TECHNOLOGY TRANSFER AND DEVELOPMENT : EXPERIENCE OF IRAN'S AUTOMOBILE INDUSTRY

A dissertation submitted to the Jawaharlal Nehru University
in partial fulfilment of the requirements
for the award of the degree of

MASTER OF PHILOSOPHY

MOHAMMAD HASSANI

CENTRE FOR ECONOMIC STUDIES & PLANNING
SCHOOL OF SOCIAL SCIENCES
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI-110067
INDIA

1997

CENTRE FOR ECONOMIC STUDIES & PLANNING
SCHOOL OF SOCIAL SCIENCES
JAWAHARLAL NEHRU UNIVERSITY

New Campus
NEW DELHI - 110 067

CERTIFICATE

Certified that the Dissertation entitled **"Technology Transfer and Development: Experience of Iran's Automobile Industry."** Submitted by **Mr. MOHAMMAD HASSANI** in fulfilment of the requirement for the award of **Master of Philosophy** of the Jawaharlal Nehru University, is to the best of our knowledge and belief, a bonafide work of the student and may be placed before the examiners for evaluation.

Chairperson

(Prof. Abhijit Sen)

Supervisor

(Prof. C.P. Chandrasekhar)

Phone: 667676, 667557 Ext. 204/249/207, 665197 Cable: JAYENU Telex: 031-73167 JNU Fax: (011) 686886

Until you reach your liberated and freeself isolated from the constricting selves of others, you will not accomplish anything.

FOROOGH FARROKHZAD

To my parents

ACKNOWLEDGEMENT

I want to express my deepest gratitude to Professor C.P. Chandrasekhar who most generously and thoughtfully made efforts to improve this work.

I also owe to my friend Mr. Issa. O. Kipera, special note of gratitute is due to my brother Mr. Hossein. Hassani from university of Shahid Bhashti Tehran, and also my brother Mr. Hassan. Hassani from Columbus College, Georgia, for their constant moral stimulation throughout the work.

I am grateful to Dr. H. Dezhbakhsh university of Emory, Georgia, and Dr. M.A. Shafia, Iran's science and technology university, Tehran, for their immense encouragement.

I should thank Mr. B.B. Singh for typing this work.

Mohammad Hassani

Mohammad Hassani

March 1997

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INTRODUCTION

The present study has two related objectives, both limited and modest in scope. One is to explore the performance of Iranian manufacturing sector in the twentieth century. The other aim is to assess the performance of imported technology and technological capabilities in the automobile sector and to use the Iranian experience as the basis for a more generalized analysis of such experiences elsewhere.

The study is presented in five chapters. Chapter I focuses briefly on the main developments in Iran's manufacturing sector. This sector has played a leading role in promoting the process of Iran's transformation from a traditional, stagnant and backward agrarian economy to a rapidly developing country.

Chapter II details the emergence, evolution and growth of Iran's automobile industry over the past three decades, and production trends and government policies during the period of the First Five Year Development Plan (1989-1993). Chapter three discusses channels of technology transfer, theories of technology and technological capabilities.

Chapter IV provides an analytical assessment of the transfer of technology in Iran's automobile industry, based on the limited empirical data available while chapter V contains a description and analyses of national technological capabilities. Chapter IV gives a summary of the findings and policy implications. The limitations and prospects for further research in the study area are also discussed.

We admit that in preparaing this dissertation we have been hindered, and at times severely handicapped, by the paucity and inconsistency of available data. Yet, we have done our best to present the available material as clearly as possible and we hope that it can be read and understood by any reader. The mistakes and shortcomings that remain are in part due to the vicissitudes of the learning process itself.

CHAPTER I

IRANIAN MANUFACTURING INDUSTRY

1.1 Introduction

The growth of the manufacturing sector has important dynamic effects in the economy as a whole. On the one hand its absorption of surplus labour helps to restructure the social and technical conditions of production in other sectors and introduce modern technology in these sectors. On the other hand, by providing technological inputs, it makes such a technical change in the other sectors possible.

We begin our inquiry into the performance of Iranian manufacturing industry by analyzing specific trends in three separate periods. In the first, comprising of the ninteenth century and the years upto the Second World War, the focus is on the role of the State in the economic affairs of the country in 1930s. The analysis of the second post-war period will be concerned with the development of the economy consequent to the establishment of budgetary and planning organisations and the emergence of oil rev- venues as the major source of financing capital accumulation.

This part will also deal with the import substitution strategy in Iran and the specific role of the State. The predominant role of the State was that of resource mobilization for development. This chapter will also look into the industrial policies of the government in the pre and post revolution eras and the first five year development plan of the Islamic Republic (1989-1993).

1.2. Evolution of Manufacturing Industry in Iran

At the end of the nineteenth and beginning of the twentieth century manufacturing existed only in a limited number of Iranian industries. The main branches were: Carpet weaving, leading workshops for the preparation of opium, Henna preparations and some fields such as mining, and shoemaking. This was despite various attempts that had been made to introduce, modern large scale manufacturing during the closing years of the nineteenth century. For examples, in 1889 a Russian entrepreneur ploughed Rials (RIs) one million into the establishment of a match factory. In 1891 a Belgian firm opened a glass factory and in 1894 Iran erected a cotton spinning plant all of which were near the capital city of Tehran. Also in 1895 another Belgian company set-up a sugar plant at Kahri Zak. (Bharir, J.,, J., 1979). Owing to the cost of obtaining raw materials,

competition from imports and some non-economic factors, all enterprises closed within a few years.

Between 1911 and 1921 there were two major developments that had important implications for the subsequent course of political and economic development in Iran. The first was the October revolution in Russia and the second was the rise of the oil sector as a major source of foreign exchange and government revenue. They both contributed in their own way to the rise of the centralised authoritarian regime of Reza Shah. Between 1913 and the mid - 1920s, prior to the world depression, there was already a noticeable decline in the terms of trade facing Iranian primary export. Further, the volume of exports stood below the pre-war period, and the stagnation of the export sector created important institutional tensions in the economy. An important factor that effected the structural rigidities of the Iranian economy and a good measure of its peripheral orientation, was its dependence on imports for the basic manufactured mass consumption goods (such as cotton textiles, kerosene, sugar and tea), which is a clear demonstration of the extreme backwardness of the economy during the period.

In Iran, in keeping with the experience of all primary exporters, the great depression accelarated the decline of foreign trade that was already taking place during the

1920s,(Moghadam, G. R., 1956). During the 1930s the newly formed centralized Shah machinery was turned into a very effective means of mobilization and central control over economic resources. Government expenditure in real terms rose from RIs 329 million in 1928 to RIs. 890 million in 1935 and RIs 977 million in 1937. The pace of capital formation accelerated in the later half of the decade. The major share of investment during this period was concentrated within the State sector. More than 20 percent of total government expenditure during the decade was invested mainly in transportation and industry. The expanding government expenditure and investment during this period were financed mainly with domestic resources through tariffs, road taxes profits of monopoly companies and deficit financing that, under the conditions of inelastic supply could be viewed as one form of indirect taxation. More than 10 percent of total government expenditure was financed through indirect taxation or deficit financing.

Table (1.1) : Statistics of large Manufacturing Industry, 1926-47 (Establishments with Ten or more workers).

Year	New establish ments	No. factories	No of Workers employeed	No factories	Horse Power (H.P)	No of Installed factorue s	Paid-up capital (Ml. RIs)
1925	2	2	462	1	1,005	1	0
1927	0	0	0	0	0	0	0
1928	0	0	0	0	0	0	0
1929	5	5	463	3	2,105	3	8
1930	1	1	2,397	1	3,500	1	187
1931	2	2	859	2	1,666	2	60
1932	8	6	2,182	6	1,599	5	67
1933	6	4	586	5	871	5	60
1934	13	13	5,675	10	4,824	11	182
1935	12	11	3,092	9	8,838	11	223
1936	14	11	5,142	13	8,654	11	443
1937	9	9	6,418	7	7,492	9	625
1938	10	9	7,417	8	9,127	8	373
1939	4	3	1,184	4	2,202	3	60
1940	3	3	67	3	550	3	11
1941	3	2	149	3	178	2	23
1942	1	1	146	1	3,300	1	14
1943	1	1	12	1	233	1	0
1944	4	4	1,949	0	0	3	6
1945	1	1	17	0	0	1	0
1946	9	7	1,409	4	223	5	15
1947	2	2	795	1	13	0	
Date not given	68	39	3143	20	5986	28	361
Total	178	11136	40,421	102	62,376	114	2,718

Reliability : Fair for number of factories and employment poor for H.P. and paid-up capital.
Source : Ministry of labour, Statistical survey of Major Industrial Plants of Iran, 1947,(P), Tehran, undated (1948?)

As can be seen from table (1-1), during these years the establishment of new factories accelerated. The number of workers employed increased by 240 percent between 1932 and 1938 and total installed horse power increased to 62367 by 1947. Table (1-1) also highlights the fact that industrialisation progressed continuously after 1929. A

remarkable feature reflected in table (1-1) is the steep increase in manufacturing industry between 1934 and 1938. During these years the number of new factories set up increased dramatically. After 1938 the growth of firms and industrial output appears to have slowed down due to second world war and few new industries came-up. The most important industries were sugar, cotton textiles, matches, and cement. A series of other smaller industries including chemicals, other textiles, soap, food processing, glassworks, leather works, rice milling and tea processing also played a role in the industrial expansion till 1938. Subsequently, the growth of firms and industrial output appears to have slowed down, possibly, because of general fear of over production or government attempts to limit profits. Moreover, the total import of industrial spare parts and replacement machinery was severely cut due to the closure of the Iran-Russia border. Consequently there was a noticeable deterioration of plant and equipment in Iranian industry.

During the war little information is available about the development of small-scale industry especially during the period between 1926-47. Many of the new industries established in the 1930s, belonged to the State which by the end of the decade was allocating 20 percent of its general budget to industry. Sixty-four factories were State owned in 1946. Out of a total of 49000 workers in large-scale manufacturing industry in

that year, approximately 50 percent were employed in State factories. Sugar, Cement, and Tobacco were entirely State controlled, although only sugar and tobacco were specifically State monopolies. In textile, tea processing, flour milling and rice milling a mixture of private and public plants operated (Bharir, J.,, J., 1971), while all other manufacturing industries were left almost entirely to the private sector.

State policy was driven on by the view that industry was required for the dual purpose of making the country modern and self sufficient. Considerations of profitability and employment creation rarely arose. Industrial production rose from an insignificant proportion of gross national product to about 5 percent between 1926 and 1947 with total employment in all industry reaching about 100,000 by the later 1950s. But owing to the effects of the war, and inherent inefficiency of factories almost all of the plants required substantial renovation, repair or replacement.

1.3. Manufacturing Industry in the Post-Second World War Period:

From the annual reports of the National Bank (Bank Meli) it is observed that there was an industrial recession from 1947 to 1952. It is stated that the government plants were rendered unprofitable owing to mismanagement, redundant employees and

extreme centralization of management that killed initiative. Above all, these factors the large volume of imports from competing producers from abroad which had flooded into the country at the end of the war rendered local firms unprofitable (Bharir, J., 1971, p. 183).

The transformation in the concerns and mode of economic intervention of the Iranian state in the post-1953 period was also to a large extent structured by the developments in the international economy and political events. The post war restructuring of the world capitalist system under the hegemony of the multinationals led to a direct investment phase of western economic dominance and created totally different conditions of accumulation from those prevailing in the inter war period. (Jazayeari A, 1989) This period embraces the introduction of the first national development plan and the nationalization of the oil industry.

Despite all the difficulties, however, the implementation of the first plan did start and the foundations of a planning organization were laid in 1949. Initial attention was paid to the industries that had already been established and which because of over-exploitation and improper maintenance, were in a pitiful state. Investments were aimed at

resuscitating these industries and creating new ones. But when the planning organization had only just begun to implement the first plan, the flow of oil revenue was interrupted due to the economic embargo on Iran by the West following the nationalization of the oil industry in 1951. With the resumption of oil payments in 1959, it was decided that a new development plan should be worked out to fit the altered circumstances. The implementation of the second development plan was successful in some respects but a failure in others. The performance of the economy during the second plan made it possible to achieve an average growth rate of 4.3 percent in current prices. The GNP rose from RIs 229 billion in 1955 to RIs 301.6 billion in 1962.

Apparently 1956 and the four subsequent years represented a period of significant advance for manufacturing industry. Imports of machinery for textile industry and all other industries grew rapidly in volume and value and the production indices of most of Iran's major commodities, sugar, cotton and woolen textiles, cement, card board, and vegetable oil, all registered continued growth. The number of industrial enterprises increased from about 45,000 in 1957 to about 70,000 in 1960. From 1959 to 1968 gross value added increased by an average of 15 percent each year, and gross value of output by a somewhat higher percentage, implying a greater vertical integration in the economy.

This high growth rate made manufacturing industry into a leading sector in the country's development effort.

The share of manufacturing output in GNP expanded from 8.5 percent in 1959 to 15.4 percent in 1968. Value added in industries and mines, which during the period under review accounted for about 23 percent of GNP increased from RIs. 106.3 billion in 1967 to RIs 195.9 billion in 1972.[1] The actual growth rate of value added in industries and mines amounted to 13 percent, or 0.6 percent higher than the fourth plan target value. As a result of the rapid growth of industries and mines, the relative share of this sector in GNP increased from 22.5 percent in 1967 to 23.4 percent by the final year of the plan period, (Jazayeari, A., 1989).

There was parallel growth in light consumer goods, intermediate goods and consumer durable and capital goods. The growth in light consumer durables, food processing, textiles, and footwear was 10.7 percent, intermediate goods (steel, fertilisers and chemicals) 19.3 percent and consumer durables (Radios, Television, and private motor

[1] Rials is Monetary Unit of Iran. In 1970 Exchange rate was RIs. 76.5 = U.S. $1.

car) and capital goods (cement and electrical equipment) 29 percent. Most of the growth in non-durable consumer goods occurred in processed food, clothing and textiles. Intermediate commodities and basic metal industries registered the fastest growth with real value added rising from RIs. 10 million in 1962 to RIs 6.5 million in 1972. In consumer durables and capital goods, most of the growth was attributable to the motor vehicle industry and electrical equipment. Manufacturing growth was largely based on the home market. Industries simply grew in response to an existing home demand which was until then satisfied by imports. The share of the value of the total manufactured export was 12.3 percent of the total manufactured value added in 1960 and about the same in 1970. Although small, the value of manufactured exports rose at an average rate of 10.5 percent from 1962 to 1970. (Karshanas. M., 1990),

1.4. Factors Promoting Industrial Growth

As was argued at the outset, the growth of Iranian industries has been mainly the result of state intervention. Neither the native Iranians nor foreign capitalists, were in the past able or willing to invest in industry.[2] Since 1953, under favourable

[2] According to Abdullaev, the bankraptcy of Amin al-Zarb, who was among richest and most influencial Iranian merchants put an end to the emerging Iranian bourgeoisie as early as 1909. The rivival of Iranian bourgeoisie did not occur unitl post 1953 period. Even then not on the basis of its own initiative and the internal dynamism of the Iranian economy but on the basis of increased oil revenue.

financial and policy conditions these two private branches of capital preferred to participate in the industrialisation programme. The indirect as well as direct contribution of the Iranian government, through a series of strategies and incentive programmes has been a major cause for economic growth in Iran. The recipient of oil revenue, the State, was the main initiator of industrial growth and it had worked out its policy in a number of ways:

1. The State invested directly in industry: under the third plan 53.1 percent of all industrial investment was by the State under the fourth 38.8 percent of all industrial investment and under the fifth 40 percent. (Karshanas, M., 1990, Hixson, A. 1983). The 1973 oil price hike increased this share so that in 1975, 60 percent of all industrial investment was made directly by the State. This phenomenon, was specially noticeable in petro-chemical chemicals, steel, gas and vehicle assembly
2. The State had provided the funds for the private sector to develop through a number of special financial institutions set up for this purpose viz. Revaluation Loan Fund, Industrial Credit Bank, and the Industrial and Mines Development Bank of Iran.

The most effective measure taken by the state, in terms of this initial impact on private investment in the 1950s, was the creation of the Revaluation Loan Fund (RLF) in 1957. The revaluation of foreign reserves in 1957 provided RIs 7.1 billion, which was earmarked for granting long-terms loans to private industry and agriculture. During the 1957-59 period the RLF provided RIs 6.6 billion as long and medium term credit at highly subsidized rates to private industry.

After 1959, at a highly subsidized value to private industry, the management of the RLF was entirely entrusted to private sector itself. Throughout the 1960s, and 1970s, the policy of financial support to private industries continued on a more massive scale through two powerful industrial finance banks. Industrial Credit Bank (ICB) and the private owned Industrial and Mines Development Bank of Iran (IMDBI), (Karshanas M., 1990). Industrial Credit Bank was formed by the plan organization in 1955 with the explicit purpose of providing long term financial assistance to private industry.

During the 1960 and 1970s the Industrial Credit Bank provided about 30 percent of large and medium term loans. It became the second largest supplier of funds to private industry after IMDBI. The formation of IMDBI in 1959 was a landmark in the development of industrial capital in Iran. The bank was created when Iranian

industrialization was entering a new era of its development. This was when the production of consumer durables and intermediate products, required new and relatively more sophisticated technology and large initial investments. It also required ample supplies of foreign exchange. IMDBI played a crucial role in all aspects of this process of industrial restructuring. It is estimated that during 1959-72 alone the bank was directly involved in the mobilization of more than 55 percent of total private fixed investment in industry. The significant involvement of IMDBI in the development of manufacturing in this period became more evident. ICB was especially geared to providing loans to modern small to medium sized firms. IMDBI was left with a virtual monopoly over government subsidized loans to the large scale manufacturing sector.

A notable aspect of industrial finance over this period was the total domination by the two major development banks, IMDBI and ICB - but particularly the former. The contribution of other industrial finance institutions, though relatively low compared to these two, were also significant. The second important aspect of industrial finance in this period was the relatively large and rapidly growing share of bank loans in financing private investment in the manufacturing sector.

Fiscal measures had also played a significant role. High rates of duty were levied on imports in an attempt to promote domestic production. The state also exempted firms from paying duty on capital goods imported for construction of their plants. It took the primary responsibility of building the infrastructure that was needed for industrial expansion which the private sector would not construct by itself.

1.5 The Role of Private Sector and Foreign Capital

As argued, historically there were no strong local entrepreneurs committed to industrialization. Private economic activity was based on trade. It was only the government's promotion of industry and the land reform programme that have brought into existence a significant number of capitalists who were willing to participate in the industrialization programme. There is little reliable data on the structure of private investment over this period, but the available data for this period shows that a relatively large share of private investment was channelled into new import substituting industries which together with government industrial investment resulted in a rapid change in industrial structure. Private sector investment in the manufacturing sector is estimated to have grown at an annual rate of growth of about 14 percent in real term over the 1965-77 period, (Karshanas, M., 1990).

The last agent in the industrialization has been foreign capital. Prior to 1960, the only significant foreign investment was in the oil industry. The state gradually encroached on this area of foreign domination so that after 1973 the foreign oil companies played no significant role in the Iranian economy.

1.6. Criticism of Industrialization Strategy in Iran

For the great majority of LDCs industrialization is still the fundamental objective of economic development policy. Statements still emphasize the argument that industrial development is necessary to achieve high rates of economic growth, provide for basic needs of the population, create more employment opportunities, diversify the economy and give rise to desirable social, psychological and institutional changes, (United Nations; 1975, p. 2). Thus, "industrialization is sought in the developing world as an essential ingredient of the expansion, diversification and modernization of their economies and thereby of improving the general standard of living" (UNIDO, 1975).

In global terms, the long term objective of the LDCs as stated in the Lima Declaration and plan of action on industrial development and co-operation (UNIDO,

1957) is that they should account for at least 25 percent of world manufacturing value added by the year 2000.

Import substitution, or inward looking industrialization, has been the overwhelmingly favoured strategy throughout the third world. The strategy was to begin to produce at home more of the consumer goods hithero imported. The main policy was protection, which meant the erection of high tariffs or quotas on competing imports and maintenance of low tariffs on imported inputs. The result was the growing inefficiency of consumer goods producers and an increased dependence on imported intermediate and capital goods to feed the new industries. However, the analyses of S.Korea's industrialisation shows the IS of the 1950's was instrumental in rebuilding the light industry and in raising the educational standards of Korea's workforce. Without the capacity and capabilities built during this period, it is hard to envisage the export take off of the 1960's.

By the early 1960s the initial optimistic outlook had turned more cautious and self critical. Import subsidizing industrialization had proved incapable of diffusing these benefits to other sectors due to the concentration of technical progress and its fruits. It

aggravated the economies' external vulnerability (Perbisch R., 1963). A study by ECLA (1970) economists such as Maria da Conceipal, Tonahes and Celso Furtado argued that once the so-called easy phase of import substitution (i.e. consumer goods industries) had passed and industrialization advanced to the substitution of intermediate and capital goods which required more capital and foreign exchange the process become stuck and industrial growth declined. Import substitution contributed nothing to creating a diversified export structure. The ECLA study also pointed to the exhaustion of the import-substituting industrialisation process and acknowledged that this inward directed development strategy had not led to diversification of exports as anticipated. [3]

Iran began to follow a strategy of import substitution similar to that adopted at the time by a number of other developing countries. But there were major differences. Many of the other newly industrializing countries, in addition to relying on primary export and foreign loans, promoted their dependence on imported capital and intermediate goods. However, Iran continued to depend heavily and almost exclusively on oil exports.

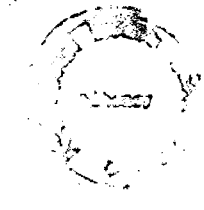
[3] To prove the ECLA's argument it is interesting to note that in Iranian case the share of manufacturered exports to manufactured value added was 12.3 percent in 1960. And about the same in 1970. Also small the value of manufacturered exports rose at an average rate of 10.5 percent from 1960 to 1970.

Between 1963 and 1972 foreign receipts from oil and gas accounted for 76 percent of the country's total export earning (Jazayeari, A., 1989).

The process of import substitution began in the 1960s and was initially confined to consumer goods. Protective measures for the domestic market were the chief stimuli with firms expanding eventually into import substitution of intermediate and capital goods.

With the growth of consumer goods manufacturing sectors, primarily food, processing, textiles, footwear, similar industrial investments in intermediate products industries were made. These were concentrated in Steel, Fertilizers, Chemicals, and Transport equipment. Capital goods production was primarily in construction materials and electrical equipment. Almost all industrial growth was oriented to the domestic market and was started in response to already existing or anticipated demand.

Vehicle assembly was an area in which rapid growth took place. By 1969 domestic firms supplied over 70 percent of the market compared with the 40 percent in 1960. Expansion of the domestic output of intermediate goods was much more uneven



with products such as paper printing, rubber, and chemicals increasing very rapidly but only limited expansion in metal products and nonmetallic minerals. By the end of 1960s, imports of these goods still accounted for 90 percent of domestic availability amounting to about 25 percent of the country's total imports.

Table (1-2) reflects the trends of import substitution and export expansion in Iran during 1960 and 1969. The change in the percentange of the ratio of consumer non-durable production to domestic availability was 6.6 percent during 1960-69. The ratio of consumer durables domestic production to availability rose by a higher amount of. 25.2. percent between 1960-69. For the whole manufacturing sector the domestic production as percentage of domestic market increased from 59.9 to 73.9, indicating a 14.0 percent points increase for the same period. By 1970, consumer goods output had increased to 68 percent of manufacturing goods over the 1962 figure of 62 percent. A similar path developed in exports with export accounting for only 4.7 percent. The sector's output in 1962 fell to 2.3 percent in 1970. The failure of manufacturing to developing non-oil export was occurring at the same time that imports were accounting for a higher proportion of inputs into the manufacturing sector.

Table (1-2) Import substitution and Export expansion in Iran., 1960 -1969.

Products Groups	Domestic Production as percent of Domestic Market			Imports as percent of Domestic Market		Expo: as percent Domestic Mar		
	1960	1969	% Change	1969	% Change	1960	1969	Change point
Consumer Non-Durable	92.8	99.4	+6.6	7.1	-10.9	10.7	6.4	
Food & beverages	87.6	98.9	+11.3	2.1	-11.1	0.8	1	
Tobacco	100	100	0	0.1	-0.3	0.4		
Textiles	98	100.8	+2.8	20.4	-9.2	27.6	21.3	
Apparel	86.7	100.1	+13.4	0.9	-13.8	1.3	1	
Wood and Furniture	77.7	75.6	-2.1	26.8	1.2	3.4	2.4	
Leather	129.4	142.6	+13.2	11.7	1.8	39.3	54.3	
Intermediate	37.3	54.9	+17.6	45.6	-17.4	0.2	0.7	
Paper	31.5	52.6	+21.1	47.5	-21		0.1	
Printing	28.4	93.7	+66.3	6.5	-65.1		0.2	
Rubber	16	59.5	+43.5	41.2	-42.8		0.7	
Chemicals	25.1	55.9	+30.8	46.3	-28.8	0.2	21.6	
Oil & Coal Products		100	+100					
Basic metal & Metal Products	31.2	38.3	+7.1	61.8	-7.3	0.3	0.2	
Nonmetallic Minerals	81.1	82.4	+1.3	17.9	-1.1	0.1	0.2	
Consumer Durables & Capital Goods	17.3	42.5	+25.2	57.5	-25.2			
Machinery (non-electrical)	0.8	6.9	+6.1	93.1	-6.1			
Electrical equipment	4.9	38.5	+33.6	61.5	-33.6			
Transport	39.7	70.9	+31.2	29.1	-31.2			
Miscellaneous	19.4	83.9	+64.5	18.0	-62.7	0.1	2	
Total	59.9	73.9	+14.0	29.5	-16	5.4	3.3	

Source: Ministry of Economy, Published in Economic Development of Iran, by Robert E. Looney, Prager, New York, 1973.

It was claimed that the economic structure has become more consumer oriented. It is true that after the sharp rise in oil revenue in 1974 the rate of growth of Consumption expenditure that had increased, on average by 9 percent a year during 1960-1973 rose by 15 percent a year during 1974-77. But, the corresponding values for capital formation were 15 percent and 24 percent respectively. As a result the share of consumption in national expenditure public and private consumption expenditure plus gross domestic fixed capital formation continued to decline from 86 percent in 1962 to 75 in 1973 and 67 percent in 1977.

Table (1.3) : Gross Domestic Fixed Capital Formation (GDFCF) at Constant Prices (1974-100)

A - In billion rials:	1965	1973	1977	1965-73	1974-77	1965-77
Agriculture	100	36.2	46.8	178.6	211.1	389.7
Oil and Gas	19.6	41.2	86.7	235.3	381.5	616.8
Industry	84.2	228.7	593.5	1290.9	1885.6	3104.5
Manufacturing &	16.3	73.5	168.1	370.3	575.8	946.1
Mining Construction	61.1	132.7	280.9	783.2	969.5	1752.7
Services	52.5	157.2	356.1	819.6	1190.2	2009.8
Total	166.3	463.3	1083.1	2532.4	3668.4	600.8
GDP at factor cost	1107.1	2737.9	3742.6	16252.6	13532.7	29785.3
B- As a percentage of total						
Agriculture	6	7.8	4.3	7.1	5.8	6.3
Oil and Gas	11.8	8.9	8	9.3	10.4	9.9
Industry	50.6	49.4	54.8	51.3	51.4	51.4
Construction	36.7	28.6	25.9	30.9	26.4	28.3
Services	31.6	33.9	32.9	32.4	32.4	32.4
Total	100	100	100	100	100	100
C- GDFCF as a percentage of of Total GDP	15	16.9	28.9	15.6	27.1	20.8

Source : The Central Bank Of Iran, National Accounts of Iran, 1959-1977.

It is evident from table (1-3) that industry had the largest share (as percentage) in Gross Domestic Fixed Capital Formation (GDFCF) at constant prices

during 1965-77. It interesting that GDFCF as a percentage of total GDP increased from 15 percent to 20.8 in 1974.

Reasons for the unfavourable socio-economic consequences of the import substitution strategy of industrialization as implemented in Iran are qualitatively very much the same as that in other countries. We are going to refer very briefly to some of the reasons for unfavourable socio-economic consequences of the import substitution strategy of industrialization.

1. Under excessive protection from domestic and foreign competition, the import substituting firm either through monopoly profiting and/or because of inefficiencies, increase the cost of inputs to other firms. Moreover, since the import substitution industries tend to buy their required capital and intermediate products from the foreign partners they do not perform any significant role in promoting "backward" linkage to domestic suppliers.

2. The liberal policy toward the importation of capital and intermediate products, regarded essential to a successful implementation of the import substituting strategy, distorts the choice of products and techniques in favour of the production of luxury

consumer goods and capital intensive industries. It also increased the country's dependence upon sophisticated foreign technology and know how with little employment creating effect. It is necessary to recall that the strategy of industrial development adapted in the pre-1979 period did not recognize the need to overcome technological backwardness as a major objective of economic policy. Capital goods and durable consumer items, such as radios, televisions and motor cars, as industrial groups that had reached to 29.5 percent in 1977 reduced to 18.7 percent in 1987 (table 1-5). Hence the development of a dynamic capital goods sector was given high priority in the first five year development plan of the Islamic Republic of Iran (1989-1993). It seems that industrialization has been therefore, very much less learning intensive than the industrialization of the developed countries.

Know-how and technology imported in the 1980s from Europe and North America, by capital goods sector firms did not have any significant stimulation to technological innovation. It "brings in complex technology, but without the sustained technological experimentation and concomitant training and innovation that are characteristic of the pioneer industrial countries" (Budget and Planning Organization, 1990). In Iran the consequences of import substitution industrialisation were the high

cost of production is a heavily protected growth industry, and heavy dependence on world markets both to build new production capital and to maintain existing capacities

1.6. Manufacturing Development After 1979

The industrial production in large enterprises, had as a result of strikes and revolutionary upheaval dropped by 67 percent in the fourth quarter of 1978/79. In comparison with its level in the final quarter (1977/78), it started rising and by the fourth quarter of 1979/80 it reached the level of annual average 130.5 or slightly more that twice its levels in the final month of the revolution. Despite this fast rate of recovery, industrial output in the last quarter of 1979/80 was still 21 percent below its level in the corresponding quarter of 1977/78 (CBI 1980). In short, the 20 percent decline in industrial production from 1977/78 to 1980/81 was partly due to general economic decline, subsequent economic embargo and the war with Iraq.

The available data show that after 1978, the rising trends in the share of manufacturing and industrial employment was reversed. Manufacturing employment declined by 14 percent between 1978 and 1988, while agricultural employment rose by

nearly 10 percent and service sector employment jumped by approximately 20 percent during the same period (see table 1-4).

Table: (1-4): Employment Trends in Iran's Active Population by Economic Sectors

Sectors	Numbers Employed (in 1,000's)				Shares of Total Employment (in percent)				Annual Growth of Value Added per Workers		
	Actual	Actual	Actual	Planned	Actual	Actual	Actual	Planned	Actual	Actual	Planned
	1962	1977	1988	1993	1962	1977	1988	1993	1962-77	1978-88	1989-93
Agriculture	3232	2966	3253	3411	50.4	33.1	28.4	25.4	5.1	3.8	4.9
Petroleum	36	56	75	100	0.6	0.6	0.7	0.7	5.7	-11.3	6.5
Industry (a)	1516	3085	2722	3803	23.7	34.4	23.8	28.3	9.5	-0.9	4.8
Services	1626	2867	5400	6105	25.4	31.9	47.2	45.5	9.1	-4.8	4.1
Total Employment	6410	8974	11450	13419	100	100	100	100	7.9	-3.8	5.2
Manufacturing & Mining	1060	1720	1480	1822	16.5	19.2	12.9	13.6	10.5	-1.7	11
Total Population	23084	34458	52775	61288							

Source: The Central Bank of Iran, National Accounts of Iran, 1959-77;

The Law of the First Economic, Social and Cultural Plan of the Islamic Republic of Iran, January 1990.

Note: Figures in Italics are rough estimates includes mining, manufacturing, construction power, and water.

This was admittedly, a highly unhealthy, but inescapable development under the prevailing conditions. This led to a decline in the share of manufacturing sector in total employment from 19 percent in 1977 to 13 percent in 1988 and of agriculture's share from 33 percent to 25.4 percent. During the same period labour productivity and income declined in all economic sectors.

Similar unfavourable trends were also noticed in foreign trade, because of declining oil income and insufficient rise in non-oil exports. The value of imports declined from $ 14.6 billion in 1977 to $ 9.4 billion in 1987 or to about one third in real terms, affecting adversely all the productive sectors and consumption. The composition of imports shows a declining share for capital goods and intermediates. As regards the non-oil exports, their nominal value increased from $625 million to 1.160 million between 1977 and 1987, but apparently with little change in real terms. Within such exports the share of manufactured goods declined from 22 percent in 1977 to 11 percent in 1988, in line with the downward trend in industrial production.

According to an industrial survey carried out in 1979, the manufacturing sector was operating at 58 percent of its capacity. The following reasons were given for reduced production: lack of raw material and intermediates 28 percent, lack of

equipment 13 percent, shortage of specialized experts and staff 7 percent, inadequacy of market outlet 13 percent, and unwillingness of labour force to work 39 percent. These problems were aggravated by wide spread economic disruption resulting from expropriation of most of major industrial enterprises belonging to the Iranian's associated with the Phalavi regime (1926-1979) as well as the nationalization of foreign investments. The revolutionary atmosphere of the country and its excesses encouraged a mass exodus of entrepreneurs, managers, skilled workers and foreign specialists, that led to large scale capital flight and the freezing of Iranian assets abroad.

In general manufacturing industry was able, despite the serious shortages of inputs, to meet the country's basic minimum requirement in many fields. There was also a modest expansion of production in domestic industries such as pharmaceutical, consumer goods and equipment parts. In addition industrial exports continued at lower volumes as large number of industrial enterprises were mobilized to support the country's war efforts.

After a decade of trial and error and gaining practical experience, the authorities approved a five year development plan. The primary aim of the plan was to regenerate the economy through long term reconstruction of the war damaged areas, promote

private investment and initiate a reform and liberalization programme primarily aimed at foreign exchange and trade policies. The breakdown of plan growth objectives by the main sectors of the economy together with the associated growth rates shows that real output increased over the plan by an annual average rate of around 7.1 percent, which is only slightly below the overall target of 8.1 percent. This situation is different, however, when one considers the growth programme of individual sectors in particular years. For example while actual average growth values under the plan for the agriculture, oil and service sectors are generally in line with those envisaged in the plan, the average annual growth value of value added in industries and mines and construction were below their target value by 6.2 and 9.2 percent.

Table: (1-5) Structural Evolution of Iran's Large Scale Manufacturing enterprises

	Share of Industrial Groupings and Branches in Total Manufacturing (in percent)				Growth Rate(in Percent)		
Industrial Grouping and Branches	1962	1977	1988	1989	1962-77 Actual	1978-88 Actual	1988-93 Actual
Non-durable Consumer Goods	69.3	35.7	44.5	41.1	9	-0.9	4.2
Food, Beverage	36.3	17.7	14.7	12.9	8.9	-4.5	
Textile, Clothing and Leather Products	29.4	15.7	25	24.4	9.2	1.7	
Wood and wooden Products	2.3	0.6	1.4	1.3	4.1	4.2	
Paper and paper Product	1.3	1.7	2.4	2.5	17.2	0.6	
Intermediate Products	13.6	34.8	36.2	40.2	21.3	-2.5	20
Chemicals	5	15	13.7	14.6	22.6	-3.7	
Non Metallic Minerals and Coal	8.3	9.8	15.3	17.5	15.1	1.2	
Basic Metals	0.3	10	7.2	8.1	43.8	-5.7	
Capital Goods and Consumer Durable	17.1	29.5	19.3	18.7	18.1	-6.5	24
Machinery, equipment metallic Products	17.1	29.5	19.3	18.7	18.1	-6.5	24
Total	100	100	100	100	13.9	-2.1	14.2

Sources: 1. Ministry of Finance and Economic affairs, Bureau of Statistics, Iranian Industrial Statistics, 1968 and 1972
2. Annual reports of the Central Bank of Iran
3. The Law of the First economy, Social and Cultural Development Plan of the Islamic Republic of Iran, January, 1990.

Table 1-6 Growth and structural Changes of the Iranian economy.

Economic Sectors	Average Annual Real Growth (in percent)			Share of Major Economic sectors in Total GDP (At Current Prices)									
				GDP Including Oil Sector					GDP excluding oil sector				
	Actual 1962-77	Actual 1978-88	Planned 1989-93	Actual 1960	Actual 1972	Actual 1977	Actual 1988	Planned 1993	Actual 1960	Actual 1972	Actual 1977	Actual 1988	Planned 1993
Agriculture	4.5	4.7	5.1	35.1	16.2	8.5	23.2	21	39.8	21.2	12.5	25.5	23.3
Petroleum[a]	8.8	-8.9	9.5	12	23.3	32.5	9.1	9.8					
Industry[b]	14.6	0	15	11.1	17.9	18.6	13.8	18.8	12.5	23.4	23.6	15.2	20.8
Services	130.4	0.9	6.7	41.6	42.6	40.4	53.9	50.4	47.7	55.4	59.8	59.3	55.9
Total GDP (at factor cost	10.4	-1.7	8.1	100	100	100	100	100	100	100	100	100	100
Of which: manufacturing	13.9	-2.9	14.2	7.4	11	7.7	6.3	8.3	8.4	14.3	1.4	6.9	9.2
GDP per Capita	7.3	-5.4	4.9										

Source: Actual Figures in this tables have been calculated from figures published by the Central bank of the Islamic Republic of Iran. The planned figures are based on figures given into the law of the First Economic, Social and Cultural Development Plan of the Government approved on 31 January, 1990.

NOTES: The data based on Central Bank Figures have been adjusted to take account of revised data for agriculture and manufacturing sectors introduced, respectively, in 1986 and 1982.

[a] the average annual growth rate of the petroleum sector was 12.8 percent during 1962-73, but declined to -1.5 percent per annum in the following period of 1974-77.

[b] The industrial sector includes: mining, manufacturing, construction, power and water, but excludes petroleum activities.

The impact of first five year development plan (1989-1993) of the Islamic Republic on large scale manufacturing enterprises can be studied by analysing table (1-5). The share of non-durable consumer goods has decreased from 69.3 percent in 1962 to 41.1 percent in 1989 and growth of the group that was negative for one decade (1978-88) registered a significant improvement i.e, 4.2 percent during 1989-93. The table (1-5) also shows that share of intermediate products as a share of all industrial grouping reached 40.2 percent in 1989 and in spite of negative growth in period (1978-88) witnessed a growth rate of 20 percent over the period 1988-93.

The second plan which covers the period 1994/95 - 1998/99, began in March 1995. This plan generally represents a continuation of the economic and social policies of the first plan, and places considerable emphasis on macroeconomic stabilization programmes. The approved plan, however, places relatively greater emphasis on the development of the agricultural sector, largely at the expense of construction and service sectors. The sectoral average annual growth rates under the plan are: 4.3 percent for agriculture, 1.6 percent, for oil 5.9 percent, for industries and 2.6 percent for other sector.

The attraction of private sector participation (both domestic and foreign) in turn will require favourable investment climate, economic, political and judicial stability. It also requires adequate incentives, liberalization of government rules and regulation, streamlining of decision-making processes, and the introduction of appropriate pricing, foreign exchange, trade, fiscal and financial policies.

NOTES

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CHAPTER II

EVOLUTION AND GROWTH OF IRANIAN AUTOMOBILE INDUSTRY

2.1. Introduction

In the preceding chapter we examined the performance of Iranian manufacturing industry as well as reviewing the industrial development strategy. The overall conclusion suggested by the available statistical evidence indicates that import substitution strategy and government intention was not able to lead the economy in the direction of self sustained growth.

In this chapter we shall carry out an inquiry of the evolution of the automobile industry in Iran. In order to present a better picture of the impact of government policies on the automobile industry we shall examine the output trends in this industry.

Though, the volume of production is modest in comparison with other developing countries like Brazil, Mexico and India, the industry has the capability to keep pace with the requirements of a growing economy.

2.2. Automobile Industry in Developing Countries

The automobile industry has been a focus of government policies in many developing countries. It is expected to act as a dynamic force for the economy as a whole and to provide substantial spread effect through backward and forward linkages with other industries and services.

Table : (2.1): Production of Automobile and Percentage of Local Contents in Developing Countries.

Country	(000 units)			
	1960	1970	1980	Local Constant (%)
Asia	26.9	107.4	473.3	
Brazil	62.2	343.7	977.7	98
Argentina	30.3	163.4	204.4	95
Mexico	24.8	136.7	303.0	60
Venezuela	6.5	48.0	94.0	40
China	-	20.7	29.0	40
Colombia	-	7.7	43.0	20
Latin America	123.8	750.2	1651.1	
India	19.1	37.4	30.5	100
South Korea	-	14.5	57.2	90
Philipines	2.9	7.6	26.6	70
Taiwan	0.4	NA	132.0	60
Malaysia	-	7.5	81.0	50
Iran	2.5	31.8	80.0	50
Indonesia	2.0	2.0	41.0	40
Thailand	-	6.6	25.0	35
South Africa	87.4	195.0	277.0	50
Nigeria	-	7.1	151.0	30
Total	238.1	9029.7	2552.4	

Sourcce: Danil. J. Johnes-James. P. Womack. (1985), Developing Countries and Future of Automobile Industry, world Development.

The increased competition within the world automobile industry and its extension to Latin America during the 1950s, together with the development of an embryonic parts industry, meant that the circumstances were particularly favourable for a government that wished to develop a local industry during this period. The drive towards overseas expansion was such that even relatively small domestic markets could not be ignored. Thus, governments began to use tariffs and local content requirements to cut off imports and started to offer incentives to firms to manufacture vehicles locally.

A number of factors prompted the government of the large Latin American countries to develop local manufacturing of vehicles and other countries to require assemblers to gradually incorporate local parts. During the 1950s, imports of vehicle and parts accounted for 11 percent of Mexico's imports and in Brazil there was a similar problem ending the immediate post war period between 1945-52 (Majalu-e, S. S., 1992). Despite the existence of small potential parts suppliers, the incorporation of locally produced parts was extremely limited during the early post war period. The existing assembly plants were organised in order to assemble imported knocked down units and failed to act as catalysts for the development of local suppliers. The growth of the

automobile industry was spectacular in the Republic of Korea with a 17 percent average annual increase between 1977 and 1986. However, former Yugoslavia and India witnessed a growth rate of only 4 percent per annum during this period. Production had also been weak in many developing countries that relied only on assembly operations during this period.

Table(2-2): Production of Car in Selected Developing Countries 1980 and 1988.

Country	Total	1980 Passenger Cars	Total	1988 Passenger Cars
Argentina	281669	78	164160	83
Brazil	1165207	84	10688754	73
Columbia	424115	76	79518	77
China	222288	2	455000	4
India	113326	27	312487	51
Indonesia	212674	13	162630	21
Iran	102154	71,10	15976	29.40
S. Korea	123135	46	1083655	80
Malaysia	100879	81	97930	76
Mexico	490006	62	338020	62
Philipine	55574	54	17456	63
Taiwan	N.A.	-	280834	79
Turkey	50845	62	149675	81S

Source: 'Majalu-e Sanat-e Sangin'. (Heavy Industry. No. 17). 1992. Tehran.

However, production of automobiles increased significantly from the mid 1980s. As table 2.2 shows, six countries among developing countries (S. Korea, Brazil, India, Mexico, China, Taiwan) were producing 69 percent of cars in developing countries (excluding Eastern European Countries) in 1988. In quantum terms they produced 3.3

million of automobile in 1988. It is interesting that South Korea's share in developing countries' production that was 3.92 percent in 1980, increased to 23.58 percent in 1988. Asian countries increased their share in world production from 10 percent to 30 percent when Western Europe's share declined from 43 percent to 32 percent between 1970-1988. Latin American countries' share also fell from 6 percent to 4 percent during 1970 and 1988.

Car production rose substantially in developing countries during the 1980s. Only in Latin American countries, car production did not reach its record levels of early 1980s, in view of a serious recession faced by these countries. Another significant development was the improvement in the performance of the automobile industry in developing countries on the export front. Between 1980 and 1988, their export shares to domestic production for automobiles increased from 20 percent to 67 percent in Republic of Korea, 17 percent to 37 percent in Brazil, from 20 percent to 31 percent in former Yugoslavia and rather spectacularly in Mexico from 4 percent to 41 percent.

2.3. Evolution and Growth of Automobile Industry in Iran

The automobile industry for many years had an important place in Iran's industrialization strategy. The first factory established in collaboration with FIAT-Italy started production in 1963. Shortly afterwards, the government encouraged the manufacture of automobiles with local content, instead of the assembly of imported CKD (Completely Knocked Down) parts in the country. In addition, the automobile factories having no manufacturing programme were asked to switch from assembly to manufacturing. Later, Iran started to produce other brands of automobiles such as Hillman, Chrysler, Chevrolet, Landrover, Mazda, Citroen, Buick, Cadilac and, Mercedes-Benz. The demand for automobiles rose from 15,246 vehicle units in 1963 73,345 in 1972 and 265568 in 1977. But production of automobile reached only 180399 units, (Central Bank of Iran, 1979).

Table (2-3): Comparison between the Automobile and other Selected Industries in Iran. 1977.

(in percentage)

Industry	Share in value added non-oil industrial secror at constant pricess.	Share in Employment in industrial sector	Share in wages and salaries in industrial sector	Share in GDFC's Industrial Sector
Spinning Textime	8.7	24.2	16.4	3.9
Vegetable Oil	4.4	2.2	2.2	8.8
Consumer Durable goods	4.7	4.5	9.6	1.1
Basic Metals	13.5	6.5	8.8	38.0
Automobile	14.2	8.2	6.9	38.3

Source : Central Bank of Iran, Consideration of Automobile Industry in Iran 1979.

Table (2-3) shows that in 1977, the automobile industry contributed 38.3 percent of gross domestic capital formation and 8.2 percent of total employment in the non-oil industrial sector. It had the largest share in non-oil industrial value added, i.e. 14.2 percent. According to data published by the Central Bank of Iran in 1972, the output capital ratio in the industry ranged between 30.3 percent to 35.6 percent between 1974 and 1977. This was much lower in comparison with other large industries in the same period (CBI, 1979).

The share of industry in total employment was not large. The employment in this sector increased at an average rate of 14.6 percent per annum, from 15,000 in 1974 to 23,000 in 1977.

After the revolution, due to general economic decline, turmoil within factories, departure of many skilled personnel, extensive nationalization of banks, insurance companies and large industrial complexes owned by businesses closely associated with old regime, lack of imported components and spare parts, a steep reduction in production occurred. An important factor that limited the industry after the revolution has been the loss of competitiveness of goods produced in Iran. The controls were not able to guarantee a steady supply of vital inputs for industry as it happened. Production was brought to a halt for lack of small inputs in automobile manufacturing firms and they had to close down for weeks while waiting for such imported inputs.

Table (2.4) : Comparsion of Value added and Investment in Automobole Industry with Large Scale Industries.

(Millions Rials)

Category	Value added				New Investments			
	1983	1994	1995	1996	1983	1984	1985	1986
Industry (Large-scale mfring	16619	1020144	1000027	N.A.	101700	106565	114185	N.A.
Machinary and Basic Metals	240411	281344	251934	N.A.	23096	28976	35654	N.A.
Automative	71891	93047	89198	39028	6922	12266	59598	39334
Annual % of changes in V.A	2990	33107	35.4	N.A.	29.9	42.4	66.2	N.A.
Percentage of investment	7.84	9.12	8.9	N.A.	6.8	11.5	52.2	N.A.

Source : Report on Large-scale Manufacturing Industry Iran's Statistical Centre, 1983,1994, 1985, 1996.

As table (2-4) shows the share in value added and new investment of the automobile industry relative to large-scale industry ranged between 7.84 percent and 8.7 percent between 1983-86. This was much lower in comparison to other large scale manufacturing. In spite of this, the automobile industry had the largest share in investment in 1985. This is because the demand for motor vehicle especially for military purposes increased as a result of the war.

Table (2.5) : Value added in Manufacturing Industry 1988-94.

(Million Rials)

Industry	1989	1990	1991	1992	1993
Capital Goods Industry	75493	109058	156270	181493	187711
Automative Industry	34663	49225	67774	80259	83240
Intermeadiate goodds Industry	35410	41977	51964	63293	79085
Consumer Durable Industry	10459	12048	14940	18957	21123
Total	121362	163083	222904	263741	283819

Source : First five Year Development Plan of Islamic Republic of Iran - 1989.

The profile of growth of value added in the first five year development plan provided in table (2-5), indicates that the share of automobile industry in the capital good industry is 45.91 percent. As can be calculated from table (2-5), the share of the value added in automobile to industry was 25 and 56 percent in 1989 and 1993 respectively. Looking more specifically at the development of manufacturing value added, the share of automobiles grew steadily. It reached 24.1 percent of the total manufacturing value added in 1990 and increased to 28.24 percent in 1991.

Table (2-6) : Production of Automobile in Iran (1977- 1990)

(in numbers)

Year	Passanger Cars	Commercial Vehicle	Buses	Trucks	Minibuses	Total
1977	104959	27411	1745	2935	4702	141752
1978	98197	15745	1241	9328	3554	128068
1979	59478	16447	1006	3368	2167	82458
1980	72632	24934	1368	1134	2086	102154
1981	61126	3320	1368	7840	3508	77162
1982	39463	97425	1393	1120	3504	142905
1983	55675	59510	2403	9175	4664	131427
1984	68311	65046	2560	14362	8497	158776
1985	335582	51268	21171	1200	9113	110142
1986	23522	16477	12986	5882	58908	16638
1987	16638	27947	337	4910	1769	51601
1988	4697	8218	838	130	2093	15976
1989	9971	3274	582	2487	1321	17635
1990	12824	9902	446	4087	1229	28488

Source : a. Automobile Industry in Iran, Report no. 89, Ministry of Industry, 1989, Tehran, Iran.
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Table (2-7) Production of Car by Manufactures (1977-88).

Year	INIM (Iran Khodrow)	Moratab Company	Zamyad Company	Iran Kaveh	Saipa	Pars Khodrow	Shahab Khdrow	Khavar	Khodrow Sazan	Mazda
1977	104160	3831	13421	925	11876	13950	687	8101	346	12600
1978	88846	3304	10430	384	21417	13527	593	7262	183	5205
1979	59581	1686	4422	166	6068	10462	298	2712	305	2495
1980	63774	3192	6010	162	9885	4493	618	3767	332	9169
1981	70399	10689	7438	166	1088	4689	938	6558	502	4683
1982	54028	70838		76	13581	5236	1146	7	2022	11142
1983	77169	5785	9530	81	11835	5330	1177	7848	2827	11355
1984	80060	5264	20210	108	15572	13250	1552	11008	3279	8493
1985	40038	3042	20806	667	11383	8962	1534	12003	2605	14942
1986	24975	13969	NA	468	9850	4653	288	18624	877	4145
1987	17622	665	7066		7199	15067	187	4973	646	717
1988	11108		130		4753	6594	364		657	1190

Source: Automobile Industry in Iran, Report No. 89, Ministry of Industry 1986

Figure (2-1) Trends in the Production of Vehicle by Type: 1977 - 1988

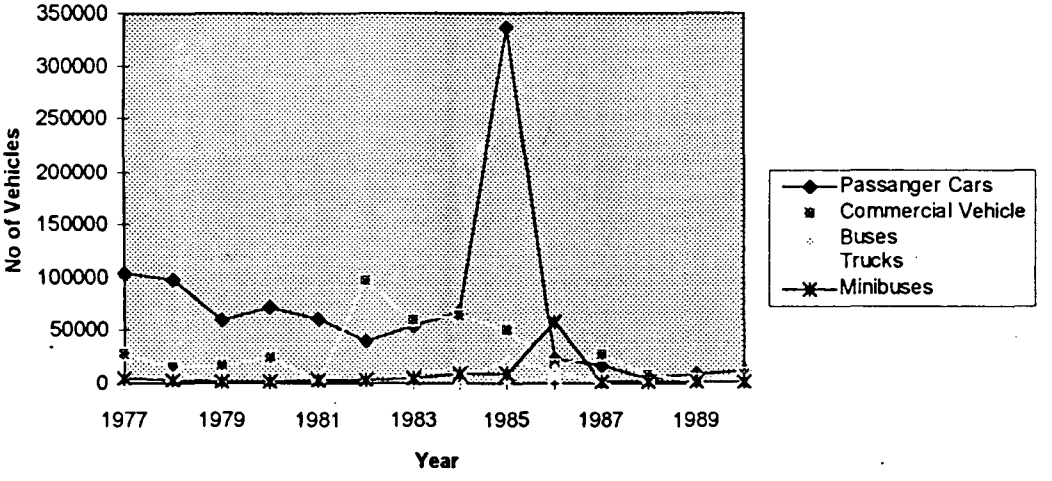

Figure (2-2) Trends of the Production of Vehicles by Manufacturer: 1977 -1988

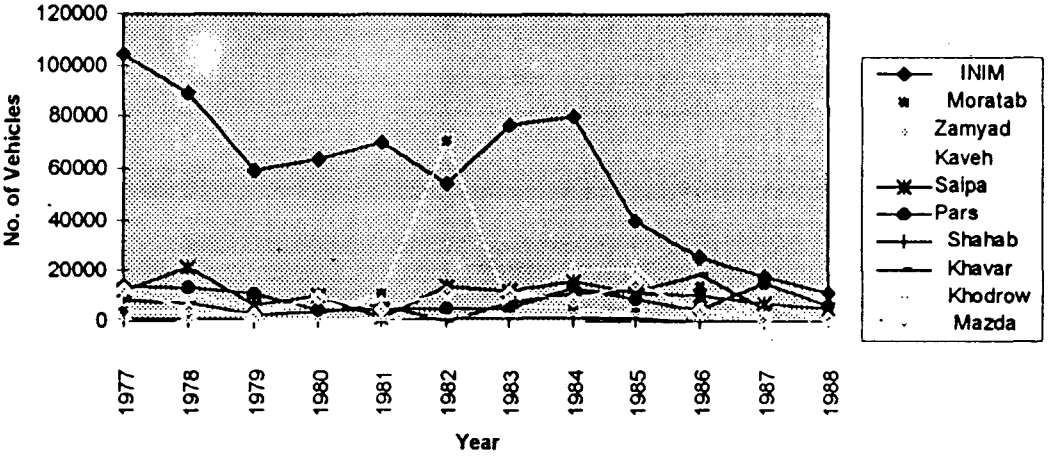

Table (2-6) provides the volume and composition of automobile production in Iran during the period 1977-90. It is interesting to note that production of passenger cars in total production was 77.4 percent in 1977 and 76.67 percent in 1990 respectively. Despite the fact that there was an absolute decrease in total car production during the 1980s, both passenger cars and commercial vehicles recorded a higher rate of production in terms of absolute numbers as well as their relative share in aggregate production during that period. Table (2-6) also reveals a significant development in 1984, when for the first time production of cars exceeded 138,776 units but decreased to 110,142 in 1985, in a period of only one year.

Table (2-7) reflects the production of cars by ten manufacturing units in Iran during the perid 1977-88. It is evident from the table (2-7) that car production of Iranian Automobile Industry was dominated by the major producer, INIM (Iran Khodrow). In 1977 the share of INIM (Iran Khodrow) in total production was 36.89 percent. The share of INIM (Iran Khodrow) in total production exceeded to 72 percent in 1983 and rose to 81.15 percent in 1988. As a result INIM (Iran Khodrow) has a significant contribution and impact on the growth of automobile industry in Iran. The production of

Saipa company that was 11.40 percent in total production in 1977 increased to 39.43 percent in 1986 and stood at 42.78 percent in 1988. Iran Khavar recorded a production of 8101 units in 1977 and the lowest of only 7 units in 1982. Virtually, since the government decided to call off the technical agreement with American company, Mack, the supply of imported components discontinued, as a result, from 1979 to 1988 Iran Khaveh remained almost closed.

The downward trend in the production of automobiles as shown in figures (2-1) and (2-2) were as a result of the general economic decline experienced in the country. More specifically however, the main reasons behind the decline are included:

1. serious shortages in raw material, imported components and electricity
2. shortage of credit facilities and foreign exchange, lack of infrastructure and continuous modernisation and development of technology
3. departure of technical trained personnel and skilled managers after revolution

Government Policies on the Automobile Industry: Pre- 1990 Protective Policies

Regarding the government policies for automobiles, the industry presents a strange story of development. The government policies in regard to this industry, specifically price control and regulation of imports, based on taxation and protection. These have in many ways shaped the industry as it was in 1980s. Bhanam Salem (1992) observes that the effective and nominal rate of protection both have been high in comparison with the other six developing countries as shown in table (2-9).

Table (2-8): Efffective and nominal rae of Production in Some Selected Countries.

(in percentage)

	Country	Iran 1970	Brazil 1966	Chile 1961	Mexico 1960	Norway 1954	Phillippines 1965	Pakistan 1963-64
a.	Effective rate of protection (ERP)	18.29	1.98	0.33	0.74	0.52	0.63	3.09
b.	Nominal rate of protection (ERP)	3.19	0.98	0.16	1.39	0.23	0.84	1.33

Source : Bhanam, Salem (1992), Iran's Automobile Industry, Faculty of Economics, Alameh Tabatabee university Tehran, Iran.

It can be argued that high tariffs and general tax policies were designed to promote industrialization The economic policy did not give local firms access to the economies of scope and scale particularly neccessary to exploit dynamic advantange in industries. The policy was also encouranging transinational corporations (TNCs).from taking advantangè of protection at the expense of local firms. They were therefore the

main beneficiaries of the import substitution process. Due to the excessive protection from domestic and foreign competition, import substitution either through monopoly profiting or because of inefficiencies, increased the cost of import substitution to other firms. Thus damaging any prospects of "forward" linkages with the rest of the economy such as provision of transport facilities to other sectors and general mobility. Moreover, since firms established under the import substitution strategy tend to acquire their capital and intermediate product from their foreign partners, their role in promoting "backward" linkage with rest of the economy was not significant. As we discussed in the previous chapter, during 1980s Iran's Industrial Sector experienced a decline in output and low capacity utilization, continued dependence on imports, deterioration of equipment, labour-management problems and declining efficiency as a result. The automobile industry remained controlled and protected in the sense that foreign investment was not allowed and thus, the industry kept shielded from foreign competition. The consumer was compelled to buy the poor quality vehicles at high prices.

In addition to the government policies there have been many economic factors coming in the way of a steady growth of the industry. Overall the Iranian automobile

In addition to the government policies there have been many economic factors coming in the way of a steady growth of the industry. Overall the Iranian automobile industry is still far behind the international standard. It is surprising to note, that after 30 years of its existence car manufacturers have not been able to design and manufacture a totally indigenous car. The Iranian automobile industry was also characterised by escalating costs which has been experienced by almost all type of vehicles. Production costs were high because of the high duties levied on imported raw materials and other inputs. This pushed up the price of the complete vehicle to rather high levels, so much so that the locally produced vehicles by the Iranian automobile industry could not be competitive in the international market. For example the price of `Paykan' was $ 15,000 in 1990 in comparison with $ 10,000 for Toyota in the world market.

In sum, the growth of Iranian automobile industry during the first two decades of its operation ending with 1980s was slow and uneventful. However, the industry witnessed significant transformation during the early 1990s. The emerging market was visible with substantial diversification in production.

Reconstruction and Preparation for Future Growth:

To remedy the situation, the state undertook a careful investigation of the problems facing this industry. In the first five year development plan the major remedial measures and policies incorporated in the plan on industry were as follows:

1. To provide new production, designing, engineering research capacities based on the plan priorities.
2. To increase domestic production and value added.
3. To improve technological capabilities of the industry.
4. Improvement in production efficiency through the rationalization of production lines and ending system.
5. Indigenization of parts and components.
6. To maximize the capacity of the machinery, foundry, and forging industries.
7. improvement in product quality by introducing efficiency by high precision machines.
8. establishment of production efficiency standard.
9. Training programmes for manufacturers and supervisors, which included training within the industry (TWI). Management Training Programme (MTP) for managers of departments, and job specific training.

10. Training within the industry which aimed at the education of production department as well as basic courses for improving the technical skill of young workers.

11. Improvement in working conditions by upgrading safety measures, lighting and sanitation facilities.

12. Reinforcement of research and development activities.

2.5. Economic Reforms and Automobile Industry

The government's liberalization programme was a complex one. It aimed, first, at economic reconstruction and expansion of output. Iran's state was aware, however, that in order to achieve these goals, it had to release private sector resources. Economic liberalization and the retraction of the state were regarded as key to the economic renewal. The idea was that to release Iranian private sector resources and allow capital to flow in to activities so far forbidden to it. The share of the private sector in the country's economy rose from 25-30 percent in the late 1980s to 75-80 percent in the course of 1990s, thus reversing the trends prevalent in Iran since the first oil boom of 1973. Under a plan drawn up by the first President Rafsanjani's government, some 800 publicly owned enterprises were earmarked for privatisation. A number of serious

problems however had to be overcome before privatisation and liberalisation could take effect[1]. In the words of official reports:

> Many of the firms [with the potential to be transfered to private sector] have weak management structure and too many employees .. which because of the current labour law cannot be sacked very easily and this problem of their potential profitability, reduced the attraction of these firms to the private sector, Therefore, it is essential before privatisation of such firms that some changes to their structures be carried out. [Economic Affairs Secretary, 1991:52).

It is possible to identify the main features of the administration's open door policy as follows:

1. Privatization of industry, mines and other industrial and non-industrial activities.
2. Deregulation of economic activity and of banking and financial services.
3. Establishment of free trade Zones across the country
4. Liberalization of trade and returning it to the private sector.

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[1] Many of Iran's economic difficulties or the eve on the Iran-Iraq war cease fire were outlined in chapter I and do not require further attention here. Nonetheless the Islamic Republic and the pragmatic leadership of President Rafsanjani tried to put an end to the revolutionary alternative in economic development strategy. The potential for redirected economic policy that emerged in the post war period was recognised. Again Rafsanjani's rise to power in 1989 was to provide opportunity for him to adjust economic policy to fit the circumstances.

The trend was to transfer heavy and other industries to the private sector. Vice-president Zanjani announced in December 1989 that the government should handle big strategic industries (Ehteshami, A. 1995). In fact, the rest of the industrial sector was to be made open to private investment and control. By the end of 1990 the status of some 800 manufacturing industrial companies was being studied by Ministry of Economics and Finance with a view to offering them to the private sector. Not surprisingly a major development in this process was the cabinet decision of 30 January 1992 to privatize Iran's main Car-making and Car assembly industries. The 10 car makers to be privatised were: Iran Kaveh, Iran Khodrow, Iran Vanet, Khavar. Khodrowsazan, Moratab, Pars Khodrow, SAIPA, Shahab Khodrow and Zamyad.[2]

[2] I happened to be in Tehran stock excange market in July 1996. The government has reactivated the stock exchange market and it is offering shares of public industries at lucractive prices to local investors. The idea is to help cut the budget deficit and draw private liquidity away from trade and brokerage towards productive investment, Till then, Iran Khodrow was the only car manufacturer that was offering its shares in the stock exchange market.

Table (2-10) : distribution of selected newcomers in Automobile Industry in Iran (1992)

(in numbers)

Company	Product	Production Capacity	Location	Foreign Collaboration
Iran expantion of vehicles company	Buses	500	Tehran	Volvo-sweden
Sina, Car Manufactuing company	Passenger Cars	25000	Hamedan	Folks Pessat & Germany
Ran Iran	Buses	500	Markazi Proviance	Volvo-Sweden
Iran Harekat	Passenger Cars	20000		
Kerman Car Manufacturing	Passenger Cars 25000	Kerman	Daewoo-South Korea	
Arya Motor	Trucks	3000	Chahar mahal Bkhtiari Proviance.	Gil-Hungery
Hamedan Car manufacturing company	Passsenger Cars	25000	Hamedan	Citroen-France
Sirjan Car Manufacturing Company	Trucks	4000	Kerman	Renault- France
Srijan Car Manufacturing comapny	Buses	2000	Kerman	New Flamer-Canada
Top Service	Passenger Cars	25000	Tehran	Mercedes-Benz, Germany

Source: Division of Statistical Evaluation. Ministry of Industry, 1992, Tehran.

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3. `Majalu-e Sanat-e Sangin' (Heavy Industry) no. 17, 1992. Tehran.

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CHAPTER III

CHANNELS OF TECHNOLOGY TRANSFER, TECHNOLOGY THEORIES AND TECHNOLOGICAL CAPABILITIES

3.1 Introduction

This chapter deals with the conceptual analysis of technology, theories of transfer of technology as well as technological capabilities. So far as transfer technology is concerned, it discusses the mechanism of transfer and the problems encountered during the process.

It is also argued in this chapter that the development of capabilities is the outcome of a complex integration between human resources, physical investment and technological effort.

3.2. Channels for Technology Transfer

Considering the economic and social circumstances of the process of technology transfer, the channels by which this transfer is accomplished are of crucial importance. This is so because if it occurs in such a way that the recipient country cannot control

either the transfer or the utilization of technology, there is a risk of dependence on the supplier of technology. Technology can be transferred in the form of a "guaranteed package", like in machinery and equipment. In such a case, the recipient can expect to receive new technology that works as each vintage of capital stock rendered absolescent over time. A country that imports machinery is not necessarily able to update and improve the technology as it becomes obsolete.

New technology can also be adopted in forms such as ideas or human capital. Updating this kind of know-how is a continuous process leading to a more meaningful transfer and adoption of technology. In practice, machinery and expertise supplement each other, and they tend to appear together. Which type of technology a country uses most depends on its objectives and goals as well as its relations with foreign countries supplying the technology. The channels through which technology is transmitted from industrial centres to the peripheries of the world can be classified as follows:

1. Importing foreign machinery and equipment. This entails what is often referred to as embodied technology transfer where machinery and equipment are acquired for setting up new industries or modernizing existing ones. Often, this kind of technology transfer is on turn-key basis.
2. Receiving direct foreign investment. (see theories of technology)

3. Joint ventures: It is important to make a distinction between two types of joint ventures, where assets, rights and liabilities are shared through joint ownership of an incorporated enterprise, and the non-equity joint venture in which the cooperation between partners is established on a contractual basis.
4. Licensing Agreement: Under this agreement certain rights of access to a technology conferred on the acquirer for a specified duration, and the agreement may consist of authorization to use industrial property rights and secret know-how.
5. Technical Assistance Agreements: The acquirer is usually seeking not just technology, i.e. specific kind of technical assistance for the setting up and operation of a productive activity. The services provided under this agreement include maintenance and repair of machinery, advice on process know-how and quality control.
6. Management arrangements: Under these arrangements operational control of on enterprise is rested by contract in a foreign entity to perform all necessary managerial function: production management (technical and engineering aspects), personnel management, procurement of goods services financial arrangements.
7. Overseas Training: Encouraging and supporting overseas training of nationals. This channel involves students, managers and technicians who go to foreign schools and universities, or are attached to foreign firms and offices for training. It also involves visit to trade fairs, congresses and other places where technological knowledge is exchanged.
8. Utilizing natural and low-cost diffusion: the transfer of know-how through trade and scientific publications, analyzing foreign products, establishing research and

educational institutes to spread modern technological expertise. etc (Gomulka S, 1971 and Assad O., 1986)

If an international comparison is made to determine to what extent various countries use these channels, some differences can be observed. Discrepancies can also be found on how the government favoured or discouraged the use of certain transfer channels.

Technology transfer through the above mentioned channels from developed to developing countries dominates debate in the literature. The debates were around such subjects as the appropriate mode of technology transfer, the role of technology transfer and its cost and effects on developing countries. The main reason behind this debate is that technology is not available free of cost. Further, most of the technology is monopolised by the developed countries

The superiority of developed countries in technology and hence their dominance and control in the technology transfer process has worried many developing countries. For the last four decades, many developing countries have been trying to break this vicious

circle of inequality by following the technological trajectory of the developed countries and attempting to catch-up. At the same time, it is pointless to reinvent the wheel. In this situation, transferring technology from the developed to the developing countries is an acceptable alternative while promoting industrialization and economic development. It is assumed that due to the superiority of technology of the developed countries the technology transferred enables the developing countries to achieve higher productivity, higher output, international competitiveness and this contributes to building their own technology capability. However, technology transfer from developed to developing countries is not completely without its ill effects.

The major issues posed for theory are: the reasons for technology transfer and its implications as far as home and host countries are concerned and the implications on developing countries' technological capability and trade.

3.4. Theories of Technology

3.4.1. Foreign Direct Investment (FDI)

The theoretical literature on technology transfer through international capital movements is mostly confined to an ad hoc modeling of externalities (Findlay, 1978, and

Das 1987). In these models, host country production efficiency is formulated as an increasing function of the presence of foreign capital.

The literature on FDI identifies three broad sets of determinants of FDI. First, is the ownership of intangible assets such as superior technologies, brand name, human capital and managerial as well as organisational capabilities (Kindleberger 1969). Second is locational advantages (Vernon 1966, Dunning 1973) that most countries must offer to induce the MNCs to utilize them across their national boundaries. The final determinant is international advantage (conceived by Coase, 1937; Arrow, K. J., 1962), that induce the firms to opt for FDI over other alternative forms of technology transfer viz., exports, licensing of technology or market transfers. While emphasising the third set of the factors, Dunning (1979, 1981) shows that the propensities to internalise vary between industries depending upon the costs of market transactions of intangible assets, and problems in the transfer of such assets. The rule of foreign direct investment in technology is explained by the eclectic theory as postulated by Dunning. He has argued that there is an investment development cycle in which a country's international investment position is related to its level of development.

Typically, a country begins with little inward and outward investments. In the second stage, inward investment rises markedly. However, in this stage outward investment also rises due to advantages in certain areas like labour intensive products and technologies in developing countries. In the final stage, overseas investment rises rapidly due to its economic and technological development and thus net overseas investments become positive. This theory also implies that the developing countries through imports of technology in the beginning when their overseas investment is negative can become exporters of technology in the later stage when development takes place.

It could be argued that the transfer operation may or may not involve specific legal contracts between the parent and subsidiary (wholly owned or majority owned). The whole transfer is dominated by the parent company and the only substantial negotiation is that which takes place between the parent company and the host government. The dominance of the parent companies in such negotiation mostly emanates from the fact that they are mostly transnational corporations that control technology in the world. This negotiation may or may not cover the supply of technological knowledge.

Foreign investment does involve technology related costs for the host country and there are potential technology related benefits in the form of externalities. The technology which is transferred could include capital goods, industrial property rights, know-how, management, marketing and organizational skills and experience. There is a considerable literature on the advantages and disadvantages of foreign direct investment for developing countries. We are not going to repeat well-known arguments, though a few of these aspects are relevant to the study. There are two aspects considered. One is related to local skills formation and the other to local technological development. A comprehensive training programme for the transfer of technological and managerial skills does contribute to phasing out dependence on expatriate manpower. Local technological development could take place through research and development activities or though contracting with local manufacturing and consulting engineering enterprises for the supply of machine, equipment spare parts and services. It has been noted that the low values of research and development expenditures of trasnational corporations in host developing countries are due to the economies of scale of centralized research and development, the small size of local markets, and the shortage of skilled manpower as well as technological infrastruture.

3.4.2. Imitation Gap Theory

In the previous theories, technology was considered to be stable all over the world. But this is not true. Because, one of the important elements of change in the world is that in technology. Monopoly power is often based on the possession of superior technology. Hence technology can be an important factor in explaining of trade patterns. A pattern that explains the inequalities between nations based on the level of technology development. Thus the earlier theory's assumption of the passive role of technology has been criticised by many authors.

The most interesting explanation of trade where technological improvements play an essential role, is the `imitation-gap theory' originated by Posner (1961). Posner demonstrated how an innovation in one country could create a comparative advantage which did not exist earlier. He also showed how the trade thus generated would gradually be eliminated by the recognition and imitation of the innovation elsewhere.

When a firm develops a new product, it is first tested in the domestic market. If

an established product may be invented with lower cost. In both the cases, the country will have a comparative advantage till the time when other countries assimilate and duplicate the innovation. This time gap is called an imitation gap. For a while the innovating country enjoys a monopoly and others have to import the good or the new technology. Thus, trade is created during the existence of the imitation gap.

In recent years technology transfer has taken place on a very large scale from developed to developing countries resulting in the changes of the trade structure of developing countries. The new body of theories was formulated to explain these changes.

3.4.3. Technological Gap Theory

The technological gap approach, developed by Posner, Gomulka, Cornwall and others, also emphasizes the crucial role of technology in the process of economic growth. According to the 'Technological Gap Theory', the greater the disparity relative to the development levels of a country in the already industrialised part of the world, the faster the rate at which the backward country can catch-up. However, if the gap is too large, technological change may not occur because the region is so backward and the difference in technological capacity is so great that the region cannot possibly apply and diffuse the

advanced technology. Thus, according to this theory, the Newly Industrialised Countries (NICs) act as mediators between (highly) developed countries and more backward countries.

3.4.4. Product Life Cycle Theory:

The product life cycle model develops the imitation gap approach by suggesting that changes occur in the input requirements of a new product as it becomes established in a market and standardized in production. The product life cycle theory is mainly associated with Vernon (1966). In the product life cycle model, international trade and investment follows a typical cycle, consisting of three stages, viz. new product stage, maturing product stage and standardized product stage. Changes in inputs and product characteristics over a time determine the most economic location at any particular moment in the product's life. The product life cycle model suggests that mature products possess a series of characteristics as compared with earlier stages in their life cycle, which make them suitable for export from developing countries. The three stages described by the model are:

(i) New Product Stage: When the product is initially innovated, comparative advantage for its production rests in the country of origin which will usually be an advanced country where Research and Development (R&D) is heavily concentrated. The innovated product

remains unstandardised. The monopoly advantages due to location and technology are characteristic of the early stages of a product's life.

(ii) Maturing Product Stage: The advantages of the first stage are slowly eroded as demand for that particular product expands and standardization slowly takes place. In the maturing products stage, cost considerations open up the demand for the new product and competition in other markets peaks-up. As a result, the innovating country's critical locational advantage gradually declines.

(iii) Standardised Product Stage: The product start emigrating to low cost locations, mainly to the developing countries through international investment and transfer of technology.

3.5. Firm-level Technological Capabilities

The microlevel analysis of technology in developing countries was developed by Nelson and Winter (1982), and explained in Nelson, (1981) and Dosi (1988). The starting point of these theories is that firms cannot be taken to be operating on a common production function. There are significant differences among firms not only in terms of size, but also in terms of technological capabilities, product market strategies, design of innovation and competitive success and cost of production. Technological knowledge is

not shared equally among the firms. Transfer requires learning because technology is tacit (M. Polanyi, 1967).[1] and different technologies also afford different possibilities for subsequent adaptations and improvement.

The first step in selecting technology or technological elements whether to upgrade existing production or establish a new line of production is to identify local needs and conditions. Furthermore, firms have more knowledge of the "own" technology, less about similar technologies of other firms. The extent to which firm level differences in technological efforts and mastery occur may vary by industry, by size of the firms and market, by level of development or by trade or industrial strategies pursued. As Dosi, (1988) pointed out, a major implication of the characteristics of cumulativeness, tacitness and partial appropriability of innovations is the permanent asymmetry among firms in terms of their process technologies and quality of output. Using this as a measure, firms can then be ranked as "better" or "worse" according to their distance from the technological frontier.

[1] Following Michael Polanyi (1967), Tacitness refers to those elements of knowledge and insights that individuals have which are ill defined, uncodified, unpublished, which they themselves cannot fully express and which differ from person to person, but may to some significant degree be shared by collaborators and colleagues who have a common experience. Conversely, Science inputs are typically universal and public.

In the neo-classical theory of production, the firm is viewed as a combination of inputs or factors of production, the most common of which are capital and labour. In order to produce output, at any time there is a given level of technology that determines the techniques available for production. A technique is therefore, effectively defined as a particular combination of factors of production. Among available techniques the firm will choose the one that, given existing factor prices, minimises total production cost. The theory shows that each firm facing a production function makes a choice of technique on the basis of prevailing factor prices but changes in the spectrum of available techniques are exogenous to the firm.

The conventional production function which is given in the following form:

$$Q = f(K,L).$$

Where Q is output, K capital and L labour, the production function can be represented graphically as a series of isoquants; curves corresponding to the constant output obtainable by the infinite number of available combinations of factors of production (techniques). Technical change in the neo-classical theory of production takes place in the forms of shifts of the production function towards the origin.

Therefore, there is a clear limitation to the neo-classical view that assumes a single decision making centre within the firm. As Martin Fransman (1984) argues, the centre makes profit minimising decisions on the basis of given technology and the array of inputs and product prices. These decisions are then automatically and successfully implemented within the firms.

The second problem with the conventional neo-classical approach arises from the assumption that the state of technical knowledge is given to the firm. It has been noted that this assumption ignores the fact that a good deal of technical knowledge is firm specific rather than being evenly distributed amongst firms.

It has been argued that an evolutionary approach is far more plausible than the production function approach. There are various ways to categorize firm level technological capabilities, with the usual sequence in developing technological capabilities being from production to investment to innovation.

3.5.1 Production Capabilities

Once a firm has acquired a technology of any sort, it must have adequate production capabilities to remain in business. Production capabilities are skills and knowledge needed for the operation and improvement of a plant. Acquisition of even "basic" capabilities such as quality control, maintenance or reaching prescribed levels of machine-efficiency, generally requires considerable expenditure of time and effort.

Production capabilities include process technological capabilities as well as product capabilities, such as product design, product redesign, product quality improvement and introduction of new products. In addition, production capabilities also cover monitoring and control functions included under industrial engineering. Industrial engineering skills are required to improve productivity by changing the time and potential sequencing of manufacturing and auxiliary operations. The more advanced the capabilities for adaptations and development are, the more time and investment are required to achieve them. However, countries as a whole tend to develop particular research customs. Some, such as S. Korea, succeeded in industrial development because their enterprises invested a great deal in R & D. Another pattern is imitation. Many capital goods producers get their

start as repair workshops. As the volume of their works grows, they establish small foundries and forges to make spare parts. Then through reverse engineering they make all the spare parts and fabricate new machines. With this experience they often proceed to designing and making new machines.

One interesting case for instance is that followed by FAMA (Fabrication de Maquitus) of Mexico. A glass producer operating since the early 20th century, it had problems of getting spare parts during the second World War. Thus FAMA set up as a repair shop to service its main plant with a small foundry, a small forge and some machinery equipment. Over the years it progressed from making spare parts to copying machines. Finally FAMA was able to produce improved machinery for glass making. (Carl, Dahlaman and Brace Ross - Larson, 1987).

3.5.2 Investment Capabilities

Every application of technology begins 3with an investment. The investment capabilities therefore include the skills and information needed to identify feasible investment projects, locate and purchase suitable (embodied and disembodied) technologies, design the plant, and manage the construction, commissioning and start-up. These functions are not always easily to perform. Many enterprises in developing

countries find it difficult to decide the best technology for their purposes. It has been argued that the technology market operates as a syndicate and it is often difficult for developing country firms to find the best suppliers and negotiate the most favourable terms and appropriate prices.

Experience of NICs shows that a growth in the ability of local enterprises to select technologies, negotiate favourable terms for its transfer and participate in the design and setting up of the plant greatly reduces process costs and increases subsequent mastering of the technology. Generally, the development of investment capabilities within a country, rather than in an enterprise, are important for setting up plants economically and later expanding and improving them. This is one of the reason NIEs, such as the Republic of Korea, are reknonwed for having low project costs and rapid implementation of its investment.

3.5.3 Innovation Capabilities

Innovation capacity consists of creating and carrying new technical possibilities through to economic practice. Innovation capacity consists of everything from the conception of new devices, product processes or systems to innovation and include

improvement in the existing technology. It has been argued that a major innovation may be developed from break through in the basic research for which a market is subsequently found[2], or from the identification of a need or for which research and development funds are allocated. A modification or improvement of existing technology (minor innovation) involves more narrowly focused applied research and development.

Most innovation activity in developing countries is of this type. Minor innovations are important because their cumulative impact can lead to productivity increase greater than those from 'major or radical' innovations. As firms accumulate production and investment capabilities they concurrently develop some capabilities in innovation. Minor innovations based on production experience often come from efforts to increase productivity.

[2] Fundamentally, there are two types of explanatory research, first it is basic research that stands with a small stock of accumulation knowledge, and this two make a substantial addition to it. It may be theoretical or applied. The theoretical research may be defined as research directed towards establishing new theoretical structures to explain scientific phenomena, or to work out limits to the application of known theories. Applied research that may be termed as research. The second type is directed to find products or process of economic value where little is known.

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CHAPTER IV

TECHNOLOGY ACQUISITION AND ANCHORAGE IN IRANIAN AUTOMOBILE INDUSTRY: CASE STUDY OF INIM

4.1 Introduction

In this chapter the performance of imported technology in Iranian automobile industry is analysed. Although, it is remarkably difficult to obtain data on Iran's technology situation, some investigation has been made by the Ministry of Industry, as well as Budget and Planning Organisation and independent researchers. This information though not substantive, provides useful insights that the study will use.

Many studies have observed that relatively high technology capabilities are necessary for the assimilation and modification of imported technology. This chapter will investigate Iran Khodrow's (INIM) experiences in technology acquisition and anchorage in the automobile industry. Focus will be on INIM's technical agreements with Talbot British Motor Company and Mercedes-Benz between 1976 and 1990.

4.2. Technology Transfer in Iranian Automobile Industry: Analysis of INIM's Case:

Basically, technology transfer consists of two main processes. First, it involves the physical movement of technical elements (i.e. technology) across national boundaries for production activities. Second, it involves the implementation of technology in the host country. The former process is referred to as `transfer of technical elements' and the latter as `anchorage of technology'. It has been argued that technology transfer can take place without an effective anchorage of the technology. But anchorage cannot in general occur without the prior transfer of the relevant technology.

Implementation of foreign technology or anchorage should be efficient enough for local employees to apply the knowledge and skills in production with minimum foreign assistance. Anchorage takes place within a micro unit - the firm, and hence covers a narrow space.

It should be noted that anchorage of technology differs in a number of ways from diffusion of technology. Diffusion means the spread of technology, usually to other firms in the industry or other industries in the economy. To the extent that both processes pertain to the absorption of foreign technology in the host country, they are similar, but diffusion is a much broader concept than anchorage. Diffusion depends largely upon anchorage and successful anchorage may be expected to be followed by

successful diffusion of technology. By absorption, technical knowledge is learned and embodied in the local system. We are going to refer very briefly, to some of the specific arrangements for the transfer of technology in the automobile industry in Iran.

For the operation of the automobile industry two main categories of technology have been transferred to Iran: (a) non- proprietary production technologies, and (b) proprietary production technologies.

Non-proprietory Technology: This production technology, refers to technical elements such as machinery operation, welding, fitting, electrical, maintenance and plant maintenance skills. This category of technology is also referred to as 'operations technology.

Proprietary Technology: This consists mainly of the process technology proper, which could be patented or unpatented. The technical elements in this category are very specific, and some times firms monopolised one in the industry for some period as a result of patent protection. Mechanisms of transfer of technology from Daimler-Benz and Talbot British Motor have been in both embodied and disembodied forms. The main mechanisms used are: (a) machinery imports (b) license agreements and (c) inter-firm communication. In discussing the details of how technology was transferred to the Iranian automobile industry a case study of the Iran National Industrial Manufacturing

(INIM) will be used. Based on the theoretical framework of the study developed in chapter III, this is intended to demonstrate the details of the mechanism of technology transfer process and the subsequent indigenisation of the acquired technology.

4.2.1. INIM (Iran Khodrow)'s Background

INIM was incorporated as a public limited company in 1962. The initial authorized capital of INIM was RIs, 1,000,000. The objectives and activities of the company included the production of Passenger cars, Buses, Trucks, Mini Buses, Small trucks and related components. Operation began in 1967 with a production level of 6,000 vehicles per annum.

The company entered into technical collaboration with Daimler-Benz in 1969 and began to produce Benz-302 Buses. The company had turned into a producer of small trucks in the early 1970s.

In 1974, INIM set up its own foundry in order to produce 6 parts of the Paykan 1600CC engine. During the 1970s it had to emphasized the building of internal capability for developing subsidiary firms through overcoming basic handicaps such as the non-availability of proper raw material and components, and the following six subsidaries were established:

1. A unit to produce cast parts such as pistons and ring pistons, with technical collaboration of MAHLEH-(Germany) in Tabriz.
2. A unit to produce ball bearings with technical collaboration of S.K.F. named Iran's Ball Bearing Company.
3. A new factory for producing fan-belts and carburetors in Mashhad.
4. A unit for production of body parts in general, mufflers, upholstery, hubcaps, and plastic components in INIM.
5. A unit for production of diesel engine with technical collaboration of Daimler-Benz in Tabriz. In addition a unit to produce welding machinery, electrical welding and related components with collaboration of C.O.C. established.

After the revolution, the main intention of the company was to introduce a new transmission system for `Paykan'. On completion of the last technical agreement with Talbot in 1987. INIM (Iran Khodrow) decided to buy the Talbot machinery in 1989. A major modification required was to design and develop a new transmission system for Paykan. The INIM (Iran Khodrow) began to search for a modern and suitable product.

The first step was the issuance of an invitation to some of the worlds' well-known bidders. The criteria used for selection included the following:

1. Reputation and international standing of the company offering the technology.
2. Experience of the company in establishing similar production facilities in other developing countries.
3. Levels of investment needed in different stages.
4. Value of local content of the production as reached in each stage.
5. Value and scope of technical assistance offered.

Finally, Peugeot was found to be the most suitable collaborator, whose offer was both for a joint venture and a license agreement. The agreement was signed in 1989. The production of Peugeot, 405 and GL S.R. started from the early 1990s.

According to the agreement 85 percent of components would be sourced domestically. INIM (Iran Khodrow) was to produce 500,000 vehicles for a period of ten years.

The transfer of technology in INIM involved several channels as detailed below:

a. Licensing Agreements

Under these agreements INIM was given certain specific rights of access to a technology conferred on the acquirer for a specific duration that included the authorization to use industrial property rights. It was stated in article twelve of the technical agreement between INIM and Talbot that: "the invention and industrial ownership rights pertaining to new parts supplied to INIM by Talbot from the date of implementation hereof shall belong to Talbot and/or as the case may be, to the concerned manufacturers". Such rights shall by no means extend to the parts utilized by INIM up to implementation date here-of and Talbot shall have no claim over the invention and industrial ownership of the latter mentioned parts. Payment under licensing is made in a variety of forms: royalties, lump sum fees, share in profits and capitalization of technology etc. This type of agreement usually includes a series of clauses regulating the rights and obligation of the acquirer and suppliers. In the case of INIM (Iran Khodrow) and the suppliers Talbot British motor company and Daimler-Benz, with regard to the use of technology

payments were mainly made through royalties and lump sum fees. However, the regulation of rights and obligations in the agreement gave rise to restrictive practices that had an adverse impact on the effectiveness of technology transfer.

b. Technical Assistance Agreements

The acquirer is usually seeking not just technology, i.e. license to use a particular process, but also a specific kind of technical assistance for the setting up and operation of a productive activity. The services provided under this agreement include maintenance and repair of machinery, advice on process know-how and quality control. Technical assistance also included training, provision of expertise and the whole spectrum of capacity and capability building activities.

c. Technical Documentation and Modification

INIM (Iran Khodrow) has received from Daimler-Benz and will continue to receive in time for production purposes, all necessary documentation. All documents

supplied were however to remain the property of Daimler-Benz. The above mentioned technical documentation includes inter-alia the following:

1. List of drawing and construction parts for parts listed in the agreement.
2. Material specification as well as DBI (DB specification of delivery) and DBN (DB standard), volume for parts material-listed in the agreement.
3. Assembly and instruction drawings.
4. Assembly inspection regulations, assembly information.

It was stated in Article three that Daimler-Benz will make available to INIM any technology modification or improvements for the Chassis as well as the Cowl of the contractual goods, which Daimler-Benz introduces in its own serial production and releases for export and will keep the technical documentation furnished to INIM upto date.

INIM would adopt at its cost such modifications and improvements without delay and shall itself alter the required manufacturing documents accordingly. At the same time INIM would adjust its spare-parts - literature accordingly.

Daimler-Benz may relieve INIM from obligations imposed on INIM by the above mentioned provision if that is possible in the opinion of Daimler-Benz without harm to the Daimler-Benz quality standard. INIM would report every third month to Daimler-Benz about the actual situation on technical modifications and about the plans of modifications. These reports should be in line with the Daimler-Benz specification. If INIM has any requests for modification of the contracted goods, INIM would submit such requests and the necessary engineering data and records to Daimler-Benz and would not introduce the modification concerned into standard production without prior approval from Daimler-Benz.

Modification initiated by Daimler-Benz as well as those originating from INIM may be utilized by the parties without any special remuneration, Daimler-Benz retaining the right to make them available to third parties.

d. Technical Assistance

It is in the interest of INIM as well as Daimler-Benz to maintain and further improve the high technical standard of the contractual goods. Consequently, Daimler-Benz would continue to advise and support INIM in the technical field, especially in the further deepening of industrialization, an increasing production capacity and in selecting the most suitable production methods and production equipment. Also, upon request of INIM, Daimler-Benz would be prepared to delegate if possible for the above mentioned purposes specialists for assembly, manufacture and planning. INIM would reimburse Daimler-Benz all charges and costs with regard to the delegation of such personnel.

e. Technological Co-operation and Exchange of Data and Services:

Iran national industrial manufacturing (Iran Khodrow) may, according to a predetermined programme and the provision here of, visit Talbot facilities for industrial research design, product design, tooling design, production centre, parts and kits testing procedures, and training and laboratory facilities, related to parts production. Talbot would complete and revise all the data, brochures, manuals and evaluation requested by

INIM (Iran Khodrow) and place them at INIM's disposal and would provide Iran National with the latest subsequent supplementary data during the period here-of.

It should be mentioned that the classification is arbitrary but it encompasses all the technical elements and know-how that have not been transferred to setup and operate a plant in Iran. These are mainly research and development (R & D) and engineering problem technologies which underlie the production process and design and manufacture of plant and equipment. These left the Iranian firms technologically dependent upon the parent companies and incapable of developing independently.

4.2.2. Anchorage of Technology in the Automobile Industry

Three principle methods are used in the industry for anchorage of technology namely: a) internal training b) on-the-job training, and c) overseas training programmes. On-the- job training is the most useful. Also, its duration is generally longer than either of the other two forms. On- the- job training is useful because it is based on the principle that training provides a practical solution to the basic educational

deficiencies, particularly in the scientific and technical fields, of the majority of the industry's local employees. In an effort to ensure that technology anchorage takes place within INIM (Iran Khodrow), the agreement had to be explicit about training. Thus it was stated in article of the agreement that Talbot would give effective practical training in the U.K. to INIM personnel as part of an agreed programme by the parties concerned. A maximum of 60 people at a time for no longer than a maximum average of three months for each individual could be trained. A similar clause was included in the agreement with Daimler-Benz . Where the company (Daimler-Benz) was to train qualified INIM personnel in its plants.

However, it must be mentioned that as much as the technical agreements covered aspects of training that is necessary for technology anchorage, this was not fully achieved. Despite the training programme providing the INIM staff with the opportunity of using up-to-date plant and equipment while training abroad, the knowledge gained was not used in Iran. When the trainees particularly those in the technical fields returned to Iran, they seldom found all the sophisticated equipment and facilities with which they

trained abroad. In many cases this led to frustration that undermined their efficiency and transfer of know-how.

The level of anchorage achieved over the period 1977-86 in INIM (Iran Khodrow), the restricted level training provided in some areas of technology, particularly in proprietary technology, the lack of opportunity and facilities to practice the skills acquired in training, the insufficient as well as inappropriate development of trained local personnel and lack of R & D facilities among them, have all had adverse effects upon the anchorage of technology in Iranian automobile industry.

Conceptually anchorage is the vital step that follows the transfer of technology and links to it the other stages in the process of assimilating foreign technology. The fact is that without the anchorage stage, neither diffusion nor assimilation of the transferred technology will occur in the host system. Anchorage is therefore vital in the acquisition and development of technology.

Table (4-1) : Situation of Manpower in Iranian Automobile Industry.

(In number)

Company Name	Graduate engineers		Middle Supervisers		Technicians and Skilled operatives		Craftsman		Workmen	
	1985	1988	1985	1988	1985	1988	1985	1988	1985	1988
INIM (Iran khodrow)	147	130	161	0	331	223	7539	2841	4796	3252
Iran Kaveh	20	7	17	9	4	11	95	179	879	189
Iran vanet	19	21	19	12	65	34	550	16	393	414
Pars khodrow	45	49	26	39	21	11	1224	551	1442	1496
Mortab	9	9	7	3	39	45	375	316	360	191
Zamvad	30	20	37	25	298	101	1709	497	1238	952
Salpa	37	27	16	18	175	29	1842	4270	966	1578

Source: Industrial Development and Renovation Organisation, (IDRO), 1988.

Table (4-2): Distribution of Manpower in Iranian Automobile Industry

(In number)

Company Name	Ph.D.MT/Ms		Graduate engineers		Techinician		Secondary School Education		Primary School Education	
	1985	1988	1985	1988	1985	1988	1985	1988	1985	1988
INIM (Iran Khodrow)	55	42	253	239	88	76	2142	1302	8881	4317
Iran Kaveh	3	2	34	14	7	0	327	116	362	210
Iran Vanet	6	4	32	20	30	13	347	176	513	255
Pars Khodrow	7	9	64	79	27	18	815	755	1851	1205
Mortab	1	1	15	11	7	5	190	160	487	386
Zamyad	12	5	55	40	16	14	1011	468	1750	884
Saipa	6	4	47	41	10	16	909	697	1583	1527

Source: Industrial Development and Renvation Orbanisation, (IDRO), 1988.

Table (4-3) : Distribution on Manpower in training Centre of Iranian Capital Goods Industry 1986.

Company	Ph.D.MT/MS	Graduate	Technicians	Secondary Education	Primary Education
Arak machine Tool Company	1	13	2	15	7
Iran Khodrow	-	3	1	3	7
Tabriz machine Tool Company	-	3	11	19	5
Tabriz Tractor Company	2	19	20	43	33
Percentage of Each Category	1.7	16.3	17	37	28

Source : Report on Performance of Industry,Ministry of Heavy Industry, 1988.

As we have noted earlier, the government provided no technical assistance to most of the firms. The Industrial Development and Renovation Organization (IDRO) which was an organisation in-charge of technical assistance to industry mainly acted as a middle man between the very large scale domestic enterprises and international multinational companies in establishing joint ventures and licensing agreements after 1978. This organisation failed to assist the manufacturing firms.

As tables (4-1) and (4-2) show, 36.96% of Iran Khodrow's employees were workers and the proportion increased to 50.44% in 1980. The distribution of manpower shows that 56.36% personnel of Iran khodrow had only primary school education in 1985. This proportion rose to 74.48% in 1988.

Table (4-4) : An average hour work for production of one unit of vehicle in INIM (Iran Khodrow) 1985.

(in percentage)

Degree	An aaverage hour work for production per one unit vehicle	percentage
Ph.D/MT/MS	0.12	.25
Graduate engineers	1.51	3.09
Technician	6.84	13.99
Secondary school Education	2.68	5.48
Elemntary School Education	37.75	77.20
Total	48.90	100.00

Source: Report on performance of Industry, Ministry of Heavy Industry, 1988.

It can be pointed out that INIM's (Iran Khodrow) technical personnel are not well-equipped to contribute to machining of high precision parts, particularly the finishing of gears, for which they required precision with 2-3 microns. To make matters worse such machining has to undergo constant change whenever a new model is produced. Due to low level of education of the majority of INIM employees as shown in the table (4-4) were less than 2 percent of an average man-hour of work input into producing a vehicle was done by graduate engineers.

Some of the deficiencies of the technology transferred in the INIM case are therefore as follows:

1. Know-how transferred by collaboration was not internalised by the firm
2. No provisions were made in the agreement for assistance for setting up of a development section or automobile research unit.
3. As a result of depressed economic conditions in 1980s, the process of transfer of improved technology that matches local needs and of the design technology needed for model change has not made the progress that it should have.

4. Although production assembly technology transfer has by and large been completed at the level of assemblers, the local capacity for absorption of technology has not risen to such an extent as to guarantee survival and development of the enterprises concerned as ongoing concerns.

5. The absence of policy of learning by doing in Iran led to the continued dependence of foreign firms and the repetitive importation of technology. (See table VI and V).

6. Other bottlenecks found are the lack of infrastructure, foreign exchange and lack of continuous modernization and development of technology.

Table (4-5) : Consumption pattern of Raw Material and Components in Automative Industry (1983-86).

Year	Consumption raw material and components (Million Rials)	Consumption of imported raw and components (Million Rials)	Percentage of Imported raw material to raw material and components (percentage)
1983	135602	77690	57.23
1984	158151	100824	46.16%
1985	127275	81690	64.18
1986	54248	34566	863.72

Source: Data on large scale industry, statistical centre of Iran, 1983, 1984, 1985,1986

Depenfdence Trends of Production on imported components.

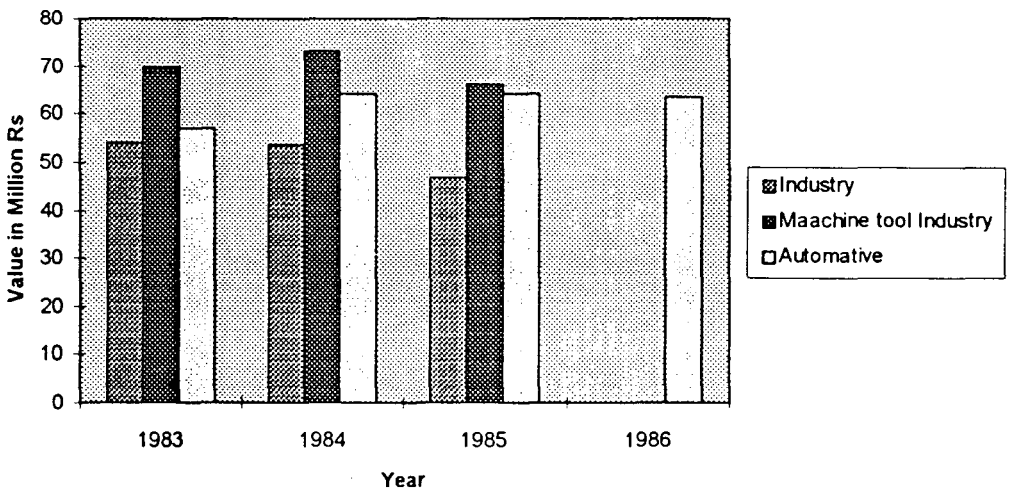

Table (4-6) Comparative data on Dependence of Production to improted raw material and components to total raw material and component in Automative Industry to Industry.

(in percentage)

Percentage of raw material to production				Percentage of total imported raw material to total raw material and components.		
Year	Industry	Maachine tool Industry	Automative	Industry	Machine tool industry	Automative
1983	28.2	37.5	37.7	54	69.9	57.2
1984	27.9	40.1	41.16	53.8	73.4	64.2
1985	23.8	34.7	38.7	47	66	64.2
1986	NA	NA	36.6	NA	NA	63,6

Source: Data on large industry, Statistical centre of Iran, 1983, 84,85, and 1986

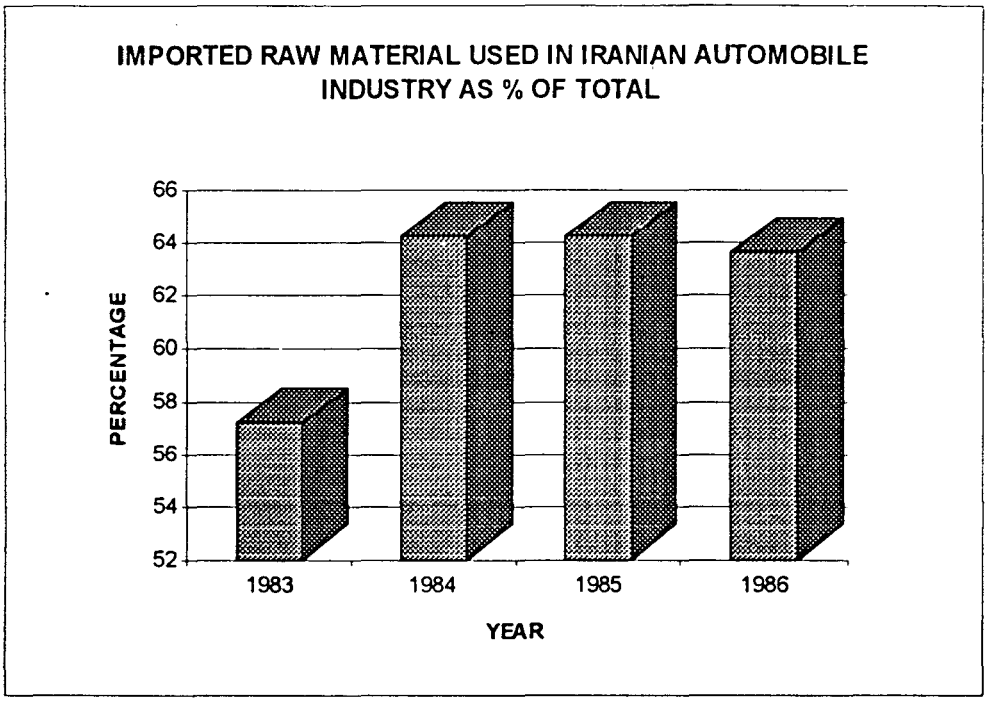

Table (4-5) shows the consumption pattern of imported and indigenous raw materials in the production of vehicle by the automative industry during 1983-86. The consumption pattern of raw material reflects the extent to which a company depends on domestic vis-à-vis foreign resources for meeting these raw material requirements. The proportions of imported raw material reveal, that the automative industry has not been able to reduce continuously the imported raw material, which stood at 50.3 percent in the1980s. In value terms imported input materials consumed in this period stood at about RIs 294,770 million during the period.

4.3 Technological capability development: The Indigenisation of Automobile Technologies

4.3.1 Indigenization Level

As we have previously discussed in chapter II. the Iranian automobile industry was heavily dependent on foreign inputs such as components and spare parts in 1970s. After the revolution the Government was determined to establish a local vehicle industry as an important part of Iran's Industrial Development. But for political and economic reasons it was very difficult for car manufacturers to invite foreign engineers with guidance provided by simple instruction manuals attached to imported machines. The staff had to achieve the standard performance. Naturally, the objective of government policy has been to encourage indigenous sources of supply either by locating suppliers or by developing their own facilities. In order to estimate the level of indigenization in Iran we analyse the data presented in tables (4-4) and (4-5).

Table (4-7): Indiginization Programme in Iran's Automobile Industry (1986).

Company	Type of Vehicle	C. K.D's per unit	Indigineous Cotent (Planned)		Indigineous Content (achieved)		Percentage of Indiginization progress
			No.	V($)	No.	V($)	
Iran Khodrow	Passanger Car	1716	380	1066	108	82	18
	Mini bus	2572	225	554	NA	NA	NA
	Bus	12604	328	2110	NA	NA	NA
Khaver	Semi-truck	2168	488	2069	22	62	3
	Truck	10838	259	1870	44	1289	69
Zamyad	Nissan (Van)	2939	202	515	-5	28	5

Since the automobile industry registered a slow progress in indigenization, out of 380 parts planned to be indigenised by INIM (Iran Khodrow) in its CKD based production of a passenger car, it could only achieve success in 108 components. In fact, progress has been observed only in the areas which required less technological sophistication.

Table (4.8) : Technology Projects in Iran's Automobile Industry (1994).

Project	**Number of Companies which have ordered for new sets**		**Sample**	**Components which can produce in mass production (%)**	**Value in $**
	No.	%			
New engine set	23	47174	-	-	470
New gearbox set	2	221854	-		
New axel set	-	-	-		
New Nissan engine set	55	76.685	20.7	11.21	1247
New Nissan Engine	49	68.92	20.7	11.48	1247
Payakn gearbox	36	84.3742	58.580	35.87	304

Source : Automobile Industry, Ministry of Industry, 1984.

Despite the fact that since the early 1990s Iran's Automative industry had started using some indigenous parts for the assembly of automobiles such as gaskets, spark plugs, springs and knock pins, the local components are still a small proportion of the total. For example, for the new Nissan engine set, local components that can be produced indigenously account for 11.35 percent of the total and for the Paykan gearbox about 36 percent. The more vital and value added parts like fuel injection equipment etc. are yet to be indigenised. As a result the Iranian Automobile Industry continued to rely heavily on imported CKD's for assembly of its cars. The value of the CKD' kit costituted a major part of the cost per unit. It can probably be argued that Iran's automobile industry engineers have indigenised those portions of the imported technology relating to start-up and operation and maintenance of the manufacturing process but at the same time have made little progress in observing the knowledge required for equipment selection, layout and planned construction. The basic design of engines and of the facilities within which they can produced have yet to be mastered.

Typically it takes 15 or 20 years to acquire the full range of production capabilities. The most distinctive characteristics of the Iranian automobile industry in its infancy stage is the low levels of production and the lack of supporting industries especially metal working and machinery building. Under such unfavourable conditions indigenisation efforts moved slowly and took various forms. Modification of the components which is the first stage of indigenization was attempted only after the 1979. Generally after this period major functional parts and components such as cylinders, pistons, crankshafts, etc were manufactured by local ancillary firms.

Parts and components manufacturers were categoriezed as follows:

1. Public and private firms that produce (pistons, piston rings, radiators, spark plugs, wheels, shock absorbers, carburetors.)
2. Private and independent firms whose products are more or less standard and sold outside the auto parts market (e.g. plastic parts, condensors, regulators, frames, etc.).

Table (4.9) : Comparative Data on Production, Employment and Percentage of output per employee in Iran's Automotive Industry.

Company	1984 Produc -tion	1984 Emplo -yees	1984 output per employ ee	1989 Produc -tion	1989 Emplo -yees	1989 output per employ ee	1992 Producti on	1992 Emplo- yees	1992 output per employe e
Iran Khodrow	52966	1296	11.5	8797	6849	1.3	27671	9600	2.9
Khodrow Sazan	3279	1303	2.5	900	478	1.9	1251	674	1.85
Khavar	12003	4259	2.8	3238	3336	0.97	5071	4812	1.8
Iran Khaveh	4149	902	4.6	140	445	0.3	2575	1033	2.5
Shahab Khodrow	1552	1663	0,93	450	1247	0.36	1145	1569	0.73
Saipa	18006	27178	6.63	4930	2523	1.95	21342	2318	9.21
Zamyad	20806	3144	6.62	147	1378	0.1	19232	155	114.2
Pars Khodrow	1250	830	6.34	2195	502	2.54	6412	2329	2.75
Mortab	5364	830	6.34	2195	502	4.4	2517	535	4.7
Iran Vanet	14489	1035	1.4	2052	476	4.3	9376	766	12.24

Source : Division of Statistics and Evalution, Ministry of Heavy Industry, 1993, Tehran, Iran.

Table 4-9 highlights the comparative data on production, employment and output per employee during the period from 1984-92. Analysis of these trends is extremely important primarily because growth in per capita output heavily depends on the investment and production capabilities. It is evident from the table that Iran Khodrow and Iran Vanet registered a steep reduction in output per employee. Shahab Khodrow

and Khodrow Sazan had the lowest output per employee in this period. During the first five development plan's output per employee has been increasing smoothly, Zamyad increased her per capita output to 14.1 per annum.

4.3.2 Ancillary Firms

Technology and efficiency in the auto ancillary sector more or less determines the quality and the price of finished cars. It is widely known that excellence in the auto ancillary sector is an indicator of industrial maturity. A point worth nothing in the Iranian case is the relatively low adaptability of both production workers and engineers to new machinery and technology. Both the ancillary firms and car manufacturers have relied heavily on foreign machinery. The technology gap was wider in the early days of their development. Nevertheless, workers at ancillary firms managed to master the operation of imported machinery with little outside help.

In the post-war period some ancillary firms have entered into technological collaboration. For instance, Gharkhashgar company signed a technical agreement with

ZF company (Germany) to transfer know-how for producing gearboxes. Iran's industrial casting company has entered into technical collaboration with Fuji Company for producing master models (Fiber-Rein, Force-Plastic). In fact, ancillary firms have focused on quality control. Improvement in manufacturing activities and applications of these formed the basis for cost reduction.

As can be seen in table (4-10) there are parts manufacturers who have specialised in automobile parts, producing products that are technically reliable. They are local enterprises that have received technological backing from foreign companies. On the basis of their technological and business management capacity established with the help of technical collaboration with foreign companies, such enterprises are now able to stand on their feet as automobile parts manufacturers. Nevertheless, their existence as parts manufacturers is somewhat threatened by circumstances such as foreign exchange shortage.

Table (4-10) : Major Manufacturing of parts and components in iran's Automobile Industry.

Tittle	Parts and Components	Production Units	Capital (M.Rils)	Emp loym ent
Engine Parts:				
Pishran	Engine parts and gear box	2700	241	143
	Diseal Engine	20000	2237	90s
Piston/ Amoredej	Piston Rings	12, 000,000	2060	1250
Piston-Iran	Pistons	1,40,000,000	3637	483
Amir Piston	Piston Rings	12,000,000	2160	339
-Gorhan'Intake & E xhast	Bulbs:			
Arva Diseal Part	Fuel infection system	430,000	1182	400
Bank of EasternAzerbijan	Fuel infection system	1440000	4665	9600
Iran	Fuel infection system	2700,000	1322	174
Transmission and Steering system:				
Tolidi knokhodrow Iran	Steering wheet	1260,000	31000	151
Motab Industrial company	Clutch disk Clutch linging	310,000	1982	353
Cluch Sazi Iran Zanjan	Clulghs & Clutchlinging	800000	2602	190
Moratab Industrial company	Crankshaft	100000	945	226
Zamyad	Differential System (set)	9000	325	9500
Edam-Tabriz	Crank shaft	35,000	3313	239
Benzka-isfahanj		80,000	1247	93
Suspension and brake system:				
Iran Vanet	Chassis	11500	4340	180
iran KobotaZonjan	Chasis	12000	3688	520
Talken Ghoskhorsan	Brake cylinder & Brakepumps	862000	1463	365
Iran Sibak	Shock absorbers	3500000	8519	125
Rad farman	Shock absorbers	1200000	759	96
Body parts:				
Aber Motor Parts	Body parts	6000	930	73
Prered Parts: Kodrowsazan, Iran	Frame & axel	100000	945	452
Iran Industrial and mine bank	Frame axel	30000	-	914
Electrical Parts:				
Chade company, Rasht	Starter & General	380000	2100	472
Knodrowkaron Iran	Starters &	-	933	39
Miscellaneous Parts:				
Iran sapahonIsfahan	Ribberbulbs	6000,000	587	122
Automobile Iran, Mashad	Bampers & hupces	1,220,000	1205	299
Vanaki-semnon	Ball Bearings	41000,000	1517	207
Iran Ballbering- Tabriz	Ball Bearing	8500,000	2613	600

Source : Department of Research and Training, Ministry of 'Jihad', (Construction) 1990, Tehran, Iran.

4.3.3. Innovation Capabilities:

Another aspect of the indogenisation of the automobile technology in Iran has been innovation, carried out in both the automobile and ancillary units. Though minor, these innovations are important because of the cumulative impact they have had on the production of automobiles in the country.

A notable innovation that has increased Iran's technology capacity in motor vehicle manufacture has been undertaken by Saipa. company. The company succeeded in developing a new system that doubles the speed of car painting. This greatly enhanced productivity in Saipa company. Another example of innovation is provided by Shahab Khodrow. This company through its R and D changed the propellant system of motor vehicles from Diseal to petrol propelled. The other main innovations and modifications of technologies that have been carried out in Iranian Automobile industry include:

1. Removal of toxic element components in the sewage.
2. Design and production of an injection antirust system for chassis profiles.
3. Design and promotion of the wind tunnel

4. Application of composite materials in automobile frames.

It seems reasonable to argue that improvement of production and new innovations are possible that R & D activities are adequate. For instance most recently the manufacturers have entered computer aided design and computer aided manufacturing (CAD/CAM) so as to speed up design and production of various components.and increase productivity. If it combines with financial and production strength then it would enable Iranian automobile industry to narrow down the technological gap relative to other countries. This could perhaps lead to achievement of competitive trade activities in the local markets and across regional markets.

NOTES

1. Industrial Development and Renovation organization (IDRO), 1988. Tehran.

2. Iran National Manufacturing Company and Talbot Motor Company Limited (1982). licensing and manufacturing agreement.

3. Iran National Manufacturing Company and Daimler-Benz AG (1976). Licensing and manufacturing agreement.

4. Ministry of Heavy Industry (1988), Report on Performanace of Industry, Tehran.

5. Statistical Centre of Iran, (1983, 1984, 1985 and 1986), data on large-scale indsutry. Tehran.

6. Ministry of Industry (1994), Automobile Industry, Tehran.

7. Ministry of Heavy Industry (1993), Division of Statistics and evaluation, Tehran.

8. Ministry of 'Jihad' (Construction), (1990). Department iof Research and Training, Tehran.

CHAPTER V

NATIONAL TECHNOLOGICAL CAPABILITIES

5.1. Introduction:

In this chapter, it is observed that in Iran, as in most developing countries, there was little explicit concern about transfer of technology. Up to the early 1980s, Iran had no comprehensive technology transfer policies or programme. However, from 1989, there has been a rather fundamental shift in science and technology policy in the country.

Although major efforts in science and technology development were instituted in 1979, it was during the first five year development plan (1989-93) that specific attention was given to transfer of technology in industry and agriculture. This has to a large extent assisted in the realization of the existing capacities.

This chapter attempts to review and analyse the existing technology capabilities in Iran in relation to these new policy developments.

5.2. National Technological Capabilities

At the country level, capabilities can be grouped under three broad categories: physical investment, human capital, and technological effort. These are strongly interlinked in such a way that it makes it difficult to identify their separate contributions to national performance (Nelson, 1982). However it should be borne in mind that if physical capital is accumulated without the skills or technology needed to operate it efficiently, national technological capabilities will not develop adequately. Also it will not help if formal skills are created but not combined with technological effort to assimilate or adopt existing technology and or to create new technology (S. Lal, 1993, F. Stewart, 1982). It can be argued that national investment in R & D and human capital have a direct influence on relative technological capability and thus on differences in productivity growth through innovation or intra-national and international technology diffusion. Physical capital formation, however is often an essential part of the application or embodiment of superior technological know-how.

5.2.1 Science, Technology and Government Policies

It is generally observed, that the current problems of the Iranian economy result essentially from inadequate production and productivity, which are attributable to technological underdevelopment. There are several factors that aggravate this condition. At the domestic level the most important cause of the problem is that R & D establishments despite their size and diversity, have a marginal role in providing the technological needs of the national economy.

These needs are furnished principally from external sources. Technology needs were thus met through importation of technology via turn-key contracts, acquisition of patents rights and through joint venture projects. This mode was not only restrictive in the use but also led to lack of linkange between industry and Rand D institutions and universities. This state of affairs has produced, inevitably a state of technological dependence. To remedy the situation the policies have been reformulated aimed at enhancing the existing capabilities, and to harmonise the development of science and

technology with people's needs. The dominant institutions of scientific enterprise in Iran are as follows:

- The Ministry of Culture and Higher Education (MCHE), whose Vice President for research is responsible for the leadership and overall coordination of research at 40 universities and 14 associated research institutions.
- The Iranian Organization for Research and Technology (IROST), under the Ministry for Culture and Higher Education where mostly applied research and experimental development upto semi-industrial production is carried out in eight departments including biotechnology and mechanical engineering.
- The National Council for Research which is the dominant body overseeing research policy. It operates under the President's Office and consists of seven commissions: industry, agriculture, water, energy, science, social science and Medicine, each coordinating research policy in the related Ministry Research Departments, Universities and Research Institutes.

During the second five year economic, social and cultural development plan, a number of measures have been adopted by the National Research Council, including support for the research centres under it, and the creation of R & D units in industry and improvement in the utilisation of research results. The National Technology Policy (NTP) contributed to producing the following mutually reinforcing results:

1. Stimulation of the national technological capability to increase domestic inputs, vis-à-vis inputs from foreign sources both quantitatively and qualitatively, through strengthening local innovative productive capacities.
2. Rationalization of the flow of foreign inputs with a view to maximizing their benefits, while maintaining a favourable socio-economic balance with, inputs from indigenous sources.
3. Preparation of the society for the inevitability of receiving and having to interact positively with the advanced technologies of the present and future.

During the Pahlavi regime (1926-1979), the government and its agents were involved in R & D units. The fund allocation for research and studies by government ministries, executive bodies, universities and other institutes in the period 1968-79 show

that the ratio of the research budget to GNP decreased from 0.34 to 0.13percent. The nominal amount however had increased 19 times by 1976 as compared with 1968. In 1974 Iran devoted 0.28 percent of GNP to R&D compared with 2.3 percent in USA and 4.7 in France. When the basis of comparison is other developing countries Iran's position becomes better only after the 1980-88 war with Iraq. (See table5-1).

Table (5-1) : Research and Development Expenditure percentage of GNP for selected countries.

(In percentage)

Country	1974	1981	1985
Iran	0.28	0.12	0.18
France	1.7		2.3
USA	2.3	2.5	2.8
S. Korea	0.4	0.6	1.8
Nigeria	0.4		0.1
India	0.4	0.6	0.75

Source : Data book, Science and Technology, Ministry of Science and technology, New Delhi, India 1993.

Table (5-2) : Scientists and Engineer engaged in Research and Development per million population of some selected countries.

(In number)

Country	1981	1985	1988	1993
Iran	48	50	90	493
Japan	3808	4458	5029	
France	1363	1898	2079	
USA	2815	3317	3265	
India	131	132	147	
Brazil	390			
S. Korea	383		1335	

Source : (a) Data book, Sciences Technology, Ministery of Science and Technology, New Delhi, India , 1993.
(b) Division of higher education, budgetend planning organization Tenven, Iran, 1990.

R&D EXPENDITURE AS A PERCENTAGE OF GNP

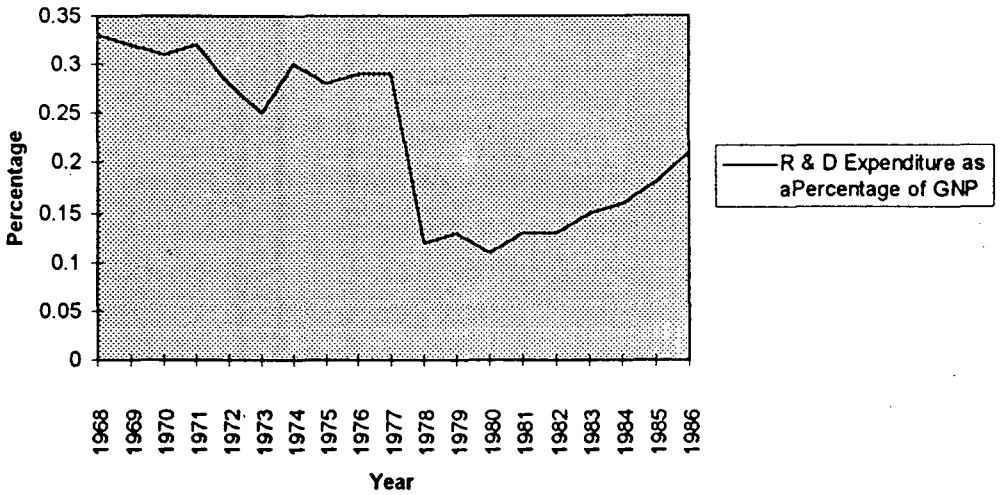

Table (5-3) : Research and Development Project by the Charateristic of work, Average of change as percantage of annual growth.

Project	1989		1990		Annual
	Number	Percent	Number	Percent	Growth
Total	1901	100	2358	100	24
Medicine	430	22.6	434	18.4	0.9
Basic Science	441	23.2	538	22.8	0.22
Social Science	275	21.9	384	16.3	39.6
Engineering	419	17.8	699	25.8	46
Agriculture	338	17.6	393	16.7	46.3
Applied Rearch	331	17.4	348	14.8	5.1
Basic Research	826	43.4	1134	48.1	37.3
Development Research	328	17.3	376	15.9	14.6
Unknown	418	21.9	500	21.2	20.2

Source : Division of Higher Education, Budget and Planning Organization 1990.

Between 1989 - 90 altogether 1950 projects have been approved by character of basic sciences in Iran of the total and for 1990 is 48.1% and basic research for 1989 13.4% and 48.1% respectively. The total projects in the form of applied projects and experimental research for 1989 are 659 and 725 respectively.

Table (5-4) : Personnel Enganged in R&D.

(In number)

	Government sector		Non-government sector		Total	
	Men	Women	Men	Women	Men	Women
Engineer & Scientists	16522	2548	2109	571	18631	3119
Research Assistants	5226	2268	240	153	5466	2421
Technician	6833	2579	194	68	7027	2627
Auxiliary Workers	3291	1229	149	113	3440	1342
Total	31872	8624	2692	905	34564	9529

Source : Worked Science Report, 1994, UNESCO, Publishing Press.

Statistics on graduates of tertiary-level education have shown a steady rise during the past few years. During the first five year development plan (1989-93), the number of graduates increased from 28637 to 59194. Noteworthy are the very low presence of women graduates in agriculture and engineering. The high figure with regard to medicine may be explained by the inclusion of nursing and paramedical subjects. The employment of scientists and engineers in R&D in relation to population is another

measure of technological effort. The number of personnel engaged in research and development in Iran in 1993 is shown in Table (5-4). It is significant that of the total 39311 R&D workers (excluding auxiliary workers), 2518 were engaged in universities and 1423 in non-university institutions.

The evaluation of science and technology policy in Iran points to:

1. Increased awareness that universities and other institutions of higher education must regard research as an integral component of their activities.
2. The importance of coordination of all research activities whether in universities or by other personnel engaged in R&D organizations through information exchange mechanisms.

NOTES

1. Richard, Nelson, (1982), Research on Productivity Growth and Productivity Differences: Deadents and next development, Journal of Economic Literature, Vol. XIL.

2. Sanjaya, Lal (1993), Policies for Building Technological Capabilities, Lessons from Asian Experience, Asian Development Review, Vol. 11, No. 2.

3. Data book, (1993), Ministry of Science and Technology, New Delhi.

4. Division of Higher Education, (1990), Budget and Planning Organization, Tehran.

5. World Science Report, (1994), UNESCO, Publishing Press.

CHAPTER VI

CONCLUSION

6.1. Introduction

This study on Iranian automobile industry is in essence a review of Iran's development strategy over three decades. Nevertheless, the fact that it focusses on the automobile industry makes the study more specific. The specificity of the study relates to using INIM's experience to represent the transfer and development of technology in Iran. It must be noted that INIM's experience is by and large insufficient to allow such generalization in the overall field of the development of technology in Iran.

Nonetheless, though, we cannot generalize on the experience, we definitely can derive lessons that are applicable to enterprises both in Iran and to other countries that are in the process of development.

6.2. Industrial Development Strategy

During the early 1950s to mid 1970s there was a considerable decline in the share of the agricultural sector in GNP. The decline in agriculture's share has been accompanied by a growth of industry. Industrial output rose from 17 percent of GNP in 1959, just over half of the share of the agriculture sector in that year, to about 23 percent of GNP in 1959, which was 5 percentage point higher than the share of agriculture. A similar shift was experienced in the composition of employment. The industrial and service sectors increased their share of employment by 9 and 2 percent respectively. By international standards the growth performance of the Iranian economy during the period was very impressive. The rates of growth of real GDP and real gross investment in the Iranian economy ranked amongst the highest in the developing countries during the period. However, as previously discussed, much of Iran's industrialization in the pre-revolution era had been state-induced and had been financed not with internally generated profits of the relevant state corporations. Rather industrial development was financed by the exchequer with foreign exchange earned from oil export and external credit. What was observed then was an ambitious import

substitution programme along the lines pioneered by other leading third world countries. As the experience of Iran has shown, even the achievement of rapid economic growth may not be itself sufficient to reduce economic duality over time. This emphasizes the difficulty of the organizational task which states in developing countries with an economic structure similar to Iran face.

It can be argued that during the 1980s Iran's industrial sector experienced highly adverse developments involving a decline in output and low capacity utilization, continued dependence on imports and the general lack of interest on the part of the private sector. There was also greater intervention by government in industrial activities and investment decisions.

In adopting a policy of self-reliance after the Iran-Iraq war, Iran adapted three broad approaches to development. The first was to build a mixed economy in which the private sector's role will expand, while that of the public sector will be confined to basic and strategic industries. The plan incorporates a supply-side economic policy according

to which most government reforms and assistance are designed to benefit producers rather than consumers. The second was to stress on economic growth and import substituting industrialization based on the nation's resource endowment. It involved the removal of bottlenecks and maximising utilization of the existing productive capabilities mainly focused on capital and intermediate goods. The third is that there has been a great change in ideas about technology transfer in recent years. This is mainly because of the realisation of the fact that technology transfer does not just entail the involved technological factors but also socio-economic and political factors. With the experience of past performance, the State's strategy has been to acquire suitable technologies and upgrade the nation's technological capabilities.

6.3. Transfer of Technology

We developed the concept of anchorage as a vital step that follows the transfer of technology and links it to the other stages in the process of assimilating foreign technology. The importance of the anchorage stage lies in the fact that without it neither diffusion nor assimilation of the transferred technology will occur in the host system.

The anchorage stage is therefore vital in the acquisition and development of technology. The foreign technology that has been transferred to Iranian automobile industry is of two types: proprietary technology and non-proprietary technologies. A combination of transfer mechanisms have been used.

While some aspects of the transferred technology have been anchored, others have not. The unanchored ones include those that determine the technological development of the industry for instance, R&D for innovation purposes. The aggregate effect of the technical agreements is that Iranian employees could not setup 'imitated' sophisticated indigenous plant. The situation derives from the fact that foreign companies had no interest in anchoring all aspects of their technology in Iran and preferred to keep their subsidiaries dependent on them. Consequently, Iran imported technology on turn-key basis and entered into contracts for the erection of full scale plants. And for doing so Iran had to rely on foreign experts.

As our inquiry shows, the transfer and development of technology is essentially a part of the total process of starting, developing and operating an industry. Therefore, while the technology that is acquired, transferred and generated, has in its turn the nation has to go through a process of learning. For each level of technology, the enterprise that starts as a joint venture or turn key project goes on to setup the plant and equipment and to train the operatives in the basic skill. The Iranian automobile industry has been acquiring technology through licensing. But it could not enter into joint development of a product with a collaborator or it could not generate sophisticated components. It can be argued that it could not obtain raw materials and finished parts etc from indigenous suppliers. Due to the integrated nature of industrial development and especially of car manufacture, this weakness hampered the development of a strong industry.

During the period of economic reforms the number of foreign collaborations has been increasing at a fast rate. This acceleration in the rate of foreign collaboration is likely to increase technological dependence unless the import of technology is backed by in-house R & D effort for its absorption and innovation. (See table 2-9, Chapter II).

Having observed the past performance and analysed the science and technology policy in Iran, it can be concluded that some attempts have been made to encourage public and private sectors develop local technological capability. Industries have been encouraged to utilise the facilities available at the nation's universities and other institutions for solving the scientific and technological problems of the nation. Also efforts have been made to promote industrial research for the creation of a self-sustaining national technology capacity for the improvement of domestic industry.

Iran's status as an importer of foreign technologies, is similar to that in several other developing countries. Thus, the main question to be asked is What do we learn from the Iranian case? Three lessons can be derived from the Iranian experience. First, when the licensor acts as the supplier of components, he has an obvious interest in increasing the volume of supplies while on the other hand, the licensee contrives to increase local content in order to minimize hard currency requirements. This often leads to a conflict of interest that becomes pronounced in several stages of the project execution and leads sometimes to delay in the progress of local content enhancement

programmes. In Iran's case this is what happened in the 1980s, and the automobile industry was faced with a serious shortage of imported components and deterirating equipment. As a consequence of the evident conflict in the automobile sector its production had fallen to a fraction of the last decades' output.

Second, it has been pointed out that production of semi finished parts (castings, and forgings is very difficult and needs long-term experience in the production of such semi finished parts. Therefore, there should be a plan to start production of such products quite ahead of time before the machining stage. Rarely as in the case of Iran do multinationals involved in technology transfers provide this type of assistance. For a technology transfer to be successful, there is need that the production of finished parts (forges and castings) be an integral part of the technology transfer agreement.

Third, the automobile industry is characterized by continuous modification of facilities. At the time of introduction of new products, the licensor should provide full assistance in creating local design and engineering capability.

As this inquiry demonstrates, the final verdict on the Iranian experience of the 1990s is yet to come. However, it should not be forgotten then that Iran did manage to recover in the early 1990s in a difficult world environment. That she has been trying where so many others have failed is telling on its own.

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