Iranian Economic Review, Vol.8, No.9, Fall 2003

The Contribution of Agriculture to Economic and Productivity Growth of Iranian Economy*

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Abstract

The historical experience of many developing countries show that many developing world has not paid enough attention and is not giving serious thought to its agricultural sector. In fact, nearly all the countries that have "undervalued" their agricultural sectors not only failed to grow rapidly, but they all encountered domestic food shortages, balance of payment crisis and some sort of political instability. To develop, industrialization is not enough. Industrialization as a path to development can not succeed without the prior or concurrent emergence of a productive agricultural sector.

Using time series data, this paper shows that variation in industrial growth has been significantly associated with variation in agricultural growth over the first period of the development process in Iran. It has further demonstrated that agricultural growth induced productivity increases, and therefore facilitated overall economic growth. Moreover, the role of agriculture was even far important than that of exports in fostering productivity in the post-revolution era. Agricultural growth compensated for the small contribution made by export growth and smoothed some of the adverse effects of inflation.

Keyword: Mono – Export Economy, Dutch Disease Problem, Sources of Productivity Growth, Chenery – Syrquin Model

I- Introduction

This paper intends to analyze statistically the significance of the contribution of agriculture to economic and productivity growth of Iran, a country that has undergone significant political, social and economic changes over the last quarter of the century. The paper also intends to test if the occurrence of 1978 revolution together with the subsequent Iran-Iraq war and

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* - This article is a revised and updated version of an original research paper undertaken at Economic Growth Center, Yale University, while the author was at sabbatical.

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world economic boycott had any impediment and adverse effect on the results. Because of the dualistic nature of the economy and weak interrelationship between the main (export-oriented) oil sector and other productive sectors, non-oil sector is considered in the analysis.

The study consists of five main parts. Part II briefly reviews the literature on the contribution of agriculture to economic development. Part III examines the economic growth performance of Iran during last forty years. Part IV introduces a model that will be analyzed in this paper and also it examines the contribution of agriculture to economic and productivity growth within a neoclassical production function framework. Part V analyzes the sources of productivity growth in the economy while the conclusions are given in the last part.

II- The Contribution of Agriculture to Economic Development

Even before the time of Ricardo, the philosophy of development has emphasized that agricultural progress contributes to the support of greater productivity throughout the economy. In his Principles of Political Economy and Taxation, Ricardo argued that a limitation on the agricultural output sets he upper limit to the growth of nonagricultural sector and to capital formation for economic expansion.

In the 20th century, the leading development economists and economic researchers have demonstrated theoretically and empirically the contribution that agriculture can make to the development process. Here, we do not try to review all the writings on the subject matter, but rather to pinpoint some of important and crucial propositions made in the literature about the contribution of agriculture to economic development and highlight the results of some of interesting empirical researches undertaken.

The process of growth and development is the unfolding consequence of a quantitative and qualitative reorientation of the entire economic and social structure of a nation. The reorientation of economic structure has been dubbed ***structural transformation*** in which an economy transforms from a high share of agriculture or primary sector to a relatively low share, in employment and output. However, this structural transformation is itself dependent on agricultural progress.

Johnston [46] in his survey of the changes in attitude towards the role of agriculture in economic development reached a now generally accepted conclusion that agricultural progress is a necessary and usually a prior condition for economic development in many third world countries. Hayami and Ruttan [82] as well as the authors of many essays collected and edited by Reynolds [78] have stressed the point that in the process of structural transformation, a

successful agricultural development is often a precondition for a long - run transformation to a developed economy at which point the contribution of agriculture to national output and employment declines.

In a provocative theoretical analysis of a dual economy, Jorgenson [50] expressed his views that it is the growth of an agricultural surplus that determines the rate of growth of non-farm employment. He argued that this surplus is both a necessary and sufficient condition for the growth of non-farm sector. Accordingly, he suggested that the capital investment that accelerates the growth of agricultural output, provide conditions for a low-income economy to escape from a "***low level equilibrium trap***".

Cypher and Dietz provided a strong evidence of the compelling correlation between the agricultural and industrial transformation that contribute to greater development, either measured by income or human development index [25, Table 9.2]. They have emphasized that "... an industrial transformation aimed at raising a nation's level of development that fails to forement an effective agrarian transformation, eventually will falter and fail..." [25].

Both Chenery [22] and Kuznets [59] have pointed to the fact that if development efforts are successful, the spread of technology and human capital accumulation generates a trend toward homogeneity among the primary, secondary and tertiary formal sectors in terms of the level of output per worker. In other words, by a successful structural transformation, all sectors of production will show a tendency toward converging levels of worker productivity overtime.

Paul Bairoch's study of the interrelationships between agricultural and industrial development in England and France, and the relevance of that experience to contemporary underdeveloped countries, emphasized that causality flowed from agriculture to industry. A substantial evidence was put forward to show that an increase in agricultural production and growth in demand for agricultural inputs supplied by industry, were major forces that gave impetus to the process of cumulative economic growth in those countries. One of his major conclusions was that the effort to foster industrial development in LDCs must "seek to create favorable interactions between industry and agriculture" [11].

Ohkawa *et.al.* [70] and many others have stressed the importance of the agricultural sector's contribution in Japan to financing investment in infrastructure and industry and also in providing funds for the expansion of education and provision of other government services. Also, according to Ohkawa and Johnston [72], one important characteristics of Japanese agricultural transformation was that agricultural and industrial development have moved forward together in a process of concurrent growth.

In the case of Brazil, Schuh has demonstrated that "agriculture contributed heavily to the development of the industrial complex of Sao Paulo" [83]. Through an ingenious use of multiple exchange rates and outright confiscation of exchange earnings, Brazilian government transferred substantial capital from agriculture to industry. Equally important, agricultural entrepreneurs also invested rather heavily in the industrial sector.

A lesson that can be learnt from the experience of advanced industrial economies is that transition from a traditional agrarian to a developed industrialized economy is a dynamic process that inevitably involves not only increasingly complex interactions among socio - economic factors, but it also requires structural transformation. The change in the agricultural system as well as its role in the transitional process is conditioned by a variety off actors including changes in the institutional arrangements, development policies, technology adoption, country's factor endowment, etc.

Nevertheless, it is now a well-accepted proposition that agriculture can make several important contributions, directly and indirectly, to the transition process. Following Kuznets [58], Meier [62] and Ghatak [38], these contributions can be summarized as follows:

Product contribution: If agriculture grows by itself, it makes a direct product contribution. Since agriculture plays a dominant role in LDCs, its growth and expansion is critically related to the growth of the home market. A growing agricultural sector with a fair distribution of farm income, stimulates the demand for manufactured products and thus makes an indirect product contribution which helps the process of industrialization. More over, the growth of the non-agricultural sector in LDCs is crucially dependent on the steady rise in food supply that helps keep inflation down.

Factor contribution: Many manufacturing industries in LDCs depend upon agriculture for the supply of raw materials. In addition, agriculture provides labor for the growth of non-agricultural sector of the economy. This labor transfer is mutually beneficial in labor - surplus economies: it will reduce the pressure of population on the land, since marginal productivity of agricultural labor is low. At the same time, it will shift factors from low productive to high productive sectors, causing the overall productivity of the economy to rise. This supply of labor & raw materials from agriculture to industry is direct factor contribution.

Furthermore, the rate of capital accumulation in LDCs can be substantially increased by an improvement of the agricultural sector. A growing and efficient agriculture is necessary to make the supply of food and raw materials more elastic and thus reducing the rate of increase in the costs of manufacturing. This

makes the profit margins intact or even to rise which is necessary for capital accumulation. This is indirect factor contribution.

But this usual view that there should be a net flow of capital from agriculture to industry in the early stages of development has been challenged by Ruttan [82] and Ishikawa [43]. They argue that due to rapid population increase and consequent growing demand for food products, it is likely that agricultural sector may require a net flow of capital from the industrial sector. However, since it is feasible to increase agricultural out put by raising factor productivity, the capital and foreign exchange requirements with in agriculture are reduced and feasibility of such resource transfer is enhanced.

Mellor has expressed the view that "both in concept and in practice, it is possible for the agricultural sector to make large net transfers of resources to other sectors. If these transfers are used productively, the rate of economic growth can be accelerated" [63].

Market contribution: Agricultural expansion stimulates aggregate demand for industrial as well as agricultural products. This is direct market contribution. But, entrepreneurial and marketing capabilities will also develop by the gradual shift from a non-market to a market-oriented agriculture, facilitating industrialization. This is an indirect market contribution.

Foreign exchange contribution: Expansion in agricultural production and exports finances development plans by earning more foreign exchange. This is direct foreign exchange contribution. However. By expanding its capability of foreign exchange earnings, agriculture helps prevent for the deterioration of balance of payments, in an otherwise situation in which paying for food imports constrains industrial sector from expansion by limiting its foreign capital inputs. This is indirect foreign exchange contribution.

Mono - Export Economies and the Problem of Dutch Disease

Since agricultural, mineral and raw material export prices are subject to wide fluctuations, a special feature of mono-export economies is their tendency toward macroeconomic instability. Higher international price of the commodity exports sets in motion a series of events that tend ultimately to slow economic activity in LDCs. This phenomenon has been labeled Dutch disease, because its effect was first noticed following discoveries of natural gas reserves by the Netherlands after 1960.

The twists and turn of boom-bust cycles and the phenomenon of Dutch disease, weakens domestic economy and reduces its productive base in many LDCs. These effects are strongest for countries that are mono-exporters. The oil boom of the 1970s and early 1980s produced similar paradoxes in an umber of countries, including Saudi Arabia, Nigeria, Mexico [39], and Iran.

"Dutch disease" model originally put forward by Corden and Neary [24], analyses the implications of asymmetric sectoral growth for the over all growth of the economy and its structural change as the result of a resource boom. The model argues that a booming sector such as oil, generates an increase in income via additional foreign exchange earnings, thus expands domestic demand and this in turn pushes up domestic prices. The excess demand for non tradables force their prices to go up compared with other products, whereas the increased demand for tradables is met by increased imports. The consequent fall in the relative price of tradables gives signals to the local resources to be drawn away from non-oil tradable sectors into now more attractive non-tradables. Since the increased oil revenue largely accrues to government, whose expenditure patterns are likely urban biased toward infrastructure, services and other non-tradables, the predictions made by the model will be intensified, i.e., a far more contraction of non-oil tradable sectors.

Thus, both analytical models of growth and structural change (like that of Chenery-Syrquin discussed in the following) and Dutch disease model predict that the share of agriculture in the economy's employment and income would decline as income grows. However, this decline could occur more abruptly and prematurely when a resource boom is part of the growth process.

III. Iran's Economic Growth Performance

The Iranian economy has undergone significant changes over the last three decades. Not only the rate of economic growth fluctuated widely during this period, but also different sectors experienced an uneven pattern of growth as well (Figure 1).

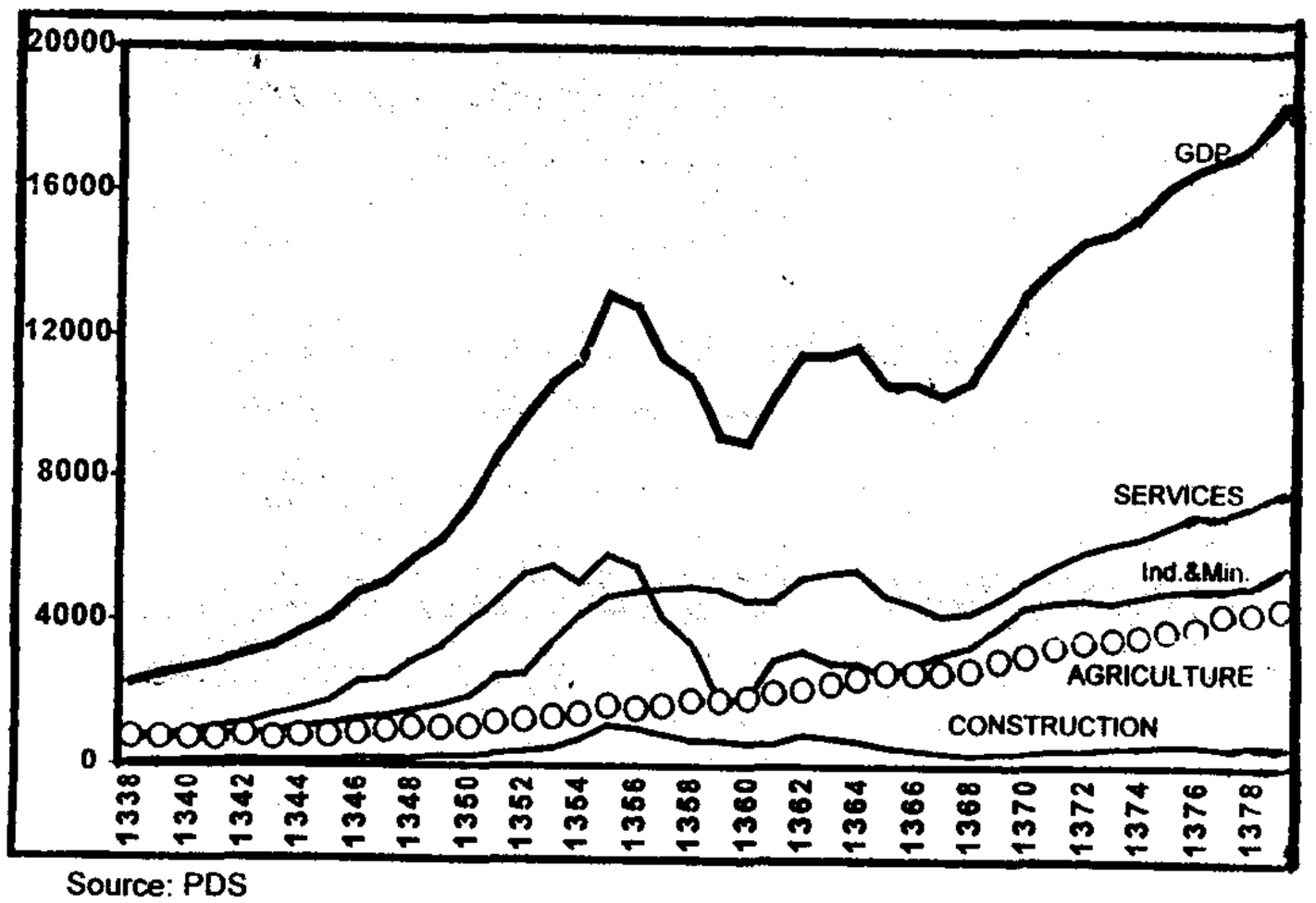
The growth process has been accompanied by sharp sectoral changes, some of which were partly policy-induced while others have resulted from fortuitous and external factors, such as revolution, Iran-Iraq war, international economic boycott, etc. The historical treatment of the growth process can be studied better, if the whole period were decomposed into three sub-periods:

The first period (1959-73): This period commensurate with the introduction of western technology and structural change in the economy. Western technology-embodied light manufacturing expanded rapidly while the government established a steel complex with a Soviet-based technology. The annual rate of growth of industrial output of about 14 percent during this period surpassed that of GDP in real terms by four points. All the funds required for development investment were raised within Iran as well as recourse to foreign assistance.

On agricultural side, the introduction of land reform in 1961 brought a dramatic change in the pattern of land ownership as well as change in the

structure of production in the agricultural sector. Following the land reform, the government in Iran envisioned modernized agriculture as dominated by large and highly mechanized agri-businesses and farm corporations. By 1976, there were 2000 production units classified as agribusinesses. Since these large-scale farms (up to 20000 hectares) had been located in areas of low population-to-land ratio, their productivity was expected to be much higher than small peasant farming [6].

Figure 1: The Trend of GDP and Its Main Sectoral Components in Iran's Economy



Source: PDS

Increased agricultural productivity due to land reform program and the establishment of agribusinesses, together with high agricultural export prices, enabled the country to maintain substantial non-oil export surpluses. Agricultural output registered an annual increase of 4.3 percent during this period, while non-oil exports showed an annual growth rate of 14 percent. Oil and non-oil exports led the country to accumulate large foreign exchange reserves.

At the end of 1960s, public investment projects started facing problems. Export prices were falling, previously accumulated surpluses had been used up, and rapidly increasing government recurrent expenditure was pushing budget deficit upward. Trade deficits started to increase and capital inflows were not sufficient to finance them. It is clear, therefore, that the government funded the modernization effort largely through deficit financing which was covered by foreign and domestic borrowing, and even more, struggled in the OPEC for increase in oil prices.

Despite the upsurge in deficit - financing, particularly in the last years of the first period, it is clear that Iran's economic growth between 1959 and1973 was fuelled by the exports of all main sectors, agriculture, oil and manufacturing. This generated income domestically, provided the major parts of government revenues and supplied the foreign exchange for importing intermediate and capital goods needed to lunch industrialization further.

The second period (1974-78): Unlike the first period, when growth was largely based and included substantial growth of agriculture and manufacturing industry, economic growth during the second period, resulted mainly from the phenomenal growth of the oil sector, in terms of sharp increases in both quantity and price of crude oil exports. The oil boom of1973-74 enabled Iran to embark upon a massive development process, which placed a strong emphasis on infrastructure (specially construction), social services and heavy industry.

Agricultural performance fluctuated widely in this period. For the first two years, it witnessed a spectacular rate of growth between 10-12 percent, which followed by a decline to a negative of -3.9 percent in the following year, and then it bounced back to 6.5 percent the year after.

The relatively slow growth of Iran's agricultural sector has been due to a variety of factors, namely the vagaries of weather, the prevalence of antiquated and inefficient farming techniques in many parts of the country, the limited supply of agricultural extension services and farm credits, and the relatively low priority of fixed capital formation in agriculture and in adequacy of price incentives in the Iranian plans [6]. However, three subsequent events made the planners pay more attention in the Fifth Development Plan: (i) an emerging food shortage the world over, (ii) the emergence of physical bottlenecks to the inflow of imports even if foreign exchange were no object, and (iii) a more sobering realization that industrialization can not be self sustaining without agricultural growth.

The industrial production performance in this period was not better than agriculture. While registering a 10.1 percent growth rate for this period, it turned negative for the last two years. The overall rate of growth of the economy fell to 2 percent per annum, while it became negative in 1977 and1978. These are well indications of the presence of Dutch syndrome in the Iranian economy after the oil price boom of 1973-74.

Indeed, following the oil price hike in 1973-74, all aspects of financial situation improved dramatically. The savings rate rose from an average of15.5 percent in 1959-73 to 23.5 percent in 1973-78. Correspondingly, the investment rate was also following the same pattern, from an average of 12.5 percent between 1959-1973, to an average of 19.7, percent in 1973-78. This high rate of investment, however, was not accompanied by a high rate of economic growth, partly because the investment mix favored large infrastructural and heavy

industrial projects with large gestation periods, and partly because the investment was apparently not highly productive. To this, it should be added the hastily and badly designed projects with poor execution as well as official corruption.

As the increased oil revenues accrued mainly to the government, its financial situation improved dramatically during the first years of the second period. The budget deficits of the late 1960s and early 1970s were replaced by substantial surpluses. But the rapid expansion of public sector expenditures soon changed the picture. The accumulated internal and external surpluses made possible by the oil boom did not, therefore, last long. Sizable budget deficits re-emerged in 1976 and afterwards. Hence, external reserves began a downward trend. The financial situation became critical in1978, the year revolution was taking place.

The fragility of the oil-dominated economy started to show its signs vividly in 1977. A softening of the world oil market in 1977-78 fuelled a revolution which was already on the road to succeed, sending GDP down to an average annual growth rate of -10.4 percent between 1976 and 1978.

The third period (1978-97): The start of the third period, is marked by the new political after-revolutionary era. Carrying over the effect of oil market recession in 1977 with its further deterioration in 1981, confusion and instability over economic policies due to internal political conflicts between rival factions, and above all, the imposed Iraqi war on Iran had all its unfavorable effects on the economy. The economic performance of real GDP declined further to average annual rate of -8.0 percent between 1978and 1981.

Despite the destruction effect of the war, increased oil exports (both in quantity and price terms) in 1979-81, turned the situation around, making real GDP to grow positively from 1981 to 1983. But this was only temporary, because export revenues declined rapidly in 1983 and there after, falling the economy into a boom-bust cycle.

In general, the implementation of development policies during much of 1980s has been hampered by a variety of economic and political factors:

(i) The enormous human and material costs of the prolonged war with Iraq.
(ii) Significant drop in oil revenues during much of 1980s which constrained severely the resources available for development programs.
(iii) Politically motivated overvaluation of foreign exchange rate, which led to distortions in economic incentives, followed by economic in efficiencies.
(iv) The general climate of economic and political uncertainly sharply reduced private investment in all sectors of the economy, including agriculture during 1980s.

Although the post-revolutionary government proclaimed agriculture an area of top priority in its development policies, but the weak performance of productivity and growth in Iranian agriculture has its origin not only in the factors mentioned above in general, but also in the investment and agricultural development policies in particular:

(i) After the Revolution, many of the agribusinesses and farm corporations set up during the Shah's rein were dissolved and their land distributed in small parcels to farmers. At the same time, their farm machinery and equipment were transferred to extension service centers [10]. This policy was not effective however, since those centers lacked organizational and professional skills.

(ii) The agricultural performance of 1980s was mainly affected by relative decline in production of staples and industrial crops. Rapid population growth during 1980s and the first half of 1990s led to increase demand for food, while on the supply side, the prolonged war made food products more scarce. Fear of inflation and political unrest and public expectations from the newly established government, led to food price control by subsidizing its costs to the public. At the same time, the government discreetly raised producer prices of food grains.

After each upward adjustment in producers price of staples (and industrial crops) due to persistent inflation, government stopped any further increase in those prices for a few years, till the newly build up inflationary pressure led to further increase in such prices. This stop-go-cycle of agricultural rice support policy had its own detrimental impact on the main commodities of agricultural production.

(iii) The reduction in public expenditures and in the supply of long-term credit during 1979-82 explains to a large extent, the considerably low levels of real fixed capital formation in agriculture in those years [69]. Further, as a result of budget cuts and material shortages, many of the infrastructural projects that started in the first few years of the Revolution, took a long time to finish [61]. It can be concluded, therefore, that agricultural infrastructure that failed to expand in the early 1980s, impeded agricultural growth in those years and intensified the negative impact of the government lopsided price policy [69].

(iv) A large part of agricultural investment during 1980s has been in the form of farm machinery [69]. It seems the reason for rapid mechanization of Iranian agriculture that actually started in the 1970s has been the soaring wage rates throughout these years. The rising labor costs together with the absence of repair shops for agricultural machinery in many rural area sand

enormous (military) drafts of labor from rural villages for the support of the war front, greatly reduced the effectiveness of agricultural mechanization policy.

(v) The restructuring of the agricultural sector and, in particular, the instability of the first few years of the Revolution, took their toll in terms of research and development of new varieties, expansion of agricultural extension and new farm practices. The budget cuts on research and development of new varieties and farm practices, deprived the agricultural sector from basic innovations that could have produced sustainable growth impetus for the agricultural sector. Research and development activities reveal their main effects in the long run and their neglect for long term period could have manifested its lagged effects in the mid 1980s and beyond [69].

(vi) Organizations born out of the Revolution aimed at changing the face of rural Iran and although they greatly influenced all aspects of the rural economy, but their controls and bureaucracies brought inefficiencies in the production process [51]. On the other hand, the extension services that grew rapidly after the Revolution could not bring changes in farm practices. The emphasis on ideology and politics rather than expertise has been cited for such failure [34].

Moreover, the staff of the new extension institutions has been inexperienced with poor managerial organization that could not design and implement projects of large scale with long duration.

In spite of all these weaknesses, agriculture did less badly compared with the overall rate of growth of the economy. By 1997, its share in non-oil real GDP increased to 23.3 percent, compared to 17.1 percent in 1979. While the industrial sector was hard hit by a massive flight of capital and skilled labor, less capital and more unskilled - labor intensive agriculture was much less affected.

The most striking feature of the Iranian economy during this period was its remarkably rapid recovery from the dislocation caused by the war. After accepting UN peace resolution in 1987, the 2-year trend indicates that the eight year war did not permanently damage the economy, despite its massive destruction effect in those years, but it simply delayed the full impact development forces which were already emerging in the second half of 1980s.This recovery is explained partly by the internal political stability and more stable formation of economic policies in the early 1980s, despite the continuation of the war, partly by the reconstruction and development of vastly damaged oil sector after signing the peace accord, and partly by an element of "catching up" as the economy responded to the war period. Thus, in the two years after the cease - fire, continued investment and substantial revival of production outside the war - affected areas resulted in real GDP to increase annually by about 7.8 percent in real terms.

IV- The Model

Historical research on the early stages of growth of currently developed countries indicates that the industrial revolution started in countries that had already experienced substantial increases in agricultural productivity. In the case of Russia (during Tsarist regime) and communist China (early development plans) where industrialization was not preceded by productivity growth in agriculture, their industrialization programs run into difficulty and, therefore, they could not maintain a high rate of industrial development. Moreover, some simulations with single-country computable general equilibrium (CGE) models have indicated that an agricultural development-led industrialization strategy leads to higher rates of economic growth, more equitable income distribution, more rapid industrialization, and a better balance of payment status.

However, it should be pointed out that the relation between agriculture and industry is one of interdependence and complementarity, rather than one-way direction. For example, there has been an extensive literature on this issue for the Indian developing economy. This interdependency can be characterized as a "***push-pull***" relation: agricultural growth "***pushes***" industrial growth, while it is being "***pulled***" by the latter over the course of development. While the full complexities of these inter-dependencies is difficult to be modeled within the confines of a model of agricultural and industrial growth, this study attempts to analyze certain relationships between the two sectors within the framework of a macroeconomic model.

The Chenery-Syrquin model offers such a framework for the analysis of growth and structural change and provides several general empirical results on this subject [21]. These results demonstrate a systematic pattern of structural change for a wide variety of countries spanning different historical periods. For the large middle-income countries-a category in which Iran has been classified from the early 1970s-the most significant structural changes include a decline in the share of agriculture in total output and exports as income increases. Accompanying this change is a marked increase in the share of manufacture in both exports and gross output. Similarly, the Chenery-Syrquin model predicts that the share of total non-tradable sector in GDP would rise substantially with income growth

The sectoral shifts predicted by the Chenery-Syrquin model should serve as a good starting point for an empirical analysis of economic growth and its sectoral contribution in Iran, particularly during the 1950s to early1970s periods. In this respect, the statistical significance of the relationship between agriculture and industry can be tested by making the following assumptions:

1- The rate of growth of agriculture (AG) and (non-oil) industry (NI) are both non-linear functions of per-capita income variable. This non-linearity was

first suggested by Chenery-Syrquin [21]. Similar models were also used by Chenery-Taylor to study patterns of economic development [20]. Hwa at the World Bank also used the model in his study to estimate the significance of the contribution of world -wide agriculture to economic growth by the use of cross-section data [43]:

$$DNI = a_1 LnY_n + b_1 (LnY_n)^2 + \varepsilon_1 \quad (1)$$

$$DAG = a_2 LnY_n + b_2 (LnY_n)^2 + \varepsilon_2 \quad (2)$$

Where, Y_n is per capita income and ε_1 , ε_2 are randomly distributed error terms. The equations are reduced form models for the determination of industrial and agricultural growths.

2- The residuals in the above two equations are linearly related. This assumption makes it possible to test the hypothesis that at times when the agricultural sector was experiencing a high rate of growth, the (non-oil) industry was also performing considerably well:

$$\varepsilon_1 = \lambda \varepsilon_2 + \theta \quad (3)$$

where, θ is a randomly distributed error term. By substituting (1) and (2) into (3) and rearranging terms:

$$DNI = \lambda DAG + (a_1 - \lambda a_2) LnY_n - (\lambda b_2 - b_1) (LnY_n)^2 + \theta \quad (4)$$

This equation implies that the disparity between industrial and agricultural growth (DNI-DAG), is a second non-linear function of per capita income.

The regression trials of the above equations were carried out for the whole period (1959-97) as well as two distinct historical periods (1959-78 and 1979-97), using income instead of per-capita income variables. As we can see from the regression results (Table, 3, in the appendix), the coefficients of income variables carry their expected signs and mostly are significant at least at 10 percent level.

The results also indicate that the growth of agriculture is a statistically significant variable in explaining industrial growth, with one exception for the post -revolutionary era. The politico-economic instability of 1980s as well as unstable economic policies of the government toward agriculture and industry can be cited as the main reasons for such an outcome.

V- Contribution of Agriculture to Economic and Productivity Growth

The empirical evidence presented in the pervious section suggests that a significant linkage exist between agricultural and industrial development, particularly during the early development process. In the following sections, the contribution of agriculture to economic growth is examined more closely within a framework of the "***source of growth***" generated through a neoclassical production function approach. The hypothesis to be tested is that agriculture contributed to economic growth through its impact on the rate of increase in total factor productivity.

Among many reasons that have been cited for the relationship between the agricultural performance and total factor productivity, two are worth mentioning:

1- Rapid agricultural growth enhances transfer of resources from agriculture to industry. As Robinson has pointed out, transfer of capital and labor from a lower productive sector such as agriculture, to a higher productive sector such as industry, is by itself a source of economic growth [79].

2- High agricultural growth brings higher quality of human and physical capital to the rural sector. A study by Hayami and Ruttan showed that about two-thirds of variation in agricultural labor productivity between developed and developing countries is associated with the difference in technology-embodied physical and human capital [42]. A more recent study by Kawagoe, et al. found that only a quarter of agricultural productivity differences could be accounted by conventional agricultural input [53].

What can be inferred from these studies is that the rate of agricultural growth should be considered as a part of productivity growth in an aggregate production function. This will allow the measurement of: a) the increased efficiency due to resource transfers from agriculture to industry; b) the impact of agricultural productivity on aggregate economic growth.

In order to minimize misspecification of the production function to be estimated below, we followed Hwa at the World Bank, by including the rate of growth of export and the rate of inflation in this function. The contribution of exports to economic growth has been rationalized on such grounds as providing economies of scales operations and more competition, leading to more efficient production. Empirical investigations by Michalopoulos and Jay [66] and Michaely [65] have shown a positive correlation of GDP growth rates with that of export. Balassa [13] and Feder [33] have also examined the contributions made by capital and labor to GDP growth in combination with exports and

found a positive relationship. Tavakoli and Karimi [86] also reached a similar conclusion about the economy of Iran.

The rate of inflation, in contrast, affects economic efficiency negatively for several reasons. First, inflation makes efficient production planning difficult, if not impossible. Second, by pushing real interest rate down, inflation gives false signals of the true cost of capital, which in turn leads to its unproductive use. It also could turn the flow of savings away from their economic use and toward unproductive investments. Third, inflation under fixed exchange rate regime widely adopted by developing countries leads to overvaluation of the domestic currency and therefore a loss in international competitiveness.

To test the hypothesis stated above, the equation for growth accounting which has been used by Fabricant & Kendrick is applied:

$$Dy = \overset{o}{A} + aDL + bDK \qquad (5)$$

Where, $\overset{o}{A}$ is the residual or total factor productivity growth (DR), Y is GDP, K and L are capital and labor, respectively, and D is used for the variable rate of change.

Since data on productivity is not available, a Kendrick index of total factor productivity (TFP) is constructed for each year. This index is of the form:

$$R_t = TFP_t = Y_t / [\beta K_t + (1-\beta) L_t] \qquad (6)$$

where β is estimated by a non-linear method, using a Cobb-Douglas linear homogeneous form function, and t is time variable.

The results of estimation show that the rates of growth of capital (DK), labor (DL), and total factor productivity (DR) all have significantly contributed to the rate of economic growth (Table.4, in the appendix).

Assuming that the rate of total factor productivity change is positively related to both the rate of agricultural growth (DAG) and the rate of export growth (DX), but negatively related to the rate of inflation (DPGNP) in the following form:

$$DR = C + eDX + \alpha DAG + d\,DPGNP + \mu \qquad (7)$$

where c is a constant and μ is assumed to be a randomly distributed error term. Then, using growth accounting framework, equation (7) can be

transformed to equation (8):

$$DY = C + aDK + bDL + eDX + dDPGNP + \alpha DAG + \mu \quad (8)$$

where: DY= average annual real non-oil GDP growth rate; DK= average annual rate of growth of real capital; DL= average annual rate of growth of labor employed (or population); DX= average annual rate of growth of real non-oil exports; DPGNP= average annual rate of change in GNP deflator.

The production hypothesis (8) is tested for the aforementioned three different periods and whole period under study by the OLS method. The estimation results show that all variables carry their expected signs. However, the inflation variable has not been significant in all three periods and agricultural growth variable showed to be significant just for the whole period of 1959-97. The coefficients of capital and export growth variables were significant in all three cases (Table 6, in the appendix).

A note on the insignificance of agricultural growth variable during the post-revolutionary period is warranted. The decline in the role played by agriculture in economic growth in this period, compared to the first, as indicated by its insignificant coefficient in the estimated regression, is consistent with the increased degree of industrialization in that period. Much preoccupation with industrial expansion, which was not productive as expected, to back up the war machinery, fueled by world economic boycott, resulted in an overwhelming investment in industry and a relative downfall of the role of agriculture in the country's economic performance.

Since we are interested in the net contribution that agricultural growth has made to the overall productivity and income growth of the economy, an alternative test was performed. In this new test, the productivity residual in the production function (net of export, capital and labor growths and inflation) was related to the rate of agricultural change in the following linear equation:

$$DY - aDK - bDL - eDX - dDPGNP = \alpha DAG + \mu \quad (9)$$

where a, b, e and d are the OLS estimates of a, b, c and d, respectively, when agricultural growth (DAG) is omitted from equation (8). The robustness of this test, and unlike total economic growth itself, is due to the fact that residuals of the production function, as indicated by the left-hand side of equation (9), need not bear any systematic relationship with agricultural growth apriori.

The result of the equation (9) shows that the marginal contribution of agriculture to economic growth remained significant at 1- percent level in the total and first sub-periods and at 10 percent significance in the second sub-period. The growth of agriculture accounted for an additional 25 percent of the increase in total factor productivity in those periods [Table.7, in the appendix].

V- Sources of Output and Productivity Growth

The estimated results of regression equations are used to compute the sources of economic and productivity growth and to evaluate the relative importance of agriculture among those sources. In this respect, the coefficients of an aggregate Cobb-Douglas production function for each period were estimated. Then, those estimates were used to construct a TFP index for each year, using the Kendrick index formula. Further, a log-linear trend line was fitted to these indices as well as to those macroeconomic variables used in this study, to estimate their rate of growths. Next, by using estimated regression equations (5) and (7), sources that contributed to economic and productivity growths were decomposed.

The comparison of results for two pre and post - revolution periods are striking. Several interesting observations emerge from this brief examination of the sources of growth in output and productivity across those periods (Table 1):

First, with regard to the long-term economic rate of growth, there is not much uniformity across periods, reflecting the leading role of politico-economic changes that have taken place, afore-mentioned earlier.

Second, the considerable factor contribution reversals to output changes, is

Table 1: Sources of Economic & Productivity Growth in the Economy of Iran (1959-1997)

Accounting for GDP Growth	1959-78		1979-97		1959-97	
	AGR	Share	AGR	Share	AGR	Share
Factors of Production:						
Capital	14.68	170.9	6.69	217.2	2.89	142.4
Labor	2.99	34.8	0.12	3.9	1.77	87.2
Productivity	4.59	53.4	1.35	43.8	0.79	38.9
Others	-13.67	-159.1	- 5.08	-164.9	-3.42	-168.5
GDP - Growth	8.59	100.0	3.08	100.0	2.03	100.0
Accounting for TFP Growth:						
Non-Oil Exports	6.39	139.2	0.55	40.7	0.16	20.2
Agriculture	4.03	87.8	2.76	204.4	1.81	229.1
Inflation	-0.74	-16.1	-2.59	-191.8	-1.62	-205.1
Others	-5.09	-110.9	0.63	46.7	0.44	55.7
TFP - Growth	4.59	100.0	1.35	100.0	0.79	100.0

the consequence of the government policy action in the later period that significantly altered the relative factor prices. Inconsistent with the country's relative factor endowment, this policy gave wrong signals to economic entrepreneurs, particularly in manufacturing, in utilization of labor and capital in their production efforts. This policy heavily subsidized the cost of capital through preferential exchange rates, encouraging foreign physical capital inflows, while severely penalized the use of labor by establishing stringent labor laws and regulations, in spite of rapid population and labor force growths. Although the benevolent policy toward capital was largely relaxed by the early 1990s, but tough policy toward labor is still in effect.

Although it can be argued that capital - intensive processes are more conducive to economic and productivity growths, the policy action taken by the Iranian government was not effective, however. Surely, effective investment using capital - intensive technology did not largely materialize, due to economic and political instability in 1980s bearing a high risk of capital confiscation. Moreover, conditions imposed by the war and world economic boycott, retarded installation or operation of those unfinished manufacturing plants.

Third, in analyzing the sources of productivity growth, it is clear fromTable.1 that agricultural growth has had a strong stimulative effect on total factor productivity, and even surpassing that of non-oil export growth in the second period. The results of Table.1 regarding the contribution of the rate of growth of agriculture to TFP growth for two distinct periods (compare4.03 with 2.76 Percent growth) confirms the propositions about Iran agricultural policy & performance in those periods. This analysis suggests that agriculture has been an engine of growth to Iran's economy. It has been as dynamic as exports in generating income and fostering productivity. It is interesting to note that Adelman [2] reached a similar conclusion for South Korea. Based on a general equilibrium analysis, she found that Korea's economic success could have fared even better under what she called an agricultural - demand - led industrialization program than under a strategy based purely on export promotion [2].

Unfortunately, the significant role played historically by agriculture in Iran's economy has been gradually deteriorated. This has been mainly due to the lack of a coherent and conductive policy toward agriculture, leaving it, more or less, to ride on the tide of boom-bust cycles generated by Dutch syndrome which is rooted in oil-dominated dual economy.

VI- Conclusion

Using time series data, this paper shows that variation in industrial growth has been significantly associated with variation in agricultural growth over the first period of the development process in Iran. It has further demonstrated that

agricultural growth induced productivity increases, and therefore facilitated overall economic growth. Moreover, the role of agriculture was even far important than that of exports in fostering productivity in the post - revolution era. Agricultural growth compensated for the small contribution made by export growth and smoothed some of the adverse effects of inflation.

The implication of the main trust of this paper for long-term development strategy of Iran is thus clear. An appropriate agricultural development strategy should be formulated to accelerate agricultural growth rates. This strategy calls for the adoption of appropriate exchange rate and pricing policies, adequate agricultural investments in infrastructure, agricultural research and extension facilities (which have been deteriorating in both quality and quantity after the Revolution) and suitable training and health services for the agricultural labor force. The cost of such shift in the development strategy is quite low and pays well for its return. In many empirical studies, the rate of return on investment in agricultural research in many parts of developing countries has been found to be very significant [29, 30].

Notes

1- For evidence, see Accelerated Development in Sub-Saharan Africa: An Agenda forAction, World Bank, Washington D.C., 1981.
2- For evidence and empirical verification, see Amuzegar, J. and A. Fekrat, 1971 and Pirasteh, H., 1999-2000.
3- C. Clark (1940), A.G.B. Fisher (1939), S. Kuznets (1957, 1959 & 1971), and H.B. Chenery & M. Syrquin (1975).
4- See B.F. Johnston & G.W. Mellor (1961), and B.F. Johnston & P. Kilby (1975).
5- The phenomenon of Dutch disease in developing countries has been studied by Michael Romer [1985].
6- See H.R. Baradaran-e-Shoraka (1998), and Yahya Fathi (1998).
7- The pre-revolution agricultural policies in Iran has been studied by Aresvik, 1976; Weinbaum, 1977, Katuzian, 1980, and Afshar, 1982.
8- See A. Gelb (1981), and H. Afshar (1982).
9- For a comparative study of agribusinesses and traditional farming in Iran, see Moghadam, 1985.
10- For a general discussion on economic policy and performance in Iran since the Revolution, see S. Karimi (1986), and A. Mojtahed & H.S. Esfahani (1989).
11- For an assessment of foreign exchange rate policies in Iran in the 1980s, see W. Lautenschlager (1986), S.Behdad (1988), and H.M. Pesaran (1990).
12- See S.V. Fallah (1982), and S. Okazaki (1985).

13- See E.L. Jones (1967), P. Bairoch (1973), and I. Adelman & C.T. Morris (1984).

14- See I. Adelman & C.T. Morris (1984), and A. Janvry & E. Sadoulet (1986).

15- See, A. Rudra (1967), S. Chakravarty (1974), G.W. Mellor (1976), K.N. Raj (1976), A. Mitra (1977), R. Thamarajakshi (1977), I.J. Ahluwalia (1979), R. Vrishna (1982), C. Rangarajan and I.J. Ahuwalia (1979).

16.The estimates of this equation are subject to the classical simultaneous equation bias, the correction for which requires the specification of a complete model of agricultural and industrial growth that is beyond the scope of the present study.

17- The early empirical result shows that neither the agricultural growth nor the manufacturing growth correlates significantly with the GDP-per capita. Therefore, non-oil GDP was used for the estimation instead of GDP-per-capital.

18- The results of the estimation of equation (2) for the two distinct periods were insignificant and thus are not shown in the appendix.

19- Since the explanatory power of these regressions are rather low, the income variables alone are not sufficient to explain industrial growth rates. These results, however, should not be a source of alarm because the main purpose here is to establish the statistical association between industrial growth rates and income levels, rather than to provide a full model for ascertaining why industrial growth rates differ annually [see Table.2, in the appendix].

20- See the note (4).

21- See S.C. Tsiang (1983), and H. Gengerg & K. Swoboda (1986).

Table 2: (Eq 1) (Dependent Variable (DNI)*)

Period	C	(Ln Y_n)	(Ln Y_n)^2	T	R^2	D.W.
1959-97	-- (-)	0.060 (1.93)	-0.0056 (-1.650)	-- (-)	0.155	1.85
1959-78	-17.28 (-1.95)	3.461 (1.91)	0.157 (-1.71)	-0.075 (-1.42)	0.047	2.05
1979-97	-- (-)	0.291 (1.73)	-0.035 (-1.82)	0.014 (2.43)	0.180	1.75

*** The t- values are in brackets.**

Table 3: (Eq 4) (Dependent Variable (DNI))*

Period	C	DAG	(Ln Yn)	(Ln Yn)^2	T	R^2	D.W.
1959-97	-- (-)	1.252 (3.03)	0.064 (2.21)	-0.007 (-2.09)	-- (-)	0.272	1.98
1959-78	14.326 (-1.96)	1.311 (2.92)	2.687 (1.79)	-0.106 (-1.37)	0.089 (-2.07)	0.365	1.98
1979-97	-- (-)	0.691 (1.005)	0.296 (1.76)	-0.036 (-1.88)	0.015 (2.59)	0.181	2.03

*** The t - values are in brackets.**

Table 4: Dependent Variable (DY)

Period	C	DK	DL	DR	T	R^2	D.W.
1959-97	-0.015 (-6.1)	0.466 (40.13)	0.538 (13.36)	0.999 (72.23)	0.004 (4.74)	0.990	1.74
1959-79	0.016 (-5.48)	0.492 (21.6)	0.695 (9.89)	0.976 (61.69)	-- (-)	0.990	1.76
1979-97	-- (-)	0.491 (32.44)	0.466 (14.95)	1.266 (59.97)	-- (-)	0.99	1.95

Note: The t- values are in brackets. The Dickey - Fuller test is used to reject the unit root & check for the stationary variables. Each variable is the integrated of first zero-difference.

Tables 5: (Eq 7) (Total Factor Productivity)*

Period	C	Trend	DX	DAG	DPGNP	R 2	D.W.	n
1959-78	--	-0.004 (-2.89)	0.47 (5.36)	0.76 (3.77)	-0.11 (-1.58)	0.73	1.87	18
1979-97	--	--	0.10 (2.61)	0.64 (1.72)	-0.14 (-1.74)	0.34	1.00	19
1959-97	--	--	0.18 (5.32)	0.39 (2.23)	-0.11 (-2.38)	0.50	1.66	37

*** See the note in Table.4.**

Table 6: (Eq 8) (Dependent variable (DY))

Period	C	DK	DL***	DX *	DPGNP	DAG *	R2	D.W.	n
1959-97	-- (-)	0.394 (4.28)	0.017 (0.04)	0.191 (5.92)	0.056 (-1.17)	0.471 (2.11)	0.635	1.71	36
1959-78	-1.298 (-3.30)	1.313 (3.57)	41.803 (3.22)	0.735 (5.18)	-0.046 (-1.08)	0.307 (1.26)	0.770	1.94	19
1979-97	-- (-)	0.309 (1.84)	0.795 (0.69)	0.114 (3.25)	-0.071 (-0.54)	0.121 (0.27)	0.589	2.00	19

*** With one year lag for the first sub - period.**

**** With one - year lag for the second sub-period. Also, See the note in Table.4.**

Table 7: (Eq 9) (Productivity Residual)*

Period	C	DAG	R 2	D.W.	n
1959-78	--	0.56 (3.45)	0.25	2.14	19
1979-97	--	0.35 (1.72)	0.40	1.47	19
1959-97	--	0.33 (2.14)	0.25	2.08	36

*** See the note in Table.4.**

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