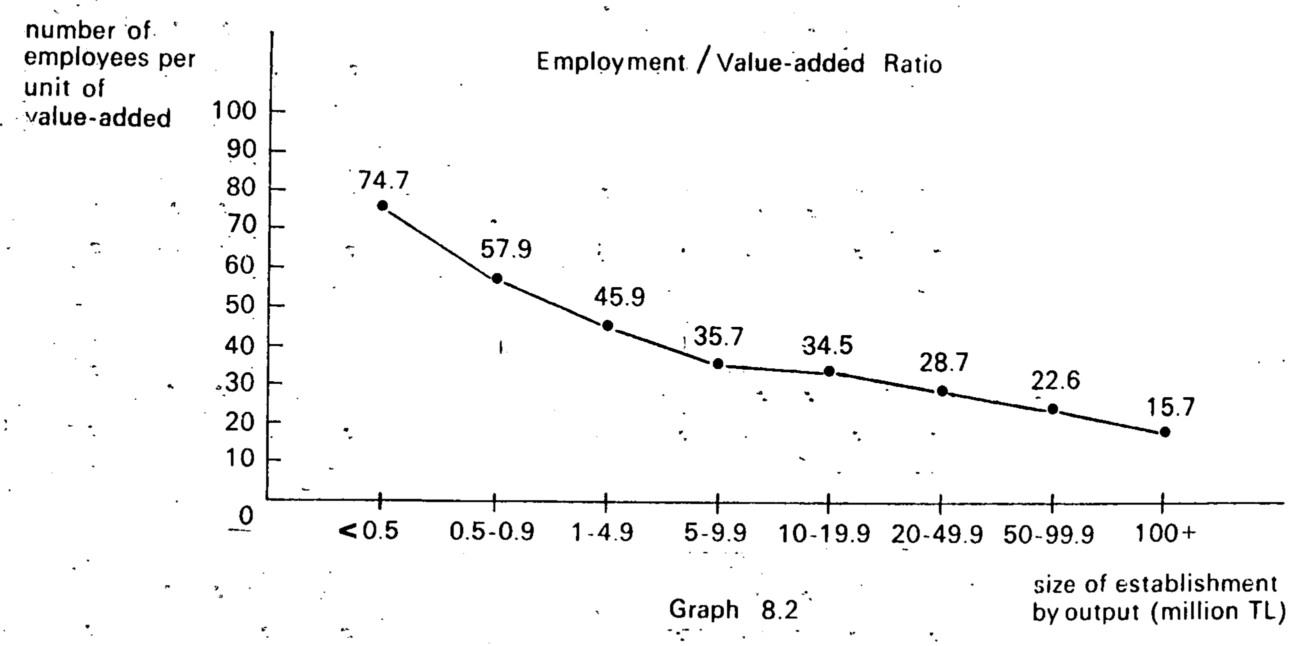
TABLE 8.2/a SIZE OF ESTABLISHMENTS BY EMPLOYMENT AND TECHNOLOGICAL LEVEL

	(1) 0-9	(2) 10-19	(3) 20-49	(4) 50-99	(5) 100-199	(6) 200-499	(7) 500-999	(8) 1000+
Capital-intensity ratio (R)	71,195	50,220	57,431	68,025	72,987	114,673	223,024	104,861
Number of employees per unit of value-added (million R)	48.6	52.1	54.1	48.3	42.7	33.3	32.1	28.5
Capital/output ratio	2.86	2.26	2.56	3.04	2.68	2.78	2.88	2.3
Average reinvestment quotient(R)	13,110	11,864	9,741	12,019	14,851	16,150	27,136	37,770
Wages and salaries per employee (annual total) (R)	8,180	9,061	10,749	13,045	13,672	15,688	18,985	17,609

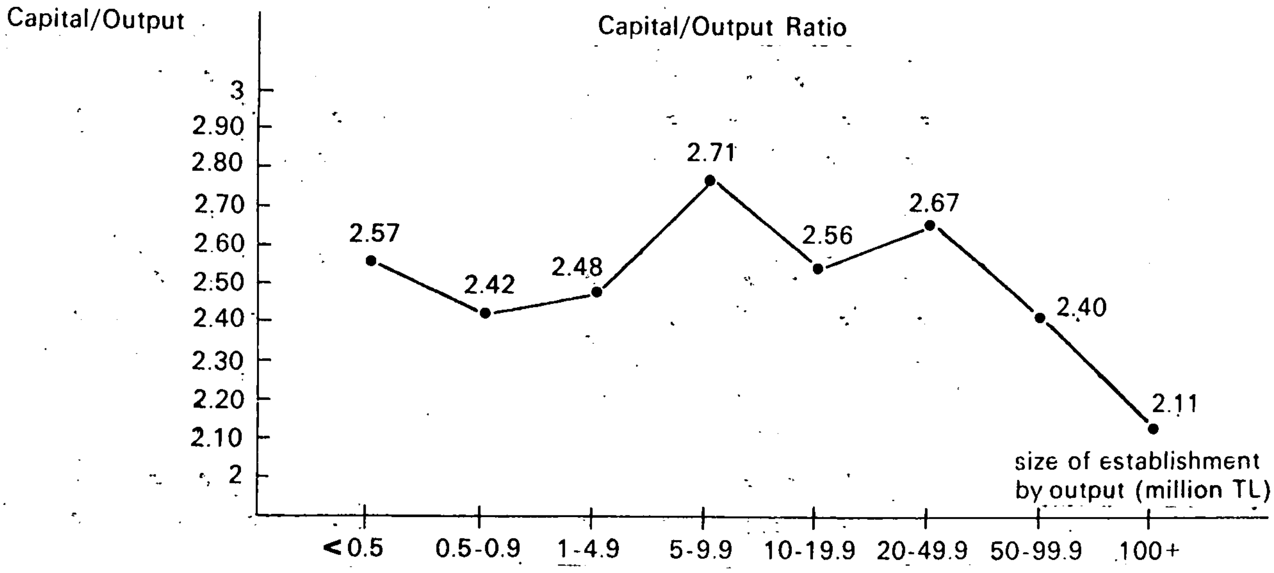
/b SIZE OF ESTABLISHMENTS BY VOLUME OF OUTPUT(MILLION R) AND TECHNOLOGICAL LEVEL

	(1) 0.5	(2) 05.-0.9	(3) 1-4.9	(4) 5-9.9	(5) 10-19.9	(6) 20-49.9	(7) 50-90.9	(8) 100+
Capital-intensity	36,010	43,603	57,123	84,631	89,745	110,577	153,868	159,103
Number of employees per unit of value-added (million R)	74.7	57.9	45.9	35.7	34.5	28.7	22.6	15.7
Capital/output ratio	2.57	2.42	2.48	2.71	2.56	2.67	2.40	2.1
Average reinvestment quotient (R)	6,062	8,581	12,066	16,860	17,508	25,807	27,159	47,811
Wages and salaries per employee (annual total) /R	7,348	9,019	10,633	12,710	14,531	16,901	22,098	23,943

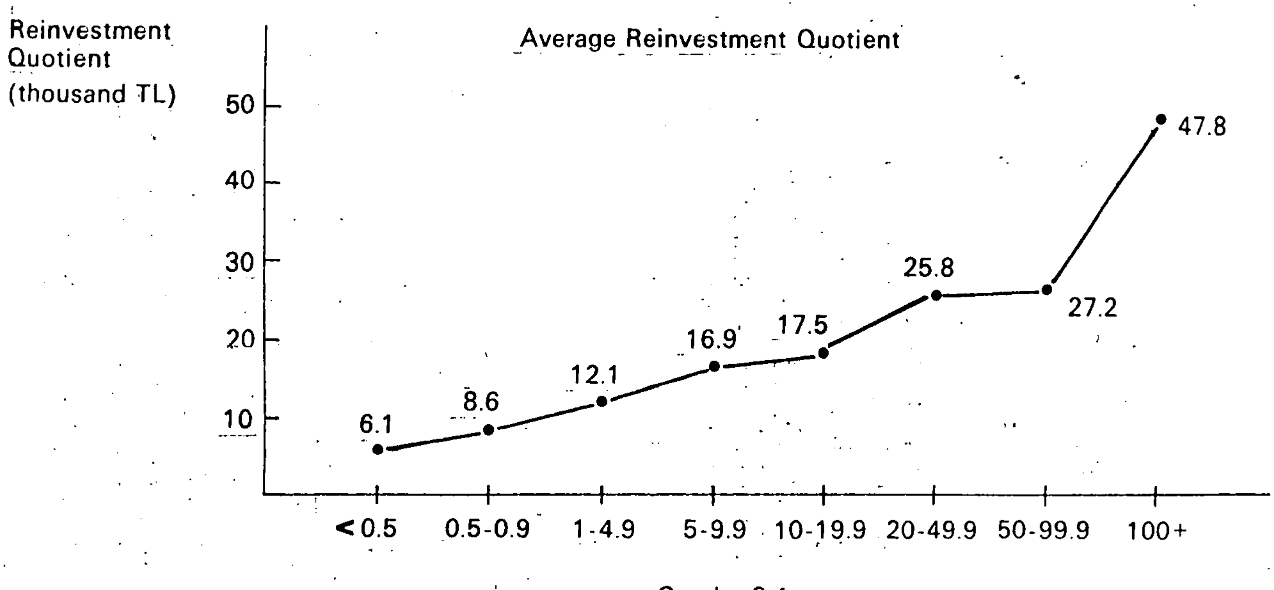
source : Same as Table 8.1



Graph 8.2



Graph 8.3



Graph 8.4

rank no.	Sectors (output concentration (1))	average output in each establishment (million TL)	Sectors (by employment (2))	average number of employees in each establishment	Sectors (cost price of capital per employee)	thousand TL.	Sectors (employee)	thousand TL.	Sectors (Average output/capital ratio (5))	thousand TL.	Sectors (Input / output ratio (6))	%
1	petroleum and coal	233.3	tobacco	399	petroleum and coal	419.1	petroleum and coal	88.5	food	3.63	tobacco	83.6
2	tobacco	101.0	transport vehicles	221	chemicals	103.4	chemicals	32.6	tobacco	2.47	basic metals	76.0
3	chemicals	19.3	paper	178	basic metals	82.7	beverages	32.1	footwear and clothing	1.99	fur and leather	72.1
4	paper	16.7	petroleum and coal	172	paper	79.2	paper	31.5	furniture and fixtures	1.87	food	70.5
5	transport vehicles	15.9	beverages	105	beverages	76.5	electrical machinery	27.1	petroleum and coal	1.78	wood products	70.4
6	beverages	15.2	textiles	104	electrical machinery	73.6	miscellaneous manuf.	25.6	fur and leather	1.73	rubber products	67.2
7	basic metals	11.8	chemicals	104	machinery	66.2	printing-publishing	25.0	wood products	1.73	metal goods	66.8
8	rubber products	9.8	earth products	85	miscellaneous	66.1	fur and leather	23.9	basic metals	1.60	chemicals	65.8
9	machinery	8.8	machinery	80	tobacco	64.6	basic metals	23.8	printing-publishing	1.57	footwear and clothing	64.2
10	electrical machinery	8.4	rubber products	77	fur and leather	61.5	machinery	22.7	metal goods	1.42	electrical machinery	64.2
11	metal goods	7.3	basic metals	73	metal goods	57.8	metal goods	21.7	textiles	1.42	textiles	63.7
12	earth products	7.3	metal goods	72	wood products	53.1	wood products	19.8	rubber products	1.43	paper	63.2
13	textiles	7.2	electrical machinery	69	textiles	52.7	food	19.8	paper	1.36	furniture and fixtures	62.4
14	food	7.1	food	66	transport vehicles	50.8	textiles	19.1	electrical machinery	1.23	machinery	61.0
15	printing-publishing	4.5	footwear and clothing	48	rubber products	43.3	transport vehicles	18.1	chemicals	1.16	petroleum and coal	60.4
16	wood products (x)	3.7	printing-publishing	48	earth products	41.3	rubber products	17.3	miscellaneous manuf.	1.15	miscellaneous manuf.	58.1
17	miscellaneous	3.6	wood products	41	printing-publishing	38.5	footwear and clothing	17.1	beverages	1.10	beverages	57.3
18	footwear and clothing	3.1	miscellaneous	35	food	37.4	earth products	14.9	machinery	1.06	printing and publishing	49.4
19	fur and leather	3.1	fur and leather	27	footwear and clothing	32.9	furniture and fixtures	14.5	transport vehicles	1.00	transport vehicles	48.8
20	furniture and fixtures	1.4	furniture and fixtures	21	furniture and fixtures	29.5	tobacco	14.4	earth products	0.80	earth products	46.2

(x) excluding furniture and fixtures

Source : based on the data supplied by the 1970 Survey of Manufacturing Industry of the SIS, which is evaluated by the National Productivity Center of Turkey.

intensity, the increasing ratio of employment/net output, can be explained only by inefficiency.

<u>Capital/output ratio</u> : The efficiency of capital investments tend to increase as establishments grow above the TL.20 millions of annual output. However, the establishments of output size of TL. 0.5-4.9 millions, and TL. 10-19.9 millions, also present possibilities of efficient capital-investments. The most productive capital equipment is within those establishments having more than TL. 100 millions of output, annually (see, Graph 8.3). The trends of efficiency do not change when we use the employment criterion for establishment size.

<u>Average reinvestment quotient</u> : There is a secular trend of increase with the increase of establishment size by the level of output (see, Graph 8.4). When we take the size of establishments by employment, the same trend exists in 20^{+} category of establishments while there is a reverse trend before this size. In fact, the category of 0-9 employee has a higher reinvestment potential than the 10-99 employee category. Since the wages and salaries paid per employee increase regularly parallel to the increase in establishment size (by both criteria), this situation can be explained by the underestimation of employment in the 0-9 employee category. Alternatively, the low wages and relatively more efficient capital investments (see, Graph 8.3) may be the cause of a higher reinvestment potential.

A Comparison By Subsectors

An intersectoral analysis of the main technological variables by the average size of establishments may provide guidelines for choice of techniques among sectors. Manufacturing subsectors have been ranked by their size, capital-intensity, labour productivity, average output/capital ratio and input/output ratio, in Table 8.3.

The first column of Table 8.3 ranks the manufacturing sectors by the average level of output in each establishment ; and the second column does the same ranking by average number of employees in each establishment. However, there is a close relationship between the order of ranking of the two columns : the rank correlation coefficient (r) is + 0.892. Consequently, we are indifferent between the two criteria in measuring the size of establishments along the manufacturing subsectors, and we shall use the first column in the following analysis.

The third column ranks the manufacturing industries by their capital-intensity, in terms of the cost price of capital per employee. The ranking is made from the highest capital-intensity to the lowest ; and, the lower capital-intensity industries can be identified as those which tend to create higher employment per unit of investment.(see, also Graph 8.5).

The level of average output in each establishment indicates the level of output concentration in establishments by industries, as well as being a measure of the size of establishments. Consequently, the positive correlation between the level of output and capital-intensity ($r = +0.675$) is also indicative of the product-intensifying nature of higher capital/labour ratio.

The level of labour productivity by sectors (column 4) is weakly related to the level of capital-intensity ($r=+0.337$). Therefore product concentration does not strongly affect the productivity of labour, along the manufacturing subsectors. Moreover, the labour productivity tends to decrease as the efficiency of capital rises : since the average productivity of labour is negatively correlated by average net output/capital ratio ($r=-0.4701$). This is not surprising in a capital-scarce economy. However, we are using the 'average' figures which could have been different if we have dealt with the 'marginal' efficiencies. Because, while the marginal efficiency of capital is expected to be higher than the marginal efficiency of labour in a capital-scarce economy, new capital investments could lead to a rise in the skill endowment of the labour force which is expected also to raise the marginal efficiency of the skilled labourers.

The input supplying industries seems strongly influencing the level of productivity of labour and capital. The level of labour productivity increases more strongly as input/output ratio increase ($r=+0.8041$) than the level of capital productivity ($r=+0.6369$). In fact, the opposite relationship would suit better to our theoretical framework. The only explanation of the present situation can be positive externalities.

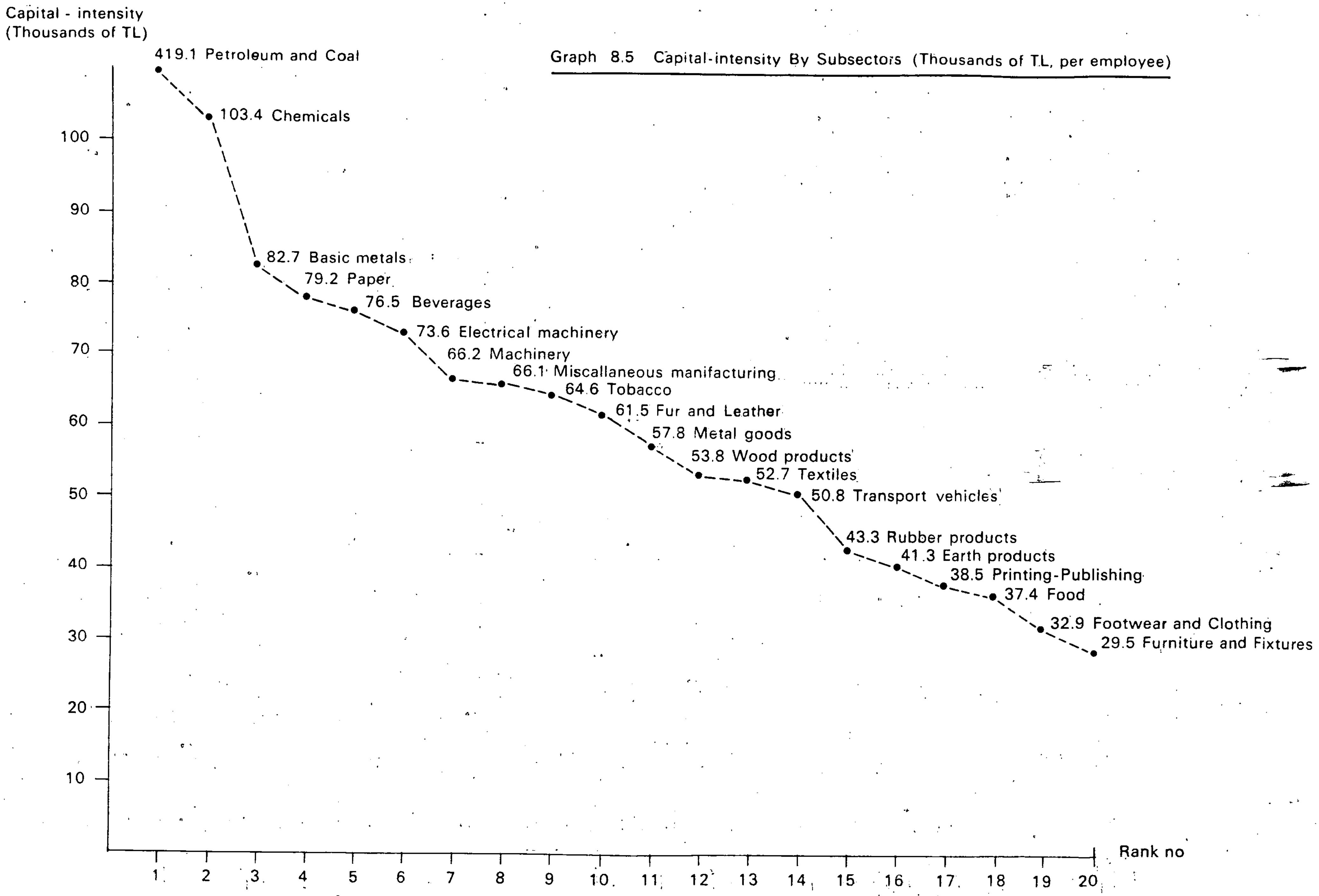
Ereğli's blast furnace presents advantages of scale compared to Karabük blast furnace no.s 1 and 2. The coke usage per ton of pig iron was smaller in Ereğli than the first and second blast furnaces of Karabük. The fuel injection system introduced in 1970 in Ereğli, reduced the coke rate by about 30 %.

The blast furnace practices of the two plants indicate that the superiority of the Ereğli furnace over Karabük furnaces is not certain when the Karabük furnaces are taken together.

Sintering Plants

The low-grade of iron ore reserves of Turkey requires the pre-treatment of the ore before charging into the blast furnace (see, the last column of Table 14.5). The sintering technology was adopted by Karabük during its expansion program and it was reported that the use of agglomerated materials increased blast furnace productivity by 20 %. In the case of Ereğli, however, the requirements of the use of domestic ore reserves were not taken into consideration. The 1971 Annual Report of Ereğli says : "Our sinter plant which will go into operation in the first half of 1972 will make it possible to use widely the sulphurous but highly ferrous ores available in the country in vast deposits."

Graph 8.5 Capital-intensity By Subsectors (Thousands of TL, per employee)



8.3 SOME DYNAMIC PROBLEMS

The importance attached to the technological characteristics of establishments of different size arises from the fact that the possibilities of 'technological pluralism' can be identified within the present structure of the technico-economic duality prevailing in the manufacturing sector. The pattern of change in the present structure may indicate the possible direction of the process of modernization from the traditional small establishments towards the large factories, as well as the division of labour and integration within this spectrum.

The small establishments are scattered over the national economy basically selling in the small local markets. But the development of commodity production tends to destroy the scattered nature of small economic units and draws together the small local markets into a national market. The ratio of marketed agricultural production in the total Turkish agricultural production increased from 33.5 % in 1950, to 64.6 % in 1970.[3] Although there is no statistical data related to agro-industries, in order to determine the development of an 'open' economy, one can easily speculate on this.

In fact, the small establishments tend to integrate to the national economy by the development of a kind of 'putting-out' system. The carpet-weaving industry presents some statistical evidence on this issue. According to Table 8.4, approximately 24.9 % of the looms used in carpet-weaving were owned by those who were spinning the thread that they use for weaving, while the rest of the weavers were buying it from the other establishments, the 'large' ones occupy an important place. About 55.9 % of the looms used in this sector were employed by the weavers working for a merchant, at their homes, in villages, districts and subdistricts. In these establishments not only raw materials and credits were supplied by the merchants but the marketing within the national economy was secured by them. The 74.4 % of the total production capacity of the small establishments was in the category of weavers working for a

3. see, SIS, Türkiye Milli Geliri, Kaynak ve Yöntemler (1948-1972), SIS publication no.681, Ankara (1973), p.45

merchant. For them, there was hardly any competition from the factories in 1965.

TABLE 8.4 ORGANIZATION AND CAPACITY OF SMALL ESTABLISHMENTS IN CARPET WEAWING (1965)

	number of looms	%	production (spuare meter)	%
a. Weavers in villages, at their homes, on their own account				
i. those spinning the thread they use	20,031	24.9	182,713	9.7
ii. those buying " " " "	13,793	17.1	281,077	15.0
b. Weavers for a merchant, at their homes in villages, sub-districts and districts	44,994	55.9	1,390,609	74.4
c. Workshops located other than home	1,358	1.7	16,740	0.9
d. Idle looms	360	0.4	-	-
Total	80,482	100.0	1,871,139	100.0

Source: SPO , Ad Hoc Committee Report on Carpet Weawing , Ankara (March 1966), p.6

The mechanism of the putting-out system is graphically explained below.[4] Apparently, this system gives a distinct example of the rural-urban integration in the process of an indigenous industrial development.

4. Based on the information supplied in Doğu Anadolu'nun Düzeni, by İ.Beşikçi, E yayınları, (Ankara (July 1969), pp. 152-54.

costs were lower. In the cases where there is a strong competition from the modern large-scale establishments, there may be a strong stimulus towards technical progress in the small establishments. For example, in Denizli province of Turkey, in cotton and silk weaving industries, the number of power looms used increased about 25 % against only 3.5 % increase in the hand-looms, during 1965-68.[6] Apart from the increased competition of the factory system, the increased availability of electricity, stimulated this change.[7] The Denizli case is a typical example of the case where large investments made in the factories producing similar commodities to the small ones and the transfer from limited regional markets to national markets is rapid.

Thus, when technico-economic duality develops basically as a result of the transplantation of the factory system to areas where pre-factory establishments have already acquired a market share, two possibilities may arise. Firstly, the pre-factory establishments may establish linkages with the factories and a division of labour develops. As long as they can compete in the small regional markets with the factory system, since they produce in short runs or special lots whereas the factory system cannot enjoy the advantages of large-scale production, such a system may not necessarily develop. As long as the artisanal skills are a source of competitive edge, this latter case is more relevant.

Secondly, competition with the factory system may force small industries to adopt low-cost and high quality methods of production. Since, when factory system enjoys the advantages of mass-production due to opening up of new markets with expanding transport facilities, it may create negative externalities on small establishments. A.P.Alexander indicates that craftsman-entrepreneurs who live under poor conditions may have a high capacity to save and plough back all earnings into fixed equipment and machinery. According to his survey made in the Aegean Region of Turkey, in the textiles industry 62 % of the enterprises were established by craftsmen ; in metal production, leather, rubber and wood, 37 % of the plants

6. I.Gülmez, "Organization and Problems of Small Enterprises In Cotton Textiles", in the NPC publication no. 107, p.55
7. ibid.

were founded by merchants and about 60 % by craftsmen.[8] However, the investible funds created in small establishments may not necessarily be invested in these establishments since the merchant-capitalist who controls the investible surplus under the putting out system may prefer more profitable outlets in small trade and services, in urban areas. Contrarily, in various other countries, the existence of a middle-man who organizes marketing, provides raw materials and supplies credit, played an important role to integrate the small establishments to the large-scale modern establishments.[9] This latter alternative presents the distinct examples of 'technological pluralism' in the case of Japan.

The long-term trends of the development of establishments of different size, are difficult to observe statistically. According to the SIS data on the distribution of value-added in industry in private enterprises, the share of small establishments was 19.25 % in 1950, 20.34 % in 1960 and 18.50 % in 1970, in the total value-added. A category of 'village industries' is distinguished in this data, referring to those small establishments located in the places with a population of less than 2 thousand. The share of the village industries in total value-added was 4.43 % in 1950, 2.09 % in 1960, and 0.87 % in 1970. This apparent decline in the relative share of the 'village' industries in total value-added, is difficult to explain by the single factor of the development of the factory system though. Also, the small establishments apart from the village industries do not show a strong trend of decline over a period of 20 years.

It is quite possible that some of the small establishments might have grown or merged into large establishments. However, the meagre statistical evidence hinders an analysis of these aspects of industrial dualism.

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8. A.P. Alexander, " Industrial Entrepreneurship in Turkey : Origins and Growth ", Economic Development and Cultural Change (July 1960). J.T. Mc Crory points out similar examples in India-see, Small Industry in A North Indian Town, Gvt. of India Press, Delhi (1956), pp.53-67

9. see, e.g., K.Fujita, "Management Structure of Small and Medium Enterprises", Asian Affairs, vol.2 (June 1957)

The data presented in Table 8.5 gives a comparison of the results of 1963 and 1968 Censuses of Manufacturing Industry. Since the coverage of these two Censuses are the same, this data is comparable. However the establishments employing less than 10 persons were excluded from these Censuses. The rather tentative conclusions that can be drawn from this data is as follows :

TABLE 8.5 CHANGES IN THE RELATIVE WEIGHT OF ESTABLISHMENTS OF DIFFERENT SIZE

Size by employment	Number of establishments	%	Number of employees	%	Output ('000 TL)	%
	1963 Census of Manufacturing Industry					
10-49	2,199	73.0	54,732	16.8	3,482,279	17.7
50-99	334	11.4	26,392	8.2	1,806,189	9.2
100-199	201	6.7	27,476	8.4	1,754,598	8.9
200-499	147	4.9	46,033	14.1	4,004,229	20.4
500-999	71	2.3	57,520	17.7	3,173,727	16.2
1000+	60	2.0	113,297	34.8	5,414,642	27.6
total	3,012	100.0	325,441	100.0	19,635,664	100.0
	1968 Census of Manufacturing Industry					
10-49	2,161	64.0	49,568	11.8	4,957,230	11.0
50-99	560	16.6	35,985	8.6	3,560,692	8.5
100-199	270	8.0	39,595	9.4	3,431,580	8.2
200-499	217	6.4	69,552	16.5	9,408,770	22.4
500-999	94	2.8	65,409	15.6	7,234,692	17.2
1000+	76	2.2	160,295	38.1	13,364,922	31.9
total	3,378	100.0	420,404	100.0	41,957,886	100.0

Source : SIS

The number of establishments in the 10-49 employee category decreased at a 3.1 % rate during the 1963-68 period ; the rate of decrease in the number of employees was 9.4 %. Both the number of persons employed and the number of establishments within 50-499 and 1000^+ categories increased over the same period. An increase in the proportion of output contributed by the establishments in 200-499 and 1000 categories is observed as well. The rate of increase of the share of employment was faster than output in the 200-499 category and slower in the 1000^+ category.

The examples given so far on the dynamic aspects of the dual economy mostly covered those industries which have traditionally developed in predominantly agricultural environments. However, industries such as electrical machinery and equipment, rubber, petro-chemicals, agricultural machinery, automative industry, etc. which have been erected mainly as a result of a transplantation from the advanced industrial nations, may not be the typical cases for the conclusions drawn so far. If we take the case of electrical machinery and equipment, this branch recorded considerable production increases in the last 20 years both in terms of quantity and variety, and the basic function of this industry have been to do the finishing process of the semi-manufactured imported electrical machinery and equipment. The first automative vehicle manufactured in Turkey was tractor which was followed by truck and bus assembling industries, and the assembly character of these industries required a strong integration with the large-scale modern establishments located in the advanced industrial countries. Similar examples can be found in the industries of electronics, pharmacenticals, and so on, that shall be discussed in detail, in the following chapters on the transfer of technology. What we would like to conclude here is that the nature of the relationship between the small establishments and the large, varies greatly from one industry to another and for different products in each industry. Consequently, the scope of the possibilities of 'technological pluralism' goes beyond the content of this thesis, for specific policy recommendations on this subject.

8.4 SUMMARY AND CONCLUSIONS

The problem of choice of techniques also involves the choice within a spectrum of the functions of the most modern and the traditional industries. Traditional industries are basically the ones which have evolved indigenously in a predominantly agricultural environment. The most modern ones, however, have been transplanted from the advanced industrial countries. In either case, there is a wide spectrum of establishments from the smallest to the largest, which present alternative technological possibilities.

The smaller is the size of the establishments, the larger is the proportion of the concentration of establishments as a percentage of the total. However, a higher proportion of output, capital stock and employment concentrates as the establishments get larger.

There is a tendency that capital-intensity rises as the size of establishments increase: i.e., the employment potential per unit of investment tends to decrease. However, this tendency is not a strong one. The productivity of labour and capital also increases parallel to the size of establishment, with a consequent rise in the reinvestment quotient: i.e., the potential of further growth is bigger in the large establishments. However, there are medium-sized establishments with relatively high productivity and employment possibilities, which may present the alternatives of a 'compromise' technology.

When different manufacturing industries are considered, although the level of output is closely related to capital-intensity, level of productivity is not affected by capital-intensity to the same extent. Inter-sectoral dependence seems to be more affective on the level of productivity of labour and capital. Consequently, a selective development among manufacturing industries may also present possibilities for a 'compromise'.

The dual technological structure creates alternatives for a successful integration between the most modern plants and the least. However, when these two categories produce similar products, the possibililities of negative externalities arise, in the long-run. Also, the establishments smaller than the largest plants may tend to merge and grow, under competitive conditions.

Given the inadequacy of the required data, these conclusions can be taken only as broadly indicative.

CHAPTER 9

INDIGENOUS R AND D CAPACITY AND ORGANIZATION IN TURKEY

The present scientific and technical research potential of the Turkish economy is rather limited to affect the rate and the direction of technical change which have been observed in the manufacturing sector. This Chapter aims to give a brief account of the present R and D capacity and organization since the launching of the First Plan.

9.1 THE PRESENT R AND D CAPACITY

The indigenous inventive capacity of the Turkish economy is hardly of any significance as a source of technical progress. The present levels of inventive activity and the R and D organization are indicative of a rather limited technological infrastructure.

Expenditures on R and D

The proportion of the GNP devoted for R and D is typically low in the Turkish economy, as is the case in the most of the underdeveloped countries (see, Chapter 4.2). The percentage share of the R and D expenditures in the GNP was approximately 0.36 % in 1964, 0.37 % in 1969, 0.38 % in 1970 and 0.26 % in 1972 (Table 9.1). Contrary to the expected increase attached to R and D activities, the decrease in the relative proportion of R and D in the GNP, in 1972, indicates that inventive and innovative activity is still far from receiving the attention that it deserves in the Turkish economy.

Viewed from the point of the sectoral distribution of the R and D expenditures, the least importance is attached to scientific and

TABLE 9.1 RESEARCH AND DEVELOPMENT EXPENDITURES IN TURKEY

	1964	1969	1970	1972
R and D expenditures(million TL)	247.5	434.7	492.0	622.0
GNP(at current prices,million TL)	68,035.2	117,148.2	130,528.5	237,760.4
% of R and D in GNP	0.036	0.037	0.038	0.026
Sectoral distribution of R and D expenditures :				
Public Sector	212.9	372.5	424.0	...
Universities	30.1	62.2	68.0	...
Private Sector	4.5	...	...	...

Source : TUBITAK, Science Policy Research Unit ; and, SPO," Preliminary Report on Science, Technology and Research " (mimeo), Ankara (1971).

technical research in the private sector and following this, in the Universities, whilst the highest level of R and D expenditures was realized in the public sector. The 86.1 % of the total R and D expenditures were financed by the public sector in 1964 ; this ratio was 86.7 % in 1969. The share of the private sector was 1.9 p.c. of the total expenditures in 1964; no information was available on the private R and D expenditures for the following years. The relative share of the R and D expenditures made by the Universities tends to remain approximately the same over time, at about 12 %.

The Third Plan explicitely states the fact that the proportion of the R and D expenditures in GNP declined to 0.35 % in 1970.[1]

1. TFYDP, op.cit., p.686

However, even the proportions varying between 0.26 % and 0.38 % tend to overestimate the scope of the existing R and D activities. Because, "most of the activities defined as R and D activities by the firms are in fact some routine work having no R and D quality at all".[2]

When we consider the distribution of the R and D expenditures among the subsectors of the three basic sectors of higher education, public sector and private sector, we distinguish that the majority of the R and D expenditures were made in the basic sciencies rather than in the applied fields. The higher education sector, for instance, is engaged almost totally with basic research. In the public sector, the Ministry of Agriculture receives the 35.2 % of the total public R and D expenditure, and it is hardly engaged in the specific problems of technology adaptation ; the Mineral Exploration Institute receives the 40 % of the public expenditures which involves the problems of exploration as well as the routine procedures-problem solving but not mainly adaptive. The Sugar Factories J.S.Co., Electrical Power and Survey and Planning Department, and the Ministry of Public Works, which receive the 11.8 % of the total public R and D expenditures do some quality control and installation activities. The Çekmece Nuclear Research and Training Center does only basic research. TUBITAK, on the other hand, took over the function of consulation to the Government Sector and of coordination among the research institutions, which is hardly 'adaptive' research (see, Table 9.2).

Research Personnel

The distribution of the existing stock of research personnel by the research sectors, indicates that the highest concentration of the number of researchers is in the higher education sector : the 61.1 % of the total. This proportion is 37.7 % in the public sector and 1.2 % in the private sector. Among the subsectors, the medical sciencies employ

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2. see, Research On The Gaps in Technology , Pilot Teams Project, Evaluation Conference of OECD, Paris, pp.19-20

TABLE 9.2 DISTRIBUTION OF RESEARCH PERSONNEL AND EXPENDITURES BY SECTORS (1964)

Sector	Research Personnel number of researchers	Research Personnel %	R and D expenditures million TL	R and D expenditures %
Higher education :	2,787	61.1	30.1	12.1
positive sciencies	393	8.6	...	...
medical sciencies	1,616	35.4	...	...
engineering sciencies	390	8.6	...	...
agricultural sciencies and veterinary	388	8.5	...	...
Public Sector :	1,720	37.7	212.9	86.0
Agriculture	900	19.7	75.0	30.0
Others(mainly mechanical engineering and construction)	820	18.0	137.9	55.7
Private Sector :	50	1.2	4.5	1.9
Total	4,557	100.0	247.5	100.0
Public Sector :			212.9	100.0
Ministry of Agriculture			75.0	35.2
Ministry of Public Works			12.0	5.6
Mineral Exploration Institute			85.0	40.0
Electrical Power Survey and Planning Dept.			12.3	5.7
Ministry of Reconstruction and Resettlement			5.5	2.5
Ministry of Health			4.9	2.3
Çekmece Nuclear Research and Training Center			1.1	0.3
AR-GE (Military R and D Center)			8.8	4.1
Sugar Factories J.S.Co.			1.9	0.5
TUBITAK (The Scientific and Technical Research Council of Turkey) and Other Research Institutes			8.3	3.8

Source : reference made to, TUBITAK, " 1964 Envanteri ve Türk Pilot Projesi Raporu" , in, E.Türkcan.

the 35.4 % of the total scientific research personnel of Turkey.

The number of persons engaged in R and D were 5,741 in 1968, averaging about one R and D personnel per 6,400 of the population: this is below the average figure for the underdeveloped members of OECD.[3] The 3,636 of these 5,741 persons were in the Universities, in 1968, which is a very similar distribution to that of 1964 ; and, the existing research personnel was also mainly engaged in basic research which hardly had any connection with the requirements of an adaptive R and D activity.[4]

According to the Third Plan, there were about 5,750 researchers (excluding social sciencies) in Turkey, by 1971. The distribution of these among research fields was as follows : 10 % in basic sciencies, 38 % in medicine, 26 % in agriculture, 22 % in engineering and 3 % in other fields. The number of social scientists was about 1700, of which, 66 % was working in the Universities and Institutions of Higher Education, 28 % in public sector and 6 % in private sector.[5]

Tendency Towards Less Basic Research

The Scientific and Technical Research Council of Turkey (TUBITAK) has been given the function of 'consultation' to the government sector and of 'coordination' of the R and D activities among the research institutions. Although the functions of TUBITAK has been clearly stated in the Plans no legal powers have been given to it, to realize its goals. Consequently, this institution acquired an 'advisory' function in practice, as it can be observed from the attached organizational chart of the scientific and technical potential of Turkey (see, Section 9.3).

Given these limited powers of TUBITAK, the number of research projects proposed to and approved by it during 1964-69, are shown in Table 9.3. The proposals were made by the universities and the public

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3. see, "Technological Gaps : Their Nature, Causes and Effects" in OECD Observer , No.33 (April 1968).
4. SPO, "Scientific and Technical Research Potential of Turkey", (mimeo.) Social Planning Department (1970).
5. The Third Plan, passim., p.685

public sector while the private sector made no proposals at all. According to the presented figures, the universities proposed 104 research projects in basic sciencies, 44 of which were rejected. There was only 1 project in basic sciencies proposed by the public sector, which was rejected. In the rest of the research categories (engineering and medical sciencies, agriculture, forestry, veterinary and husbandry) 566 research projects were proposed, of which 326 were rejected, on the grounds that they do not comply with the strategy of the national science policy. There was an inherent tendency towards less basic research in these practices. However, to what extent has this tendency been transformed into reality has not been able to be determined.

According to a survey made by the State Planning Organization to find out the present research projects in the public sector excluding the Universities, in 1970-1971, the 1 % of the research projects was in the basic sciencies, 2.2 % in development, 6.7 % in applied research, and 85 % in the activities indirectly related to research. Within this last category are, technical information services, standardization and testing, training and education, etc.

TABLE 9.3 THE NUMBER OF RESEARCH PROJECTS PROPOSED TO AND APPROVED BY TUBITAK DURING (1964-1969)

	proposed number of projects		number of projects approved	
Research Category	by the Universities	by the public sector	the Universities	the public sector
Basic Sciencies	104	1	60	-
Engineering Sciencies	166	28	106	16
Medical Sciencies	139	18	75	5
Agriculture, forestry, veterinary and husbandry	115	100	77	47
T o t a l	524	147	318	68

Source : E.Turkcan, "A Case For Science Policy in a Developing Country", by TUBITAK, p.23

9.2 SCIENTIFIC AND TECHNOLOGICAL RESEARCH POLICY AND ORGANIZATION

The Policies of The First and The Second Plans

The State Planning Organization of Turkey (SPO) has been given the authority of promoting the economic and technical research projects in accordance with the Five Year Plans and the annual programs.

The First Plan emphasized on the need to create an 'atmosphere suitable for research' , the need for an 'organized research activity', 'personnel training' and 'the establishment of documentation facilities'.[6] The proposed measures in relation to these objectives were far from being a concrete policy formulation though. The 'freedom of research' and a higher financial support for the research activities were stated as necessary to create the 'suitable' atmosphere for research. As far as the research organization is concerned, the establishment of the Scientific and Technical Research Council of Turkey (TUBITAK) would help to organize the basic and applied researches in natural sciencies. The long-term socio-economic planning would be supported by the establishment of a Social and Economic Research Institute. For personnel training, the only outlet was seen to send students abroad. The sole achievement of the First Plan application was the realisation of the establishment of TUBITAK.

The Second Plan explicitely states the necessity to organize industrial research directed to application, instead of basic research.[7] At the outset, the Second Plan emphasizes on the need to modernize economic activities which "depends upon the use of modern technology and know-how".[8] The following problems have been mentioned in relation to the industrial sector : the small manufacturing industries occupy an important place and they usually operate below the optimum capacities ;and, the public enterprises are unable to obtain advanced industrial technology whereas the lack of specialization leads to inefficiencies.

6. FFYDP, passim., pp.466-467
7. SFYDP, passim., p.43
8. SFYDP, passim., pp.3-4

However, the required scientific and technological activities to overcome these problems were not formulated in the Second Plan.

The Second Plan stated the following scientific and technological targets :[9]

(1) A selective policy will be followed in the allocation of science and research funds.

(2) The scope of basic research will be limited and the basic research requirements of the economy will be met through international technical cooperation. TUBITAK will support the basic research demands of the Universities and will cooperate with them.

(3) Research on technology, organization and quality and process control, which will minimize the investment and operating costs and maximize output, will be given priority.

(4) The Social and Economic Research Institute will be established to carry out research on the socio-economic structure of Turkey. This Institute will cooperate with TUBITAK, the "Institute of Public Administration of Turkey and Middle East" and the SPO.

(5) The SPO and the Universities will cooperate with TUBITAK on a regular basis.

(6) The "Industrial Resaarch Institute" will be established and this Institute will carry out research in relation to long-term industrial planning.

(7) Research expenditures of the public enterprises will be considered as investments whose target, scope, time length and other characteristics will be formulated as investment projects.

(8) A "Scientific and Technical Documentation Center" will be established by TUBITAK.

(9) The scientific and technical works of the international organizations will be followed up and cooperation with the advanced and underdeveloped countries will be promoted.

(10) The private enterprises will be induced by the activities of TUBITAK, to carry out and organize research and development.

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9. ibid., pp.198-201

However, the achievement of these targets has been very limited. The "Scientific and Technical Documentation Center" (TÜRDÖK) was established in 1967. Marmara scientific and Industrial Research Institute was also established involving some of the research units organized in the Universities attached to the Institute.[10]

The total number of higher education students sent abroad was 1,181 as a total of the 1963-71 period, which was the 19.7 % of the planned number of persons to be sent abroad. The distribution of these among research fields was as follows : 20 % in social sciences, 27 % in operational research, 17 % in agriculture and veterinary, 7 % in health, 12 % in engineering, 10 % in basic sciences and 7 % in other fields.

The limited achievements of the First and the Second Development Plans in developing and organizing the scientific infrastructure of the Turkish Economy has led to further 'brain-drain'. The Third Plan, referring to the United Nations statistics, says that the annual average number of Turkish scientist that emigrated to the advanced countries during 1962-1967 period, was 375. The sectoral origin of these were as follows: 51.5 % medical sciences, 40 % engineering, 5.5 % natural sciences and 3 % social sciences.[11] The Third Plan indicates that the socio-economic measures required to prevent this situation were not applied at an adequate level.

The Third Plan Measures

The need to base the decisions concerning investments, employment and production targets, on scientific grounds and research results, has been repeated in this plan. The specific policy measures suggested are as follows :

10. The Third Plan, passim., p.685-688
11. ibid.

(1) TUBITAK will play a leading role to meet the research requirements of the industry and development, and it will establish an affective communication and cooperation system among the Universities, other public institutions and the private sector.

(2) The universities, and the public and private institutions will prepare their long-term research plans which will be organized under TUBITAK, so as to prevent repetitive research.

(3) Research units will be established to carry out the research projects demanded by the private and public institutions. These units will also be organized under TUBITAK.

(4) The State Planning Organization will coordinate the research activities in the field of economics and social sciences.

(5) The qualified manpower deficiency of the universities will be overcome by post-graduate studies abroad. A central organization will be established to plan these studies.

(6) A consistency will be provided between the policies of employment, wages and salaries, and research environment, in order to prevent 'brain-drain'.

(7) The needs of the research institutions will be determined in order to decide on the allocation of the funds devoted for research and development.

(8) 'Specialised libraries' will be established. For this, the National Library and TUBITAK will carry out an inventory work.

(9) Computers will be extensively used for research and development activities and organization.

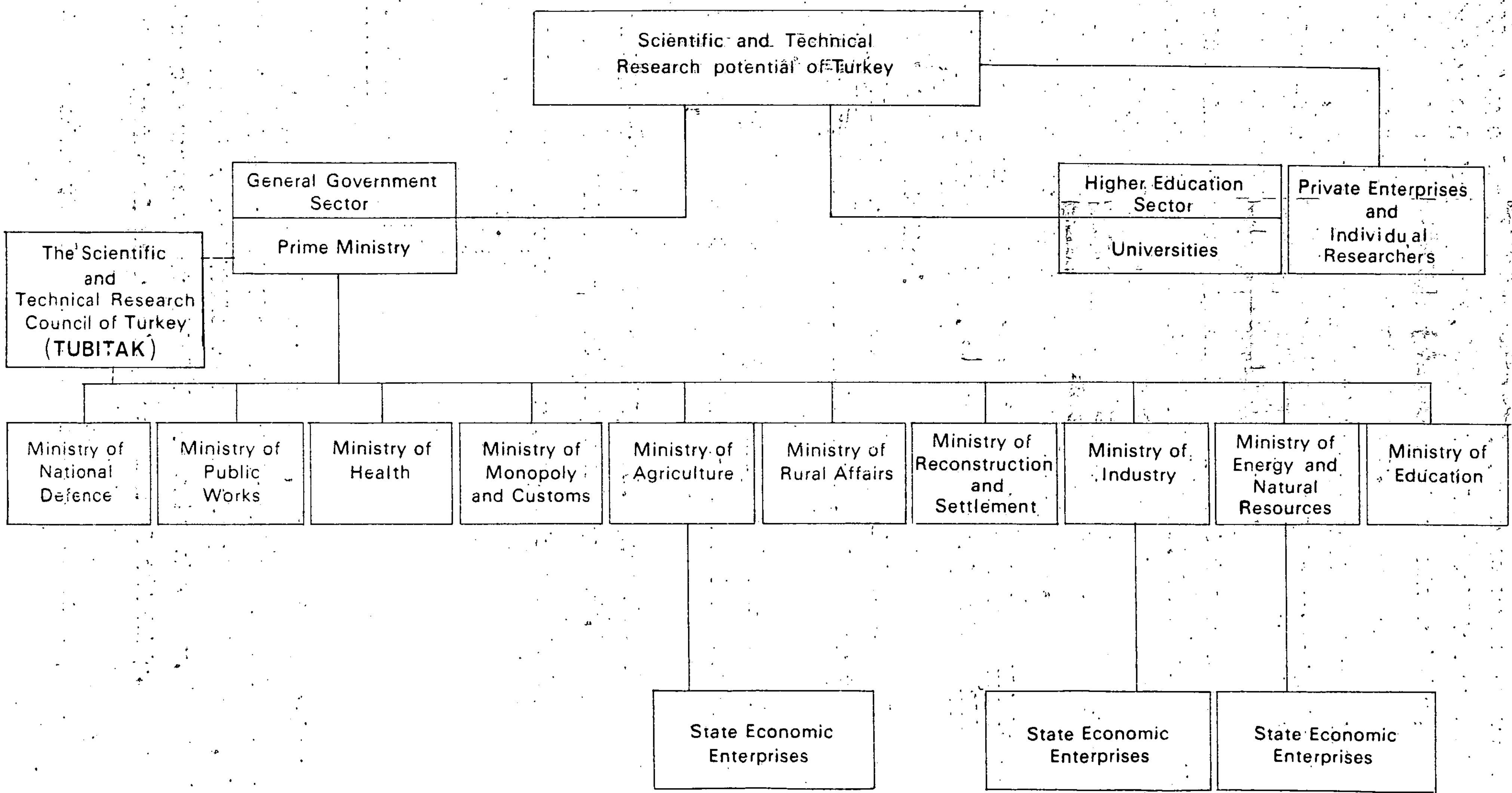
R and D Organization

The present R and D organization, has been shown in the attached organizational chart of the scientific and technical potential of Turkey. There has been a very little change in the planned period, in order to reorganize the present potential in an affective way. Most of the measures suggested by the plans remained as wishful thinking.

Considering the legal status of the research organizations,

ORGANIZATIONAL CHART OF THE SCIENTIFIC AND TECHNICAL POTENTIAL OF TURKEY

(The Research Organization For Social Sciences Excluded)



and the nature and extent of the research activites they carry out, two major categories can be distinguished :

(a) Universities and other higher educational institetions ;
(b) Other public organizations.

In higher education, 8 universities have potential for doing research in various branches of positive science in their 39 faculties and 428 departments. In the rest of the public organizations, there are altogether 60 units carrying out researches. 23 out of these 60 research units belong to general budget departments, 8 belong to subsidiary budget departments, 23 belong to public economic enterprises, while the remaining 6 units have special status.[12]

Table 9.4 gives the distribution of researchers in each university, by their academic qualifications. Apparently, each university demonstrates different characteristics as far as the academic qualifications of their teaching staff is concerned.

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12. SPO, "Scientific and Technological Resarch Potential of Turkey" , Social Planning Department (1970)

TABLE 9.4 THE DISTRIBUTION OF RESEARCHERS BY ACADEMIC STATUS IN EACH UNIVERSITY (1968)

The ratio of each category of teaching staff to the total teaching staff Universities	Professors %	Assistant Professors %	Assistant and experts %	Dr.'s Assistants %	Total
Istanbul University	23	20	16	41	100
Ankara "	21	14	14	50	100
Ege "	15	8	16	61	100
Atatürk "	5	8	33	54	100
Hacettepe "	3	9	28	60	100
Karadeniz "	3	10	22	65	100
Middle-East Tech.Univ.	3	3	50	44	100
Istanbul " "	31	12	18	39	100

Source : SPO, "Scientific and Technological Research Potential of Turkey", ap.cit.

The organization of the public institutions with different legal status are listed below including their research expenditures, by 1968.

a) OFFICES WITH GENERAL BUDGET	Amount of expenditure	%
- State Planning Organization	43.600.000 TL	38.57
- Ministry of National Defence	2.246.000 TL	1.98
- Ministry of Public Works	2.659.802 TL	2.38
- Ministry of Health	11.957.107 TL	10.52
- Ministry of Agriculture	43.965.581 TL	38.89
- General Directorate of State Meteorological Services	1.909.700 TL	1.68
- Ministry of Commerce	47.500 TL	0.07
- Ministry of Reconstruction and Resettlement	773.000 TL	0.79
- General Directorate for Land and Resettlement	495.000 TL	0.44
- Ministry of Education	5.592.800 TL	4.92
T o t a l	113.272.240 TL	100.00

b) OFFICES WITH SUBSIDIARY BUDGET (Universities excluded)	Amount of expenditure	%
- General Directorate of State Highways	13.348.000 TL	56.51
- General Directorate of State Hydraulic Works	9.670.000 TL	40.94
- General Directorate of Monopolies	598.970 TL	4.55
T o t a l	23.616.970 TL	100.00

c) ORGANIZATIONS WITH SPECIAL STATUS		
- The Scientific and Technical Research Council of Turkey	16.200.000 TL	8.31
- Atomic Energy Commission	17.307.953 TL	8.88
- Electrical Power Survey and Planning Administration	44.298.000 TL	22.73
- Mineral Exploration Institute	117.000.000 TL	60.05
T o t a l	194.805.953 TL	100.00

9.3 CONCLUSIONS

The objective of alleviating the unemployment problem through the use of 'employment maximizing' techniques of production, as well as fulfilling the other objectives(or restraints, such as maximum output increase, changing the product-mix, improving labour quality, etc.) requires an integration of these objectives, to the present R and D capacity and organization. We can take this integration at two different levels. Firstly, the scope of the present R and D activities must be extended so as to cover these objectives at an adequate level. However, an unqualified increase of the R and D expenditures may lead to uneconomic results. Particularly at the present stage of technical change where the main source of innovation is external (which is the subject matter of the following Chapters) the extension of the present R and D capacity and organization along the 'adaptive' lines of research may be more economic. This is the second point that we should make.

However, even the determination of the required lines of 'adaptive' research involves a higher level of R and D organization and expenditure. Also, the development of an indigenous R and D capacity and organization should suit the technological development strategy of the country. As it is discussed in the fourth part of this thesis, there is no such strategy coherently formulated in the Turkish case. Consequently, the priorities of a possible development of the present inventive and innovative capacity, are difficult to determine.

CHAPTER 10

SOURCES OF INNOVATION

Innovation is the application of inventions into the field of production. The limited scope and organization of the scientific and technological infrastructure of the Turkish economy, reduces the innovative as well as the inventive capacity of the industries. Consequently the present rate and direction of the observed technological progress in the manufacturing sector have been affected to a large extent by the foreign sources of supply of technology, which are exogenous to the Turkish economy.

10.1 ALTERNATIVE SOURCES OF TECHNICAL PROGRESS

PRIVATE SECTOR

According to a survey carried out by the Scientific and Technical Research Counsil of Turkey, which covered 308 private manufacturing firms in 1968, external sources of innovation account for a major part of the improvements in the production methods and processes.[1]

The following sources of technological novelty were identified by this survey :

1. " The Provisional Results of the Survey on Technological trends in the Private Sector " , by Scientific and Technological Research Council of Turkey, (December 1968).

a. R and D performed by the firm
b. Technology transfer agreements (licence, patent, royalty) made with foreign firms
c. Improvements in the techniques by the importation of machinery, equipment and implements
d. R and D contracts made with the universities of other domestic institutions
e. Copying the new production techniques and goods orginated in other countries.

The emprical results of the survey indicated that the private firms use either one or more of these sources of new technology. The use of these sources by order of importance was as follows :

1. firms using only <u>one source</u> .... e
2. firms using <u>two sources</u> .... c e
3. firms using <u>three sources</u> .... a c e
   e a c
4. firms using <u>four sources</u> .... acbe
   acde
   aced
   bace

The R and D projects ordered to the domestic research institutions are of the least importance according to the above ranking.

The R and D activities performed by firms themselves is observed in those firms that use three or four different sources of technological novelty. The order of importance of this factor is either first or second. However, as mentioned earlier, the nature of these activities is quite different from 'research' and the extent of their contribution to the improvements in production technology is obscure.

Importation of machinery, equipment and implements and copying the new production technologies and goods originating abroad are the two sources that are used by nearly all firms included in the survey.

The importance of the use of non-proprietary technologies decreases as a firm obtains new techniques from a variety of sources.

Technology transfer agreements have the first place in those firms obtaining techniques from four different sources and as being the least frequent channel of transfer of technology. However, the survey refers to the operation stages of the plants. If the project evaluation and construction stages of an industrial transplant are considered, this factor may become a more important source of technical change.

R and D Performance By Size of Firms

Table 10.1 shows the research performance and the reasons for not undertaking research, of the private firms, by the size of their capital stock. We know from Chapter 8 that, the larger the establishments become, the higher is the capital stock that they possess. Consequently, although the size of capital stock by 'firms' is taken in Table 10.1, it is broadly indicative of the R and D undertaking of the 'establishments' by size.

It is observed from Table 10.1 that about 43 % of the total number of firms involved in the survey undertake R and D while more than fifty percent of them do not. Viewed by the size of capital stock of the firms in each category, 49 % of category I, 35 % of categories II and III, 49 % of category IV and 33 % of categories V and VI, mention that they undertake R and D. However, these figures need to be interpreted cautiously, because ; (a) the number of firms involved in the survey are 5.32 % of the total, and, (b) the meaning of 'R and D' as understood by each responding firm is unknown.

The major cause of 'not undertaking R and D' is the existence of alternative sources of technology : about 52 % of the firms' not undertaking R and D' mentioned this reason, while the 40 % of them mentioned the limited markets, and about 8 % did not mention any particular reason for 'not undetaking R and D'.

Thus, the alternative sources of technology such as copying the new production techniques and goods originated in other countries, improvements in techniques by the importation of machinery, equipment and implements, technology transfer agreements, and R and D contracts made with the research institutions seem to play an important role on determining 'not undertaking R and D'.

TABLE 10.1 THE RESEARCH PERFORMANCE AND THE REASONS FOR NOT UNDERTAKING RESEARCH, ACCORDING TO THE SIZE OF CAPITAL STOCK

Size of Capital Stock	Number of Firms				Reasons for Not Undertaking R and D		
	Undertaking R and D	Not Undertaking R and D	Unknown	Total	Limited Markets	Alternative Sources of Technology	Unknown
I. More than TL.1,000,000	56	57	2	115	17	37	3
II. TL.500,000-1,000,000	12	20	2	34	7	13	-
III. TL.250,000-500,000	17	30	1	48	14	11	5
IV. TL.100,000-250,000	23	21	3	47	9	10	2
V. TL. 50,000-100,000	9	17	1	27	8	8	1
VI. Less than 50,000	9	19	-	28	11	5	3
Unknown	6	3	-	9	-	3	-
T o t a l	132	167	9	308	66	87	14

Source : The survey made by the Scientific and Technical Research Council of Turkey op.cit

Profitability of Technological Dependence

The firms that mentioned the 'other' sources of technology as more profitable than undertaking R and D, tend to have a higher weight in the following industries : petroleum and coal, furniture and fixtures, beverage, mineral goods, paper, fur and leather, electrical engineering and printing (see, Table 10.2). Apparently there is no tendency that the more research-intensive an industry is, the higher is the dependence on external sources of technology. However, the results presented in Table 10.2 should be interpreted cautiously since the ratio of respondents to the questionnaires in each industry have different representative values.

A Comparison of Sources of Innovation In Public and Private Sectors

There is no ready-made survey on the sources of innovation specifically in the public sector. However, an analysis of the diversified information by some of the subsectors may provide a comparative framework.

Petrochemicals Industry :

The leading petrochemicals plant in Turkey, is Petkim Anonimous Co.. The interviews that we have made with the Petkim officials and the data obtained, indicate that the main source of technological innovation in this sector has been the transfer of foreign technology, at the initial years of the establishment.

Petkim is a public company which has no foreign equity share. The nominal capital of this company was TL 700 millions, with the corresponding shares :[2]

Turkish Petroleum Co.Inc. (T.P.A.O.)	55 %
The State Pension Fund	25 %
The Armed Forces Mutual Assistance Fund	20 %

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2. Petkim , by Petkim Petrokimya A.Ş., Istanbul (1972).

TABLE 10.2 CAUSES OF 'NOT UNDERTAKING RESEARCH' BY INDUSTRIES

		(1)	(2)	(3)	(4)
Code No.	Industry	Limited Markets	Other Sources are more proiftable	Unknown	Total
20	Food	10	13	3	26
21	Beverage	1	-	-	1
23	Textile	21	19	3	43
25	Wood products	3	1	-	4
26	Furniture and fixtures	-	1	-	1
27	Paper	1	3	-	4
28	Printing	2	3	-	5
29	Fur and leather	1	3	-	4
30	Plastics	6	9	1	16
31	Chemicals	8	8	-	16
32	Petroleum and coal	-	2	-	2
33	Earth products and glass	4	8	2	14
34	Basic metals	4	3	-	7
35	Mineral goods	-	8	2	10
36	Mechanical engineering	3	-	2	5
37	Electrical engineering	1	5	1	7
38	Transport vehicles	1	1	-	2
	Total	66	87	14	167

TABLE 10.3 SOURCES OF INNOVATION IN PETKIM PETROCHEMICALS ANONIMOUS CO. OF TURKEY

(A)

Plant and the year of Start-up	Licencor	Engineering firm[x]	General engineering[x]	Number of foreign experts involved[xx]
1. Ethylene (1967)	Stone and Webster(British)		Foster Willer (American)	70(a)
2. Polyethylene "	ICI (both of them British)	Simon Carves	Foster Willer	9(b)
3. VCM (1968)	ICI and Solvick Solvez	Humpreys and (Glasgow)	Foster Willer	5(c)
4. PVC "	"	CTIP(Italian)	" "	8(d)
5. Chlor Alkali "	Ohlin and Mathieson (USA)	Pinch-Bamak (German)	" "	7(e)
6. DDB "	Conoco-Uope	Foster Willer Italiana	Petkim	4(f)
Expansion				
1. Ethylene(1970-73)	-	Stone and Webster	Petkim	-
2. Polyethylene(1971-72)	ICI(the initial agreement goes on	Simon Carves	Petkim	-
3. VCM (1971)	the initial Petkim agreement		Petkim	-

[x] design and production of the licenced technology is made by the engineering firm; the general engineering involves the assembly, actual construction and modifications of the transferred plant in the process of construction

[xx] (a) this figure includes the 10 experts that were involved during the operation stage at various periods of time during 1967-70

(b) during 1967-70 ;

(c) during 1968-70 , utmost 3 experts together at a time

(d) " " " " " " "

(e) " " " " " " "

(f) during 1970-72 ; only in assembly operations, for 2 months each

Source: Petkim General Directorate

(B)

Payments :

Foreign experts: $120-150 daily wages-residence-TL2,000 monthly 'pocket money' (approved by the Ministry of Finance)

Licencing fees: TL 103 million - royalty rights for 10 years at 12%

Total investment: TL 2 million and 138 million

(C)

The Training Programs Abroad

Number of persons sent abroad for years:	1965	1966	1967	1968	1969	1970	71	72
a) undergraduate study[xx]	11	31	33	13	7	6	7	4
b) MA[xx] and training[x]	1	1	2	52	41	5	6	3

[xx] financially supported by Petkim

[x] half of the costs are paid by Petkim the other half by the licencors; the training programs were held at the HQ's of any of the intermediary companies.

(D) Research and Adaptation:

4 engineers and a director(an economist) are doing quality control, adaptive research in terms of a successful application of the licenced knowledge, without any modifications on the basic knowledge transferred; Tubitak contributed TL 4 million in 1973 for this group of researchers. No foreign involvement is observed in this field.

The nominal capital is of only minor importance in the establishment of such a plant. The total investments made in Petkim was TL 2,138 billions - i.e. about 67 % of the total investments were obtained from external sources (Table 10.3/B). The rate of interest paid on foreign loans was 4.5 %. The Ad Hoc Committee Report on petrochemicals says that the foreign leans were given on condition that the intermediary firms from the creditor countries would carry out the project engineering, supply the machinery and know-low needed.[3] The technology suppliers are enlisted in Table 10.3/A, by the plants in concern and the number of foreign experts involved.

In fact, at the pre-operation stages of the establishment of the new plant, there was no alternative but the foreign sources of technology, since this is a typical case of transplantation of an industry developed in the advanced industrial countries. The production methods and processes of the petrochemicals outputs were totally alien to the Turkish economy. The consequent use of foreign experts and the licencing agreements made with the technology suppliers eventually led to an accumulation of knowledge and industrial experience in this field.

The training programs abroad helped to provide the personnel requirements of the new plant (Table 10.3/C). Beginning in 1968, Petkim was able to carry out the construction activities of the new investments. In 1971, it started to undertake its engineering works. The technical and administrative personnel supplied by the Turkish Petroleum Co., receiver industries and the universities contributed to this development.

The R and D unit established in Petkim is a small team basically engaged in adaptive research (see, Table 10.3/D).

The royalty agreement was for 10 years at a 12 % rate. The Ad Hoc Committee Report indicates that the duration of rayalty payments was over a too long period for such a research-intensive field where the present technology may become obsolete during this period. According to the Petkim officials, the 12 % royalty rate was 50 % higher than the alternatives that had existed at the project selection stage.

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3. SPO, Ad Hoc Committee Report on Petrochemicals, SPO publication no. DPT : 1193-ÖİK :156, Ankara (March 1972), p.vi

Textiles Industry :

About 30 % of the textile output is produced by the public sector-by Sümerbank which also operates in other sectors besides textile.[4] The report of the science Policy Unit of TUBITAK, prepared for O.E.C.D., says that the research performed by this sector is rather symbolic.[5] When research institutions are broken down into universities, public and private institutions, it is observed that the universities do not conduct any research in this field.

> "As for the public sector, Merions Plants of Sümerbank is the only institution conducting research in this category. A survey covering 22 larger firms has been conducted to determine the R and D of the private sector. Seven firms have stated that they were performing research. However, only one of these has given the amount of research expenditure. It is TL 250.000. Thus, the annual research expenditure in the sector has been found to be one million TL."[6]

The report does not give the amount of expenditures made by the public sector. Instead, it states : "Consequently, the research expenditure in the textile sector would be assumed to be 1 million TL., within the most optimistic and tolerant point of view. It is very likely that the real figure is much lower than this, since some routine works are included in the research activities".[7]

Taking the 45 % of the firms in this sector, which are large enough, as to their sales and manpower, to apply technical innovations to a greater extent, the report states the following origins of technical innovations, by order of importance :

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4. Research on the Gaps in Technology Between O.E.C.D. Countries (Report On The Textile Sector of Turkey) , by the Scientific and Technical Research Council of Turkey (Science Policy Unit), Ankara(March 1968),p.13

5. ibid., pp.18-22

6. ibid.

7. ibid.

1. Abroad
2. Suppliers of equipment and raw materials
3. R and D performed by the sector
4. Other Sectors
5. Customers
6. Government research and advisory institutions.

Although the proportion of public firms in the above sample has not been stated, the conclusions reflect the situation in the public sector to a great extent since public firms tend to be the largest ones, in the economy. However, the first and second, and, the fourth and fifth, sources of innovation mentioned above coincide to a large extent and no brief conclusion can be drawn from this information on the origins of innovation.

In order to be more precise on this issue, we have interviewed the ten largest textile firms located in the Aegean Region. The names and the technico-economic characteristics of these firms are enlisted in Appendix E. One of these firms is a branch of Sümerbank, which is the only public 'establishment' in our sample. The results of the interviews indicated that there are no major differences among firms as far as the sources of innovation in this sector are concerned.

The most of the textile machinery employed by these establishments were imported. In the two of them, domestically produced weaving plants were found. However, the domestic production of these plants which were based on the copying of a foreign design, was stopped due to their technical inferiorities compared to imported weawing machinery (see, Appendix E). The owners of these domestically produced plants were planning to sell them to smaller firms, producing for local markets.

The installment of the imported machinery park was made by foreign experts. The occasional replacement of parts has been based on the importation of them whereas no foreign experts has been required. The failures in machine operation has been reported by the public establishment to its central organization in Ankara; the private firms consult with the suppliers abroad-if necessary. They all organize manpower training courses and do on-the-job training, beginning with apprenticeship. Their engineers and master workmen are engaged in routine quality control procedures. But no R and D activity is performed in these firms. The public establishment's managers report that they enjoy the advantages of the R and D carried out at their headquarters.

Pharmaceuticals Industry :

The public institutions are not involved in the production of the pharmaceuticals industry. The Universities do some academic work, but the scope of this work is rather limited. "All the new products and production processes in the sector depend on foreign R and D activities. The entrance of new technologies into the country is realized through the activities of foreign companies which have begun their activities in the country after the ratification of Act No. 6224 in 1954, and through licence and patent agreements. No doubt, the entrance of new products into the sectors is also realized through imitation".[8]

It can be said that excluding the clinical researches for the appraisal of new pharmaceuticals and the two companies who make research in their own laboratories, there is no R and D activity in the sector.[9] One big domestic company has two laboratories for R and D activities with a technical personnel of 7 men (a chemical engineer, a doctor, and a pharmacologist) and a laboratory personnel of 8 men. It has established a "scientific research and reward fund" in cooperation with universities' staff members, for the purpose of encouraging medical research workers. For all these activities, the company is reported to spend TL 660 thousand her year. Another company has an expenditure of TL. 200 thousand per year.

Iron and Steel Industry :

This industry will be discussed in detail, in the Third Part of the present thesis. The major points that must be mentioned here are : first, technological innovations in the sector, are based on foreign R and D

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8. Research on the Gaps in Technology Between OECD Countries (Report on the Pharmaceuticals Sector of Turkey) Ankara (May 1968), p.44

9. ibid., p.40

directly through importation of machinery and equipment, or licencing agreements with intermediary companies, both in public and private sectors. Second, the only research activity in this field is conducted by the Faculty of Mines of Istanbul Technical University, which is limited to the 'metallurgical problems' arising in the production process.

Plastics Industry :[10]

Plastics industry is closely linked both to the chemicals industry, from which it receives raw materials, and to the manufacturing industries to which it furnishes raw materials. In fact two main types of enterprises can be found in this sector : (a) enterprises producing plastic materials only ; and, (b) enterprises manufacturing chemical products and plastics materials.[11]

The latter category involves the Petkim Petrochemicals plant in Turkey, which has been discussed earlier. Petkim, like other "enterprises with a horizontal structure, that is, those that produce other chemical products as well as plastic materials and, sometimes finished products, are interested in developing a broader type of research... from the acquisition of new technical and scientific knowledge (basic research), to the study of new processes and new products, the improvement of operating techniques, of already produced products, the study of new outlets for products, etc. (applied research), and the application of discoveries to commercial uses (development research)".[12] Ih the case of Petkim, however, all the research activity in the plant is directed to the successful application of the licenced foreign technology, without any modifications on the basic knowledge transferred.

10. see, SPO, Plastik İşleme Sanayii Özel İhtisas Komisyonu Raporu, publication no. DPT : 1179 - ÖİK : 150, Ankara (February 1972), pp.4-9, 17, 52-53, 58-59, 80-84, 90-92.

11. Gaps in Technology Between Member Countries : Sector Report on Plastics, Third Ministerial Meeting on Science of OECD Countries, (11th and 12th March, 1968), Paris (29th February 1968), pp.140-141

12. ibid.

As far as the vertically organised enterprises such as those producing only plastic materials, or producing plastic materials and subsequently transforming them into finished products, are concerned, they are small and scattered enterprises, hardly interested in R and D, in Turkey. They use the machinery and equipment produced domestically which lead to low productivity and inferior quality.[13] It is expected that increasing competition will either require the replacement of the present machinery with the imported ones, or, a shift in the technology of the machinery-supplying enterprises will be realized.

The supplier industries provide the following "technical services", to the plastics industry :[14]

a."development" works ; these works include the in-plant quality control ; and, the follow-up of the nature of the market demand, outside the plant.

b.in-plant organization ; coordination of the sales, marketing and production departments as well as doing market research, arranging training programs for the personnel, translation of the literature supplied by the licencing firms, and teaching the properties of the new products originated abroad.

c.services for the customers ; the determination of the complaints and the demand of the customers, arranging seminars for them in cooperation with the vertically organized enterprises, and supplying information for the technological developments in the field of plastics.

d.standardization and other services ; the specifications of the Institute of Turkish Standards, are applied in this industry by the aid of the suppliers. Also, the restrictions put by the Ministry of Health, in relation to pollution and food industries, are followed within this vertical integration.

The domestic production of the raw materials and intermediary products required by this industry have not reached to a stage where it can meet domestic demand. The total output capacity in the plastics industry has

13. the Ad Hoc Committee Report, op.cit., p.8-10

14. ibid.

not replaced imports to a large extend either. According to the 1971 projections, production of PE (low-density) was 12,000 tons, against 30,000 tons of imports ; the production of PVC was 9,000 tons and its imports was 21,000 tons, in the same year. The other plastic products were totally imported.[15]

Concluding Remarks

A comparative analysis of these five manufacturing subsectors, indicate that the indigenous sources of innovation occupy a secondary place while the transfer of technology from advanced industrial countries is of primary importance in the present state of technological development. The forms of vertical and horizontal integration, the level of competition and the nature of demand in segmented markets, the gradual expansion of the indigenous engineering and 'development research' capabilities, and the size of enterprises, tend to determine this development. The pattern of integration with the external sources of technology differs in the public enterprises from the private ones, in the sense that the enterprises requiring heavy capital outlays and system specific technology , can be supported more easily by public sources of investment. Although the industrial transplantations require the involvement of foreign experts both at the pre-investment and the operation stages of the new plants, the present stage of industrial development presents opportunities of obtaining the necessary manpower from the already developed industries. Accompanied by the manpower training schemes developed parallel to the process of transplantation, a considerable expansion of the industrial skills has been observed. What seems to be the least importanton in the process of industrial transplantation is the contribution to the local R and D capabilities.

15. ibid., pp.56-57

10.2 TECHNOLOGICAL DEPENDENCE : THE MAJOR SOURCE OF INNOVATION

The relative significance of the foreign sources of technology can be observed at an aggregate level in terms of (a) purchases of patents, importation of know-how via licencing agreements, direct contracting of individual experts and consulting companies, training nationals for specific production projects, and technical information services; (b) transfer of process technology embodied in capital goods, parts and intermediary products ; and (c) investments of the multinational companies in the form of joint ventures or wholly owned subsidiaries. The last category is the subject matter of Chapter 11 ; we shall discuss a and b in this section.

Patents and Licencing Agreements

The pressure of industrial competition both at the national and international level forced industries to devote large-scale expenditures to technological research and development. It is generally recognised that innovative activities and disclosure of results are undoubtedly favourably influenced by the patent systems. However, the history of patent laws has been marked from their beginning by considerable controversy regarding their social and economic costs and benefits. The main arguments put forward in support of the patent system are the following:[16]

a. patent law is considered an important incentive to invent by offering the inventor the possibility of reward ;

b. the patent system is regarded as stimulating industrial firms to carry out additional investments necessary for the further development required to bring the invention to commercial use ;

16. see, Restrictive Business Practices Relating To Patents and Licences, O.E.C.D. Report by the Committee of Experts on Restrictive Business Practices, Paris (1972), pp.4-5

c. by providing protection for the inventor, the patent law ensures that inventions are disclosed earlier to the public than otherwise ; consequently, it decreases the possibility of duplication of inventive activities and facilitates other inventions ;

d. it is argued that the patent law encourages the exchange of technological information in the international field by assuring the protection for industrial property on foreign nationals.

Paris Union Convention of 1883, which has been accepted by many nations, ensures, in exchange for the grant of a right of exclusivity for a specific period of time, that the public is informed of new technical developments with the minimum delay.[17] Although the provisions of this Convention have been revised since it was first formulated, two of its basic principles are still relevant : first, within 12 months after the application for a patent to be granted in a certain country, the rights of the patentee to apply for the issue of the same patents in other member countries is reserved ; second, any member country should treat her own nationals and the applicants of other nationalities, equally.[18]

Turkish Positive Law, abiding the provisions of the revised form of the Paris Union Convention, grants patent rights after examining the invention as to its patentability - novelty, level of inventiveness and commercial utility. The number of patents granted to Turkish and foreign nationals during 1950-75, is shown in Table 10.4. If we take the number of patents granted as an indication of technological progress, the domestic sources account for approximately 10.4 % of the total patents registered during 1950-1975. The remainder of this total was granted for foreign nationals.

The nature of the patents granted to the Turkish inventors should be qualified. According to the information supplied by the Ministry of Industry and Technology, the domestic inventions were originated mostly

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17. For a summary review of the provisions of the present patent laws, see, Ö.F. Erdem, Patentin Hukuki, Ekonomik ve Teknik Yönleriyle İlgili Bir İnceleme, Ankara (June 1971), pp.19-32

18. ibid.

TABLE 10.4 NUMBER OF PATENTS GRANTED TO TURKISH AND FOREIGN NATIONALS DURING 1950-75

Years	Domestic	Foreign	Total	Share of Domestic Patents in Total
1950	64	119	263	0.243
1951	93	268	361	00.257
1952	82	456	538	0.153
1953	86	393	479	0.180
1954	44	193	237	0.228
1955	112	615	727	0.157
1956	57	400	457	0.177
1957	30	292	322	0.093
1958	52	328	380	0.137
1959	27	786	813	0.032
1960	35	590	625	0.056
1961	18	245	263	0.069
1962	31	383	414	0.075
1963	103	412	515	0.200
1964	29	524	553	0.052
1965	45	555	600	0.075
1966	79	707	786	0.100
1967	51	557	608	0.084
1968	25	447	472	0.056
1969	16	241	257	0.062
1970	11	197	208	0.056
1971	52	386	438	0.135
1972	19	636	555	0.035
1973	27	284	311	0.087
1974	15	231	246	0.065
1975	30	432	462	0.069
Total	1233	10657	11890	0.104

Source : Division of Industrial Property, Ministry of Industry by the craftsman-entrepreneurs, and they arise at the engineering processes of the already extant techniques ; they do not create major novelties of methods of production and processes. The knowledge registered by the foreign inventors tend to give access into new products, processes and capital equipment, contrary to the patents registered by the domestic inventors. Almost all of the foreign-owned patents were issued to the multinational companies.

Given the import-substitutions policies pursued intensively particularly during the planned period, the patenting procedures employed by the multinationals can be viewed as an instrument of tariff-jumping process. However, a true account of this agrument is difficult to make for the whole Turkish Economy. One of the leading causes of this difficulty is stemming from the unwillingness of the officials of the Ministry of Technology and the Ministry of Finance, to release information on the extent and the nature of licencing agreements in the manufacturing sectors. The partial data discussed in the earlier sections provide some clues though.

Imports of Investment Goods and Intermediary Products as a Source of Technology

The close relationship between capital formation and technical progress has been discussed in Chapter 7. The extent of import dependence in capital formation can be seen from Table 10.5. The percentage of imports in gross fixed capital formation decreased from 34.6 in 1950, to 29.2 in 1960 and to 16.3 in 1970. This declining trend stopped during the seventies and the ratio of imports in gross fixed capital investments rose up to 25.2-28.7 % . Among the causes of this shift are the changing emphasis of the new investment programs towards the technology-intensive manufacturing sectors in the Third Plan period, and the frequent devaluation of the Turkish Lira against the foreign currencies required to finance imports.

The share of consumption goods in total imports has shown a secular decline in the Turkish Economy. This is accompanied by the increasing share of the imports of raw materials up to 61.7 %, while the investment goods occupied a share of imports within the range of 50.1-34.1 %, during the Third Plan period.

TABLE 10.5 PERCENTAGE OF IMPORTS IN GROSS FIXED CAPITAL FORMATION AND THE DISTRIBUTION OF IMPORTS BY COMMODITY GROUPS

Years	Import Dependence in Capital Formation	Distribution of Imports			
		Investment Goods	Raw Materials	Consumption Goods	Total
1950	34.6	46.0	33.4	20.6	100.0
1955	24.9	54.3	31.1	14.6	100.0
1960	29.2	52.1	38.5	9.6	100.0
1961	26.1	44.8	45.3	9.9	100.0
1962	28.7	45.0	47.8	7.2	100.0
1963	29.3	45.8	48.8	5.4	100.0
1964	21.2	45.7	49.4	4.9	100.0
1965	19.5	42.2	53.5	4.3	100.0
1966	21.3	47.5	47.5	5.0	100.0
1967	17.6	47.2	47.9	4.9	100.0
1968	16.9	48.0	47.2	4.3	100.0
1969	14.6	43.8	49.4	5.0	100.0
1970	16.3	47.0	48.0	5.0	100.0
1971	23.8	43.7	51.3	5.0	100.0
1972	28.7	50.1	45.3	4.6	100.0
1973	28.1	48.0	47.6	4.4	100.0
1974	25.2	34.1	61.7	4.2	10010

Source: 1950-69 data is obtained from, National Income and Expenditure of Turkey 1948-72 , SIS (1973), pub. no.680, pp.100-101 ; and, the Ministry of Commerce Foreign Trade General Secreteriat.
1970-74 data is obtained from, İktisadi Rapor 1975 , by the Union of Chambers, Ankara (1975), pp.34 and 453.

The significance of the imports of intermediary goods as a determinant of the technical practices of production varies among manufacturing subsectors. If we take the share of intermediary goods imports in unit output as an indicator of this situation, the percentagewise ranking by subsectors is as follows :[19]

Chemicals	59.56 %
Paper and Printing	44.92 %
Mechanical Engineering	38.25 %
Electrical Engineering	24.67 %
Transport Equipment	19.07 %
Metal Goods	12.87 %
Basic Metals	10.87 %
Petroleum and Coal Products ..	5.45 %
Rubber	4.23 %
Textile and Clothing	1.03 %
Wood Products	0.16 %
Food	0.01 %

The factors like high import pricing, overvalued exchange rate, tax laws encouring the import substitution policies with high import-dependence, the priorities of the import quotas and the foreign inward investments in some of these industries, are among the causes of an increasing intermediary goods imports.

10.3 SUMMARY AND CONCLUSIONS

The phenomenon of transfer of technology occupies a leading place as a source of technical progress both in the private and public sectors. Transfer of proprietary techniques of production is more important than the transfer of non-proprietary ones. The relative insignificance of the domestically registered patents in quantity as compared to the foreign patents, and the fact that the novelties involved in the domestic inventions tend to be related rather with routine procedures than major novelties are among the leading determinants of the transfer.

19. c.i.f. value of imports obtained from K.Chakraverti-O.Yeğenoğlu, Flow Structure of Imports,Turkish Economy:1967 and 1968, SIS National Income

The variety of the sources of knowledge about the alternative technologies, the extent of R and D activities that the technology receivers are engaged in, the profit expectations with given market size, and the sectoral characteristics in relation to the demand and supply of technology, are also determinant on using external sources of innovation instead of domestic sources.

The sector studies show that the forms of integration among industries are important in the dissemination of knowledge within the national economy. In the public enterprises, the possibilities of utilizing the heavy capital outlays required for certain industrial transplantations affect technical progress both with respect to the transfer phenomenon and the forms of domestic integration.

The imports of capital goods and intermediary products are among the important channells of transfer of technology, in the Turkish Economy. These channells will be further discussed in evaluating the costs and benefits of technology transfers, in the subsequent chapters.

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and Commodity Flow Project, paper no.2, Ankara (June 1973), p.65 ; output figures have been obtained from the <u>1971 Annual Program</u> , passim. Table : 149

CHAPTER 11

TRANSFER OF TECHNOLOGY AND EMPLOYMENT IN FIRMS WITH FOREIGN CAPITAL

The foreign capital investments have been considered as an important means for covering up the savings gap and overcoming technological insufficiencies, in Turkey. For example, the Second Plan States :

"... Private foreign capital will be considered important as an additional source of savings, foreign exchange and technology... A special attention will be paid to accept private foreign capital in those branches of industry which cannot be undertaken by Turkish entrepreneurs due to insufficient technical know -how, experience and capital. The inflow of foreign capital into economic activities which are not foreseen in the Plan or Programmes, or which tend to stimulate trends in domestic consumption, will not be permitted."[1]

Consequently, the issue of employment created by foreign capital investments can be viewed ; (a) as employment due to the level of investments ; and, (b) as employment determined by the technological properties of these investments.

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1. SFYDP, passim., p.119

11.1 LEVEL AND IMPORTANCE OF FOREIGN CAPITAL INVESTMENTS IN MANUFACTURING INDUSTRY

Concept of Foreign Capital

This concept is used synonimously with the concepts of "Foreign Inward Investments", "Foreign Private Capital", "Foreign Capital Investments" and "Direct Foreign Capital Investments". It expresses the ownership of the foreign companies (mostly, multinationals) on a certain amount of investment made in Turkey. The external loans provided by the other states and the portfolio investments (or, the multinational manipulations in international stock exchange) are excluded from the concept of foreign capital.

There are two operative laws in relation to the inflow of foreign capital investments in Turkey : Act No. 6224 (The Foreign Investment Encouragement Law) and Act No.6326 (The Petroleum Law). The latter one will not be a matter of discussion here since the former is directly concern of the manufacturing industry. Another Law governing foreign investment, the 1962 Decree 17 (For The Protection of the Value of Turkish Currency) concerns sales companies and other low-priority investments. Also, foreign capital inflow takes place by special laws concerning specific investment projects,[2] which will not be included in this study either.

The amount of foreign investments is assessed and fixed by the "foreign capital base" which is described by Article 2 of the Act No. 6224, as follows :

"The following items imported from abroad for the efficient establishment, expansion or reactivation of an enterprise as envisaged by this Law :

1. Capital in the form of foreign exchange ;

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2. e.g. the Law Relating to Ereğli Iron and Steel Mills Corporation, No. 7462/1960, enabled a joint venture to be established.

2. Machinery, equipment, instruments and the like, machinery components, spare parts and materials and other necessary goods approved by the Committee ;
3. Intangible rights such as licences, patent rights and trade marks and services ;
4. Profits converted into capital through reinvestment."[3]

"The Committee" is formed under the SPO by Act No.933, concerning the Implementation of the Fndamentals of the Development Plans, enacted at 7 August 1967.[4]

According to Act No.6224, technology in the form of patent rights, licences and know -how may be brought in as "capital". A firm which brings foreign money not according to Act No.6224, but by registring it with the Central Bank, cannot include technology in capital". This is important, since if the technology is in the capital, then the payment of dividends is the only way of transfer of money abroad.

Foreign Capital Inflow

The authority to whom application should be made under Act No's 6224 and 933, is the SPO. The merits of the application are decided by this organization and the value of the licences, patent rights and know-how is assessed by the experts chosen by the SPO.[5] Appeal is possible to the High Planning Commission. On the other hand, technology, having no precise definition, is the subject of agreements made according to the Code of Obligations.

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3. The document of Act No.6224 (January 18, 1954) ; and Foreign Investment Encouragement Law , The Union of Chambers Investment Promotion Publications Series, No.E-1/63, Ankara (11.4.1964)
4. Prior to Act No. 933, the "Committee" was formed under the chairmanship of the General Manager of the Central Bank, by the Director Generals of the Treasury, Domestic Trade, Industrial Affairs, the Chairman of the Board of Research and Planning of the State Enterprises, and the Secretary General of the Union of Chambers.
5. There is no specific limitation on the size of foreign investment, but investments of less than $.3 million are not likely to be considered, unless perhaps in a highly specialized product or an export-oriented operation.

During the term between 1954 and the end of 1972, the number of investment permits given by decrees was 247. The capital value of the permits issued during 1951-1974 and the actual arrivals of foreign capital in value terms, are observed in Table 11.1.A comparison of the cumulative total of the capital value of permits issued and actual arrivals, indicates that the ratio of realized investments to the permits, is 55.7 %, by the eno of 1973. The cause of such a low level of realization of foreign investments is difficult to distinguish. There is a secular trend of increasing ratio of realization since the launching of the Second Plan. The First Plan was stating that by obtaining increasingly higher amounts of project-bound credits from international financial organizations, it was intended to reduce the inflow of financial sources as "foreign capital".[6] The Second Plan, however, showed a shift of emphasis by favouring the inflow of foreign capital through promotion measures taken under the Act No.633. These measures may partly explain the relatively faster inflow of foreign capital, since the enforcement of the Second Plan.

Since 1967, however, when SPO took over advisory responsibility for all foreign investments negotiations, the governments have become increasingly selective toward foreign investment and each investor must negotiate his project on a case-by-case basis. When the SPO revaluated the decrees issued prior to 1967 it was realized that 72 of the permits had not been put into practice ; and 47 were applied in contradiction with the conditions stated by Act No.6224. Consequently, 121 decrees were gradually cancelled until 1970.

The type of the foreign capital inflows was as follows by the end of 1973 : the investments in kind (machinery, equipment and accessories) were the 53.61 p.c. of the total capitalization ; the investments in cash were the 42.14 % and the ratio of the proprietary rights (licence, patent, trademark and services) was 4.25 %.[7] The capitalized profits are included under the heading of investments in cash.

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6. FFYDP, passim., p.510

7. These proportions are based on the data by the end of 1967, evaluated by the Union of Chambers, on the basis of the information obtained from the Ministry of Finance.

TABLE 11.1 PERMITS ISSUED FOR INFLOW OF FOREIGN CAPITAL AND ACTUAL ARRIVALS OF FOREIGN CAPITAL (1951 - 1974)

(thousand TL)

Years	Permits Issued For	Cumulative Total of Permits Issued	Actual Arrivals	Cumulative Total of Actual Arrivals	Ratio of Realization %
1951	4.800	4.800	3.410	3.410	71.0
1952	26.993	31.793	2.993	6.403	20.1
1953	18.197	49.990	1.148	7.551	15.1
1954	108.440	158.430	2.598	10.149	6.4
1955	48.968	207.398	8.002	18.151	8.8
1956	66.954	274.352	21.655	39.806	14.5
1957	42.895	317.247	10.531	50.337	15.9
1958	57.693	374.940	15.068	65.405	17.4
1959	69.474	444.414	19.825	85.230	19.2
1960	48.926	493.340	18.711	103.941	21.1
1961	80.055	581.395	43.056	146.997	25.3
1962	133.604	714.999	87.246	234.243	32.8
1963	243.849	958.848	91.386	325.629	34.0
1964	125.281	1.084.129	69.885	395.514	36.5
1965	93.320	1.177.449	95.598	491.112	41.7
1966	229.933	1.407.382	69.580	560.692	39.8
1967	170.239	1.577.621	67.750	628.442	39.8
1968	196.255	1.773.876	92.357	720.799	40.6
1969	373.661	2.147.137	61.367	782.166	36.4
1970	152.471	2.299.608	90.550	872.725	38.0
1971	67.256	2.366.864	102.917	975.642	41.2
1972	145.546	2.512.410	129.125	1.104.766	44.0
1973	136.868	2.649.278	374.000	1.425.766	55.7
1974	6.000	2.655.278	..	..	..

Source : TÜSİAD, 1975 Yılının İlkbaharında Türk Ekonomisi , Istanbul (April 1975), pub.no TUSIAD-T/75.4.22, p.137.

Foreign Capital Inflow By Country of Origin

Distribution of foreign capital inflow to Turkey is given in Table 11.2, by the countries of origin. The foreign capital inflow of the U.S.A. origin is at the highest level with a relative share of 17.12% while the number of West German firms established in Turkey under Act No. 6224 is the highest, as compared to the firms of other country origin.

The relative share of the European countries within the total amount of foreign capital investments is 68.97 %. In this group of countries, the members of the EEC have a share of 51.86 %.

The registered origin of the firms under Act No.6224 does not, in fact, reflect the real source of many of these firms. For example, according to the Ministry of Commerce, the Abbot Pharmacenticals Co. of American origin is registered as a Venezuellan company ; the Italian Pirelli is registered as of Switzerland origin ; the Swedish Atlas Copco is registered as a Belgian company. The reason for this is that the multinational firms organize some of their international operations via their subsidiaries abroad, instead of from their headquarters.

Sectoral Distribution of Foreign Capital Investments

The foreign capital investments concentrated in certain manufacturing sectors. These sectors are (in an order of concentration) motor vehicles, chemicals, agricultural machinery and implements, electrical appliances and electronics, metal goods, glass and machinery (see, Table 11.3). There is a parallel concentration of the number of firms in the sectors of chemicals, electrical appliances and electronics, metal goods and motor vehicles.

The sectoral concentration of foreign capital investments indicate, firstly, that the research-intensive industries like chemicals (including pharmaceuticals), electrical engineering and electronics, and mechanical engineering are receiving a higher investment share. The research-intensity, however, cannot be a sole determinant of foreign capital inflow since the industries of relatively "mature" goods such as motor vehicles, glass and some of the metal industries, also receive a hig-

TABLE 11.2 FIRMS UNDER LAW 6224 BY COUNTRY OF ORIGIN(As of Dec.31,1974)

Country of Origin	No. of Firms	Authorized Foreign Capital (TL Millions)	Authorized Foreign Capital % of Total Foreign Capital
West Germany	23	299.9	15.28
U.S.A.	20	336.1	17.12
Austria	7	32.9	1.67
Belgium	5	76.9	3.91
Denmark	5	83.6	4.26
France	8	215.4	10.97
Holland	5	102.7	5.23
United Kingdom	5	46.5	2.37
Sweden	1	0.05	0.02
Switzerland	16	294.7	15.02
Italy	6	193.2	9.84
Japan	1	80.0	4.07
Canada	1	29.8	1.52
Kuwait	1	64.8	3.30
Venezuela	1	4.5	0.22
Mixed	6	100.9	5.14
Total	111	1.962.3	100.0

Source : TUSIAD, Turkey, An Economic Survey 1976 , Istanbul (April 1976)

TABLE 11.3 SECTORAL DISTRIBUTION OF FOREIGN CAPITAL INVESTMENTS

Manufacturing Sectors	No. of Firms	Foreign Capital Investments (thousand TL)	%	Average Capital Concentration in Each Firm (thousand TL)
Food, Liquor, Tobacco	8	211,479	5.43	26,435
Textiles	3	29,048	0.01	9,683
Paper	1	84,932	0.02	84,932
Rubber	1	378,000	9.70	378,000
Plastic Processing	1	9,867	0.02	9,867
Chemicals	26	559,813	14.37	21,531
Glass	1	230,000	5.90	230,000
Motor Vehicles	8	713,500	18.31	89,188
Metal Goods	11	368,685	9.46	33,517
Machinery Manufacturing	6	228,031	5.85	38,005
Agricultural Implements	4	463,200	11.89	115,800
Electrical Appliances and Electronics	14	455,067	11.68	32,505
Cement	3	150,000	3.85	50,000
Packing and wrapping	1	2,100	-	2,100
Construction Materials	1	12,000	0.03	12,000
T O T A L	92	3.895,723	100.00[x]	42,345

(x) the sum total does not add up to 100 due to the exclusion of more than two decimals

Source : based on figures supplied in 1975 Yılının İlkbaharında Türk Ekonomisi , op.cit., p.134 ; and, in Turkey, An Economic Survey, op.cit.

her share. Considering the industries of food, textiles, beverage and tobacco which tend to produce some traditional products as well as mature ones, it can be concluded that those sectors which present already developed market potentials, under highly protective import substitution policies may create investment stimuli for the multinationals.

Secondly, in the science-based industries, the capitalized proprietary rights are observed. The ratio of these rights in the total capital investments was, 51.40 % in mechanical engineering, 3.31 % in metal goods, 2.30 % in transport vehicles, 1.36 % in chemicals and chemical products, and 0.59 % in electrical engineering. In fact, among these, only the industries of mechanical and electrical engineering, and chemicals (including pharmaceuticals) are in the character of science-based industries.

The capital inflows may not necessarily include proprietary rights but the licencing agreements attached to the process of this inflow may be related to the sectoral distribution of the foreign investments. Further clues can be seen in Table 11.4, which gives a breakdown of the net transfers of the payments made as a result of such agreements within the scope of Act No. 6224. For instance, payments made for the textiles industry include both the payments for new products (e.g. synthetic fibres) and new processes (e.g.automatic looms). In beverages, brand names (like Coca-Cola) may provide a competitive stronghold in the already developed domestic markets, which are included in the "other manufacturing industries" category, in Table 11.4. The payments for such proprietary rights through licencing agreements tend to concentrate in those sectors where concentration of capitalized proprietary rights is observed - such as electrical engineering, rubber products, chemicals, metal goods and transport vehicles.

Thirdly, viewed from the point of average level of capital concentration in each firm by sectors, the investment requirements of a given product market under certain technological constraints, determines the level of inflow of foreign capital investments. For instance, we observe in the last column of Table 11.3, that the sectors which require heavy capital outlays for the realization of investments are rubber, glass, agricultural implements, motor vehicles, paper, mechanical engineering, etc.

Fourthly, 5.44 % of the foreign capital investments are concentrated in the consumption goods industries, 30.01 % in the intermedi-

TABLE 114 NET TRANSFERS OF THE PAYMENTS MADE FOR THE INVISIBLE RIGHTS WITHIN THE SCOPE OF LAW NO.6224 ON THE ENCOURAGEMENT OF FOREIGN CAPITAL AND THEIR SECTORAL DISTRIBUTION BY THE END OF 1969($)

Items included in the invisible rights or kinds of payments	Branches of Economic Activity									
	Textile Industry	Rubber Products Industry	Chemicals Industry	Earth Products	Metal Goods Manuf.	Machin. Industry xx	Elect. Engin.	Transp. Vehic. Manuf.	Other Manuf. Indust.	Total
Patents	-	-	403,868	-	5,843	-	392,331	-	-	802,042
Licences	-	-	65,525	71,178	321,240	-	234,792	-	-	692,735
Royalty	28,687	-	-	77,478	-	404,490	1,824,609	224,744	26,343	2,586,351
Know-how	-	1,415,159	-	-	-	-		-	-	1,415,159
Technical aid, assistance, etc.	-	2,626,869	-	-	-	-		-	-	2,626,869
Licence-patent[x]	-	87,914	-	-	-	-		-	-	87,914
Patent-technical[x] assistance	3,000	-	-	-	-	-		-	-	3,000
Brand names[x] and tech.assiss.x	35,000	-	-	-	-	-		-	-	35,000
Total	66,687	4,129,942	469,393	148,656	327,083	404,490	2,451,732	224,744	26,343	8,249,110

Source: Union of Chambers of Commerce, Chambers of Industry and Commodity Exchanges of Turkey

(x) Different kinds of payments that are either made as a joint payment or do not fit to the general categories listed

(xx) Including mechanical engineering in both agricultural and non-agricultural machinery ary goods industries and 61.07 % in the investment goods industries.

Types of Foreign Ownership

Table 11.5 shows the foreign equity share in the capital assets of the firms operating under Act No. 6224, by 1970. Accordingly, in 17 firms foreign partners possess more than 75 % of the capital stock, of which 6 firms are the wholly-owned subsidiaries of the multinationals; in 16 firms foreign partners possess less than 25 % of the capital stock; in 31 firms a share of the capital stock within the range of 26-50 %, and, also in 31 firms more than 50 % but less than 75 % of the capital stock, is owned by the foreign partners.

Thus, the majority of the foreign capital investments is made in the form of joint-ventures while the 6 wholly-owned subsidiaries are in the pharmaceuticals and chemicals. However, this tendency is not a strong one since it is not observed in the other sectors.

The multinationals may prefer to possess a smaller share of capital investments made in the joint-ventures in Turkey, firstly to reduce the risk of investing in a politically instable country. Secondly, the bureaucratic handicaps raised against the foreign capital investments can be overcome more easily by indigenous partners. Thirdly, the technology agreements made with the subsidiaries of the parent firm located in different countries, and the raw material dependence on these sources, tend to increase the control of the multinationals over the joint-ventures established in Turkey.

TABLE 11.5 INDUSTRIAL DISTRIBUTION OF LEADING FOREIGN-CONTROLLED FIRMS BY THEIR SHARE OF OWNER'S EQUITY HELD BY FOREIGN COMPANIES (BY THE END OF 1970)

Branches of economic activity	Total number of firms	Category of foreign equity by percentage of total capital assets and the no. of firms in each category. Less than 25%	Between 26-50%	and 51-75%	more than 75 %
Food	4	2	-	1	1
Beverage	4	1	-	1	2
Food and beverage	1	-	1	-	-
Tobacco	1	-	-	1	-
Textiles	4	2	-	1	1
Pharmaceuticals	12	-	1	2	9
Other chemicals	16	-	6	7	3
Rubber and plastics	4	-	1	3	-
Electrical machinery and appliances	14	2	6	6	-
Metal Products	10	2	5	3	-
Non-metallic goods	2	2	-	-	-
Machinery, instruments and parts manufacture and assembly	6	2	3	-	1
Transport vehicles assembly	7	1	5	1	-
Cement	2	-	-	2	-
Glass	2	2	-	-	-
Paper	1	-	-	1	-
Miscallaneous manufactures	5	-	3	2	-
T o t a l	95	16	31	31	17

Source: Based on the records of the Ministry of Commerce of Turkey. At the end of 1970 125 firms were recorded as operating within the scope of Law No:6224 on the Encouragement of Foreign Capital in Tu rkey. We have excluded six of these from this table due to the insufficient information on either the share of foreign firms in total assets or on the area of economic activity.

11.2 EMPLOYMENT AND TECHNOLOGY IN FIRMS WITH FOREIGN CAPITAL SHARE R

Level of Employment In Firms With Foreign Capital as Compared To Manufacturing Total

The total number of employees was 503,566 in the total manufacturing industry and 40,147 in the firms with foreign capital, in 1973; accordingly, the share of firms with foreign capital in total manufacturing employment was 7.98 %, in that year (see, Table 11.6, first three columns).

This share was above the total manufacturing average in the following industries : electrical machinery and equ ipment, rubber and tyre industy, chemicals, stone and earthware, motor vehicles, beverage and pharmaceuticals.

A Comparison Of Sales Ratio With Employment Ratio

The gross revenues of the manufacturing total and the firms with foreign capital, are given by manufacturing sectors in Table 11.6 (the last three columns). The share of firms with foreign capital in gross revenue was 16.42 %, in 1973. Apparently the firms with foreign capital possess a smaller employment share than their sales share, in the manufacturing industry.

It is important to note that the sectors with above-average gross revenue shares, tend to be the above-average employment sectors, as far as the share of firms with foreign capital is concerned. In other words, as the firms with foreign partnership possess a larger market portion, they tend to create larger employment, in the manufacturing industry. The examples are, chemicals, pharmaceuticals, rubber and tyre, stone and earthware, electrical machinery and equipment and motor vehicles.

TABLE 11.6 SHARE OF FIRMS WITH FOREIGN PARTNERSHIP IN GROSS REVENUE AND EMPLOYMENT OF MANUFACTURING INDUSTRY (1973)

Manufacturing Sectors	Employment		Share of firms with foreign capital in Employment (%)	Gross Revenue		Share of firms with foreign capital in Gross Revenue (%)
	Manufacturing Total	Firms with foreign capital		Manufacturing Total (Thousand TL)	Firms with foreign Capital (Thousand TL)	
Food industry	93.256	2.236	2.39	26.524.973	1.368.456	5.16
Beverage Industry	10.974	1.887	17.21	2.545.784	221.859	8.71
Textile industry	142.461	718	0.51	20.413.511	216.530	1.05
Non-leather Good and Clothing Industry	6.340	157	2.48	882.325	11.000	1.25
Paper and Paper Prod.Ind.	14.642	140	0.96	3.121.071	110.000	3.52
Chemical Industry	13.760	3.363	24.43	3.471.973	1.598.246	46.05
Pharmaceuticals Industry	21.629	2.174	10.06	5.254.153	1.558.706	29.67
Rubber and Tyre Industry	11.469	2.929	25.55	2.076.467	1.215.219	58.53
Plastic Goods Industry	10.330	487	4.71	2.095.401	281.320	13.42
Glass Industry	8.254	408	4.94	1.107.255	151.430	13.67
Stone and Eartwhare Indus.	29.747	5.617	18.88	3.890.194	1.438.017	36.97
Metal Goods Industry	33.628	1.980	5.89	5.589.572	728.736	13.04
Non-electrical Machinery and Equipment Industry	37.962	2.808	7.39	7.334.643	1.310.208	17.86
Electrical Machinery and Equipment	20.059	6.242	31.14	3.916.561	1.575.823	40.21
Motor Vehicles	49.055	9.001	18.34	9.723.818	4.299.712	44.21
T O T A L	503.566	40.147	7.98	97.947.701	16.085.262	16.42

Source : same as Table 11.3

Capital-intensity, Employment Concentration, And Foreign Capital Portion

Average employment concentration in each firm with foreign partnership is higher than in the total manufacturing average (excluding paper and paper products industry-see, Table 11.7, first two columns). This case is particularly salient in the industries of beverage, earth products, motor vehicles, rubber and tyre, and metal goods. Since the total manufacturing sector includes all establishments with more than 10 employee or 50 HP capacity, the average figures of employment in each manufacturing establishment is expected to be lower than the firms with foreign partnership.[8]

The capital-intensity figures indicate that the firms with foreign partnership require a higher capital investment than manufacturing average to create one employment opportunity in the following sectors : paper and paper products, metal goods, mechanical engineering and motor vehicles (see, Table 11.7, last two columns). The divergence between the two capital-intensity figures is not that big in chemicals and electrical machinery industries. The data presented in Table 11.7 is not suitable for a comparison in other sectors.

Does capital-intensity increase proportionate to the foreign capital share in the total capital of the firms operating under Act No.6224? The data presented in Table 11.8 gives a comparison of these two variables: the rank correlation between them is rather weak (r -0.2447).

8. Since none of the firms with foreign partnership have branches located in different regions, the concepts of 'firm' and 'establishment' can bee taken as synonimous.

TABLE 11.7 EMPLOYMENT AND CAPITAL-INTENSITY IN FIRMS WITH FOREIGN CAPITAL AND AS MANUFACTURING TOTAL

Sectors	Avreage number of employees in each		Average Capital-intensity(thousand TL)	
	Manufacturing Establishment	Firm with Foreign partnership	Manufacturing total	Firm with foreign partnership
Food industry	66	319	37.4	
Beverage "	105	1,887	76.5	51.29[x]
Textile "	104	218	52.7	40.45
Footwear and clothing industry	48		32.9	
Paper and paper products "	178	140	79.2	606.65
Chemicals(including pharmaceu-Ticals)	104	205	103.4	101.10
Rubber and tyre industry		976	43.3	129.05
Plastic goods "	77	487		20.26
Glass "		408		563.72
Earth Products "	85	1,872	41.3	26.70
Metal goods "	72	990	57.2	186.20
Machinery "	80	234	66.2	246.16
Electrical machinery industry	69	390	73.6	72.90
Motor vehicles "	221	1,285	50.8	79.27

(x) also including tobacco

Source : Table 8.3 and sources of Table 11.3

TABLE 11.8 CAPITAL INTENSITY AND FOREIGN CAPITAL SHARE IN MANUFACTURING FIRMS WITH FOREIGN PARTNERSHIP UNDER LAW 6224

Manufacturing Sectors	Capitalization			Total Capital Per employee (thousand TL)
	Total Capital (Thousand TL)	Foreign Capital (thousand TL)	Portion a% of Total	
Food, Liquor, Tobacco	211,479	136,522	64.50	51.29
Textiles	29,048	21,451	73.84	40.45
Paper	84,932	48,717	57.36	606.65
Rubber	378,000	222,480	58.80	129.05
Plastic Processing	9,867	3,841	38.93	20.26
Chemicals	559,813	299,152	53.40	101.10
Glass	230,000	46.000	20.00	563.72
Motor Vehicles	713,500	272,565	38.20	79.27
Metal Goods	368,685	85,510	23.19	186.20
Machinery Manufacturing	228,031	88,771	38.92	246.16
Agricultural Implements	463,200	179,509	38.70	
Electrical Appliances and Electronics	455,067	261,083	57.30	72.90
Cement	150,000	45,092	30.06	26.70
Packing and wrapping	2,100	1,050	50.00	—
Construction Materials	12,000	57	0.48	—
T O T A L	3,895,723	1,711,811	43.94	96.69

Source: TUSIAD (April 1976), op.cit.p.124; and, TUSIAD(April 1975), op.cit., p.134

Productivity and Employment

Given the conflict between productivity and employment, there is no clear tendency that foreign capital investments concentrate in higher productivity growth sectors. The higher productivity growth sectors can be identified as follows :

Annual Average Increase In Labour Productivity (%) (1963-72 period)[9]

Rubber and tyre	13.7 %	Paper and printing	2.7 %
Transport equipment	9.9	Food	2.4
Tobacco	9.2	Metal goods	1.5
Petroleum and coal	5.4	Wood and cork products	1.3
Beverages	4.2	Basic Metals	1.0
Chemicals	3.8	Electrical machinery	- 0.2
Textile and clothing	2.8	Machinery	- 2.0

The transport equipment, chemicals and rubber industries are among the hhigher productivity growth sectors, where a higher concentration of foreign capital investments is also observed. Contrarily, the electrical and mechanical engineering sectors which occupy the third and the fourth places from the point of view of foreign capital concentration, realized an annual decrease in labour productivity over the period of 1963-72. The other sectors with foreign capital investments, such as textile and clothing, paper and printing, food, and metal goods, showed-relatively moderate increases in productivity.

Foreign investments in electrical machinery, paper and printing and metal goods are highly capital-intensive as compared to the average of manufacturing total, despite the fact that there has been either moderate productivity increases or productivity decrease, in these sectors. Conse-

9. The SPO data, gathered in relation to the Third Plan studies.

quently, the sources of productivity change can be other than the capital-intensity change in these sectors - which has already been discussed in the previous chapters.

The influence of the foreign capital inflow on sectoral productivity change can be determined (a) by the relative weight of firms with foreign capital, in the total sectoral output ; (b) by the relative progressiveness of the technology adopted, in these firms ; and, (c) by the technological multiplier affect that the foreign capital inflow may generate in the economy.

If we take the share of firms with foreign capital in gross revenue as an indication of their relative weight in the economy, the following sectors' productivity may have been affected by the overall productive operations of these firms : rub er and tyre, chemicals, and motor vehicl es. The relative progressiveness of the technology adopted and the technological multiplier affects will be considered in the Third Part of this thesis, in relation to a case study in the iron and steel sector. However, some partial examples can be cited in the earlier chapter, supporting the possibility that these latter factors might have influenced the sectoral productivity levels to some degree.

Wages and Employment

A survey covering 79 firms with foreign partnership showes that there were 31,367 employees in these firms, in 1972 ; the average level of employment in each firm was 397 in that year.[10] The distribution of these 31,367 employees as direct and indirect labourers, was 76 % and 24 %, respectively. The number of personnel of foreign origin was 254.

In 1972, there were 1,060 administrative personnel, 168 research personnel and 2,066 technical experts in the 79 firms included in the survey: the relative share of the employees of foreign origin in each category was 11 %, and 6 %, in turn. The average montly payment for each employee was TL 2,471 for the Turkish nationals and TL 13,300 for the foreign nationals.

10. M.Şahin, Türkiye'de Yabancı Sermaye Yatırımları, Ekonomik ve Sosyal Yayınlar A.Ş., Ankara (1975), Ch.'s 6 and 7.

In the administrative personnel category, the average monthly payment for each employee was TL 7,866 for the Turkish nationals and TL 16,919 fr the foreign nationals ; in the research personnel category, these amounts were TL 4,153 and 9,077, respectively ; in the technical experts category, the Turkish nationals were paid TL 4,734 and the foreign nationals were paid TL 12,244, on average.[11]

The higher wages and salaries paid by the firms with foreign partnership has led to a shift of personnel particularly from the public establishments to the firms operating under Act No.6224. This tendency has been particularly important among the administrative and research personnel. Firms with foreign partnership arranged training programmes for 2,439 personnel in Turkey and for 145 persons abroad, in 1972.

11.3 INDIRECT INFLUENCE OF FOREIGN CAPITAL INFLOW ON EMPLOYMENT

The indirect influence of foreign capital inflows on employment can be twofolds. First, the externalities and linkages created by foreign capital investments may lead to a shift in the level and skills of employment in firms outside the Act No. 6224. The difficulty of quantifying such influences has been mentioned earlier. (However, some examples can be cited on such affects in the sector studies made in Chapter 10.1)

Second, the long-term increase in savings gap resulting from foreign capital inflows has a negative affect on the rate of growth of employment. Here, we shall attempt to give a brief review of this latter case.[12]

11. ibid.
12. In fact, an assessment of the total affect of foreign capital investments on balance of payments may provide a general framework ffor an analysis of the savings gap. However, the difficulty in obtaining adequate data on the main variables prevents such a thorough analysis. For example, there is no export data for the firms with foreign capital, per se. In the industrial sectors where a higher foreign capital investments is concentrated, exports have increased rapidly. Over the period of 1968-1975, the exports of chemicals goods increased from $. 3.03 millions to 37.7 millions ; of electrical machinery and appliances from $. 0.03 mil-

TABLE 11.9 AFFECT OF FOREIGN CAPITAL INFLOW ON BALANCE OF PAYMENTS

(million dollars)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Years	Profit Transfers	Foreign Capital Inflow[x]	1/2 (%)	Current Account Balance	Capital Transaction Balance	Foreign Trade Balance	Balance of Payments
1964	- 10	24	41.6	- 109	158	- 126	49
1965	- 15	22	68.1	- 76	149	- 108	73
1966	- 16	30	53.3	- 158	185	- 228	27
1967	- 25	17	147.0	- 114	167	- 162	53
1968	- 32	13	246.1	- 222	208	- 268	- 14
1969	- 32	24	133.3	- 214	268	- 264	54
1970	- 33	58	56.9	- 171	365	- 360	194
1971	- 36	45	80.0	- 109	344	- 494	235
1972	- 35	43	81.4	- 8	160	- 678	152
1973	- 35	79	44.3	484	433	- 769	917
1974	- 71	88	80.2	- 702	244	-2,245	-428
1975	- 36	305	11.2	-1,808	577	-3,338	1,455
1976	- 60	27	222.2	-2,254	415	-3,169	1,751

(x) Net of repatriated investments ; about 3.6 % of the total investments made during 1952-70 was repatriated.

Source: Union of Chambers, İktisadi Rapor 1975 , Ankara (May 1975), p.485; and, TUSIAD, Turkey, An Economic Survey 1977 , Istanbul (April 1977) p.172

Transfer of Profits

Under the Foreign Investment Encouragement Law, no restrictions are imposed on profits to be transferred abroad and the capital broughtin can be taken out of Turkey after a period specified in the investment permits. According to the data presented in Table 11.9, the profit transfers exceeded the amount of foreign investments made in the 1967-1969 period and in 1976. The ratio of profit transfers to foreign investments made during 1964-1976, varied between 11.2 % and 81.4 % (excluding the 1967-69 period and 1976) - see columns 1,2 and 3. The current account balance on which the transfer of profits make a negative influence showed a chronical deficit over 1964-1976 period, excluding 1973 (column 4). The positive balance of the capital transactions was certainly positively affected by foreign capital inflows (column 5). Given the foreign trade deficits and negative current account balance, the positive capital transactions balance and the movements of gold and reserves, led to a positive balance of payments during the period of 1964-1976, excluding 1968 and 1974.

Payments For Proprietary Rights And External Debts

Apart from the transfer of profits, payments for proprietary rights, interest payments on external debts and the repayment of these debts, obtained under Act No.6224, constitute an important part in the total transfers.

For example, during 1970-74 period, the total amount of transferred profits was TL 516,199 thousand, while the payments for proprietary rights was TL 104,918 thousand, and the combined amount of loan repayments and interest payments on total loans obtained was TL. 325,655

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lions to \$. 0.80 millions ; of glass and ceramics, from \$. 1.03 millions to 17.87 millions;of metal goods and machinery from \$.0.18 millions to \$.13.92 millions, etc.Contrarily,in the metal goods sector where the foreign capital cancentration is in the sixth place,exports decreased from \$.16.69 millions in 1968,to \$.12.68 millions,in 1975. See, Iktisadi Rapor 1976 , by the Union of Chambers, op.cit., p.535

thousand.[13] Thus, the burden of these latter category of payments was about 83.5 % of the transfer of profits, over the period of 1970-1974.

The common way of paying for patents, licences and know-how is that of royalty, which is a matter of legal agreement in Turkey. The percentage of royalty ranges from 1 % to 12 %, according to whether there is a capital-investment relationsihp in a joint venture between the licence agreement parties. The export of Turkish money in relation to such legal agreements is stated in the 5th Article of the Communique on Current Invisibles which refer to licence contracts and "similar rights". The Ministry of Finance is the final authority for the commercial activity relating to payment for technology whereas the Ministries of Agriculture and Industry are consultant advisors. An exception to this is the drugs industry where the final authority on the transfer of money is the Ministry of Health and Social Welfare. In this industry, the agreements are never about a drug itself, which is not patentable, but about production methods.

It should be noted that the firms in Turkey that are branches of foreign concerns cannot pay royalties for technology to their parent firms.

Import Dependence

Some firms take a proportion of their returns in the form of profits on the intermediate goods sold to the receipent company. The magnitude of these profits may depend on whether the technology supplier can establish a monopoly of supply of intermediates to the receipent and also perhaps on the degree of monopoly which the receipent has in its domestic market.

The industries where such an import-dependence may exist have been identified in section 10.2 (p.195), in terms of share of intermediary goods imports in unit output. There is a tendency that this share

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13. TÜSİAD (April 1975), passim.

is higher in those industries where foreign capital concentration is higher. This situation is related with the highly protective import substitution policies which stimulate tariff-jumping foreign inward investments. Also, the following factors have been determinant on high import dependence in certain industries : the highly valued Turkish Lira, the priority in foreign exchange allocation to the imports required by the import-substitution industries, and the continuing isolation from external competition due to the investments geared to produce for the domestic markets.

One of the leading consequences of high import dependence is the phenomenon of transfer pricing : the import prices of certain intermediary products is higher than their selling prices in the markets of country of origin. However, the extent of this phenomenon is difficult to determine. (Some examples are presented in Appendix F)

11.4 SUMMARY AND CONCLUSIONS

The most important contribution to employment of the foreign capital investments made in Turkey is no doubt in terms of closing the savings gap. This also tends to create employment in those industries whose operation or establishment is related to the existence of firms with foreign capital.

The would-be employment in relation to the alternative technologies open to the use of foreign firms is of only theoretical importance. Because, although labour-intensity may be determinant on the part of the foreign firms when a trade-generating strategy is relevant, tariff-jumping inward investments tend to dominate in the Turkish case. On the part of the policies pursued by the Turkish governments, employment creation by the foreign inward investments is considered after the objectives of attracting further investible resources and foreign exchange to the Turkish economy.

Consequently, the tendency of higher capital-intensity in firms with foreign capital than domestic ones may to some extend reflect the factor proportions prevailing in the advanced economies and the level of employment created by these firms is related rather with the volume of their investments and their market share. Also the firms with foreign partnership tend to be larger than the domestic firms, in terms of employment.

The higher capital-intensity does not necessarily lead to higher productivity in the firms under Act No. 6224. In other words, higher capital-intensity may not necessarily indicate the transfer of 'advanced' technology, by these firms.

The contribution of the foreign capital firms to local skills is accompanied by the transfer of qualified personnel from domestic public firms under higher wage motives.

The positive affect of foreign investments on covering up the savings gap tend to be reduced in the long-run by the transfer of profits, payments for proprietary rights, interest on and repayment of foreign debts and high import requirements of the assembly industries.

PART III

TECHNICAL CHANGE IN IRON AND STEEL INDUSTRY

A CASE STUDY OF EREĞLİ IRON AND STEEL PLANT

CHAPTER 12

SIGNIFICANCE OF IRON AND STEEL INDUSTRY IN TURKISH MANUFACTURING SECTOR

It is a commonplace to note that modern industry was built on a framework of metal, particularly ferrous metal. This phenomenon is shaped by the seperate characteristics of metal and the superiority of iron and steel products with respect to other materials. Therefore, it is not surprising to see many of the newly industrializing nations to devote resources in erecting iron and steel plants - given the fact that benefits of international trade and specialization along the lines suggested by factor endowment theory is ignored in the present world of economic practice.

Parallel to the development of industry in Turkey at an annual average rate of 10.4 % during 1963-1975, iron and steel industry has been one of the rapidly growing industrial branches. The annual rate of increase of its output was 22.5 % in the First Plan period, 9.9 % in the Second Plan period ; and, 14.7 % annual growth rate was foreseen for the Third Plan period.[1] The share of total manufacturing investments made to this sector was 17.55 % , over the period of 1963-77.[2]

1. SPO, Iron and Steel Division
2. see, Table 7.2., p.125. This ratio is based on the realized investment figures for the first two plan periods and on the estimated amount of investments for the 1973-1977 period.

12.1 IS EMPLOYMENT CRITERION IMPORTANT IN IRON AND STEEL INVESTMENTS ?

Iron and steel industry is one of the most capital-intensive industries. Consequently, the level of employment per unit of investment made to this industry is limited. Factors other than employment, however, plays an important role in investing to this industry. For example, the foreign exchange bottleneck met by many industrializing countries leads to adopt import-substitution policies in various branches of industry, including iron and steel. The development of metal goods and machine-building industries, and the ever-increasing demand of the construction sector for iron and steel products, also contribute to the desire of these countries to erect iron and steel plants at home.

Capital-intensity In Iron and Steel

The rate of growth of employment in iron and steel sector was 211.9 % over the period of 1974/63, in Turkey.[3] This rate of growth of employment in the iron and steel sector was faster than the manufacturing total, over the same period. An important determinent of this growth was that the highest share of total manufacturing investments was made into the iron and steel industry during the 1974/63 period.

A sectorwise comparison indicates that iron and steel industry occupies the third place among the manufacturing subsectors, with respect to its capital-intensity. By 1970, the cost price of capital per employee was TL 419.1 thousand in petroleum and coal industry, TL 103.4 thousand in chemicals and TL 82.7 thousand in basic metals.[4] Viewed from the point of integrated iron and steel plants, capital-intensity is much higher than the basic metals average. For example, the total value of fixed assets per employee was TL 2,808,267 thousand in Ereğli Iron and Steel Plant and TL 979,590 thousand in Karabük Iron and Steel Works Co., by 1972.[5]

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3. see, Table 6.8, p.115
4. see, Graph 8.3 and Table 8.3, pp.152-153. The basic metals industry includes iron and steel, and metallurgy.
5. The Annual Reports of the two plants.

Time Preference Problem

For a short-run employment maximizing strategy, investment in iron and steel sector is not desirable as compared to the other manufacturing branches of more labour-intensive character.

It should be noted that the arc furnaces producing special steel, tend to be the labour-intensive branches of the iron and steel industry. The investment required per employee in arc furnaces was TL 54.5 thousand, in 1967.[6] The development of these industries has been parallel to the development of the integrated steel plants which provide the iron required for their production. Therefore the existence of such relatively labour-intensive alternatives within the iron and steel sector does not necessarily exclude the need to invest in heavily capital-intensive branches. Moreover, the special steel production is not an alternative to the rolling products of the integrated plants.

The policy decisions made in favour of a long-run cemployment maximizing strategy eliminates the worries of a short-runnperspective stemming from the high capital-intensity of this sector. The postponement of the employment objective to the future is related, on one hand, with the expected externalities and forward linkages of the iron and steel sector, and with the backward linkages of the early development of the consumers goods industries in Turkey, on the other.

Per Capita Steel Consumption As An Indicator of Industrialization

There are three salient advantages of ferrous metals : great strenght in proportion to weight and volume, plasticity and hardness.[7] It can be shaped without loss of elasticity, it can be worked with precision and it holds its shape well under abrasion and heat. Steel is a superior

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6. based on the data given in Demir-Çelik ve Metälürji Endüstrisi Semineri, NPC publication no.77, Ankara (1970), p.93
7. see, D.S.Landes, The Unbound Prometheus, op.cit., pp.250-69
8. OECD, Gaps In Technology Between Member Countries : Iron and Steel (Sec-

variety of iron. Its these proporties of iron and steel, which made them the most important materials for machine-bbuilding, frames, etc. The iron and steel industry is a traditional industry with a history dating from 1500 B.C. which showed a rapid developmens from 1856 A.D. when Bessemer announced his preumatic steel process.[8]

As a result of the intimate connection between ferrous metals and machines and many other products of modern industry and living, the consumption of steel <u>per capita</u> has been one of the most accurate measures of industrialization. The per capita crude steel consumption figures by countries presented in Table 12.1, indicate that the advanced industrial nations have a much higher level of <u>per capita</u> crude steel consumption than the industrializing nations.

The level of steel consumption tends to be correlated with thee share of industrial sector in the gross domestic product. This share (also including the construction sector) was as followssin selected industrialized nations, in 1973 (at market prices):[9] West Germany 51.8 %, France 45.4 %, Italy 40.7 %, U.K. 40.7 %, U.S.A. 33.9 %, and Japan 44.9 %. In the selected industrializing nations, the same proportion was: 33.1 % in Spain, 27.7 % in Greece and 28.3 in Turkey.[10] Although the advanced industrial nations are also possessing a higher steel production capacity, the volume of pig iron and steel trade between them is much higher than the trade of these products between the industrializing nations and the advanced industrial nations.[11]

The functional relationship between industrial advancement and the level of crude steel consumption has been an important determinant of investments in iron and steel sector, in the industrialigsing countries. Since one of the common targets of these countries has been "structural change" - involving the increase of the contribution of industrial sector to the GDP, the development of their iron and steel sector

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tor Report), (11th and 12th March 1968), Paris, p.5.

9. Eurostat, <u>Basic Statistics of the Community (1975-76)</u>, p.24

10. ibid.

11. see, ibidh, pp.212-213

TABLE 12.1 PER CAPITA CRUDE STEEL CONSUMPTION BY SELECTED COUNTRIES (1973)

Country	Crude Steel Production (thousand tons)(1974)	Per capita crude steel consumption (kg.)
U.S.A.	135,300	711
Japan	75,700	688
West Germany	53,200	652
U.S.S.R.	133,000	518
France	27,000	495
U.K.	22,400	441
Italy	23,900	411
Spain	11,500	314
Bulgaria	2,240	232
Greece	600	172
Yugoslavia	2,700	171
Turkey	2,000	56

Source : V.Aytekin, "Türkiye Demir-Çelik Sanayii : Bugünkü Durumu ve Geleceği" (May 1976) ; paper presented at the Symposium on Iron and Steel, by the Ministry of Industry and Technology, (10-14 May 1976), Ankara

has been a leading growth-oriented phenomenon.

12.2 RELATIVE IMPORTANCE OF IRON AND STEEL INDUSTRY IN TURKISH MANUFACTURING SECTOR

Total Employment

The distribution of total employment by manufacturing subsectors is shown in Table 6.8, in comparison with the years of 1963 and 1974. Accordingly, the share of iron and steel industry in the tatal manufacturing employment, increased from 3.0% to 4.3%, over this period. The level of employment was higher in the sectors of textile and clothing, transport vehicles, metal goods, machinery, non-ferrous metals, tobacco, chemicals and forest products. These are relatively labour-intensive industries - excluding chemicals. Also, the industries of textile and clothing, tobacco and forest products was given priority in manufacturing investments, prior to the planned period of economic development.

Production

The production values of manufacturing subsectors are presented in Table 12.2, by 1967 and 1974. The share of iron and steel production remained within the range of 5.9 to 5.4 %, over 1967-74 period. The traditional sectors like food and textile showed a decreasing share in the total manufacturing output while the share of machinery and transport vehicles industries increased.

The quantity of iron and steel output by years, can be observed in Table 12.3, column one.

TABLE 12.2 MANUFACTURING OUTPUT BY SUBSECTORS

(at current prices, million TL)

	1967	%	1974	%
Food	17,939	33,9	65,097	26,9
Beverage	812	1,5	3,257	1,3
Tobacco	2,423	4,6	6,962	2,9
Textile and clothing	9,100	17,2	39,115	16,2
Wood Products	1,973	3,7	9,052	3,7
Paper	386	0,7	2,664	1,1
Printing	446	0,8	1,590	0,7
Fur and Leather	258	0,5	7,264	3,0
Rubber	986	1,9	2,253	0,9
Plastic	378	0,7	3,062	1,3
Chemicals	2,366	4,5	10,592	4,4
Petrochemicals	-		3,675	1,3
Petroleum products	3,483	6,6	26,627	11,0
Fertilizer	-		3,257	1,3
Cement	741	1,4	3,135	1,3
Earthware	577	1,1	2,576	1,1
Glass	390	0,7	1,774	0,8
Ceramics	174	0,3	618	0,2
Iron and Steel	3,128	5,9	12,991	5,4
Non-ferrous metals	734	1,4	3,774	1,6
Metal goods	2,040	3,9	6,814	2,8
Machinery	1,200	2,3	8,345	3,5
Agricultural Machinery	451	0,9	-	-
Electrical Machinery	709	1,3	4,551	1,9
Scaling Instruments	-		697	0,3
Electronics	304	0,6	1,960	0,8
Highway vehicles	1,506	2,8	8,727	3,6
Railway vehicles	201	0,4	548	0,2
Shipbuilding	120	0,2	765	0,3
Aeroplane	12	-	-	
Total (TL)	52,895	100	241,745	100
Total ($)	5,877		16,672	

Source : SPO, Annual Programs 1971, Table 149 and, 1976, Table 94.

TABLE 12.3 THE OUTPUT, CONSUMPTION AND IMPORT OF IRON AND STEEL PRODUCTS DURING 1960-1976

(thousand tons)

Years	Output	Consumption	Imports
1960	290	530	260
1963	360	760	400
1965	620	950	340
1968	1020	1300	270
1970	1560	1750	370
1971	1600	1840	290
1972	1200	2200	730
1973	1880	2210	1150
1974 (x)	2300	2600	1600
1975 (x)	2680	3050	1960
1976 (x)	2900	3400	1100

Consumption and Imports

The annual average rate of growth of demand for iron and steel products was 12.3 % in the First Plan period, 12.4 % in the Second Plan period and a 14.7 % rate of annual average growth was foreseen for the Third Plan period.[12] The rate of growth of production was 18.0 %, 10.1 % and 15.0 %, respectively. However, these rates of growth of production were far behind meeting the total demand. The consequent rapid increase in imports of iron and steel products can be observed in Table 12.3. The burden of imports on the balance of payments was TL 78 millions (or about $. 5.2 millions), in 1972.

12. see, H.Çetinoğlu, "Bugünkü Dünya Şartları İçinde Türkiye'nin Demir ve Çelik Siyaseti Ne Olmalıdır ?", paper presented at the Iron and Steel Symposium (31 May - 4 June 1976), at the Ministry of Industry and Technology, Ankara.

One of the reasons of increasing dependence on imports of iron and steel products has been the strategy of avoiding unused capacity and following up the domestic demand to expand the production capacity accordingly.

Also, the demand projections used as a basis of decisions to invest in the iron and steel sector has created an important bottle-neck in establishing the production capacity geared to meet the increasing demand. For example, the demand projections of three different sources for thee years 1972 and 1977 were as follows :

Source	projected demand(thousand tons) 1972	1977
Ayyıldız Consultancy Firm	2,392.8	4,645.2
SPO (Candır)	3,701.0	6,939.1
John Miles and Partners	3,450.0	5,814.1

The SPO estimates were made in 1969 ; the estimates of the Ayyıldız Consultancy Firm were made in June 1969 ; and, John Miles and Partners completed their projections in October 1967.[13] The actual demand figure for 1972 is the closest to the projections of the Ayyıldız Consultancy firm ; and, the 1977 projections of the three sources indicate an overestimation. However the rate of expansion of the production capacity has remained much behind the actual demand.

Intersectoral Dependence

As an input supplier to many other industries, iron and steel industry forms the basis of growth of these industries. The SPO estimates of demand for iron and steel products by consuming sectors show that about 47 % of total iron and steel consumption was made in the construction sector in 1963 and this ratio is expected to decrease to 32.3 % , in 1982. According to the figures presented in Table 12.4,the highest growth of consumption of iron and steel products is estimated in the machine-building

13. Demir-Çelik ve Metalürji Semineri , op.cit., pp.10-11

and transport vehicles industries : the share of machine-building industries is expected to rise from 9.93 % in 1963, to 19.59 %, in 1982 ; and, the share of transport vehicles industry is expected to rise from 10.89 % to 20.76 % over the same period. The total consumption of iron and steel products rises in all branches of manufacturing activity but at a slower rate than in machine-building and transport vehicles industries.

12.3 PRESENT PRODUCTION CAPACITY IN THE TURKISH IRON AND STEEL INDUSTRY

The planned period investment in the iron and steel industry has been affected by the demand projections included in the formulation of the plans. The demand estimates by products of steel incorporated in the Perspective Plan, are shown in Table 12.5. The expected changes in the relative weight of different product categories are as follows : in the total output, the share of rolling mill products (excluding flat products) would decrease from 51.96 % in 1963 to 42.75 % in 1982 ; the share of flat rolled products expected to increase from 27.06 % to 30.80 %, the share of machine and tool steels was expected to increase from 6.14 % to 8.48 % and the share of casting was expected to increase from 14.84 to 17.99 %, over the same period. The expansion of the production capacity seems to approximate to these estimates which, in fact, remained below the realized demand.

TABLE 12.4 ESTIMATES OF DEMAND FOR IRON AND STEEL PRODUCTS BY CONSUMING SECTORS

(thousand tons)

Consuming Sector / Years	1963	%	1967	%	1972	%	1977	%	1982	%
Machinery	61.5	8.05	33.5	8.59	177.9	8.59	357.2	9.66	710.6	10.24
Electrical Machinery	2.3	0.31	8.4	0.79	23.4	1.13	50.4	1.36	121.7	1.75
Agricultural Machinery	12.0	1.57	19.8	1.82	113.3	5.46	242.9	6.56	527.6	7.60
Means of Transportation	83.4	10.89	121.6	11.17	267.3	12.88	573.7	15.50	1440.3	20.76
Metal Products	185.1	24.20	243.0	22.33	427.6	20.61	774.8	20.94	1432.9	20.66
Mining Petroleum and Gas	12.2	1.60	22.5	2.06	53.7	2.59	120.9	3.27	189.2	2.73
Construction	361.1	47.20	506.3	46.42	886.5	42.75	196.5	37.73	2254.6	32.49
Oil and conserved Food Stuff	26.5	3.47	45.1	4.14	77.6	3.74	109.1	2.94	143.6	2.07
Cotton and Hayproduction	3.5	0.45	4.3	0.39	5.4	0.26	6.3	0.17	7.6	0.11
Others	17.3	2.26	25.0	2.29	41.6	2.01	69.3	1.87	110.9	1.59
T o t a l	764.8	100.00	1088.4	100.00	2074.2	100.00	3701.0	100.00	66939.2	100.00

Source : SPO, early estimates for the preparation of the First Plant and Prespective Plan

TABLE 12.5 ESTIMATES OF DEMAND BY IRON AND STEEL PRODUCTS

(thousand tons)

Years Main Products	1963	%	1967	%	1972	%	1977	%	1982	%
1)Rolling Mill Products (Excluding Elat Products)	396.6	51.96	560.2	51.46	1017.5	49.08	1741.5	47.07	2968.6	42.75
Bars	234.6	30.79	326.8	30.02	579.1	27.94	952.5	25.75	1564.1	22.57
Heavy Structural Steel	26.6	3.48	28.4	2.61	59.2	2.85	117.7	3.18	210.6	3.04
Light Structural Steel	52.8	6.88	78.8	7.24	160.9	7.77	327.1	8.84	644.3	2.29
Rails	36.6	4.79	66.3	6.09	110.0	5.30	146.9	3.97	187.5	2.70
Wires	46.0	6.02	59.9	5.50	108.3	5.22	197.3	5.33	362.1	5.13
2)Flat Roll Products	207.3	27.06	295.33	27.13	570.8	27.50	1041.8	28.13	2134.5	30.80
Plates	8.2	1.08	13.3	1.22	27.2	1.31	55.9	1.51	105.9	1.53
Hotrolled Sheets	63.5	8.29	79.9	20.36	147.9	7.13	285.9	7.72	607.5	8.77
Cold " "	30.4	3.96	59.4	5.45	168.8	8.14	327.6	8.85	784.7	11.33
Galuanized "	28.8	3.76	37.5	3.45	61.5	2.96	107.5	2.90	194.1	2.79
Tin Plate	33.3	4.34	45.8	4.21	67.7	3.26	89.5	2.66	146.1	2.11
Stripand Rings	12.7	1.65	16.4	1.50	25.6	1.23	43.5	1.17	76.7	1.11
Welded Steel Pipes	30.4	3.98	43.0	3.94	72.1	3.47	122.9	3.32	219.5	3.16
3)Machine and Tool Steels	47.3	6.14	71.8	6.66	156.0	7.52	285.4	7.71	588.1	8.48
Machine " " "	26.8	3.49	43.8	4.03	107.9	5.20	203.4	5.49	441.8	6.37
Tube Steel	20.5	2.65	28.0	2.63	48.1	2.32	82.0	2.22	146.3	2.11
4)Castings	113.6	14.84	160.5	147.5	329.9	15.90	632.3	17.09	1247.9	17.99
Tube Costings	26.8	3.50	27.6	2.54	68.6	3.31	115.8	3.13	208.6	3.01
Pig Iron "	81.8	10.68	114.5	10.53	205.5	9.90	400.4	10.82	292.9	11.43
T o t a l	764.8	1.00	1088.4	1.00	2074.2	1.00	3701.0	1.00	6939.2	1.00

Source: early estimates for the preparation of the First Plan and the Perspective Plan.

1976-77 Production Capacity

The coke, pig iron, steel ingot and rolling products output of 1976-77, and the expansion programs for each product category, are shown in Table 12.6 by the plants producing each product. However, the total amounts of the production capacity of each output is overestimating the present actual capacitybbecause of the delay in the production schedule of Isdemir-a recently established public plant.

If the total rolling products capacity presented in Table 12.6 has been realized, the total rolling products demand estimates presented in Table 12.5, would have been almost met. According to the SPO, the estimated demand for the total iron and steel products in 1976 was 3,399 thousand tons. The 2,970 thousand tons of this amount was foreseen to be produced demestically and the remainder was to be imported. For the domestic production to be realized, approximately 800 thousand tons of semi-finished product (pig iron, scrap, flat and rolled semi-finished products) was to be imported. Thus , not only the finished products but the products of the blast furnaces and steel furnaces was expected to be below the demand projections. The amount of finished goods imports was projected about 293 thousand tons, which costs approximately TL 5 billion.

The expansion programs of the four leading iron and steel plants of Turkey may lead to a higher capacity than the present level of demand. However, the 1982 projected demand is 6,939 thousand tons while the total steel production capacity that will be created by the completion of the whole expansion program is 4,130 thousand tons. The consequent dependence on imports may be higher than 2,629 thousand tons, if the present delays of expansion continue.

TABLE 12.6 PRODUCTION CAPACITY IN 1976-77 AND EXPANSION PROGRAM

Plants[x]	Coke		Pig Iron		Steel Ingot		Rolling Products	
	1976-77	expansion program	1976-77	expansion program	1976-77	expansion program	1976-77	expansion program
Kırıkkale	-	-	-	-	60,000	260,000[a]	50,000	250,000
Karabük	960,000	960,000	600,000	850,000[a]	600,000	1,050,000[a]	450,000	850,000
Erdemir;	640,000	1600,000	650,000	1,600,000	800,000	1,500,000	650,000	1,350,000
İsdemir	1,100,000	2200,000	850,000	1,700,000	1,800,000	2,000,000	930,000	1,860,000
Other [c]	-	-	-	-	450,000[c]	(x x)	900,000[c]	(x x)
T O T A L	2,700,000	4760,000	2,100,000	4,150,000	2,110,000	4,810,000	2,980,000	4,310,000

(xx)unknown; (a)obtained from 1974 Annual Program Investment Projects Book; (c) the estimated amounts

(x)It is assumed that the whole plants of Isdemir will start production in 1977 ; the expansion program of Erdemir will be completed in 1978-1982 ; and the Kırıkkale's and Karabük's expansion will be finished by 1978-1979.

Source: V.Aytekin, op.cit., p.8

12.4 CONCLUSIONS

Iron and steel industry is one of the most capital-intensive industries and its short-run contribution to employment is limited. The governments which prefer to invest into this industry consider the linkages and externalities that it creates in the other manufacturing sectors such as metal goods, machinery, transport vehicles, and so on ;also, the foreign exchange bottlenecks that the industrializing nations face is another determinant of the import substitution policies pursued in this sector.

Since there is a functional relationship between industrialization and steel consumption, the industrializing countries take investment into iron and steel sector as a growth-oriented phenomenon.

The highest ratio of manufacturing investments have been made in the iron and steel sector, in Turkey, during the planned period. However, the relative share of employment of this sector in the total manufacturing employment remained relatively small. This is because of the capital-intensive character of the sector.

The demand for iron and steel products increased rapidly parallel to the rapid industrial growth of Turkey. The iron and steel production capacity remained behind this growth and the supply tends to depend on imports at an increasing amount in the coming years.

CHAPTER 13

PRODUCTION TECHNOLOGIES FOR INTEGRATED IRON AND STEEL PLANTS

There are three basic and consecutive technological processes in the prepartion of the end product of the steel industry. These are iron-making, steelmaking and shaping of the steel to the finished product. No direct process for the production of steel from iron ore has yet been widely applied on an industrial scale.[1] An integrated steel plant involves these three consecutive stages. The purpose of this Chapter is to make a brief discussion of the basic methods of production at each of these three stages.

13.1 IRON-MAKING : THE BLAST FURNACE [2]

Increasing Capacity

The shape of the blast ffurnaces remained more or less the same during the last fifty years. The significant change that the blast furnaces have undergone is their capacity. As they have become larger to

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1. OECD (March 1968), op.cit., p.8
2. Iron or is the main raw material for ironmaking. The agent used for reduction is coke. The furnace employed is a large strong vertical shaft furnace. The prepared ore, coke and fluxes are fed in at the top, and pre-heated air usually enriched with oxgyen is blown in at the bottom. Hydrocarbons may also be injected into the lower part of the furnace. The earthy latter in the ore combines with the fluxes and forms the slag. The pig iron and slag are run in the molten state from the bottom of the furnace.

provide increasing quantities of pig iron, their productivity in terms of furnace hour, has increased.

The volume of the blast furnaces has reached above 2.000 m^3 in 1966 and furnaces with more than 4.000 m^3 in 1966 and furnaces with more than 4.000 m^3 capacity was seen in 1971, in the world.[3] Today, the leading countries which have blast furnaces with a volume larger than 4.000 m^3, are, Japan, the U.S.A., West Germany, France and the U.S.S.R.

The daily product (in trems of tons per m^3) of the blast furnaces tend to show a secular increase as the production capacity rises up to 2.300 m^3 and a stagnation of the rise of this productivity is observed after 2.000 m^3 capacity.[4]

Various Blast Furnace Techniques and Preparation of Furnace Charge

Various techniques have been introduced to improve the efficiency of the blast furnaces and to increase the quality of the pig iron and hot metal production. Among these techniques are higher blast temperatures, enrichment of the blast with oxygen, fuel injection system, high top pressure of gas within the furnace and the preparation of the furnace charge.

The preparation of agglomerated materials through sintering and pelletising helps to feed the blast furnace with fines of uniform size which facilitates the flow and the regular distribution of gases and the reduction of the iron oxides.

The consequences of the use of these methods have been the reduction of the fuel consumption of the furnace, of the iron ore charge

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3. F.Dikenç, V.Aytekin and C.Ensari, "Demir-Çelik Üretim Teknolojisindeki Gelişmeler" (mimeo), presented to the Symposiumm on Iron and Steel, by the Ministry of Industry and Technology, (10-14 May 1976), Ankara.
4. ibid.

and the required coke consumption per ton of pig iron. The coke rate per ton of pig iron is considered as an indication of the technological level of blast furnace operation. The average level of coke consumption per ton of pig iron was estimated by 197.5 about 400 kg.s in Japan, 570 kg.'s in the U.S.A., 570 kg.'s in Spain and 540 kg.'s in the U.K.[5]

13.2 STEEL MAKING

Alternative Processes

There are four major processes in steel-making : Bessemer, open-hearth (Siemens-Martin), electric and oxygen.

The Bessemer process may be used to remove carbon and other impurities from the molten iron. It is successfully used with hematite iron. However, by this process, phosphorous cannot be removed and the steel output is brittle and weak.

The open-hearth process enables the use of scrap instead of iron while Bessemer process can only use molten iron.[6] The application of the "basic process" to both Bessemer and open-hearth convertors removes phosphorous from the steel product. The open-hearth process takes a lengthy cycle time (about 8 hours) which makes an accurate metallurgical control possible but this increases the capital costs.[7]

The electrica furnaces can produce the special steel alloys .

The introduction of the oxygen convertors allows the successful use of iron with varying phosphorous content and the use of scrap.

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5. see, Iron Making and Steel Making, vol.1, no.1 (1974).
6. H.G.Roepke, Movements in British Iron and Steel Industry, 1720 to 1951, University of Illinois Press (1956), p.60
7. U.N., The European Steel Market in 1959 , Geneva (1960), p.117
8. British Iron and Steel Federation, The Steel Industry The Stage I Report of the Development Coordinating Committee , (July 1966), p.40

The control of nitrogen and oxygen content and the production of special steel is possible, by this process. It's production cycle time is about 18-25 minutes, which decreases the capital costs and operational expenses considerably.[8] The rate of savings is much ihigher in the case of depreciation and renumeration costs than in conversion costs (see, Table 13.1) by the use of this process.

TABLE 13.1 COST OF STEELMAKING WITH VARIOUS METHODS[x]

Processes	coversion cost per ton	depreciation and renumeration of fixed capital per ton	Total
	units of cost,100-conversion pluss capital cost of LD-low phosphorous		
LD-low phosphorous iron (oxygen)	74.5	25.5	100.00
LD-high " " "	79.7	26.8	106.5
Ajax-high " "	86.3	39.80	126.1
Fixed open hearth-oxygen	95.2	43.1	138.3
Fixed open hearth	92.2	46.8	139.7
Kaldo-low phosphorous iron (oxygen)	116.0	29.6	145.6
Tilting open hearth-high phos.iron	101.8	49.5	151.3
Kaldo-high phosphorous iron	122.1	31.2	151.3

(x) The study assumes in each case the charge of pig iron and scrap was on a 77/33 ratio ; that each type of process would be making 1 $\frac{1}{2}$ million tons of steel per year ; that fixed capital would be renumerated at 12-$\frac{1}{2}$ percent per annum ; and that depreciation would be charged at the rate of 4 percent per annum on 90 percent of plant cost, using a 'straight line method'.

Source : <u>The Steel Industry</u>, op.cit., p.39

Given the assumptions of the cost estimates with various methods, presented in Table 13.1, the oxgyen process(e.g.LD), is 40% more efficient(in terms of reduction in unit output costs)than the fixed open hearth process, in the case of low-phosphorous iron.The relative cost saving effects of the other processes can also be observed from Table 13.1.

TABLE 13.2 DISTRIBUTION OF WORLD STEEL PRODUCTION BY PROCESSES (1950-1970) (million tons)

Years	Bessemer		Siemens-Martin		Electric Arc		Basic Oxygen		Total	
	ton	%	ton	%	ton	%	ton	%	ton	%
1950	20	10.5	160	84.2	10	5.3	-	-	190	100.0
1955	30	11.1	210	77.8	30	11.1	-	-	270	100.0
1960	35	9.5	260	70.2	35	9.5	40	10.5	370	100.0
1965	35	7.8	280	62.2	35	12.2	80	17.8	450	100.0
1970	20	3.4	230	39.6	90	15.5	240	41.4	580	100.0

Source: <u>Iron Making and Steel Making</u>, op.cit.

Diffusion of Alternative Processes

Bessemer and Siemens-martin processes were discovered in the late 19th Cuntury. Electric arc furnace is the product of early 20th century. The successful application of the oxygen process was achieved in 1948. Since, then, the oxygen convertors have been accepted for large-scale production. The rate of application of oxygen steelmaking processes expressed as a percentage of total crude steel production can be seen for the world total, in Table 13.2.

It is observed that steel production by Siemens-martin furnaces slow while the steel production by Bessemer process decreased, during 1950-1970 period (however, an increase in production with Bessemer convertors is observed until 1965). The share of both Bessemer and Siemens-Martin processes in total world production showed a regular decline. The share of steel output by basic oxygen furnaces increased to 41.4 % in 1970, from nil in 1950. The share of electric arc furnaces increased from 5.3 % to 15.5 %, over the same period, in the total world production of steel.

The absolute size of the oxygen steelmaking vessels has increased considerably and the competitive position of the process vis-à-vis other processes was thus gradually enhanced.[9] The usual practice is the establishment of two alternating furnaces with 250-400 tons volume of each.

13.3. FINISHING PROCESSES

There has been important innovations in the methods of steel ingot casting and in the rolling mills. The variety of the final products has led to numerous changes in the technology of the rolling mills which shall not be discussed within the narrow scope of this Chapter.

An important method of steel ingot casting which should be noted here is 'continuous casting'. The continuous casting method has the

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9. OECD (March 1968), op.cit., p.12

following advantages compared to the classical methods of casting : it reduces wastage, saves capital by shortening the casting period and reduces the expenses of mould. Among the early users df this method Austria, the U.S.S.R., West Germamy and Japan can be counted - who adopted it in the early 1950's. They were followed by the U.K. and U.S.A. in the early 1960's.

13.4 ECONOMIES OF LARGE-SCALE PRODUCTION

Economies of large-scale production is an important determinant of efficiency in the iron and steel industry. In 1969, there were 5 plants in Japan, 1 plant in West Germany, 1 plant in Italy and 1 plant in the U.K., with an annual crude steel capacity of more than 10 millions tons;[10] there was 1 plant in West Germany with an annual crude steel capacity within the range of 6-10 million tons. Within the interval of 3-6 million tons of annual steel capacity, Japan had 2 plants, West Germany had 3 plants and the U.K. had 1 plant. The majority of the steel plants were concentrated in the smaller capacity intervals, particularly within the category of less than 9.5 million tons. However, the heavy competition in the world steel markets urges the leading producers to achieve the productivity levels of their competitors which involves the adoption of more efficient processes on a larger scale, *inter alia*.[11]

The capacity and process relationship can be observed from Table 13.3, for a hypothetical Latin American plant, by 1962. Although the estimations presented in this table are old, they are qualitatively indi-

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10. SPO survey on World Iron and Steel Industry.

11. BSC, for instance, suggests the closing down of older works in Scotland after the crisis of the last two years, to concentrate production on the Ravenscraig complex : "Output should have doubled from the present 1.5m.tonnes per year from two basic oxygen steelmaking vessels to mare than 3m.tonnes ... In addition existing, developed and completely new electric arc steelmaking capacity will bring this figure up to around 4.5m.tonnes by the early 1980s."*The Financial Times*,Nov.29,1976;'An Industry At the Crossroads'by L.Thornton

TABLE 13.3 UNIT COSTS OF STEELMAKING, AT DIFFERENT STAGES OF PRODUCTION, BY DIFFERENT METHODS OF PRODUCTION, IN HYPOTHETICAL LATIN AMERICAN STEEL PLANTS

(US dollars, at 1962 prices)(per ton of pig iron, sponge, steel ingot, flat rolled products)

	Capacity of plant in thousands of tons per year						
	100	200	400	500	800	1.000	1.500
a-Iron ore reduction costs by different reduction systems							
Coke blast furnace	49.39	44.39	40.91	39.72	38.40	37.69	36.67
Direct reduction	37.60	34.46	32.16	-	-	-	-
b-Costs of various steel-making processes							
Open-hearth furnace	84.88	77.86	69.67	67.21	64.10	62.54	60.14
Electric steel furnace	77.51	70.99	63.92	61.69	58.89	57.68	55.77
L-D process	75.61	68.41	61.64	59.73	56.70	55.26	53.38
c-Costs of finished products							
Flat rolled production	192.09	173.84	139.17	131.35	115.85	108.12	103.44

Source: U.N., Interregional Symposium an the Application of Modern Technical Practices in the Iron and Steel Industry to Developing Countries, Prague-Geneva- November 1963, New York, 1964, pp.104, 105, 107.

cative of the effect of alternative processes and capacity, on unit costs of steelmaking. The economies of scale is observed at every stage of steelmaking process. Although an increase of capacity from 500 tons to 1.500 tons per year, creates faster economies in open-hearth furnaces than in L-D convertors, the unit costs of output in L-D process in lower than in open-hearth process, at different levels of plant capacity. An increase of annual capacity from 500 tons to 1.500 tons reduces the total costs of per ton of flat rolled production, by 22 percent.

13.5 FINAL REMARKS

This chapter has discussed the basic methods and processes of steelmaking in relation to integrated plants. A through account of these methods is beyond the scope of this thesis. Therefore, various known methods of iron and steel making have been left out ; such as the direct reduction of iron ore, sponge iron production, special steel methods, numerous finishing processes and automation.

Thus, this chapter has made a brief description of the leading iron and steel production methods and processes, which we shall make reference in the next chapter.

CHAPTER 14

TECHNICAL CHANGE IN TURKISH IRON AND STEEL INDUSTRY : THE CASE OF EREĞLI IRON AND STEEL PLANT

The level of technical progress in the iron and steel industry is one of the important determinants of the cost/price structure of the iron and steel products used as input in the dependant industries. We shall discuss this phenomenon with the aid of a case study of one of the leading integrated iron and steel plants of Turkey ; namely, Ereğli Iron and Steel Factory.

14.1 ECONOMIC CONDITIONS WHICH LED TO THE ESTABLISHMENT OF EREĞLİ

Import Bottlenecks And Need For Product Innovation

The idea of establishing a new integrated steel plant in Turkey was put forward by the officials of Karabük Iron and Steel Works, in 1958. Karabük is a State economic enterprise which was the only integrated iron and steel plant in Turkey, until the construction of Ereğli was completed in 1966. There were two basic reasons supporting the idea of establishing a new steel plant :

First, the domestic production of finished iron and steel products was not at a level to meet domestic demand. About 18.5 - 35 %of the total supply was being imported during the 1956-1960 period ; the ratio of imported semi-finished products in the total imports gradually increased from 2 % in 1956 to 20 % in 1960 (see, Table 14.1). The import requirements of this sector was hardly met particularly in 1957 and 1958, when imports of finished products decreased in quantity, due to the foreign exchange bottlenecks. A rapid inflation of 16.2 % on annual average and a slowing down growth rate at an annual average of 4.7%,characterizes this period of the Turkish economy.

TABLE 14.1 DOMESTIC PRODUCTION AND IMPORTS OF IRON AND STEEL PRODUCTS (1956-1960)

Years	Domestic Production of Finished Products (Tons)	Imported Finished Products (Tons)	Ratio of Imported Finished Products to The total Supply(%)	Quantity of imports of Sami-Finished Products(Tons)	Ratio of Imports of Semi-Finished Products (%)
1956	250,644	134,533	35.0	5,135	2.0
1957	290,552	79,978	21.5	11,829	4.0
1958	298,912	68,208	18.5	8,722	3.0
1959	346,039	166,104	32.0	42,571	12.0
1960	358,237	193,312	35.0	70,484	20.0

Source: SIS, Annual Statistics Bulletins

Second, newly emerging industries of transport vehicles, metal goods, canning and some machine-parts were increasing the demand for flat rolled steel products which were totally imported. Accompanied with the import bottlenecks, the need for product innovation led to the adoption of an import-substitution strategy.

The Founders of Ereğli

The establishment of Ereğli Iron and Steel Plant was arranged by a special Act No.7462, dated 28.2.1960. Accordingly, the new plant would be in the form of a joint venture of the domestic private and public sectors and the foreign capital.

The lumpiness of the reqired investments played a crucial role in determining the form of parthership. When the Turkish officials got in touch with American Import-Export Bank for financial aid, The Bank asked for a market survey to be carried out by American Koppers Associates S.A. This company later supplied the machinery and equipment installed in Ereğli. American Import-Export Bank suggested two more multinationals to be involved in the construction of Ereğli : Foster Wheeler World Services Co. which assembled the plant and Morrison-Knudsen Co. that carried out the General engineering works - except land excavations, port construction, drainage works and domestic transportation ; these were undertaken by the Turkish firms.

The partners of Ereğli are shown in Table 14.2, by their share of invested capital. The invested capital is distributed as follows : 58 % Turkish public sector, 21 % Koppers Associates S.A. which also represent two other American firms ; and the remainder was owned by the Turkish private sector. According to the Act No.7462, the 60 % of the voting rights at the Board of Directors, was given to the domestic private and foreign partners. Thus, although Ereğli had a public enterprise status by the distribution of invested capital, its administration was given to the private domestic-foreign partners.

TABLE 14.2 FOUNDERS OF EREĞLİ IRON AND STEEL COMPANY AND THE DISTRIBUTION OF THE INVESTED CAPITAL

Public Sector :	General Directorate of Turkish Iron and Steel Works-Karabuk	TL 153,000,000
	Sumer Bank General Directorate -Ankara	153,000,000
Private Sector :	Iş Bank of Turkey - Ankara	5,008,000
	Ankara Chamber of Commerce and Industry	125,000
	Other Shareholders	103,868,000
Foreign Sector :	Koppers Associates S.A. - Zurich	98,988,500
	Other Shareholders	9,550,000
T o t a l		523,539,500

Source : Annual Reports of Ereğli Iron and Steel Co.

External Debts

The foreign financial sources played a more important role than it is observed in Table 14.2. The total amount of loans given by external sources for the establishment of this plant was about 3 times more than the stockholders equity. The leading creditor was the U.S.Agency for International development that supplied the 76.8 % of the total external loans, at a 5.75 % annual interest rate ; the rest of these loans were given by OECD, Chase Group and foreign partners (see Table 14.3)

TABLE 14.3 FOREIGN CAPITAL INFLOW AND THE FOREIGN CREDITS UNDER THE LAW NO.7462, FOR THE CONSTRUCTION OF EREĞLI IRON AND STEEL CO.

Loans from foreign partners	TL 110,380,000
AID loans	1,131,895,000
OECD loans	187,025,000
Chase Group Loans	45,000,000
T o t a l	1,474,300,000

Source : K.Bulutoğlu, Türkiye'de Yabancı Sermaye , Gerçek Yayınevi, Istanbul (1970), p.161.

It is important to note that these loans became available for only the given package of investments and they were not available for alternative uses. Consequently, there is no real possibility of investing in more labour-intensive industries, of these resources.

14.2 TECHNIQUES TRANSFERRED TO EREĞLİ

A Capital-Intensive Plant

An overview of capital-intensity in Karabük and Ereğli indicates that, Ereğli has a higher capital-intensity :

a) fixed assets(excluding accumulated depdeciation) per employee ;

Ereğli	Karabük
$\frac{2,808 \text{ million TL}}{3,892} = 721.5$	$\frac{979.6 \text{ million TL}}{11,168} = 87.7$

b) total assets per employee ;

Ereğli	Karabük
$\frac{4,019 \text{ million TL}}{3,892} = 1032.9$	$\frac{2,548 \text{ million TL}}{11,168} = 228.2$

This comparison can be interpreted in two ways : Firstly, Karabük was established in 1939 which was expanded and modernized during the period of 1959-1961. Such an old plant whose fixed capital assets have been depreciated (in accounting terms) to a large extent, connot be compared with a modern plant established relatively recently. Secondly, the higher level of investment expenditures per employee in Ereğli, may reflect the 'rent' paid in return of modern technology transferred ;and, it may also reflect the 'monopoly rent' for the technology suppliers who possess a quasi-monopolistic advantage over the new knowledge.

Blast Furnaces

The technical practices in the blast furnaces of Ereğli and Karabük are presented in Table 14.4.

TABLE 14.4 TECHNICAL STRUCTURE OF THE BLAST FURNACES IN TWO INTEGRATED IRON AND STEEL PLANTS IN TURKEY (1970)

Technical Properties	Ereğli	Karabük Blast Furnace No. 1	2	3
Hearth-diameter (meters)	8.5	4.5	4.5	7.0
Production capacity per furnace-hour(ton)	63.7	16.6	15.5	40.4
Iron ore charge per ton of pig iron(kg)	1,920.0	1,913.0	1,913.0	1,906.0
Coke usage per ton of pig iron (kg)	874.0	914.0	970.0	850.0
Sinter charge(kg per ton of pig iron)	-	Average of three furnaces:971		
Average grade of iron ore (%)	51.0			53.5

Source : The Annual Reports of the two plants

Karabük had three blast furnaces in 1970. The first two of these were relined and expanded during 1957-59 and the third one was constructed in 1962. The third furnace used automatic charging techniques. While the stoves of the first two blast furnaces worked manually, the third one has an automatic control and stove-charging system, and automatic regulation of its air, humidity and temperature.[1] Fuel injection system is used in three of these furnaces.

The Ereğli blast furnace has the largest capacity than each of Karabük's. The fuel injection system was introduced in 1970. It has automatic charging techniques.

The iron ore and coke consumption per ton of iron production is lower in Karabük furnace no.3, than in Ereğli's blast furnace. However,

1. U.N., Automation in the Iron and Steel Industry, New York (1965), and the information obtained from the Karabük of ficials.

TABLE 14.5 IRON ORE RESERVES IN TURKEY

(million tons)

Region	Visible reserves	Probable reserves	Grade (Fe %)
Divriği A - Kafa	24	4	59
Divriği B.C	5	1	50
Pınargözü, Çetinkaya	8	1	57
Gürün/Otlukilise	5	-	55
Hekimhan/Deveci	6	3	55
Hekimhan/Kanakuz	2.5	1	57
Kayseri/Karamadazı	5	2.5	61
Divriği/Akdağ	1.5	1.8	-
Elazığ/Avşar	-	1.5	60
Kayseri/Kösedağ	0.1	2	56
Ankara/Kesikköprü	5	5	55
Adana/İntepe	10	-	50
Kütahya/Çatak	5	-	55
T O T A L	72.1	22.8	
Divriği A-kafa	7	-	35-40
Divriği C	4.5	-	35-40
Kangal/Tavşanlı	1	0.5	35-40
Kangal/Çetinkaya	2	-	52
Gürün/Otlukilise	2	-	48
Hekimhan/Deveci	2.5	-	49
Balıkesir/Eğmir	10	1.5	43
Bingöl/Avnik	2	-	50
Balıkesir/Ayazmant	2.5	2	57
Balıkesir/Şamlı	10	-	64
İskenderun/Payas	6	80	32
Adapazarı/Çamdağ	25	40	32
Mersin/Örendüzü	-	85	35-40
Malatya/Doğanşehir	-	3	40
T O T A L	74.5	212	

Source : S.İzgiz, Demir Çelik ve Metalürji Semineri, op.cit. pp.107-108

Steel Plants: Best-Practice Technology

The steelplants of Ereğli represent the "best-practice plant" since its productivity per furnace hour relates to the most up-to-date technique which was available at the pre-investment stage of establishment (see, Table 14.6).

TABLE 14.6 TECHNICAL PRACTICE IN STEEL-MAKING PLANTS OF TWO MAJOR INTEGRATED IRON AND STEEL PLANTS OF TURKEY, IN 1970

Technical Properties	Ereğli Iron and Steel co. (foreign, public and private partnership) best-practice plant (1)	Karabük Iron and Steel Works (public enterprise) (2)
Technology used	20 LD-convertors 90 tons capacity each	6 Siemens-martin furnaces 150 tons capacity of each
Production per furnace-hour	280 tons on average	17.8 tons on average
Production per labour hour	531 kg.[x]	453 kg.

[x]this figure includes the finishing process for flat rolled products which possibly decreases the average labour productivity of the LD-convertors as shown relative to the real labour productivity figure

Source: (1) 1970 and 1971 Annual Reports of Ereğli and, "Information on Ereğli Iron and Steel Factory Turkish Anonymous Co." (mimeo.) by Ereğli Educational Directorate
(2) Prime Ministry of Turkish Republic, High Control Committee, 1970 Annual Report of Iron and Steel Works of Turkey, Ankara (1971)

Karabük's steel plants represent the best-practice technology of the pre-1950 period.

The hourly production of the L-D convertors of Ereğli was 15.7 times more productive than the Siemens-Martin furnaces of Karabük, in 1970.

Finishing Processes

A comparison of the techniques employed in the finishing stage of production in Karabük and Ereğli is not relevant. Because, Ereğli is specialized in the production of flat rolled products while Karabük produces other rolling mill products and castings.

Level of Technology Adopted In Ereğli Compared With A Counterpart In U.S.A.

A comparison of the level of technology adopted in Ereğli with a counterpart in the U.S.A. shows that Ereğli has relatively backward techniques of production, at every stage of the production process(see, Table 14.7).

According to Table 14.7, in 1966 the man-hours worked per metric ton of pig iron was about 4.5 times lower in the blast furnaces of Armco Steel Plant (U.S.A.) than in Ereğli. In the steel furnaces, the man-hours worked per metric ton of steel ingots produced, was approximately 3.6 times in Armco than in Ereğli. The level of productivity in cold rolling operations and finishing operations was no better in Ereğli than in the earlier stages of production, as compared to Armco.

An apparent reason for the lower level of productivity in Ereğli, is the smaller scale of production than Armco plant. The size of production capacity in Ereğli was smaller than in Armco, 2.8 times in the blast furnace (in terms of monthly production of pig iron) ; 2.3 times in the basic oxygen furnace (in terms of monthly production of ingots on a 2 turn basis) ; and, 1.4 times in the hot strip mill (monthly production).

The Armco report on the low level of productivity and poor financial performance says :

> "The principal limitations and restrictions which impose this grave situation upon Ereğli are : the poor quality and high cost of domestic iron ores ; the present unsatisfactory and extremely costly capital and debt structure ; the still inexperienced and remotely located exe-

Table 14.7 PRODUCTIVITY ANALYSIS IN EREĞLI AND ARMCO STEEL PLANT(USA)

	Ereğli	Armco
Blast Furnace :		
Monthly production of pig iron(metric tons)	29,184	84,128
Man-hours worked per metric ton of pig iron produced	1.41	0.31
Basic Oxygen Furnace :		
Size of furnace vessel (metric tons)	80	136
Monthly production of ingots(2 turn basis)(metric tons)	36,103	82,350
Man-hours worked per metric ton of ingots produced	0.975	0.267
Hot Strip Mill :		
Monthly production(thousand metric tons)	23.5	35.5
Man-hours per metric ton of output	0.45	0.25
Cold Rolling Operations :		
Man-hours worked per metric ton		
Pickle line	0.68	0.24
Tandem mill	0.94	0.37
Cleaning line	0.60	0.34
Annealing	1.78	0.22
Temper rolling	0.77	0.41
Finishing Operations :		
Man-hours worked per metric ton		
Tinning line	3.79	2.23
Stilling line	0.72	0.31
HR CR shears	1.10	0.34

Source : "Report to the Agency For International Development on a Study of Ereğli Demir ve Çelik Fabrikaları T.A.Ş., Located at Ereğli, Turkey", by ARMCO Steel Corporation, Middletown, Ohio (December 1966) cutive management ; and the excess employment costs resulting from overstaffing".[2]

For the improvement of the production performance of Ereğli, the following measures were recommended;[3]

Blast Furnace :
- use 50 p.c. high grade ore practices
- install fuel oil injection
- rebuild and enlarge the heart from 28'-0" to 29'-6" diatemer by decreasing the brick thickness of the furnace wall
- install top pressure equipment and revamp for higher temperature

Basic Oxygen Furnace :
- increase oxygen supply
- increase burnt lime supply
- install 6 strand continuous casting machine

Hot Rolling Mills
- adopt altermate rolling practice
- install supplemental fuel on ingot and slab heating
- install roll side shifter

Cold roll Finishing
- extend warehouse building
- add 3 annealing furnaces
- provide auxiliary crane hoist

Miscallaneous
- replace worn mobile equipment
- add maintenance shop aquipment

The possibility of improving the grade of domestic iron ores is excluded in the Armco recommendations. However, Ereğli realized the establishment of a sintering plant in 1972. The fuel injection system was introduced in 1970. The other Armco recommendations, on the other hand, were not realized until 1972.

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2. Armco report, op.cit. pp.1-5

3. ibid.

14.3 PRODUCTION COSTS

A Comparison With Import Prices

A comparison of the domestic prices of the products of Ereğli with the f.o.b. import prices from the EEC countries is given in Table 14.8. The column d of the table shows the domestic selling prices as a percentage of the import prices. Accordingly, the domestic prices of various products is higher than their import prices from 73 p.c. to 125 p.c. The last column of Table 14.8 compares the domestic production costs with the import prices. In this case, the production cost of hot rolled products is almost the same as their average import products. The other products' costs are higher than the import prices at various rates from 4 p.c. to 72 p.c.

TABLE 14.8 COMPARISON OF DOMESTIC PRICES AND COSTS OF EREĞLİ'S PRODUCTS WITH THE EEC PRICES

Products	EEC countries' Average f.o.b. prices(TL/ton)x	Domestic production selling Prices(TL/ton)	Domestic production Costs[xx] (TL/ton)	Comparison of EEC prices with domestic prices and costs	
	(a)	(b)	(c)	d-(b/a)	e-(c/a)
Hot rolled products	1,290	2,230	1,287	1,73	0,99
Cold rolled products	1,380	3,030	1,642	2.19	1.19
Plates	1,235	2,300	1,287	1.87	1.04
Tin plate	1,920	3,600	2,203	1.88	1.19
Sheet bars	750	1,600	1,300	2.13	1.72
Bloom	780	1,450	1,280	1.86	1.64
Pig iron	555	1,250	800	2.25	1.44

(x)TL 9 per dollar is used to convert the EEC prices into TL since this official exchange rate is used in imports of iron and steel products; it is reported that the c.i.f. prices may be higher than the f.o.b.prices within a 10 p.c. range.

(xx)including taxes

Source : Data obtained from the SPO, covering 1969.

The determinant of high costs other than those discussed in the previous sector, will be analysed below.

Location

The location of Ereğli near the coal fields near Zonguldak instead of near the main iron ore field, in Divriği-Çetinkaya-Hekimhan area, has been an important cost-increasing factor.[4] Iron is transported from a distance of about 1100 kilometres from Divriği to Samsun by rail and from Samsun to Ereğli via shipping.

Average total cost of iron ore brought from various mines : TL 166.4. The freight and handling costs in the total cost :

a) rail : TL 68.9
b) dock : TL 24.6
c) ship : TL 17.9
total: TL 111.4

The figures relate to 1966 and the equivalent cost of imported ore at Ereğli was 145.13 including a 15.7 p.c. customs duty, in that year. However, Karabük plant was also in conveniently located and the cost of iron ore in Karabük was 160 TL/ton in that year.[5]

The average landed cost of coal to Karabük was about 185 TL/ton in 1968, whilst it was about 200 TL/ton in Ereğli, althoughEEreğli was no more than about 25 miles from Zonguldak.[6] The domestic scrap prices, on the other hand, were 450 TL/ton on average against 400 TL/ton import price and imports were relatively cheaper due to location near the sea.

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4. see, Üçüncü Demir Çelik Tesisleri Yer Seçimi Etüdü, prepared by SADA Industrial Research Agenty for Samsun Chamber of Industry(September 1967)
5. see, A.Candır, "Türk Demir Çelik SanayiiningGenel Sorunları", Demir-Çelik ve Metalürji Endüstrisi Semineri, NPC.pu.no.77, Ankara(1970)
6. K.S.Gill, An Outline of a Long-term Integrated Development Programme For Iron and Steel, SPO : 849 - İPD - 286 (Sept.1969)

Capital Costs

Among the causes of high capital stocks are the lengthy period of construction, the high level of investments made per uunit of output, working capital requirements and interest on loans.

The average lenght of time for the construction of a steel plant in the EEC is about 2.5 years whilst this was just over 4 years in the case of Ereğli Iron and Steel Plant.[7] The bottlenecks in abtaining construction material and delays in the imports needed for the construction of the plant were among the causes of this situation.

As far as the capacity usage is concerned, in 1966, 99.0 p.c. of the hot metal production capacity, 69.1 p.c. of the steel ingot capacity and 77.8 p.c. of the flat rolled production capacity was utilized. This was due to the bottlenecks in obtaining iron ore and coka as well as the manpower, management and other adjustment problems discussed earlier. During 1967-70 period, non of the plants of Ereğli worked below 90 p.c. of the capacity. In 1971, the ratio of the actual production was 67.0 p.c. of the capacity in hot metal production, 65.1 p.c. in steel ingot production and 94.2 p.c. in flat rolled products. These ratios were the result of relining of the blast furnace in 1971 with the result that the blast furnace ceased to operate for 3.5 months and consequently, production of ingot also ceased.

The lenghtly construction period showss itself up, firstly, in the pre-operating expenses. These were TL 56 million in 1966, 52 million in 1967, 47 million in 1968, 42 million in 1969 and 32 million in 1970. Secondly, the depreciation expenses of the pre-operating prior are written-off after the operation starts with the consequent higher amortization expenses per annum. These were, TL 89.7 million in 1967, 88.9 million in 1968 90.6 million in 1969, 132.6 million in 1970, and203 million in 1971.

7. see, W.Turkcan, "Türkiye Demir-Çelik Sanayii Yapısı ve Optimumm Kapasite Büyüklükleri", Demir-Çelik ve Metalurji Endüstri Semineri, op.cit., pp. 61-66

TABLE 14.9 COMPERATIVE PRODUCTION COSTS IN EREĞLI AND KARABUK (1970)

	Ereğli		Karabük	
	million TL	%	Million TL	%
1. Purchased materials (1)	558.09	58.53	688.05	42.52
2. Direct labour	134.70	14.13	289.49	17.89
3. Indirect labour			22.13	1.36
4. Depreciation (2)	132.61	13.96	73.60	4.56
5. Miscallaneous expenses (3)	128.04	13.38	544.89	33.67
6. Total cost of production	953.44	100.00	1,618.16	100.00
7. Add: selling services	18.85		14.87	
8. Total costs	972.29		1,633.03	
9. Add: income earned	132.27		502.63	
10. Total value of output sold	1,104.56		2,135.66	
11. Value added (line 10 minus 1)	546.47		1,447.61	
12. Net value of fixed assets (2)	2,808.27		979.59	
13. Capital/output ratio (line 12 divided by 11)	5.139		0.676	
14. Unit costs of output (TL per ton)	1,836		Hot metal : 667.08 Steel ingot: 953.67 plates :1645.56	

(1) purchases made in 1970 plus inventories from 1969 minus inventories in Decembre 31 1970.

(2) the value of machinery, equipment and buildings are depreciated according to their initial book values without any revaluation, the net value fixed assets is equal to the book value of these assets minus accumulated depreciation.

(3) including services bought from other industries, general and administrative expenses and taxes paid ; including losses incurred by Ereğli due to devaluation and interests paid.

Source: Ereğli's Statement of Income and balance Sheets by Decembre 31, 1969-1970 and 1970 Annual Report, op.cit., ; and, Iron and Steel Works of Turkey, 1970 Annual Report , op.cit., pp.7,10,213 and 222

The high capital costs of Ereğli can be observed in comparison to Karabük, in Table 14.9. In the fourth row of this table, the depreciation expenses and their percentage share in the total costs are given : by both criteria, depreciation costs in Ereğli appear to be much higher than Karabuk, in 1970. One of the other high cost element is the purchased materials. It can be observed in the thirteenth row that the capital/output ratio in Ereğli was well above the capital/output ratio in Karabuk. However, the conclusions to be drawn from Table 14.9 must be taken cum grano salis. Because although the technology and cost structure of the both plants at the iron-making and steel-making stages of production can be compared, the differences in the finished products of the two plants make a comparison of the total composition of costs irrelevant.

The cost of direct and indirect labour is the 14.14 p.c. of the total costs in Ereğli, and 19.25 p.c. in Karabuk. This may be due to the relatively more labour-saving character of the Ereğli's plants.

The affect of Ereğli's dependence on external loans is analysed in Table 14.10. The row 'c' indicates that the dependence of the company on the foreign financial resources increased through time compared to the start-up time. This was mainly due to the revision and expansion programs carried out starting from 1967. The ratio of the payments for installments, interest and bank charges varied between the 5.80 p.c. and the 12.85 p.c. of the long term debts during 1966-70 (row 'e'). These payments absorbed the 15.44 to 26.74 p.c. of the sales proceeds during the same period.

TABLE 14.10 EREĞLI'S DEPENDENCE ON LOANS AND ITS BURDEN(BY DECEMBER 31,İN '000 TL)

	1970	1969	1968	1967	1966
a.Owners equity	523,346	523,213	521,872	521,707	521,338
b.Long term debts	2,848,501	2,035,393	2,206,614	2,210,869	2,073,679
c.Ratio of 'b' over 'a'	5.44	3.89	4.23	4.24	3.98
d.Installements,interest and bank charges	366,145	223,391	234,184	128,155	98,014
e.Ratio of 'd' over'b'(%)	12.85	10.98	10.61	5.80	4.73
f.Sales proceeds	1,369,105	1,216,895	989,593	829,817	560,536
g.Ratio of 'd' over'f'(%)	26.74	18.36	23.66	15.44	17.49

Source:Eregli Demir ve Celik Fabrikaları T.A.S.,1970 Annual Report , Ankara (March 1971), pp.27, 30-31

Manpower and Management Problems

The manpower requirements of Ereğli was met from three sources : the manpower already trained in Karabuk, the expatriate supervision that carried out on-the-job training and the engineering personnel obtained from the other manufacturing industries. A small number of supervisors capable of organizing the work of unskilled workers placed under their authority led to poor performances in the maintenance works and particularly in the finishing stages of the production.

The poor management consulting services and the gap between the administrative organizations of the two headquarters in Ankara and Eregli were responsible of inefficient management practices. This coupled with the lack of an efficient planning and scheduling procedure, was responsible for high inventory levels. The limitation of inventory investments to 20 p.c. of annual sales was essential to keep up with the practice of the U.S.steel industry.[8] The overstaffing was an important cause of low productivity. Against the 3,800 employees in Eregli, about 1,100 persons were excessively employed which was composed of 875 wage employees and 240 non-supervisory salary employees.[9] What needed in Ereğli was the elimination of personnel excesses and the improvement of the performance of required force through better training, proper work scheduling and use of incentives to encourage high output.

There were 18 expatriate personnel in Eregli at the initial stages of production, which was gradually reduced to 9 in 1969, to 6 in 1970 and to 4 in 1971. The total salaried personnel increased to 4,096 in 1971, of which 1,167 were salaried and 2,929 were wage-earners.

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8. Armco Report, passim., pp.1-3
9. ibid.

14.4 SUMMARY AND CONCLUSIONS

The decision to establish a new iron and steel plant, namely, Eregli, was determined by the bottlenecks of foreign exchange required for imports of iron and steel products, and by the need for product innovation induced by the demand of dependent industries.

The lumpiness of investments needed for the establishment of Eregli led to the use of tied-aid and the formation of a joint venture with the multinationals. The investible funds obtained in erecting this plant were available only for the given investment package : there was no possibility of using the same funds for relatively labour-intensive projects.

The blast furnace of Eregli was not the 'best practice' plant at the time when it started operation. Among the causes of this were the disregard to the domestic ore reserves which requires sintering and the use of agglomerated materials to increase blast furnace productivity; and the non-use of various other blast methods which were known and already in use, at the time of construction, at the advanced industrial countries.

The steel plant of Eregli is an example of the international diffusion of the most up-to-date steel technology via multinationals.

However, productivity in the different stages of steelmaking in Eregli, was much lower than at a counterpart of it located in the U.S.A. The small scale of production, representing a tarifff -jumping transplantation <u>par excellence</u>, was one of the leading causes of mlow productivity. The lack of various production methods complementary to the basic processes was also determinant on low productivity, as well as the poor quality of domestic iron ores and the inexperienced and remotely located executive management.

The result of low productivity was inefficiency and high costs, particularly when the prices of Ereğli's products were compared with the import prices. An important cost-raising factor was the location of the plant by the coal fields instead of by the iron ore reserves of the country; this increased the transport costs considerably. The capital costs were high as a result of the high level of investments made per unit of output, the lengthy period of construction, and the interest payments on loans.

The poor management and overstaffing can be counted as productivity decreasing factors. No R and D was carried out in Ereğli.

PART IV

POLICY RECOMMENDATIONS

CHAPTER 15

POLICY RECOMMENDATIONS

The existence of scope for higher employment prospects in the manufacturing sector, requires a change of attitude towards employment so as to adopt it as a leading target, at the policy making level.

However, the problem of employment in relation to technology is a complex one and considering employment as an independent target is an oversimplification. For example, sacrificing the growth of efficiency in those branches of manufacturing activity where traditionalism and backwardness are accompanied with technological primitivism, is contradictory to the very concept of economic development. The development of commodity production tended to destroy the scattered condition of the small economic units, that is the characteristics of a backw ard economy, and tended to draw together the small local markets into a national market. The inflow of advanced production methods and processes from the world metropolitan centers of technology, to the national markets of the industrializing countries, makes it rather hypothetical to limit our thinking within the framework of a closed economy. Therefore, the question of "How long one would continue to use the high-cost methods in an expanding market economy ?", has a crucial importance.

The consequent conclusion of this thesis will be threefolds:

Firstly, the real solutions to the problem of unemployment involve far more than policy towards employment per se ; they involve, decisions on the patterns of industrialization, on relationship to international markets and on the totality of the prevailing economic conditions in relation to technical change.

Secondly, the common view adopted in the present literature as "either output or employment" is misplacing the issue to some respects. Because, it is a reality that the relatively labour-intensive techniques of production and the "high productivity islands" are essentially coexisting within the framework of an inter-industry dependence, along the manufacturing subsectors and under product differentiation. Also, some of the investible funds are available only for given package of projects which may involve the transplantation of highly sophisticated methods of production and processes. However, in those cases where there is an apparent conflict between the objectives of employment and output in terms of the allocation of given investible resources, the problem is to decide for the relative importance of these two objectives.

Thirdly, when maximum employment objective is highly weighted, it is possible to select the labour-intensive production techniques among those which are already available (given the long-term investment-intensive trend of technological progress). As a compromise solution, these technologies which may be more efficient than the pre-existing plant and equipment and more labour - using than the most up-to-date ones, can be sought.

The following policy recommendations are made on the basis of these general guidelines.

15.1 NEED FOR A TECHNOLOGICAL DEVELOPMENT STRATEGY

Policies Towards Employment in Development Plans

The Turkish Development Plans consider "the creation of employment for the existent ever growing manpower arising from the rapid increase in population", as a consequence of economic development and "not as a selected target".[1] Thus, with the predetermined target of maximization of output, the plans and the annual programs discuss the problems of industrialization by placing a great emphasis on savings of foreign exchange and on costs of production in relation to export possibilities.

There is no clear technological policy in relation to inter-

1. SFYDP, passim. pp.679 and 141.

industry and within-industry preferences based on economic objectives like employment, growth rates, consumption, imports and exports, in the Plans. Some adjustments in the input-output tables have been observed in relation to the expected changes in technology. Ultimately, instead of specific policies, general principles have been formulated in the Plans, which are broadly suggestive of the direction of these objectives . These planners at the end of the decision-making chain are left with these general principles. Consequently, a tendency which emerged at various levels of decision-making, is that all technologies which represent some degree of advancement, and the transfer of all machinery, equipment and skills representing the so-called 'modern technology', are desirable. The implicit assumption under this practice in relation to employment is that investment in those techniques of production which may lead to high productivity increase may solve the unemployment problem in the future.

However, the possibility that it may be an illusion to postpone the solution of the unemployment problem totally to the future has been explicitely accepted in the Third Plan:[2]

> "It may be contradictory to attempt to solve the unemployment problem by directing investments to labour-intensive technologies in all productive sectors in the short-run, or by establishing and extending the unemployment insurance system, given the target development through industrialization and full-employment in the longrun..(however)even the most rapid industrialization effort may solve the employment problem by the 1990's. Consequently, it is necessary to adopt labour-intensive technologies in construction and services sectors,which are not subject to international competition, in the Third, Fourth and Fifth Plan periods, to the extent that plan targets are not delayed."

The lack of coordination between the policies of science, technology and economic development, has been an important determinant of the present flexibility of criteria employed in evaluating the investment projects, research projects, training and education schemes and transfer of technology. The following quotation from the "Ad Hoc Committe Re-

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2. TFYDP, passim., p.122

port of Science, Technology, and Research" for the preparation of the Third Plan, is quite clear on this issue :[3]

> "... it is difficult for our committee who has no knowledge of the other ad hoc committees set up for the preparation of the TFYDP, and their studies, to recommend relevant and consistent proposals related to the science. technology and research sectors which are directly or indirectly related to nearly all of the sectors of the economy. As a result it has been decided to present measures on the basic elements of the determination and control of technology".

A technological development policy need not necessarily formulate the ways and means of obtaining the most up-to-date technology ; but it must formulate how the strategy of manufacturing development will be realized, and, how will the long-run full-employment target will be established with a given pattern of technical change. This requires the formulation of the patterns of technical progress within the coherent totality of the strategy of economic development. The priorities set in the plans must be integrated at both micro and macro levels. The present state of technical development should be understood to form the basis of a new strategy of technological progress ; this requires further research in this field. Only after the formulation of a national strategy for technology, it may become possible to talk about the technological re-equipment of the industries, the methods of evaluating the efficiency of new equipment, designs and blue-prints, the possibilities of encouraging R and D, the incentives required to reachrch to the targets of this strategy, and, finally, the possibilities of a compromise between employment and output objectives.

3. SPO, "Ad Hoc Committee Report On Science, Technology and Research " for the preparation of the Third Plan, Ankara (July 1971), pp. 19-20

Criteria For Inter-Industry Priorities

The sector studies that have been made in the Second Part of the present thesis indicate that there are possible areas of specialization in manufacturing which present alternatives for employment and growth. The tentative conclusions of the sector studies are as follows:

(a) A selective development among manufacturing industries may present possibilities of a compromise between the objectives of output increase and employment increase. Although there is a relationship between the level of productivity and capital-intensity, it is not a very strong one ; the intermediary input-dependence affects the level of productivity more strongly.

(b) The negative relationship between labour producticity and capital/output ratio, along the manufacturing subsectors, indicates that the efficiency of capital may not increase to the extent of increase in capital-intensity ; on the contrary a tendency of decline in the marginal efficiency of capital may prevail ; this tendency should be further explored by subsectors.

(c) Output can be increased by realizing economies of scale, in some of the labour-intensive manufacturing branches. (The traditional view on the labour-intensity in relation to the consumer goods industries should be altered withsthe inclusion of some of the investment goods industries-such as machine building)

(d) A higher proportion of output, employment and capital stock is concentrated as the establishments become larger, in each industry. A parallel increase in the efficiency of labour and capital, and the intensity reinvestment quotient, is also observed. The increase of capital-intensity as establishments get larger, does not show a regular pattern. There are relatively small or medium-sized establishments with higher productivity and employment possibilities which may present alternatives of "compromise" technology. These alternatives should be considered in relation to the level and the nature of demand.

(e) The possible "compromise" technology alternatives may also presented areas of specialization for export markets.

Inter-Industry Priorities in the Plans

The plans consider the possibility of reconciling the objectives of employment and output, by subsectors, as follows:

> "Emphasis will be given to sectors which have high employment potential, to raise the employment level and reduce unemployment. In addition, in all sectors high priority will be given to projects which offer many employment opportunities and which would save capital and create employment without increasing production costs. Research on the selection of technology will continue in order to attain the desired development in this area. Taking into consideration the capital/manpower and capital/production coefficients and the utilisation period of different technical equipment, research will be directed to find the maximum employment creating types of equipment without hindering the productivity of the investment and to find the most productive type of construction according to the same criteria."[4]

In other words, the bias in favour of output growth is maintained while employment increasing alternatives are considered as potentialities. In consequence, however, the official bodies issuing investment promotions and the state economic enterprises which follow up the framework drawn by the plans to a larger extent, are in a position to use their discretion.

The Third Plan States that in industries where foreign competition is affective in terms of the quality and price of the products, the "most advanced techniques" will be used : such as the industries of chemicals, petro-chemicals, machinery, metal goods and non-ferrous metals.[5] In those industries where "differences in quality of product is acceptable, labour-intensive technologies will be adopted : such as ship-

4. SFYDP, passim., p.149

5. TFYDP, passim.,pp.898-99

building, electronics, wood products and earth products industries".[6] However, the stated within-industry choice is not accompanied by inter-industry priorities in the Third Plan.

The machine-building industries have been given a special weight in the plans. The Second Plan says :"The machinery manufacturing industry is a sector which has many side effects on the industrialization movement. In this sector it is essential to direct technical and financial means towards large establishments."[7] The Third Plan adds to this, that the machine-making industries should be geared to the production of the most modern machinery and equipment basically through licencing agreements.[8] It is stated that a rapid development of the investment goods industries is a means of closing the technological gap between Turkey and the advanced nations. In this sector, in all new branches to be established, domestic technological content must be increased ; project, design and engineering services must be encouraged ; the quality standards should be followed to enhance competition with foreign firms ; the present public enterprises should be reorganized and the bottlenecks created by the lack of qualified personnel should be overcome.[9] Since these industries are non-mass production technologies (except agricultural machinery) involving a whole range of activities from hand-looms to diesel engines and spare parts, they may allow the economies of specialization in small-scale establishments.

The following points are made in relation to technology in each sector, in the plans :

Electrical machinery : this employment generating industry must be directed towards exports ; it must not acquire the characteristics of an assembly industry.

Electronics : a labour-intensive and engineering-intensive sector which must be encouraged with an export-led objectives

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6. ibid
7. SFYDP, passim, p.532
8. TFYDP, passim, p.505
9. ibid
10. see, SFYDP, passim., pp.474, 414, 483, 425, 398, 463, 428 and, 459; also see, TFYDP passim., pp.513, 529, 482, 393, 392, 342 and 312

Iron and steel : capacity expansion is needed to meet domestic demand ; an iron and steel master plan should be made and the co-ordination of technology, location and product choice should be accordingly.

Metal goods : the large-scale investments and advanced techniques of production should be given priority.

Chemicals : public organisations must follow up the development of new technologies abroad and their adaptation to lacal conditions ; the present level of already adopted production methods should be improved.

Plastics : The new products and processes originated abroad should be imported ; the present slow pace of technical change should be accelerated and the present machine park should be renewed ; the new investments in machinery must embody the most advanced technologies. Within this sector some labour-intensive alternatives may also exist.

Textile and clothing : the present capacity utilisation must be increased and the requirements of exports should be met.

Food : Coordination is needed among the present establishments.

Wood products : there is no institution following up the technological developments in this sector.

Leather goods : the deficiencies of technical personnel and know-how prevents the production of quality products ; problems of raw material supply should be solved.

Earth products : improvement of quality and standardization is necessary.

Cement : unit costs must be reduced.

Small Industries

In the face of high employment potentials presented by these industries, improvement of their efficiency and organization must be encouraged. There is a widely unused capacity in these establishments at present, where there are many craftsman-entrepreneurs actively operating small, seperate enterprises.[11] Consequently it is not possible for these industries to produce at even the minimum capacity and to benefit from the rapidly developing production and management techniques of the rest of the industrial sector. There is no information system providing knowledge for the alternative possibilities that they can utilize.

A relevant marger policy, possibly by improving and reorganizing the already existing cooperatives, supply of credit and cooperation to obtain machinery and raw materials and training the present labour force through institutionalizing apprenticeship, may help to raise productivity in these industries. The cooperative organizations may get access into industrial information that they need by cooperating with the Documentation Center.

Research must be done to find out the relatively simpler machine designs that may have economic scales of output in these establishments. The development of the cooperative organizations may help to use the investible surplus created by these industries for their development.

The small industries may be oriented towards a production system to complement large-scale industny and to enable it to benefit from large-scale markets through sub-contracts.

Improvement of the productivity of these establishments is necessary to increase their competitive potential vis-à-vis the products of large establishments and imports. Also, their exports potential can be increased by a production organization of the handicrafts and cottage industries, geared to meet export demand.

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11. see, SFYDP, passim., p.141

The Third Plan states that the small industries whose present level of technology is wasting resources and those with no growth potentials will not be encouraged.[12] Further research is suggested by the Third plan to find out the small establishments which may grow into larger units, require small capacity and repair services and relatively low level of sophistication of skills and also to distinguish the artisanal products that may survive by their very nature. These categories of establishments will be supported by the goverment, according to the Third Plan.

15.2 SCIENCE POLICY AND ORGANIZATION

Lack Of A Coherent Science Policy

The resources to be devoted to the scientific and technical research activities, the ways of encouraging the development of indigenous R and D, and the extent of need to depend on foreign technology can be determined only after the formulation of a clear technological policy for the requirements of the industry.

In the advanced industrial countries, science and technology developed under the demand of industries for new methods and process.[13] The present lack of remand for research in Turkey is among the leading determinants of the difficulty in formulating a coherent science policy. Technical change is mainly dependant on external sources and there is no selective attitude towards this change which is originated exogenously. The present pattern of industrialization is taking place behind highly protective tariff walls, production is geared to the domestic markets and competition is barely realized. The prevailing capital-intensive bias of the imported technology is encouraged by government policies. The present wages/prices and saving policy tends to be make labour

12. TFYDP, passim., pp.562-563
13. However, the possibilities where inventions procede innovation without a relevant demand for commercial application, have been considered by various authors ; see, Chapters 1 and 4.

intensive technologies undesirable for profit-maximizing objectives. The institutionally determined capital prices under the loan quotas, lead to the formation of interest rates below a natural equalibrium. The highly valued Turkish Lira makes imports quite attractive and the problem becomes not the imports of specific machines involving given technological properties, but the imports of the available machinery with relatively cheap napital loans before a new devaluation takes place.

Thus, the demand for technology <u>per se</u> is of oonly secondary importance and the lack of demand for research is a normal consequence of these economic and technological conditions. Only a clear technological development policy which should be an integral part of the industrialization stratgey, may lead to establish consistency among various policies, that may ultimately lead to a demand for scientific and technological research.

Adaptive Research

There is a nucleus of R and D personnel and institutions in Turkey, working in a network of the universities, public enterprises and private enterprises. The scope of this present capacity should be expanded. The smaller a country's technological base and the faster the global rate of accretion of technological capital, the more economical it will be for a small country to stress assimilation of proven technology rather than to risk undertaking basic research.

A tendency towards less 'basic research' has been promoted by TUBITAK in the recent years; however the extent of the development of adaptive research is difficult to determine. Its functions can be twofolds : (a) research to meet the situations arising from the imported technology ; and, development for analysing the innovative products of others in order to create imitative, but simpler, equivalents ; (b) research and development to find out the present state and tendency of technology outside the spehere of technology from foreign sources. These two ends may converge towards a possibility of compromise under the prevailing factor proportions, resource endowment and level of technical progress, in Turkey.

Public Sector

There is an underutilized capacity in the public sector due to the uncoordinated character of research in this sector. The research personnel is also under the burden of consulting and teaching which directs their efforts away from the main research funntions.

There are no independent research units in the ministries and the public enterprises, which make coordination difficult.

The research funds devoted to these institutions are made under a budget organisation. However, payments should be made by research programmes organized under functional categories rather than in an administrative manner. There is no control over how these funds are uused, whether they are directed to the planned objectives. A coordinating independent body can exercise such a control.

An overall coordination of the research activities, purchases of machinery and equipment and training schemes may prevent the waste of resources devoted to this sector.

Academic Sector

There is repetitive research in the Universities which leads to loss of time and misuse of the present capacity. The prevailing disorganisation is aggrevated by the teaching duties that the research personnel is overloaded.

The level of research expenditures devoted to the Universities is inadequate.

Since these funds are not given for specific investment projects, their use by type of research is difficult to determine.

Private Sector

The demand of this sector for R and D is particularly meagre. There are virtually no research workers in this sector. It remains far behind the target research expenditures foreseen in the plans. It does not propose as many research projects as it could to the present research organizations outside the private sector.

The study of the problems of industrial transplantation under a seperate institution in each manufacturing branch, may contribute to the objectives of adaptive research. Promotion measures such as devoting a certain share of tax payments for sectoral R and D may encourage the development of these activities, in the Private sector.

TUBITAK and Other Organizations

The Scientific and Technical Research Council of Turkey (TUBITAK), is given the mandate of organizing basic and applied researches in natural sciences. Therefore it is far from functioning to relate local science and technology to production. It is not a "National Science Council" which helps to organize the overall research activities and often take over a more specific objective of generating "appropriate technology".

The present disorganized and misoriented state of R and D activities has led this organization not to be able to perform its main functions. Its consequent affect on the development of national scientific efforts has been very limited. The only successful dialog that it has been able to establish is with the Universities. This is partly affected by its authority to spend a small proportion of its budget for research grants. However, the lack of acceptable R and D proposals has led to a rather low level of grant funds available for this purpose.

There has been a number of research institutes planned to be established. The establishment of these institutes would alleviate the problems faced by TUBITAK. For example :

- The establishment of the Economic and Social Research Organization has been mentioned in the plans. But as yet no progress has been made in this field.

- The aim of establishing an Industrial Research Institute to carry out research in relation to long-term industrial planning has been initiated by the formation of Marmara Scientific and Industrial Institute. However, the present state of development of this institute is stilll far from achieving the established targets.

- The Scientific and Technical Documentation Center has been established under TUBITAK, as TURDOK. However, this Center is not a National Documentation Center which may fulfill the required services of a national development policy.

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The limited success of TUBITAK and the efforts in relation to establishing the other institutes, is affected by the factors that leads to the failure of formulation of a technological development strategy in the country.

An Industrial Documentation Center

Not only the small and medium sized companies but also the large companies often have a problem in locating sources of information, as well as the information itself. -If properly used, industrial liaison centers can help local firms, which seldom have the financial means or the incentives to embark on the risky and uncertain processes of innovation, to make worthwhile use of the results of national and international scientific research and technological innovations.

This Center may be coordinated with the meagre are dispersed documantation services located in the ministries and the Universities, the Industrial Documentation Center being the central organization. The SIS surveys can be collected and evaluated under this organization with the aid of NPC, SPO and the Universities.

Cooperation With International Economic Agencies

The present state of cooperation with the international agencies like U.N.I.D.O.(United Nations Industrial Development Organization), B.I.R.P.I. (United International Bureaux for the Protection of Industrial Property), U.N.C.T.A.D. (United Nations Conference on Trade and Development), and others, has been at an inadequate level. A systematic collection of the works of these organizations, a regular inflow of knowledge gathered at these and the related departments on proprietary and non-proprietory technology, must be provided. Information on sources of supply, cost and quality of foreign equipment, on financial assistance and training programmes should be obtained and located at the related national institutions.

A National Science And Technology Council

The overall organization and coordination of the scientific and technical research potential of Turkey should be integrated under A National Science and Technology Council. An inventory of the present scientific research capacity of the country must be made under this organization. The Universities, Industrial Documentation Center, Economic and Social Research Organization, Industrial Research Institute and TUBITAK must be reorganized under such a central Council.

15.3 POLICY RECOMMENDATIONS ON TRANSFER OF TECHNOLOGY

There is no doubt that the formulation of a national strategy for technological development and scientific research, may help to determine the relative weight of reliance on alternative channels of transfer of technology. A national documentation center and increased cooperation with international organizations related to the transfer phenomenon, may contribute to diversify the external sources of supply of technology.

Imports of Machinery and Equipment

There is a need to expand the spectrum of choice out of which relatively more labour-using alternatives can be chosen, in those branches of industry where employment maximization is the main objective. It may be possible to reconcile the objective of maximum employment with the objectives of productivity, export, positive externalities and a gradual upgrading of local skills, if such a bundle of alternatives exist.

The diversification of the sources of supply of the machinery and equipment to be imported, may help to answer the following questions, on more economic grounds : Which machinery, from which country and at what price ? What is the level of embodied technology to be transferred? What is the optimal capacity for each alternative under the demand conditions prevailing in the domestic markets and export markets ? To what extend does each alternative reduce technological dependence in terms of intermediary inputs, spare parts and maintenance, and involvement of foreign experts ? What will be the credit/debt payment structure for each alternative ? What is the required training for indigenous personnel ?

Thus, by pushing the technological characteristics forward, with the other conditions attached to given alternatives, a shift from an attitude of investment *per se* to technology *per se* will be realized. The present legal procedures in granting investment permits and import quotas, should be modified accordingly.

There may be cases where the importation procedure must be accompanied with some adaptation : such as the reduction of the scale of operation, simplifying some processes, and improvising to meet the dearth of maintenance and support facilities. Ifthe technology is too sophisticated to undergothis transformation - and much advanced technology is - then it can not be transferred through the direct importation process.

There is no doubt that a successful adaptation of imported technology depends to a large extent on the capacity of the country's itself. The concentration of the country's R and D activities on adaptive, rather than innovative projects, will contribute to this end. Also , the development of the domestic machine-making industries may help to overcome such bottlenecks. A national documentation center may prevent the repetitive importation of technology.

Although general technology and system specific technology can be successfully transferred through direct importation, the firm specific technologies may not be given access to.

Foreign Capital Investments

The Turkish attitude towards foreign capital investmnets is dominated by the objective of closing the savings gap. However, the tech - nological considerations must also receive the attention needed to contribute to the improvement of the present technological substructure and employment at a higher level.

Although a higher share of foreign capital investments concentrated in research-intensive industries, investments are also observed into the industries where general technology in relation to "mature goods" is already extant. In this latter category of industries where there is already developed market potentials and where the indigenous firms are able to operate, the inflow of foreign capital investments can be limited. If a trade-generating strategy in the labour-intensive branches of such industries, is followed by the multinationals, their capital investments can be allowed. However, their contribution to employment and exports should be secured. On the other hand, foreign capital investments should be directed towards to areas of investment goods which are given high priority in the

Third Plan.

There is no doubt that a higher average capital-intensity in firms with foreign capital is closely related to the research-intensity of their investments, as well as their quasi -monopolistic control over technology. Although it is difficult to distinguish the relative weight of these two factors in determining the cause of high capital-intensity, a seperation of the proprietory rights from the "capital" base, might help to treat the technology content of foreign capital investments explicitely. When a technique becomes absolete in the advanced markets, payments for proprieotary rights bust be stopped.

In the case of system-specific and firm-specific technologies related to highly sophisticated methods of production, a higher degree of foreign involvement may be necessary for a successful transplantation. Even in such cases, a tariff-jumping operation may tend to dominate in order to exploit the domestic market. In order to prevent this, payments for proprietary technology can be not a percentage of domestic sales but a percentage of exports.

The training of the local experts should be explicitely scheduled in the initial agreements made with the foreign firms. It should be noted that the training of the qualified personnel can contribute to the development of the indigenous capabilities at a higher level. However, the foreign firms attract the indigenous administrative and research personnel and technical experts, by a high wage and salary policy. The extent of use of already trained and educated domestic personnel must be limited to a necessary quantity and the training schemes must be adjusted so as to employ the newly trained indigenous manpower at a higher level.

The present level of technology (which also includes the present scale of production) adopted in the firms with foreign capital, is not efficient enough to meet the requirements of external competition. Foreign inward investments must be encouraged at the pre-investment stages of production so as to transfer advanced technology to create the so-called 'high productivity islands'.

The negative affect of foreign inward investments on the long run savings gap can be reduced only by a careful negotiation of the transfer costs. A thorough check of the employment/investment / trade/licence mix, a short-term duration of licencing agreements, a search for alternative licensors to avoid from high royalty rates and restrictive clauses on exports, are essential.

The present legal practices in relation to foreign capital investments are scattered under different ministries. There are conflicting views and evaluations on a certain investment project by these different bodies. These complications must be presented by establishing a seperate Foreign Investment Encouragement Institute under the Prime Ministry.

APPENDICES

APPENDIX A : INDUCED INNOVATION HYPOTHESIS

According to the induced innovation hypothesis if with a constant price level, money and real wage-rates rise relative to interest rates, then this is expected to make it profitable to use more capital-using methods of production in a competitive model.[1] Maintaining the assumption that the firm is a price-taker, firstly, the measurement of the capital cost by the rate of interest paid on capital is not realistical.[2] As W.E.G. Salter explains the issue is not a question of the relationship between the wage rate and the interest rate, but rather a question of the relationship between the wage rate and the prices of capital goods.[3] His formula is as follows :

> "The dual influences of changes in the price of capital goods and interest rates may be illustrated by combining both into a measure of capital goods per annum incurred at different dates by a given real investment. This may be achieved by the use of the annuity formula. In effect, one calculates the sum of interest plus amortisation charges per annum incurred by the purchase of a given 'machine' in 1930 and 1950, and the movement represents the effect of both changing interest rates and capital goods prices. Because changes in the interest rates are relatively mmore important for investments with a long life, the extent to which a change in the interest rates affects capital costs per annum depends upon the life of the investment. Thus, in making such calculations one must distinguish changes in capital costs for different lives".

1. see, e.g. W. Fellner, "Two Propositions in the Theory of Induced Innovations", in <u>The Economics of Technological change</u> , op.cit. p.205.
2. For the classicists, the rate of the interest represent the social and private cost of capital because the rate of interest is assumed to be equal to the rate of return when at that rate of interest two alternative production possibilities are equally profitable. See, L.L. Pasinetti, "Switches of Technique and the "Rate of Return" in Capital Theory", in <u>Capital and Growth</u> , op.cit., pp.261-65. This question is obscure in many of the discussions on
3. passim.

An important reason for introducing the price of capital goods as an alternative to the interest rate is that even though the wage rate and interest rate may be constant, the capital goods may cheapen as a result of technical progress and reduce the capital costs of real investment and so induce substitution of capital equipment for labour. In a growing economy, expansion of the use of capital goods may be rapid enough to offset the fact that each unit of capital is used with progressively less labour. However, at the outset of capital-using bias there should be a rise in the profit rate for new capital even though capital goods do not cheapen although technical change may increase its supply. In other words, we are involving the possibility of an imperfection in the capital market into our thinking. In this latter case, the rate of return is expected to be higher than the interest rate as a source of capital-using bias.

For the entrepreneur, the problem may be easier than it is for the theoretician because he must forecast the reward he can expect to reap in relation to the money he chooses to leave at risk. He plans to recover the loans borrowed over a reasonable period by calculating the outgoings and in comings of cash for each year (discounted cash flow). Another way of assessing industrial efficiency may be the ratio of earnings/capital assets employed (the rate of return criteria) for the entrepreneur as suggested earlier. However this may involve the accounting problems of valuing the capital assets in use as well as the technical problems mentioned in Chapter One. Many of the unsettled questions that beset capital theory and growth theory are by passed by the use of a money scale in the choice between alternative investments.[4] Under these conditions, for the entrepreneur what matters in relation to the cost of capital may be the rate of interest and the price of capital at the preinvestment stage of the alternative projects and depreciation as a component of unit output costs at the operation stage. The expected cost sheet of a unit output composed of raw material costs, the conversion costs and the capital costs may be what matters for the price-takes firm.

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the induced innovation hypothesis ; see, e.g, C.Kennedy, "Induced Bias in Innovation and the Theory of Distribution", <u>Economic Journal</u>, vol.74 (Sept.1964)

3. passim

We can expand our understanding of the induced innovation hypothesis with the aid of Figure i. The left-hand side of the figure establishes a positive functional relationship between the wage/rental ratio and capital-intensity. The wage/rentral ratio represents the weighed unit price of each factor-input by their quantity e.g., share of wages and salaries in net output. Thus the curve f(w/i) which represents the transformation of the factor-price frontier into relative capital intensities, assuming that such a continuous transformation is possible. On the right-hand side of the diagram, the production function for changing of capital input while labour is kept constant is shown. Capital per unit of labour is represented on the ordinate, output per unit of labour is measured on the abcissa. The production function f(k) refers to a given state of technical knowledge.

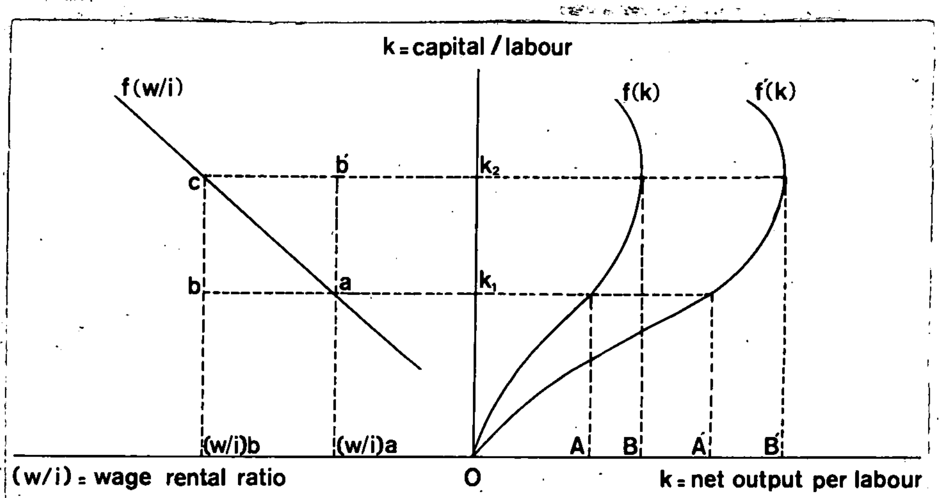

Figure i.

Let us assume that the causal relationship between labour productivity and capital-intensity starts with a given wage/rental ratio, $(w/i)_b$. This ratio may be determined by the relative marginal productivities of each factor of production as well as the relative intensity that is used ; when

4. D.Davies and C.Mc Carthy <u>Technological Economics</u> , London (1967), pp. 71-83.

institutional factors determine (the) factor prices, the wage/rental ratio may reflected the factor-price frontier which is formed under imperfect market conditions. For the atomistic firm, for the given (w/i)a, the transformation curve indicates the k_1 level of capital per labour as the maximizing condition. The corresponding level of output which is subject to distribution is OA. Assume that the wage/rental ratio increases to (w/i)b, say due to monopsonistic labour market. At the given level of output indicated by k_1, the share of profits in expected to decline ; in other words, an inelastic transformation curve represented by $\overline{ab}$ is the one that shows the relationship between the already installed technology k_1 and the new distribution condition (w/i)b. However, when the firm scraps or replaces the old vintages of capital goods or when it expands its production capacity by making new investments, the entrepreneur may choose to go back to the earlier transformation curve which indicates k_2 level of capital-intensity that gives a higher profit rate than at point b. The higher marginal productivity of capital- assuming that diminishing marginal productivity do not arise as k increases - may explain the higher net output per labour as k_2 is employed. The output to be distributed is OB, in this latter case.

If the wage/rental ratio remains at (w/i)a level but if the new investments adopt k_2 level of capital-intensity, this may imply ; (a) an equal rate of increase in the marginal productivity of the fixed factor, labour (e.g. due to higher skills that may be required to operate k_2), to the increasing marginal productivity of capital which is employed more ; (b) further imperfections in the labour markets ; (c) a proportionate decline in the marginal productivity of capital to its increasing quantitiy ; and, (d) an irrational behavior which results in the same share of the labour input in the net output, although more capital is employed. This relationship between the capital-intensity and distribution is represented by b', in Figure i.

A shift in the technological knowledge is represented by f'(k). This may allow a neutral technical change that may not alter the factor-price frontier. In other words "modern" capital equipment may allow a higher net output to be distributed the constant proportions between capital and labour. However, when modern capital equipment may also be more capital-using, a movement from k_1 to k_2 also involves a shift from f(k) to f'(k). This may require the employment of more skilled labourer and new administrative and managerial functions to be performed. The consequences of the change in the

APPENDIX C : ALTERNATIVE CAPITAL-INTENSITIES IN CONSTRUCTION SECTOR TWO EXAMPLES

A comparative analysis of a labour-intensive apartment construction technology with a highly capital-intensive office building construction is given in the below table. In fact the technology used in the construction of both types of buildings are ranging from primitive material and means (e.g., stone, sun-dried mudbrick, wooden frame) in smalle towns and willages to modern materials (e.g., re-inforced concrete and steel, and even imported luxury materials) in large cities. The technological dividing line passes between reinforced concrete-brick -wood-stone for both the construction of frame and masonry. Even in the large cities, however, the use of modern (and often luxury) materials is accompanied by primitive means of construction. In our examples, the apartment building construction is an example of the use of 'red brick' with re-inforced concrete frame structure; it uses only one elevator and employs manual-labourrfor the rest of the construction activity. The office building, on the other hand, is a re-inforced concrete and steel frame structure, using concrete formssand blocks with red brick masonry. The total cost of construction equipment in the office building per worker per year is about 14.4 times more than the investment equipment per worker in the case of the construction technology used in apartment building.

The machines listed under the equipment used in the office building are mainly obtained through imports. Although Turkey started the production of construction machinery with assembly line methods in the early 1960's, production of machinery specifically related to construction activities was in the form of steel framework production and small capacity engines for the machines.[1] The main sources of technology of construction machinery assembled or partly produced in Turkey were based on licencing agreements with Swedish, West German, United States and the United Kingdom companies. The OECD report points out that the level of technologiss of thee

1. OECD, Scientific Research and Technology in Relation to the Economic Development of Turkey (Volume II, The Construction Sector), Paris (February 1967), pp. 64-66.

A Comparison of the Labour-Intensive and Capital-Intensive Techniques in Bulding Construction :

	An Apartment Building Completely Constructed by Hand - Ankara	Kızılay(Emek)Office Building, Designed by a Turkish Firm, Constructed by the Co-operation of a German Firm
Description	5 storey building, 1175 m^2 reinforced concrete frame structure; 'red brick' masonry	Total area, 22,000m^2; height, 73.45 m; reinforced concrete anamestrel-frame structure; concrete forms and blocks; 'red brick' masonry
Equipment used	One elevator	Aggregate plant, automatic scales, concrete plant, concrete-pouring by Tower Crane and Self-Grimping Crane, automatic load elevator
Total cost of building	798,750 TL	40,000,000 TL
Total cost of construction equipment	3,000 TL	350,000 TL
Average number of employees worked	20(one-year construction period)	in, foundation, concrete and masonry(two years) :130 finishing works(two years) :80
Construction investment[x] per employee per year	$\frac{798,750}{20}$ - 39,937 TL	$\frac{40,000,000}{420}$ - 95,000 TL
Investment in equipment per employee per year	$\frac{3,000}{20}$ - 150 TL	$\frac{950,000}{420}$ - 2,160 TL

(x) ' construction investment' is used to mean gross value of consturction output

Source: Scientific Research and Technology in Relation to the Economic Development of Turkey (Volume II, The Construction Sector) , by OECD, Paris (February 1967), pp.13-19.

have outweighted these gains. If the total cost figures (which also include the transfer costs) could be as low as it is calculated, the technological unemployment created by the choice of a highly capital-intensive technique is expected to be much higher than as three times as the level of employment created ; because a much larger output could be produced by 40,000,000 TL, through the use of a more labour-intensive technology.

APPENDIX D : PRODUCTIVITY AND EMPLOYMENT IN LARGE AND SMALL ESTABLISHMENTS

The indices of number of employees and labour productivity in small and large establishments are given in Tables i and ii, by manufacturing subsectors. A sectorwise analysis of the relationship between employment and productivity reveals no conclusive results on this issue :

Assuming y-employment indices, and, X-indices of labour productivity ;

In the large establishments : $\log y - 2.2455 - 0.02321 \log x$
$(8.6383)(-0.1963)$
$R^2 - 0.00203$ D.W. -1.677199

In the small establishments : $\log y - 3.7325 - 0.6853 \log x$
$(4.4299)(-1.8346)$
$R^2 - 0.14405$ D.W. -1.40324

One of the causes of this relatively weak relationship between employment and productivity is the rather short period of time used in the regression analysis. Although the high employment and productivity growth sectors can be distinguished in Tables 8.2 and 8.3, this has been excluded by the same token.

TABLE i INDICES OF EMPLOYMENT AND LABOUR PRODUCTIVITY IN LARGE MANUFACTURING ESTABLISHMENTS IN 1968(1963-100)

Sector Code	Industry Group	Indices of Number of Employees	Indices of value-added per employee
20	Food manufacturing	136.2	146.8
21	Beverage industries	146.3	246.8
22	Tobacco manufactures	170.8	341.2
23	Textiles manufactures	125.9	143.1
24	Footwear and other wearing apparels	136.7	132.8
25	Wood and cork products	128.9	81.6
26	Furniture and fixtures	176.9	100.7
27	Paper and paper products	113.5	131.8
28	Printing,publishing and allied industries	134.0	124.3
29	Fur and leather products	102.9	100.2
30	Rubber products	166.9	393.3
31	Chemicals and chemical products	159.4	131.2
32	Petroleum and coal products	133.6	479.0
33	Non-metallic mineral products	157.9	144.0
34	Basic metals manufactures	217.0	201.0
35	Manufacture of metal products	152.8	126.8
36	Manufacture of machinery	268.9	93.55
37	Electrical machinery,apparatus and supplies	198.5	96.2
38	Transport equipment	162.1	143.4
39	Miscallaneous manufacturing industries	262.0	144.4
	Total Manufacturing	148.4	183.8

Source : Based on the figures supplied by the National Productivity Center of Turkey in Productivity Statistics : Manufacturing Industries , NPC publication no.76, Ankara (1970)

TABLE ii INDICES OF EMPLOYMENT AND LABOUR PRODUCTIVITY IN SMALL MANUFACTURING ESTABLISHMENTS IN 1968 (1963-100)

Sector Code	Manufacturing Industries	Indices of Number of Employees	Indices of value-added per employee
8	Mill products	231.8	131.6
10	Other food stuff manufacturing	80.0	320.6
11	Sprits	109.8	102.6
12	Non-alcoholic drinks	60.1	147.3
14	Textiles	57.0	312.9
15	Footwear manufacturing and repair	141.5	271.6
16	Clothing	161.9	249.4
17	Wood and cork products	283.9	130.5
18	Furnitures and fixtures	185.1	168.2
19	Paper and paper products	305.8	123.4
20	Printing, publishing and binding	157.6	153.5
21	Fur and leather products	175.4	183.7
22	Rubber products	108.7	276.2
24	Other chemical products	81.6	378.5
28	Non-metallic goods	127.3	155.8
31	Mineral goods	111.7	164.5
32	Non-electrical machinery	239.8	143.0
33	Electrical machinery	122.8	153.7
34	Mechanical transport vehicles	102.1	164.5
35	Other transport vehicles	227.7	154.7
36	Plastic goods	1.168.7	188.2
37	Miscallaneous manufacturing	214.6	112.6
	T o t a l	146.0	--

Source : SIS, 1968 Sektörel Küçük İmalat Sanayii Tahmini , SIS publication no. 686, Ankara (1973), pp.52-54

Table iii Employment in Manufacturing Industries by Large Establishments[x] and Small Establishments.

Industry Code	Manufacturing Industries	Number of Employees in 1968 Large Establish.	Small Establish.	Total	Number of employees in1963 Large Establish.	Small Establish.	Total
8	Mill products	6,356	14,485	21,201	7,064	6,405	13,473
9	Sugar factories and refineries	15,370	-	15,370	25,089	-	25,089
10	Other food manufacturing	46,716	32,254	79,970	33,549	41,574	75,123
11	Sprits	5,076	885	5,961	4,435	806	5,241
12	Non-alcoholic drinks	1,345	1,666	3,011	180	2,770	2,950
13	Tobacco	42,906	-	42,906	16,764	360	17,124
14	Textiles	114,382	17,922	132,304	104,738	31,464	136,202
15	Footwear manufacture and repair	2,886	50,509	53,395	2,372	35,685	38,057
16	Clothing	4,932	98,340	102,732	669	60,748	61,417
17	Wood and cork products	8,091	82,098	90,189	6,147	28,915	35,062
18	Furnitures and fixtures	1,646	20,361	22,007	1,022	11,003	12,025
19	Paper and paper products	8,888	3,694	12,582	7,582	1,208	8,790
20	Printing,publishing and binding	6,917	8,462	15,379	5,270	5,369	10,638
21	Fur and leather products	2,154	15,751	17,905	2,147	8,978	11,125
22	Rubber products	8,846	2,203	11,049	6,339	2,027	8,366
23	Chemical fertilizers	2,883	-	2,883	2,815	-	2,815
24	Other Chemicals	18,810	2,009	20,819	11,633	2,462	14,095
25	Oil refineries	1,184	-	1,184	1,177	-	1,177
26	Other petroleum and coal products	476	-	476	667	297	964
27	Cement	8,541	-	8,541	6,711	-	6,711
28	Non-metallic mineral goods	22,563	12,060	34,623	13,577	9,474	23,051
29	Iron and Steel	23,583	-	23,583	6,870	-	6,870
30	Other basic metals	14,002	-	14,002	6,088	-	6,088
31	Mineral goods	23,999	68,397	92,396	21,512	61,222	82,734
32	Non-electrical machinery	11,459	2,015	20,474	5,343	3,760	9,103
33	Electrical machinery	9,507	7,513	17,020	5,584	6,119	11,703
34	Mechanical transport vehicles	12,424	16,787	29,211	2,573	16,436	19,009
35	Other transport vehicles	18,208	13,437	31,645	14,997	5,901	20,898
36	Plastic goods	4,617	17,449	22,066	1,425	1,493	2,918
37	Miscelleneaus manufacturing	2,399	20,847	23,246	1,098	9,545	10,643
	Total	450,626	517,504	968,130	325,441	354,021	679,462

X Large establishments employ 10 persons;small establishments employ 1-9 persons

Source:SIS,1968 Sektörel Küçük İmalat Sanayii Tahmini,SIS publication no.686,Ankara(1973) pp.28,55

APPENDIX E : INTERVIEWS WITH TEN TEXTILE FIRMS ON SOURCES OF INNOVATION

We interviewed the ten largest firms (by their product value, turnover, capital stock, employment and profitability), in the Aegean Region. The names of these firms are enlisted in Table iv.

Theesource and the technological properties of the machine park of the two of these plants are shown below, by 1973.

Firm A

The Weaving Plants

Obtained From	Seller Firm and Type of loom	Year	Quantity	Rotation Per Minute	Power Capacity of Each Loom	No. of Looms Per Worker
Britain	Nothrop, P.S. Model, narrow-looms	1948-50	?	180	HP 1 - 0.5	10/1-15/1
Domestic-made	Yumlu, Northrop design, large-looms	1953	?	140	HP 1 - 0.5	12/1-15/1
Belgium	YPPES, Picanol-large	1967	80	220	HP 2	
Belgium	YPPES, Picanol-narrow	1967	10	220	HP 1.5	

Firm B

I. The Weaving Plants (All Automatic Looms)

Obtained From	Seller Firm and Type of loom	Year	Quantity	Rotation per Minute	Power Capacity of Each Loom	No. of Looms Per Worker
Germany	Ruti	1955	128	180	(HP)1	16/1
Domestic-made	Yumlu-British Northrop design	1960	44		(HP)1 $\frac{1}{4}$	15/1
Britain	... ...	1965	26	180	(HP)1 $\frac{1}{4}$	8/1
"	... Semi-electronic	1968	10	220	(HP)10	3/1
"	... ...	1971	22	180	(HP)1 $\frac{1}{4}$	8/1
"	... double-cloth-weaving	1972	48	170	(HP)2	12/1

II. The Spinning Plants

Switzerland	Rieter Co., Vater Spinning looms	1954	14	10,000	?	?
"	" "	1959	4	11,500	?	?
"	" "	1960	1	13,000	HP 10	3/1
"	" ""	1963	10	13,000	HP 10	3/1
"	" "	1966	5	13,000	HP 10	3/1
"	" "	1967	11	13,000	HP 10	3/1

Table iv THE FIRMS WITH A TURNOVER ABOVE ONE MILLION TURKISH LIRA IN 1971

Record No of the Firm (1)	Name of the Firm and the Type of Production (2)	Turnover In 1971 ('000 TL) (3)	Value of Capital Stock ('000 TL) (4)	Profit in 1971 ('000 TL) (5)	Profitability As Percentage of (%) : Capital (6)	Turnover (7)	No. of Workers In: (xx) Direct Product^N (8)	(xx) Indirect Product^N (9)	Total Work-hours employed in 1971 (10)	Total Power Capacity (HP) (11)
TEXTILE INDUSTRY (Code No:23)(Ten Biggest Firms;all combined plants including spinnign, weaving and finishing processes)										
531	SUMERBANK (x) (public) Basma (no spinning)	186,083	29,000	58,424	201,4	31.5	1916	118	4,371,000	8097
155	PAMUK MENSUCAT T.A.Ş. (x) Cotton Products	156,845	7,700	21,012	272,8	13.3	1399	71	3,098,000	3772
29	KULA (x) Wollen-cotton products	118,569	5,000	20,616	452.3	19.0	2257	45	4,852,000	3850
236	ŞARK SANAYİİ Cotton Weaving-Spinning	76,537	11,550	327	2.8	0.5	1435	39	3,421,000	3254
753	TAC SANAYİİ (x) Cotton Products	75,697	10,000	14,663	146.2	19.3	777	167	1,818,000	3087
1676	BERGAMA Cotton weaving	46,271	21,000	13,360	63.6	28.9	926	38	1,098,000	3693
1493	İZMİR BASMA Basma-iplik	28,565	5,000	5,973	119.4	20.9	316	56	354,000	1856
324	YUN MENSUCAT (Kula Partner) Wollen Weaving	24,614	4,400	643	14.6	2.6	406	25	992,000	787
4797	SEZAK Carpet Weaving	21,544	2,500	1,442	57.7	6.7	172	10	331,000	359
2490	Nakış İpliği Fabrikası	13,166	3,150	1,115	35.4	8.4	271	8	599,000	?

(x) exporters ; (xx) November 1971

Source : The Aegean Chamber of Industry

In both firms, a domestic-made weaving plant, called YUMLU is used. The YUMLU Co., imported most of the assemly parts from British Northrop, in the early 1950's. Later it copied the Northrop design and casted all the parts required, at its own workshop. Its production was cheaper than the import costs. However, technically it was not suitable for a 3-shift working system. The number of breakdowns was higher which led to high repair and maintenance costs, as well as raw material wastage. Consequently, the textile firms chose to import the textile machinery that they needed.

The costs of alternative weaving plants was as follows :

			output capacity		
Northrop	(1951) :	TL 30,000	76,800	shawl/8	hours
Yumlu	(1953) :	TL 17,000	52,000	"	"
Large Pikanol	(1967) :	TL 107,000	66,200	"	"
Narrow Pikanol	(1967) :	TL 80,000	-	-	-

When YUMLU plants were substituted by new imported machinery, they were sold to smaller firms serving to the local markets in the typical Anatolian cities.

APPENDIX F : AN EXAMPLE OF THE PHENOMENON OF TRANSFER PRICING

According to a report prepared by the Ministry of Health and Social Services, the phenomenon of transfer pricing has been observed to a large extent in the field of pharmaceuticals. A comparison of the transfer price and the external market price of certain pharmaceuticals products, is given below, by the name of the firms producing these products.

Name of firm	Name of product[x]	Transfer Price \$ [xx]	External Market Price \$ [xx]
Santa Farma	Lucidril substanse	64	27
M.Nezzat	Neobenodyn	56.41	15
Sandoz	Lanotosid (1 gr.)	19.5	5
West German I.F.	Ekstra de belladon	7.75	4.35
Deva	Endometasin	411	120
Roche	Tri metoprin	517	175
Turk-Hoechst	Frosemid	160	75
Roche	Niyrazepam	2050	96
Eczacıbaşı	Clomifen sidrat	1857	138
Carlo-Erba	Cloramfenicol	87	50
Squip	Preludin metil tetraclyn	600	48
Iltas	Tri metaprim	257	175

[x] names of these products are copied from the report as they were written there

[xx] per kg.

Source: 7 Gün 11 July 1973 , p.23

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APPENDIX B : DATA USED ON THE TURKISH MANUFACTURING INDUSTRY, 1951-1970

	Value-Added (Million TL) at current Prices) (1)	Price Deflator Index (1968=100) (2)	Value-Added at Constant Prices (VA)	Employment (L) (3)	Productivity ('000 TL) (VA/L)	Annual Average of Daily Current Wage (4)
1951	1,362.0	31.6	4,310.1	621,055	6.940	4.62
1952	1,537.0	32.2	4,775.3	645,876	7.390	5.17
1953	1,826.0	32.5	5,618.5	671,711	8.364	5.50
1954	2,163.5	35.2	6,146.3	698,579	8.798	6.24
1955	2,682.3	38.7	6,931.0	726,522	9.540	7.21
1956	3,249.8	42.7	7,610.8	755,583	10.073	8.24
1957	4,140.5	49.4	8,381.6	785,806	10.666	9.22
1958	5,304.5	58.2	9,114.3	817,238	11.152	10.90
1959	6,852.4	73.0	9,359.5	849,928	11.012	13.28
1960	6,871.9	74.3	9,948.9	884,659	10.681	14.45
1961	7,652.0	73.3	10,439.3	920,045	11.347	15.59
1962	9,055.4	84.3	10,870.8	949,885	11.444	16.48
1963	10,661.0	85.1	12,427.6	984,282	12.728	17.91
1964	11,807.9	86.6	13,635.0	1,019,929	13.369	19.50
1965	13,467.9	90.2	14,931.2	1,056,875	14.128	21.64
1966	16,153.4	93.8	17,221.1	1,095,147	15.725	23.28
1967	18,790.5	98.7	19,037.6	1,134,781	16.776	25.85
1968	21,359.8	100.0	21,359.8	1,175,875	18.165	28.22
1969	24,558.7	102.9	23,866.6	1,218.462	19.587.	32.13
1970	27,463.3	112.2	24,477.1	1,263.624	19.371	34.97

Sources: See notes below:

Notes: (1) Obtained from the Dept.of Social Statistics of the State Institute of Statistics of
(2) SIS, National Income of Turkey, 1948-1972, publication No.681 (1973), p.85
(3) See, note(1)
(4) 1950-1957 figures have been obtained from,T.Bulutay,An Econometric Appraisal,Ankara Turkey(SPO);covers the wage-earner registered with the social Security.
(6) 1963-1969 figures are based on the 1971 Annual Program,Tables:31,32,33 and 34 1960-1962 and 1963, SIS publication No's.460 and 490;and,N.Serin, Turkey's Industrial
(7) S.Korum, Wholesale Price Indices in Turkey , Ankara(1968),p.45 ; and,Statistical Year
(8) Statistical Yearbooks 1960-62, 1963 and 1971, ibid.;Statistical Yearbook 1964-1965,
(9) T.Bulutay,ibid.p.197 ; the 1948 depreciation figure was multiplied by 20 to obtain the tal stock: consequent years' net investment figures were added to 1948 estimate to

IN CHAPTER 7

Real Average Daily Wages (5)	Investments (At Current Market Prices)(million TL) (6)	Whole sale Price Indices (1953=100) (7)	Output (At Current Market Prices(million TL) (8)	Output (At fixed prices) (million TL)	Capital stock (At Current Market Prices) (millon TL) (9)
-	122.5	97	-	-	1,092.0
-	124.5	98	2,764.5	2,820.9	1,179.0
-	235.9	100	-	-	1,328.0
-	291.0	111	3,930.0	3,540.5	1,410.0
8.37	373.3	119	5,029.0	4,226.1	2,154.0
9.22	516.4	139	5,982.2	4,303.7	2,796.0
9.79	367.7	165	7,793.6	4,723.4	3,487.0
11.25	427.8	190	9,994.4	5,260.2	4,187.0
13.32	449.4	227	113,697.2	6,034.0	5,693.0
13.96	596.4	239	14,895.2	6,232.3	5,775.0
14.46	547.5	246	15,787.2	6,417.6	7,162.0
15.43	1,465.5	260	17,199.1	6,615.0	9,820.0
15.60	2,305.2	271	19,635.7	7,245.6	-
16.79	2,019.9	269	23,052.8	8,569.8	-
17.58	1,964.5	298	28,668.5	9,787.9	-
18.72	2,593.0	307	34,175.3	11,132.0	-
19.41	3,433.6	331	41,957.9	12,676.1	-
21.61	4,348.2	341	46,891.0	13,751.0	-
23.51	5,463.4	366	-	-	-
24.98	-	390	-	-	-

urkey (SIS)

1967),p.191;the rest of the figures have been obtained from the State Planning Organization of

ring investments prior to 1963 have been obtained from the Annuaire Statistique de la Turquie
ation, Ankara(1963),Table:2.9. All figures are gross.
ok of Turkey 1971 , SIS publication No.670
publication No.510 ;N.Serin,ibid.,p.194-a.
years capital stock assuming that the depreciation allowances account 5% of the existing capi-
each the consequent yearly capital stock figures.