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Inputs accumulation or productivity: which factor is the leading contributor to economic growth in Iran?

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Abstract

In this study, we attempted to determine the key factors leading to economic growth for Iran economy over the period 1960–2006. In particular, we sought to clarify whether the growth of Iran was driven mainly by factor accumulation or by improvements in efficiency namely, debate of K (factor accumulation) versus A (productivity gains). The analysis of the sources of growth shows that the role of Total Factor Productivity (TFP) in determining economic growth is insignificant and often detrimental. Most of the growth is due to the accumulation of physical capital and improvements in the quality of labor. Thus, we conclude that in the debate of A versus K we take the side of K. Bases on the experiences of Iran as a oil dependent country, accumulation of capital seems to be the major determinant of economic growth.

Key words: growth accounting, productivity and factor accumulation, Iran economy, Cointegration.

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1- Introduction

Identifying the key factors in sustained growth is critical for designing economic policies that lead to higher standards of living. Two main forces have been thought to play a major role in sustainable growth: accumulation of physical and human capital (referred to as K) and the adoption of advanced technologies) referred to as A. Economists argue on the magnitude of the contribution of each of these factors to promoting growth. According to the neoclassical growth model, the returns to physical capital are assumed to diminish as more is accumulated, thus limiting its role in sustaining growth and increasing the likelihood that productivity changes become a key factor in explaining growth. Such a prediction provided ground with the emergence of the new growth theories that emphasized the role of knowledge and technology on economic growth.

Oil exporting countries are prone to high volatility in economic activity, and therefore it is crucial to identify their sources of growth. Iran faces the challenge of increasing its growth rate to reduce unemployment and improve the living standards of its population over the medium term. Growth performance in recent years (6.1 percent during 2000–2006)[1] has been satisfactory, and was driven by major economic reforms as well as by transitory factors, such as high oil prices and expansionary fiscal and monetary policies. Questions about the determinants of growth in Iran and the long-term sustainability of relatively high growth rates arise. Given that past experience shows that the Iranian economy can grow at relatively high rates over an extended period, a first step is to examine the historical sources of growth and discuss the relevance of various contributing factors for the medium term. The second step is to provide an analytical framework for the formulation of growth-enhancing policies.

This paper uses a growth accounting exercise to quantify the historical sources of growth over the period 1960–2006, including human capital accumulation and the contribution of Total Factor Productivity (TFP) to growth. To this end, we use the growth accounting methodology to identify the proximate determinants of economic growth. The paper also presents an

1- The source for real GDP data for Iran is the Central Bank of Iran database, http://www.cbi.ir/

empirical study to quantify the role of several other contributing factors commonly discussed in the cross-country growth literature, including macroeconomic stability, trade openness, and oil revenues.

The paper is organized as follows. In the section 2, we discuss the performance of the economic growth during the period 1960-2006 as dictated by data availability. Section 3 takes on the theoretical foundations of the growth accounting exercise. A brief survey of previous empirical studies dealing with oil exporting countries or the MENA region is provided in Section 4. In section 5 we describe the data and presents the decomposition of the growth of output into the contributions of physical capital, human capital, and total factor productivity. A regression model of the determinants of growth in the Iran is then specified and estimated in section 6. A summary and some concluding remarks are presented in Section 7.

3- Performance of economic growth in Iran

Because consistent macroeconomic data is available only from the year 1960 onward, we limit our analysis to the period 1960-2006. Table 1 contains a summary of the main macroeconomic indicators for the Iran and oil exporting countries in MENA region for the period 1960-2006. Overall the performance of the economy fluctuated widely over the years. The fluctuations seem to result mainly from changes in oil prices and revenue. In this period, real GDP growth in Iran averaged 4.7 percent a year and 2 percent in per capita terms. Non-oil GDP grew at a faster speed of 5.8 percent during the period. This period can be broken down into three distinct sub-periods:

The period 1960–76 was characterized by high growth performance, indeed one of the fastest growth rates in the world: the economy grew at an average rate of 9.8 percent in real terms, and real per capita income grew by 7 percent on average. As a result, GDP at constant prices was almost 5 times higher in 1976 than in 1960. This excellent performance took place in an environment of relative domestic political stability, low inflation, and improved terms of trade, as evidenced by the rising oil prices. Both oil output and oil prices increased significantly during the period: oil production grew at an annual average rate of 10 percent while oil prices relative to import prices increased by 214 percent during the sub-period. This was the period when the government directed the surpluses from high oil prices into the physical and social infrastructure.

With the exception of the 1977-88 period, real non-oil GDP has always maintained positive growth rates. The period 1977–88 witnessed significant reduction in economic growth due to the disorder in the result of the 1979 revolution, the eight-year war with Iraq, the international isolation of Iran, the increased state dominance of the economy, and the dropping in oil output and revenue. In 1988, oil production was only 36 percent of its level in 1976; and oil prices were 40 percent lower in real terms. This resulted in negative real GDP growth of 2.4 per year on average. Excluding oil output, non-oil GDP also declined, albeit at a more moderate speed (0.5 percent per year).

With the reconstruction effort and a partial recovery in oil output, real economic growth recovered during 1989–2006 to an average of 4.9 percent per year. This period, however, was marked by sharp fluctuations in the growth pattern, as the postwar economic boom (1989-93) was followed by the stagnation of 1993–94 when the economy was hit by lower oil prices, lack of external financing, and economic sanctions. The resulting severe debt crisis, together with inappropriate macroeconomic policies, had an unfavorable impact on growth, which was around 3.6 percent during 1995–2000. In the more recent period (2000-06), real GDP growth picked up to 6.2 percent due to significant progress in economic reforms-such as the exchange rate unification, trade liberalization, the opening up to foreign direct investment, and financial sector liberalization- but also to high oil prices and expansionary fiscal and monetary policies.

The growth performance of Iran compares favorably with the rest of the countries in the Middle East and North Africa (MENA) region, which averaged 4.3 percent a year during the 1960-2006 period. Among the 17 countries in the region, only four-Oman, Syria, the U.A.E., and Yemen-grew faster than Iran. However, historical growth in Iran also exhibits higher variability than in the rest of the region: the standard deviation of Iran's growth rate is only exceeded by those of Kuwait, Lebanon, and Libya (Table1).

Table 1: Economic Growth in Iran and MENA Region, 1960–2006 (In percent, average for the period)

	Economic Growth Rate (%)				Standard deviation
	1960-1976	1977-88	1989-2006	1960-2006	1960-2006
Iran	9.8	-2.4	4.9	4.7	8.30
Oil-producing MENA countries					
Algeria	5.9	2.3	2.1	3.5	6.13
Bahrain	4.5	4.3	4.6	4.4	5.34
Kuwait	4.1	-2.1	1.9	1.5	14.35
Libya	14.0	-0.2	-0.1	4.6	11.98
Oman	9.8	6.0	4.9	6.8	8.30
Qatar	7.0	-0.3	4.9	4.0	7.62
Saudi Arabia	7.7	2.0	2.7	4.3	6.48
United Arab Emirates	12.5	-0.5	6.8	5.4	8.23
Average oil MENA countries	8.2	1.5	3.5	4.4	8.25
Average non-oil MENA countries	4.6	4.7	3.7	4.3	6.90
MENA average (exc. Iran)	6.6	2.8	3.6	4.3	7.75

Source: International Financial Statistics (IFS).

3- Theoretical Foundations

In this section, we analyze the determinants of economic growth using the growth accounting framework by decomposing aggregate GDP growth into labor, capital and technical progress (see Solow, 1956). The point of departure for growth accounting is an aggregate production function that expresses the relationship between inputs and output:

$$Y_t = A_t\ f(K_{t,} L_t) \qquad (1)$$

where Y_t, K_t, and L_t represent aggregate output, physical capital stock, and labor force, respectively. The term A_t, often referred to as Total Factor Productivity (TFP), is designated to capture a host of factors that affect the overall efficiency. These factors include, among others, technology level, quality of management and governance, strength of institutions, geography and climate, property rights, legal and regulatory framework, cultural factors, domestic political and international environment, and structural reforms such as financial sector or labor market liberalization. Physical capital is considered as a homogeneous capital good, with no distinction made between equipment and non-equipment capital goods, or between private and public capital goods (implicitly assuming that the productivity of the two types of capital is the same).

The basic growth accounting equation is expressed in terms of either the growth of output (Eqn. (2)) or output per worker under the assumption of constant returns to scale (Eqn. (3)):

$$\frac{\dot{Y}}{Y}=\frac{\dot{A}}{A}+\alpha\frac{\dot{K}}{K}+\beta\frac{\dot{L}}{L} \tag{2}$$

$$\frac{\dot{y}}{y}=\frac{\dot{A}}{A}+\alpha\frac{\dot{k}}{k} \tag{3}$$

Where a dot on the top of a variable denotes its derivative with respect to time, and α and β are the shares in total income of payments to capital and labor, respectively, and lower case letters stand for the respective per worker term .Eqns. (2) and (3) express growth rate of output or output per worker as the sum of weighted average growth rates of inputs and the growth of TFP(or TFPG), which is often referred to as the Solow Residual.

Researchers have long recognized the significance of human capital in explaining economic growth. To accommodate that, a measure of human capital is incorporated as an input in the production function, either explicitly or augmented in labor as follows:

$$Y_t = A_t f(K_t, L_t H_t) \tag{4}$$

where H_t is a measure of the human capital stock that is embodied in the labor force, and the expression L_t H_t denotes a skill-adjusted measure of the labor input. The growth of output can be broken down into the contributions of factor accumulation and factor productivity as follows:

$$\frac{\dot{Y}}{Y}=\frac{\dot{A}}{A}+\alpha\frac{\dot{K}}{K}+(1-\alpha)\left(\frac{\dot{L}}{L}+\frac{\dot{H}}{H}\right) \tag{5}$$

Alternatively, we can express Eqn. (5) in terms of output and capital per worker:

$$\frac{\dot{y}}{y}=\frac{\dot{A}}{A}+\alpha\frac{\dot{k}}{k}+\frac{(1-\alpha)\dot{H}}{H} \tag{6}$$

Growth accounting equations are used to break down the growth of output of individual sectors, industries, or countries over time into the contributions of inputs and TFP. When applied to US and European data, Solow's (1975) methodology generated large residuals and attributed a significant role to productivity growth. Denison (1962) allowing the enormous input heterogeneity, accounted for changes in the quality of labor input as a result of variations in working hours, education, age and gender composition, and sectors. Incorporating elements of input quality helped to account for part of the residual but kept growth in TFP as a major factor for explaining output growth.

4- Review of Empirical Literature

Only a few empirical studies have dealt with oil exporting countries or the MENA region largely due to lack of data. However, as data became available for more countries of the group, some researchers have addressed these countries in the context of a larger sample. Among the early studies to estimate physical capital stocks and analyze the sources of growth is that of Nehru and Dhareshwar (1993). They disregarded human capital and found that for the MENA region, the contribution of capital accumulation was the major factor behind economic growth in the period 1960–90. The growth of TFP was among the lowest in the world and even turned out to be negative during the sub-periods of 1973–90 and 1980–90. The only exception was Turkey, which experienced a much higher contribution of productivity than physical capital in the period 1980–90.

Another comprehensive study was conducted by Collins and Bosworth (1996). They adopted the Nehru and Dhareshwar (1993) data and extended it to 1994. Aware of the significance of human capital, they included an index of labor quality as an input in the production function. The share of physical capital was again assumed to be identical across countries at a rate of 0.35

while the weight of labor was taken to be 0.65. Their findings are in line with Nehru and Dhareshwar (1993) despite the fact that the production function they assumed differed by the inclusion of human capital and the magnitude of the shares of inputs in income. They found a negative contribution of TFP to growth in all sub-periods during 1960–94 with the exception of 1960–73. The contribution of the human capital measure over the whole period amounted to about one third of the growth of output per worker. The results were kept unchanged under deferent assumptions of the share of capital (0.3 and 0.4) and human capital measures.

Bisat et al. (1997) is one of the few studies which MENA is addressed as a region. However, like previous studies, the authors exclude human capital. Using a share of capital in national income of 0.3, the authors find that for the majority of countries in their sample (9 out of 13), the average annual growth TFP was negative over the period 1971–96. Thus, they concluded that Arab countries suffered from the effects of factors which reduced the aggregate production efficiency over time. When using regression estimates, they found that, in general, the estimated share of physical capital is larger than 0.3 with some of the estimators being negative or outside the interval (0, 1). A significant difference was not detected when applying the estimated shares to find the annual growth TFP. Most of the countries witnessed a negative growth of TFP regardless of the method or the sub-period used to estimate the share of capital.

Senhadji (2000) relied on Collins and Bosworth’s data, but instead of using a priori value of the share of physical capital, they estimated it for individual countries and then used the regional averages to find the contributions of physical capital, human capital, and TFP to the growth of output per worker. They applied the fully modified OLS in levels and first differences. The estimated share for the MENA regions was found to be 0.63 when estimation is done in levels and 0.54 when the production function is estimated in first difference. However, within the sample of MENA countries, the range of the shares was very wide (from 0.24 in Turkey to 1.00 in Israel). When the author decomposed the growth of output per worker for the period 1960–94, he found that physical capital accumulation accounted for more than 75% of the growth, while the contribution of TFP was negative. Only during 1960-73 there was a positive contribution of TFP to economic growth. However, the contribution of TFP amounted to 1.22% of the 5.86% GDP growth.

Makdisi and Limam (2000) indicated that all the five MENA oil-dependent countries in the sample recorded negative TFPG. But, for the entire sample of 92 developing countries, they find evidence of predominance of capital contribution over that of labor and TFPG.

Harvei(2005) examines the major sources of economic growth in South Korea using annual time series data (1960 to 2003). The time series properties of the data are analysed by Perron's innovational outlier and additive outlier models. The empirical results based these models show that the most significant structural breaks over the last four decades which have been detected endogenously in fact correspond to the regime change (e.g the 1979 Islamic revolution) and the Iraqi war in the 1980s. Finally, an ARDL methodology is employed to obtain the short and long-term determinants of economic growth. The results show that while the effects of gross capital formation and oil exports are highly significant, as expected, non-oil exports and human capital have an even smaller effect than had been anticipated. Akhtar(2006) undertakes an empirical investigation of factors that contributed to economic growth in Indonesia for the period 1966 to 2003. The computed sources of growth indicate that for the last 40 years the most important source of growth in Indonesia was capital accumulation, about 60 percent. The contribution of labor to economic growth during this period was about 32 percent, while technological progress contributed the remaining 8 percent.

5- The Sources OF Growth in Iran

Data on output, labor, physical capital, and a measure of human capital are needed to implement the sources-of-growth exercise. The source for real GDP and investment data for Iran is the Central Bank of Iran database. The measurement of inputs, especially physical and human capital, is somewhat problematic and involves many assumptions. As a measure of the labor input, the total hours worked obtained by multiplying employment times the average hours actually worked serves as a reasonable proxy for the flow of labor services. However, in the absence of detailed data on total hours worked, researchers use either labor force or total economically active population (population between the ages 15–64). In our paper, we use the total labor force as our measure of the labor input. The source for employment data is the Central Statistical Office of Iran annual census. We use data on past investment to construct a time series of capital stock as follows:

$$K_t = (1-\delta)^t K(0) + \sum_{t=0}^{t-1} l_{t-1}(1-\delta)^t \tag{7}$$

According to Eqn. (7), the capital stock of the year t equals the initial capital stock net of depreciation (at an annual rate of δ) plus the sum of the stream of net investments. Moreover, we can use a variation of Eqn. (7) to describe how capital stock evolves as follows:

$$K_t = l_t + (1-\delta)K_{t-1} \tag{8}$$

According to Eqn. (8), the capital stock in a certain year, K_t, equals the capital stock of the previous year, K_{t-1}, net of depreciation, plus the flow of gross investment in the current year, I_t. Thus, in order to construct a capital stock series we need an estimate of the initial capital stock, $K(0)$, and an estimate of the depreciation rate of capital stocks, δ. The capital stock depreciation rate is 4.9 percent, consistent with the estimates of the Central Bank of Iran[1], and the initial capital stock is determined through the "rough-guess" method suggested by Barro and Sala-i-Martin(1995). Education measures have been considered by researchers as a proxy for human capital stock that optimally should include formal and informal education, on-the-job-training, health, nutrition, and social services. In this paper, the human capital (H) is estimated in terms of average years of schooling following the standard definition used by Lucas (1988). The average years of schooling of the labor force are drawn from World Development Indicator Data Base.

1. With regards to the rate of decay, we estimated the initial capital stock and consequently the whole series of capitals using three alternative assumptions; 4%, 5%, and 6%. When applying these rates in our growth accounting exercise, we found that our choice of depreciation rate does not seem to matter. Thus, we present our findings using 4.9% as our choice.

There are many methods to estimate the share of capital (α) in Eqn. (5). First, using national accounts to find the compensation to labor and capital in the national income. This approach is rarely employed due to unavailability of data for most developing countries. Even for developed countries there are serious difficulties in allocating income of self-employed workers between the returns to capital and labor. Second, using a priori measures in the neighborhood of 30–40% for the share of capital. Some economists who have broadened the definition of capital to include human capital, externalities and R&D have taken higher values. Many studies, based on either national accounts or parametric estimates, have found that the share of capital for developing countries appears to be larger than that of industrial countries and often tops 40%. Third, direct estimation of a Cobb–Douglas production function in a log-linear form:

$$\ln Y_t = a + \alpha \ln(k_t) + (1-\alpha)\ln L_t H_t + \varepsilon_t \tag{9}$$

The Eqn. (9) assume constant returns to scale to reduce heteroskedasticity and eliminates multicollinearity, although not allowing us to test the hypothesis of constant returns to scale. In our study we utilize the third (or econometrics) method to estimate the share of physical capital based on identifying the long-run relationship between output and inputs by applying the Johansen cointegration test .Indeed applying OLS to non-stationary time series gives rise to some serious problems, especially running into spurious correlations between the variables. When dealing with a system of non-stationary variables of order one, it is possible to find a linear combination of the variables that is stationary despite the fact that the variables individually are not. In this case, the variables are said to be cointegrated and there exists a long-run relationship between the variables.

For cointegration analysis we have to pretest the variables in the system for unit roots. To test whether the underlying processes contain a unit root, we use augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to assess the order of integration of the series (Dickey and Fuller, 1979; Phillips and Perron,. 1988). Computed statistics for all variables in level (log of output, physical capital and quality-adjusted labor), indicated that they were integrated of order one [I (1)] at the 5 percent level of significance. First differencing of data was sufficient to achieve stationary on the same criteria (see Table 1 in appendix). In the next step, we conducted the Johansen cointegration test base on trace and maximum eigen value statistics. The results reveal that the hypothesis of no cointegration can be rejected at the 5% significance level (see Table 2 in appendix).

An important product of the Johansen's test is a normalized cointegration vector or estimates long run relationship. The estimated share or coefficient of capital (α) is 0.63 and highly significant. The share seems to be higher than what researchers typically assume it to be (the frequently used share of 0.3–0.4). A higher α would result in a rise of the contribution of physical capital and a decline in the contribution of TFP. Moreover, Iran experienced relatively high rates of growth in capital stocks amounting to 6.99 % during the period 1960-2006, mostly derived by the flow of income from oil. The growth rate of capital stock in Iran has been higher than that of most regions. Compare the figure with 5.23 % for MENA, 4.56% for South Asia, 4.63 % for Latin America, 3.91 for industrial economies, and 4.08 for Africa. The only comparable region was East Asia, in which the growth rate was 8.47% per annum during the period. MENA countries have also been experienced higher capital stock growth rates than the main blocks of developing countries (Africa and Latin America)[1].

One of the measures that is often used to evaluate capital utilization over time is the Incremental Capital-Output Ratio (ICOR). This ratio provides a rough estimate for the net investment needed to increase output by one dollar. The lower this ratio, ceteris paribus, the higher the utilization of capital. It has been documented that ratios of 2–3 are typical for industrialized countries. The ratio for Iran is estimated[2] 5.1, exceeding the average long-run ICOR for the MENA countries (2.57), South Asia (1.38), Latin America(1.35), industrial economies(1.63), East Asia(3.54) and Africa(2.23)[3]. Our findings reveal a possible low degree of efficiency of investments in Iran when compared to the rest of the world.

1. Makdisi, S. and I. Limam (2005)
2. ICOR is given as the coefficient a_1 of the following OLS regression: $K = a_0 + a_1Y$
3. Hakura (2004).

Our growth accounting exercise is concluded by breaking up the growth rate of output into the contributions of physical capital, human capital, and TFP. The contribution of physical capital is calculated as its share in income times its annual average growth. Likewise, the contribution of human capital is found by multiplying its share in national income (1-α) multiplied by its growth rate. TFP's contribution is the residual.

The results of the growth accounting exercises are shown in Tables 2. The contribution of TFP to growth is positive during the high growth sub-period of 1960–76 and becomes negative (-10.6) during the political disorder and war period of 1977–88. This result points to the critical importance of political and external developments for Iran's economic growth. The results for 1989–2006 indicate that the contribution of TFP to growth is negative (-1.7) possibly due to slow progress in structural reforms and increased macroeconomic instability. Moreover, during the whole period 1960–2006, the average contribution of TFP to growth is negative (minus 1.3 percent). Indeed, the decline of TFP seems to be a major factor in the sluggish growth of GDP. The negative growth of TFP indicates that Iran economy has suffered from factors leading to lower production efficiency over time and failed to improve the efficiency of their production factors. Our findings are in line with many earlier studies covering developing countries. It has been documented that TFP did not contribute to growth in a large number of developing countries, with TFP being negative in many cases (see Senhadji, 2000; Collins and Bosworth, 1996; and Bisat et al., 1997). Accumulation of physical capital seems to dominate as the major determinant of the growth records of the economy over the period 1960–2006. In other words, we find that the role of physical human capital has been essential in determining economic growth. During the period 1960–2006, the contribution of capital was in the range of 79% of GDP (as mentioned before, a higher α, ceteris paribus, tends to raise the contribution of physical capital and lower that of human capital and TFP).

The results of our analysis emphasize the need to investigate the policies that may have a role in determining productivity. Some essential measures are: First, maintaining stable macroeconomic environment. Second, accelerating structural reforms (privatization and financial reforms).

Third, investing more effectively in the social sectors (education and training). Finally, strengthening the institutional and information base.

Table 2: Sources of growth 1960–2006

Period	Average Growth of Y	Contribution of (%)		
		Capital(K)	Human Capital (LH)	TFP
1960-1976	9.8	4.4	2.5	2.9
1977-1988	-2.4	4.9	3.3	-10.6
1989-2006	4.9	3.4	3.1	-1.7
1960-2006	4.8	3.7	2.4	-1.3

6- The determinants of economic growth in Iran

The literature on growth proposes a great number of explanatory variables (see Barro, 1991, Gregorio and Guidotti, 1995). Recent econometric studies of growth have focused on cross-country data. Many of the variables used in these studies are difficult to use in time series regressions because of data limitations. Besides theory, our choice of variables in this study is guided by the specific economic conditions and environment of the Iran economy as well as by data availability. The dependent variable is real GDP growth. The independent variables are as follows.

Gross domestic investment as a ratio of GDP is one of the important variables used in growth regressions. Economic theory suggests a positive relationship between investment that encourages capital accumulation and aggregate output growth. But issues of causality between investment and growth are often discussed.

Changes in a country's terms of trade may have an important positive effect on growth. An increase in the terms of trade means increased net exports and aggregate output. The opposite may also be true. Because of lack of data, the terms of trade variable is represented by the real oil revenues. This is a good proxy in view of the fact that oil represents more than 70% of Iran exports.

Many empirical models of growth have attempted to measure the influence of macroeconomic stability and uncertainty on growth. Such stability, by facilitating long-term planning and investment decisions, encourages saving and capital accumulation by the private sector (Hadjimichael and Ghura 1995). The most frequently used proxies for macroeconomic instability is the inflation rate. While a low inflation rate may stimulate growth, a high rate may stifle growth.

Trade openness generates technology spillovers and provides the economy with access to specialized inputs from abroad. The literature finds a significant effect of trade openness on growth. Greenaway, Morgan, and Wright (1998) cover 73 countries and use a dynamic regression framework to investigate potential lagged effects of openness on growth. They find that the positive effect of trade openness on growth becomes more significant over the long term, while in the short term, this effect is much less important. To examine the link between trade openness and economic growth, we adopt the imports to non-oil GDP ratio as a proxy for trade openness because of the lack of data on average tariffs and nontariff barriers to trade for the entire period 1960–2006.

Accumulation of human capital is an indicator of endogenous growth and is often used in empirical growth models. In most regressions, this variable has a positive coefficient (Barro, 1991). Investment in human capital increases technological progress and raises labour productivity. This is expected to stimulate growth directly as well as indirectly by augmenting the productivity of capital. For Iran, human capital is measured by the secondary school enrolment ratio.

Finally, other factors such as political variables may also play an important role in economic growth. Alesina et al. (1992) find a significant negative relationship between political instability and growth. This result is particularly strong when there are significant changes in the ideological position of the executive branch. In another empirical study, Mauro (1997) finds a negative correlation between political risk and economic growth. Other empirical studies show mixed results on the relationship between income inequality and economic growth.

Table 3 summarizes the major determinants of growth in the Iran. The dependent variable is real GDP growth. Moreover, we have also included lagged dependent variable as a regressor to avoid the dynamic misspecifications. The statistics of the regression show that all variables are significant at the 95 percent confidence level, and explain 89 percent of variance of growth. Moreover all the diagnostic tests are satisfactory. The results are largely consistent with the cross-country evidence and stylized facts on economic growth. The constant term has a negative and significant coefficient. This result is in conformity with the earlier finding of a negative average TFP growth. The signs of all explanatory variables are consistent with our expectations. We discuss below the key variables explaining growth in Iran.

As expected, domestic investment has a positive and significant effect on GDP growth indicating that a 1% increase in domestic investment raises income by about 0.66%. Both public and private investments are expected to stimulate growth. Public investment provides the infrastructure and services needed by other sectors, while private investment which has been increasing in recent years may boost growth through increased productivity and value added in the manufacturing, trade and services sectors.

Changes in the oil revenues have the most statistically significant effect on Iran growth. The Iranian economy is heavily dependent on oil revenues, with about 15% of nominal GDP originating in the oil sector. Moreover, about 50% of the government's revenues and 70–75% of exports are derived from the oil[1]. An increasing terms of trade index – measured by the oil revenues- is expected to stimulate growth. As Table 3 demonstrates there is a strong relationship between growth in real income and changes in oil revenues. Intuitively, in an oil-dependent economy, the exogenous increase in export revenue will release foreign exchange constraints, stimulating economic activities from both supply and demand sides.

1. http://en.wikipedia.org/wiki/Economy_of_Iran and Budget Law of Islamic Republic of Iran, 2000–2006.

Table 3: Determinants of Growth in Iran, 1960-2000

variable	Coefficient	t-value
Constant	-3.58	-3.67**
$\Delta \ln Y_{i,t-1}$	0.31	4.67**
Investment Ratio	0.66	2.41**
% change in oil Revenues	0.26	4.60**
inflation	-0.31	-1.95*
Import to GDP ratio	0.30	5.10**
secondary school enrollment	0.04	1.77*
War dummy	-4.67	-6.03**
R^2	0.90	-
F Statistics	18.40**	-
D.W	1.89	-
Serial correlation	1.25	-
Functional Form	1.11	-
Normality	1.02	-

Notes: For diagnostics, Godfrey's LM test for serial correlation, Ramsey's (1969, 1970) RESET test for functional form, White's (1980) general heteroscedasticity test for heteroscedasticity and, Jarque-Bera test for normality have been performed.
** significant at 5%
* significant at 10%

A %1 increase in the inflation rate leads to a decrease by %0.31 in the growth rate. This result confirms that the high inflation rate is harmful to the Iran economy so that any increase in inflation from the previous period negatively affects growth. Therefore, the Iran policy makers should keep inflation at least on par with the inflation rates of its trading partners.

Of all the variables studied here, political instability and war has the strongest (negative) effect on growth, reducing growth by about 4.6 percentage points per year during the 1977-88 sub-period.

The human capital variable as measured by the secondary school enrollment ratio, is positively and significantly correlated with growth. This result is also theoretically consistent. Education and training increase the productivity of labor as well as the efficiency with which other resources are used.

Overall, the results of the growth model are very much in keeping with our priori expectations. The results are likely to be representative of oil exporting countries that share very similar economic characteristics with the Iran.

7- Summary and conclusions

The objective of this paper was to explain the determinants of growth in the Iran economy as a representative oil-dependent economy. The paper considers the A versus K debate, namely, which factor is the leading contributor to economic growth: productivity gains (A) or factor accumulation (K). The long-run share of capital in income is estimated using cointegration method. We find that the share of capital is much higher than the conventional share of 0.3–0.4. In analyzing GDP growth by source, we found capital to have the most important contribution, followed by quality-adjusted labor, while total factor productivity had a negative average contribution. Indeed, when considering the whole period under investigation, we find that changes in TFP do not seem to amount to a sizeable share of GDP growth. The negative TFP growth is perhaps a reflection of the nature of investment, which is dominated by public investment and low productivity projects in the services and residential sectors.

Econometric results indicate that unlike the case of countries with diverse resources, natural resource abundance has been a stimulus for growth in Iran as an oil-dependent economy. In addition, increased domestic investment rate, investment in human capital and oil revenues have strong positive effects on economic growth in the Iran. On the other hand, the relation between inflation and economic growth in Iran is negative so that inflation has deterrent effects on growth.

The Iran economy faces many challenges in achieving sustainable growth. In view of the analysis in this paper, we draw the following main policy conclusions:

1. Structural reforms, in a stable political environment, would be key to improve the growth performance over the medium and long term. To increase the long term growth rate of the economy above its historical trend of 4.6 percent per year, policies should be directed at increasing productivity (measured by TFP). Moreover, the cross-country empirical evidence and the empirical findings for Iran show that growth is directly associated with factors such as trade openness, macroeconomic stability, and political stability. These findings call for effective implementation of structural reforms-trade and FDI liberalization, privatization and deregulation to

increase the size and role of the private sector, and financial sector reform to eliminate practices such as financial repression that harm long-term growth. Other reforms, such as the elimination of subsidies—as well as fiscal, monetary and exchange rate policies aimed at increasing macroeconomic stability—would also play a critical role in enhancing growth performance.

2. Increases in the efficiency of human capital resources through education investment appear to be an important explanatory factor of Iran's growth. In this respect, achievements in Iran since the 1979 Revolution have been very important, with more than tripling of the average level of schooling of the working population since 1979 (from 1.5 years of schooling to about 5 years). Education policies aimed at allocating increased resources to primary and secondary education, as well as promoting on-the-job training programs would further enhance growth prospects. The need for further efforts in the educational area becomes evident when we consider that Iran has an illiteracy rate of about 20 percent, despite the substantial progress achieved in the past.

3. With respect to the contribution of physical capital to economic growth, Iran's investment rate—which averaged more than 30 percent during 1960–2006—is already high by international standards, even when compared with the high-growth countries of East Asia. Its payoff, however, as measured by average ICORs, does not suggest that it should be increased further, but that the efficiency of investment projects needs to be improved. The low efficiency of many investment projects undertaken in Iran, especially in agriculture, industry and mining, and housing, could be explained in part by subsidized energy and inputs and negative real interest rates on bank financing. Nonetheless, despite the high rates of investment over the past years, physical infrastructure is in need of upgrading and modernization.

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Appendix: cointegration analysis

Table 1: Unit-root tests

variable	Augmented Dickey-Fuller(ADF) Levels	Augmented Dickey-Fuller(ADF) First differences	Phillips-Perron(PP) Levels	Phillips-Perron(PP) First differences
ln Y	-2.51(0.32)	-3.62(0.01)	-2.31(0.42)	-3.54(0.01)
Ln K	-5.38(0.00)	-7.03(0.00)	-2.12(0.52)	-5.43(0.00)
Ln LH	-2.54(0.31)	-3.37(0.06)	-2.74(0.23)	-3.51(0.05)

Table 2: Results of Johansen's maximum likelihood tests for multiple cointegrating relationships

Null hypothesis	trace Statistics	trace p-value	maximum eigenvalue Statistics	maximum eigenvalue p-value
$r=0$	49.11	0.02	28.77	0.01
$r\leq 1$	23.46	0.19	21.13	0.23
$r\leq 2$	11.88	0.16	14.26	0.18