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Environmental Kuznets Curve and Growth Source in Iran

Summary: Recent empirical research has examined the relationship between certain indicators of environmental degradation and income, concluding that in some cases an inverted U-shaped relationship, which has been called an environmental Kuznets curve (EKC), exists between these variables. The source of growth explanation is important for two reasons. First, it demonstrates how the pollution consequences of growth depend on the source of growth. Therefore, the analogy drawn by some in the environmental community between the damaging effects of economic development and those of liberalized trade is, at best, incomplete. Second, the source of growth explanation demonstrates that a strong policy response to income gains is not necessary for pollution to fall with growth. The aim of this paper investigates the role of differences source of growth in environmental quality of Iran. The results show the two growth resources in Iran cause, in the early stages, CO₂ emission decreases until turning point but beyond this level of income per capita, economic growth leads to environmental degradation. I find a U relationship between environmental degradation (CO₂ emission) and economic growth in Iran.

Key words: FDI, Trade, Source of growth, Environment.

JEL: Q56.

The importance of economic growth cannot be overstated. Growth performances vary across countries and regions. The determinants of growth are not unique for all countries that contribute to such variations. The growth pattern is linked to characteristics of countries such as economic base, population growth, unemployment rate, and investment in physical and human capital, flow of foreign investment, industrial growth, trade, and development of financial institutions.

Also trade openness as FDI has emerged as one of the main argument among economist and policy makers in explaining the growth phenomena in developing countries (Dilip Dutta and Ahmed Nasiruddin 2001; Philip J. Dawson 2006; Estrada Ruiz, Mario Arturo, and Su-Fei Yap 2006).

The aim of this paper is to examine the impact of Iran's two sources of growth on environmental quality. In the former we will study whether FDI and trade (as two sources of economic growth) increase pollution in Iran. The remainder of the paper is organized as follows: Section 1 provides the relation between FDI and economic growth. Section 2 will therefore present the relationship between trade openness and economic growth. I will review Iran's economy in Section 3. In the Section 4, I will study the environmental Kuznets curve (EKC) hypothesis. Section 5 presents the model and the results and Section 6 includes summaries and concludes.

1. The Role of FDI as a Growth Engine

Direct investment constitutes principal capital invested, reinvestment of profits, and loans between the overseas mother company and its local subsidiary. Generally, factors attracting direct investments depend on three determinants specific to the host country. In addition to advantages pertaining to the foreign company undertaking the investment. See John Harry Dunning (1993) and UNCTAD (1998) for a detailed discussion of these determinants. The first determinant relates to economic policy and the institutional framework; the second determinant deals with business facilitation arrangements and incentives; and the third rests on purely economic factors which largely identify the type of direct investment. Investment incentives (the financial ones like tax exemptions, customs tariffs, subsidised fees for use of infrastructure; and the monetary ones like reduced interest rates etc.) are governed by WTO regulations in the context of the Agreement on Subsidies and Countervailing Duties, and hence cannot be overused. From an economic logic vantage point, these incentives are justified only in cases where direct investments lead to positive external effects. These factors are grouped into three types of variables: the first pertains to market-seeking investments, which depend on per capita income and its growth, market size and free trade areas; the second deals with efficiency-seeking investments, which depend on labour costs, quality of infrastructure and transportation networks, and the cost of other production factors; and the third relates to resource/asset-seeking investments, which depend on the abundance of natural resources and the supply of infrastructure assets.

Developing countries in Asia have come increasingly to see foreign direct investment (FDI) as a source of economic development, modernization, income growth, employment, and so poverty reduction. This is apparently reflected by their currently pursued economic policies, which is explicitly intended to improve conditions to attract FDI and to maximize the benefits of the presence of FDI in their domestic economy. Over the past two decades these countries have implemented broad ranging economic reforms, including the liberalization of their foreign trade and investment regimes and domestic markets and privatization of state companies, which has had an effect on the flow and nature of foreign investment.

A number of studies have been undertaken to determine whether FDI impacts positively on economic growth. Two types of studies, i.e. macro and micro, have generally been conducted to study the relationship between FDI and economic growth. Micro studies usually find no positive evidence that FDI makes a positive contribution to economic growth. Macro studies, on the other hand, which frequently include a variable for inflows (or the stock) of FDI, often find FDI to positively affect economic growth under certain conditions. For instance, a study by Eduardo Borrensztain, Jose De Gregorio, and Jong-Wha Lee (1998) tested the effect of FDI on economic growth in a cross-country regression framework. They used data on FDI received by developing countries from industrial countries only. They found some indications that FDI has a positive effect on economic growth, but this impact was dependent on the human capital stock in the host economy. The higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when a sufficient absorptive

capability of the advanced technologies that it brings is available in the host economy. The results suggest that most of the effect of FDI on economic growth likely derives from efficiency gains rather than an overall higher induced level of investment.

Findings from other studies using the same analytical framework such as from David Dollar and Aart Kraay (2001), Martin Rama (2001) and Tøndel Kolstad (2002) also support the notion that the role of FDI is important when it comes to increased economic growth in developing countries.

Usha Nair-Reichert and Diana Weinhold (2001) argue, however, that traditional panel and time series estimators often impose homogeneity assumptions across countries in studies of the relationship between FDI and growth. Their findings, meanwhile, show strong evidence of considerable heterogeneity across countries. This indicates that incorrectly imposing the homogeneity assumption on the data can lead to biased estimates and faulty policy implications. To circumvent the problem, the authors use mixed, fixed, and random (MFR) panel data estimation to test for causality between FDI and economic growth in developing countries. Results from the MFR estimation differ substantially from traditional panel data causality results. While traditional tests suggest a significant and uniform impact on growth from FDI, this study finds the causal relationship between investment (foreign and domestic) and economic growth in developing countries to be highly heterogeneous. While domestic investment seems to be strongly correlated contemporaneously with growth, it is not generally a strong causal determinant of future growth. In addition, the study finds a causal relationship from FDI to growth and there is some evidence that the efficacy of FDI is greater in more open economies, although this relationship is highly heterogeneous across countries. The study also finds no statistically significant role for human capital in economic growth, but this does not mean that human capital is unimportant, since the relationship between human capital and growth is quite complex and may not be adequately captured in linear models.

Also Maria V. Carkovic and Levine Ross (2002) dispute the generally positive findings on the FDI-growth relationship. They argue that the many macroeconomic studies that find a positive link between FDI and growth do not fully control for endogeneity, country-specific effects, and inclusion of lagged dependent variables in growth regressions. After controlling for these statistical problems, the authors find that FDI inflows do not exert an independent influence on economic growth. The studies mentioned above illustrate the ongoing controversy regarding the importance of FDI on economic growth. While an exhaustive literature has already emerged to support each side of the debate, closure remains elusive.

Another important channel through which FDI can have a great contribution to economic growth in developing countries is by supporting export growth of the countries. In the literature, export growth is often associated with trade liberalization, though the latter also means more imports. So, there are two basic questions here. First, is there a positive correlation between trade liberalization or export growth in specific and economic growth. Second, is there also a positive link between FDI and export growth. With respect to the first question, economic theory offers many reasons to expect trade liberalization or export growth to stimulate economic growth, as

openness provides many benefits including access to global market, technology and to appropriate intermediate and capital goods and raw materials; and the benefits of increased economies of scale and market competition. See Robert E. Lucas (1988) or Gene M. Grossman and Elhanan Helpmann (1991a), for example, for a discussion. Over the 1990s the conviction that openness is good for economic growth was fostered by several highly visible and well-promoted cross-country studies from e.g. Dollar (1992), Jeffrey D. Sachs and Andrew M. Warner (1995). Recently, however, these have received rough treatment from Francisco Rodriguez and Dani Rodrik (2001), who argue, *inter alia*, that their measures of openness are flawed and their econometrics weak. Moreover, as argued in Ann Harrison (1996) and Alan L. Winters, Neil McCulloch, and Andrew McKay (2002), liberal trade is usually only one of several indicators of openness used, and one which often seems to weigh rather lightly in the overall result. Winters, McCulloch, and McKay (2002) argue, however, that, while trade liberalization is likely to benefit economic growth under any circumstances (because they enlarge the set of opportunities for economic agents), a quasi-permanent effect on economic growth almost certainly requires combination with other good policies as well, including investment policies.

2. Trade Openness and Economic Growth

The relationship between trade openness and growth is a highly debated topic in the growth and development literature. Yet, this issue is far from being resolved. Theoretical growth studies suggest at best a very complex and ambiguous relationship between trade restrictions and growth. The endogenous growth literature has been diverse enough to provide a different array of models in which trade restrictions can decrease or increase the worldwide rate of growth (see Grossman and Helpman 1990; Paul M. Romer 1990; Luis A. Rivera-Batiz and Romer 1991a, 1991b; Kiminori Matsuyama 1992). Note that if trading partners are asymmetric countries in the sense that they have considerably different technologies and endowments, even if economic integration raises the worldwide growth rate, it may adversely affect individual countries (see Lucas 1988; Grossman and Helpman 1991a, 1991b; Alwyn Young 1991; Rivera-Batiz and Xie Danyang 1993).

There are a number of ways that rapid expansion in trade and “outward orientation” can contribute to increased economic growth. Trade growth may lead to an increase in the scope for economies of scale due to an enlargement of the market size, and encourage the allocative efficiency and competitiveness of exporting firms. If there are incentives to increase investment and improve technology, this would imply a productivity differential in favour of the export sector. Hence, even if the export sector expands at the expense of other sectors, a positive effect will be impacted on aggregate output (Benno J. Ndulu and Njuguna Ndungu 1998).

Increased exports may also affect aggregate output by relaxing the foreign exchange constraint. By helping to increase the imports of intermediate inputs, export expansion relaxes a crucial bottleneck and facilitates the export of inputs embodying recent techniques (Augustin Kwasi Fosu 1990a). The significance of exports in economic growth has also been buttressed by the literature on endogenous growth theory which spells out the importance of increasing returns to scale and the dynamic spil-

lover impact of the export sector's growth. According to this theory, trade may increase long-run growth by allowing the economy to specialize in those sectors with scale economies that arise from research and development, human capital accumulation, or learning-by-doing. The non-export sector could also benefit from positive externalities such as improved management styles and more efficient production technologies generated by the export sector through increased trade (Anne O. Kruger 1984).

Given the potential contribution of the trade to economic growth, structural adjustment programmes initiated in the early 1980s in Sub-Saharan African countries sought, among other things, to promote export growth by improving incentives to producers in the export sector (Awudu Abdulai and Peter Rieder 1995). This was mainly done through exchange rate realignments and increased export producers' shares of world prices, as well as rehabilitation of the export infrastructure. Prior to the reforms, African governments adopted exchange rate and trade policies which were typically anti-export.

Exchange rates were commonly overvalued, reflecting the interest of the political elite in cheap imports. Exports were sharply reduced as a result of export crop taxation (Abdulai and Wallace E. Huffman 2000).

In contrast to the argument advanced above on the impact of trade expansion on economic growth, some scholars, for example, Jagdish Bhagwati (1988) and Grossman and Helpman (1991a) suggest a reciprocal relationship between the two economic indicators. According to them, increased trade produces more income, and more income also facilitates more trade. Santo Dodaro (1991) also argues that as countries become more developed, they are more likely to get prices right and to follow a more neutral policy stance both with respect to exports and with respect to the domestic economy. Thus, trade growth would be dependent on the level of development. These diverse lines of arguments seem to reveal the complex relationship that exists between GDP growth and export growth. Other key variables such as investment climate, political conditions, labour supply, indebtedness etc., all tend to influence the relationship between export growth and GDP growth substantially. Given these arguments, several analysts have examined this relationship, particularly the causality between the two economic indicators. However, the empirical evidence from the studies in this area appears mixed. Studies by Subrata Ghatak, Chris Milner, and Utku Utkulu (1997) for Malaysia and Uravashi Dhawan and Bagala Biswal (1999) for India find empirical evidence in support of export-led growth. On the other hand, work done by Irene Henriques and Perry Sadorsky (1996) for Canada show evidence in support of growth-driven exports.

While studies using cross-sectional data for developing countries considered Sub-Saharan Africa (Fosu 1990b; Kofi Amoateng and Ben Amoaku-Adu 1996), the recent plethora of time series studies (see, for example, Ghatak, Milner, and Utkulu 1997; Shamshad Begum and Abul F. M. Shamsuddin 1998; Dhawan and Biswal 1999) are largely on Asian countries, with very scanty empirical evidence on individual countries in Sub-Saharan Africa. Although cross-country aggregate analysis of growth shed light on the reasons behind differential rates of growth among different countries, its limitations have been pointed out by several authors (see, for

example, Hollis B. Chenery, Hazel Elkington, and Christopher Sims 1990; Robert B. Williamson 1998). Prominent among the drawbacks is the constancy of parameters across observations, which implicitly assumes that all countries have a common economic structure. In a production function context, different countries are assumed to operate with identical production functions. In cases, where the production function is complicated by the existence of non-optimal allocation, an additional assumption involved is that the degree of misallocation is identical across countries.

3. Foreign Investment and Trade as Iran's Growth Sources

International trade contributes significantly to Iran's economy and has increased dramatically over the past few years. Between 2004 and 2007, Iran's total trade in goods (exports plus imports) nearly doubled, reaching about \$147 billion in 2007. Iran enjoys a growing and positive trade balance in goods, benefiting from high international oil prices. This trade surplus registered at about \$36 billion in 2007. Exports totaled about \$91 billion, while imports reached about \$55 billion that same year. Overall, Iran's external sector position has strengthened in recent years. The current account balance reached an estimated \$29 million in 2007, about 10% of Iran's GDP at market price (IMF, "Islamic Republic of Iran: 2008 Article IV Consultation", August 2008, IMF Country Report No. 08/284). The current account surplus is expected to decline in 2009 with the drop in international oil prices.

International Monetary Fund (2004) examine the link between trade openness and economic growth in Iran, they adopt the imports to non-oil GDP ratio as a proxy for trade openness because of the lack of data on average tariffs and non-tariff barriers to trade for the entire period 1960-2002.

Macroeconomic stability is proxied by the inflation rate, due to the lack of data on government deficits and exchange rate distortions for 1960-2002. Terms of trade are proxied by the change in the ratio of oil prices to the import prices of industrial goods. Since oil represents about 80 percent of Iran's exports, and 95 percent of imports are industrial goods, the ratio of the prices of these two types of commodities is a good proxy of the terms of trade. Financial development is proxied by the change in the ratio of broad money (M2) to non-oil GDP. Finally, they include a dummy variable for the sub-period 1977-88 to take into account the effect of political instability and war on growth.

The statistics of the regression show that all variables are significant at the 95 percent confidence level, and explain 82.7 percent of variance of growth; there are no structural changes during the period (Chow tests); no autocorrelation (AR test); and there is no-heteroscedasticity (ARCH and hetero tests) of the residuals of the regression.

The results are largely consistent with the cross-country evidence on economic growth. Increased trade openness and macroeconomic stability (measured as a reduction in inflation rates) are positively correlated with growth. Also, improvements in the terms of trade are positively correlated with growth.

Iran's savings and investment performance offers a mixed picture. The long-term investment trends are positive and indicate a significant increase in the flow of resources to investment as opposed to consumption since 1995. Iran's national ac-

counts data show that the share of investment in GDP (measured in inflation-adjusted prices) has increased from 26% in 1995 to a peak of 40% in 2004. Furthermore, there was a gradual shift from investment in construction to investment in machinery during this period. The share of machinery in total gross investment rose from 41% in 1995 to 61% in 2004. Source of data is Central Bank of the Islamic Republic of Iran, Annual National Accounts.

As noticed by Djavad Salehi-Esfahani (2008), the rapid increase in machinery investment is an indication of investors' growing confidence in the long-term prospects of the Iranian economy. He also points out that most of the growth in machinery investment in recent years is attributable to private investors rather than to the government. The increase in investment and the growing share of private sector investment are both consequences of active government policies that were intended to promote manufacturing and industrial activity-including a variety of producer subsidies and subsidized government loans for industrial projects.

This positive long-term trend has been disrupted by the moderate decline in investment during more recent years. During 2003-2006 the share of investment in Iran's GDP suffered a steady decline, from 40% (2003) to 35% (2006). The fact that Iran earned record oil revenues in this four-year interval suggests that the decline in investment was not due to a shortage of liquidity or financial capital. Rather, the main causes of this decline were political uncertainty and economic mismanagement.

4. Environment and Growth: The Basic Empirical Analysis of the EKC

The environmental Kuznets hypothesis (EKC) predicts an inverse U-shaped relationship between environmental pollution on the one hand and per capita income on the other. The EKC hypothesis states that economic growth degrades the environment at low-income levels, but as incomes rise, harmful environmental impacts decrease. According to the theory, the environment is initially exploited to a great extent in order to create economic growth. When an economy becomes developed enough, the environment becomes more valued, and technical progress makes it possible to create wealth with less environmental stress. This means that one should be able to find a level of income after which the negative environmental impacts of economic activity will decline.

This shape is due to the scale, composition, income and technique effects. At first, the increasing scale of economic activity as well as its changing composition from agricultural towards industrial activities generates more pollution. However, as income rises, demand for environmental quality increases and governments introduce more stringent environmental regulation. This income effect, the replacement of old technologies by environmentally less harmful ones, together with the changing composition away from an industrial towards a post-industrial economy puts downward pressure on pollution. Eventually, as income passes some threshold level, better techniques, an increased demand for environmental quality and the composition effect outweigh the scale effect and environmental quality increases with growth.

In effect, the EKC is a special case of the general Income-Emission Relation (IER). Before the early nineties the IER was said to be more or less linear: higher incomes meant more production and consumption, and it was presumed emissions would rise. This relation caused considerable concern as rich countries showed high growth rates and environmental pressures increased.

The basic empirical analysis of the EKC starts from an estimate of (a variation of)

$$e_{it} = \delta_i + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \beta_3 Y_{it}^3 + \varepsilon_{it} \quad (1)$$

with e_{it} a proxy for environmental pollution, δ_i a country specific effect, Y_{it} per capita income, Y_{it}^2 per capita income squared and Y_{it}^3 per capita income cubed and ε_{it} an error term. The subscripts i refer to a cross-section and the subscript t to time. The EKC hypothesis requires that $\beta_1 > 0$, $\beta_2 < 0$ and $\beta_3 = 0$.

The income level at which environmental degradation begins to decline is called income turning point (ITP). The ITP of an EKC is obtained by setting the first derivation (with respect to income) of equation (1) equal to zero and solved for income; this yields $-\beta_1/2\beta_2$.

With $\beta_1 > 0$, $\beta_2 < 0$ and $\beta_3 > 0$ an N-shaped pattern is obtained, i.e. there is a second turning point, after which the environmental degradation rises again with increasing income.

The EKC's inverted U-shaped relationship between emissions and income implies that at one point in time, environmental pollution will eventually turn negative. Including income cubed or using logarithmic dependent variables (David I. Stern 1998) solves this problem. However, both solutions can be questioned. Although the third order polynomial in per capita income would only reveal an inverted U-shaped path between emissions and income if income cubed is insignificant, the evidence seems to suggest that this is generally not the case. Grossman and Alan B. Krueger (1995) for instance find an N-shaped EKC. However, due to the fact that the second income turning point is out of their sample range, they do not put much emphasis on the possibility that emissions could increase with income after a period where the opposite has occurred. Most authors have followed this practice and largely ignored a significant estimate for income cubed. However, the presence of a significant estimate for per capita GDP cubed, i.e. an N-shaped EKC, implies that emissions will rise indefinitely once the trough income level is reached. This seems to be at odds with the EKC-hypothesis. If popular demand is one of the forces that puts downward pressure on environmental pollution, it seems to be contradictory to assume that it will not continue to play its role once income has passed its through level. One can further question the interpretation of a significant estimate for income cubed.

However, the statement of the hypothesis makes no explicit reference to time. Truly, the EKC is a long run phenomenon. In other words, it is a development trajectory for a single economy that grows through different stages over time. That is, *ceteris paribus*, in their process of development, individual countries experience income and emission situations lying on one and the same EKC. Empirically, this development trajectory can be observed in cross-country cross-sectional data, which represents the countries with different (low, middle and high) income groups (of the world) corresponding to their emission levels. Assuming all countries follow one

EKC, then at any cross-section of time, it should be observed that some countries are poor shaping the initial stage of EKC, some are developing countries approaching towards peak or start to decline and other are rich produce falling stage of EKC. Evidently, thus, under the null hypothesis of EKC and under the assumption of invariance of the income -emission relationship, for a given set of cross-country cross-sectional data on income and emission, the emission on income regression line should be an inverted-U-shaped empirical EKC.

5. Econometric Methodology and Data

5.1 Estimating Framework and Technique

The FDI and openness-growth linkage assumes that export growth provides a significant contribution to economic growth. Several researchers have attempted to capture these phenomena by incorporating exports into the aggregate production function (see, for example, Fosu 1990a, 1990b; Andy C. C. Kwan, John A. Cotsomitis, and Benjamin K. C. Kwok 1999). Since the main objective of this study is to examine the FDI and openness-led growth hypothesis, the model employed by Fosu (1990b) is adopted:

$$Y = (X) \quad (2)$$

where Y represents per capita GDP and X denotes the level of FDI or openness (the ratio of imports + exports to GDP). The FDI or openness is as explanatory variable in equation (2) accounts for the relationship between growth of FDI or openness and economic growth.

I estimate a system of simultaneous equations (The two-stage least squares (2SLSF)), in which CO₂ emission and per capita GDP are endogenously determined by country-specific characteristics. This system approach takes into account the endogeneity of per capita GDP.

I estimate a two-equation system using 1980-2011 data for Iran. For the first equation I assume that per capita GDP and CO₂ emission are joint products, produced by country-specific factors: per capita GDP squared, per capita GDP cubed and the level of FDI or openness.

Data are obtained from the World Bank's 2012 World Development Indicators' (WDI's) CD-Rom and on-line WDI 2012¹.

To conserve notation I suppress time and country subscripts in describing the model. The joint CO₂ emission function is:

$$F(\text{CO}_2 \text{ emission, per capita GDP}) = G(Y, Y^2, Y^3, X) \quad (3)$$

I invert the relation F()=G() to obtain the per capita GDP function: per capita GDP = f(X), which represents the relation between per capita GDP and FDI or openness.

¹ <http://publications.worldbank.org/wdi>.

5.2 Results

I estimate the system of simultaneous equations of the two-stage least squares (2SLS) using 1980-2008 data for Iran. I test the stationarity of variables in the model. Therefore, I make the unit root test of Dickey Fuller to test for it. The results show that all variables are stationary at level in Iran (Table 1).

Table 1 The Dickey Fuller Test at Level for All Variables

Variables	Test statistic	1% Critical value	5% Critical value	10% Critical value
CO2	4.127	-2.655	-1.950	-1.601
Per capita GDP	2.118	-2.655	-1.950	-1.601
Per capita GDP squared	2.940	-2.655	-1.950	-1.601
Per capita GDP cubed	1.199	-2.655	-1.950	-1.601
FDI	2.083	-2.655	-1.950	-1.601
Openness	4.895	-2.655	-1.950	-1.601

Source: Research findings.

Although there may well be reason to suspect non-orthogonality between regressors and errors, the use of IV estimation to address this problem must be balanced against the inevitable loss of efficiency vis-a-vis OLS. It is therefore very useful to have a test of whether or not OLS is inconsistent and IV or GMM is required. This is the Durbin-Wu-Hausman (DWH) and Wu-Hausman test of the endogeneity of regressors.

Adrian R. Pagan and Anthony D. Hall (1983) derive a heteroskedasticity test under the null hypothesis of homoskedasticity in the IV regression. The Pagan-Hall statistic is the presence of heteroskedasticity elsewhere in the system. We find the presence of heteroskedasticity in this model. Although the consistency of the application of the instrumental variables (IV) coefficient estimates is not affected by the presence of heteroskedasticity, the standard IV estimates of the standard errors are inconsistent, preventing valid inference. The usual forms of the diagnostic tests for endogeneity and overidentifying restrictions will also be invalid if heteroskedasticity is present. The conventional IV estimator (though consistent) is, however, inefficient in the presence of heteroskedasticity. The usual approach today when facing heteroskedasticity of unknown form is to use the Generalized Method of Moments (GMM), introduced by Lars P. Hansen (1982). GMM makes use of the orthogonality conditions to allow for efficient estimation in the presence of heteroskedasticity of unknown form.

We know “Good instruments” should be both relevant and valid: correlated with the endogenous regressors and at the same time orthogonal to the errors. Correlation with the endogenous regressors can be assessed by an examination of the significance of the excluded instruments in the first-stage IV regressions.

Table 2 The Model Estimation as Economic Growth is Determined by Openness Variable

Variable	Coefficient	t student
C	2.960235	2.15**
Per capita GDP	-.0013594	-2.62**
Per capita GDP squared	2.56e-07	1.05
Per capita GDP cubed	5.87e-11	0.55
Number of observations		29
Centered R ²		-2.1250
Uncentered R ²		0.7361
Wu-Hausman test ⁽¹⁾		29.56235
P-value		0.00001
Durbin-Wu-Hausman test ⁽¹⁾		16.00580
P-value		0.00006
Pagan-Hall general test before estimation		0.041
GMM ⁽²⁾		
Chi-sq(.) P-value		0.9978
Hansen J statistic ⁽³⁾		0.000
Curve turning point ⁽⁴⁾		2655.078125

Notes: T-statistics are shown in parentheses. Significance at the 99%, 95% and 90% confidence levels are indicated by *, **and ***, respectively. (1) Tests of endogeneity of per capita GDP under H₀ hypothesis. H₀: Regressor is exogenous. (2) Test of Pagan and Hall (1983) designed specifically for detecting the presence of heteroskedasticity in IV estimation under H₀ hypothesis. H₀: Disturbance is homoskedastic. (3) Overidentification test of all instruments show the equation is exactly identified. (4) The turning point of curve is obtained by $-\beta_1/2\beta_2$.

Source: The World Bank's 2009 World Development Indicators.

Table 3 The Model Estimation as Economic Growth is Determined by FDI Variable

Variable	Coefficient	t student
C	24.45109	2.39*
Per capita GDP	-.0150626	-1.98**
Per capita GDP squared	2.47e-06	2.02**
Per capita GDP cubed	5.98e-09	0.52
Number of observations		29
Centered R ²		-3.3650
Uncentered R ²		0.6471
Wu-Hausman test ⁽¹⁾		33.42128
P-value		0.00001
Durbin-Wu-Hausman test ⁽¹⁾		16.59014
P-value		0.00005
Pagan-Hall general test before estimation		0.081
GMM ⁽²⁾		
Chi-sq(.) P-value		0.9940
Hansen J statistic ⁽³⁾		0.000
Curve turning point ⁽⁴⁾		3049.1093

Notes: T-statistics are shown in parentheses. Significance at the 99%, 95% and 90% confidence levels are indicated by *, **and ***, respectively. (1) Tests of endogeneity of per capita GDP under H₀ hypothesis. H₀: Regressor is exogenous. (2) Test of Pagan and Hall (1983) designed specifically for detecting the presence of heteroskedasticity in IV estimation under H₀ hypothesis. H₀: Disturbance is homoskedastic. (3) Overidentification test of all instruments show the equation is exactly identified. (4) The turning point of curve is obtained by $-\beta_1/2\beta_2$.

Source: WDI's.

We may cast some light on whether the instruments satisfy the orthogonality conditions in the context of an overidentified model: that is, one in which a surfeit of instruments are available. In that context we may test the overidentifying restrictions in order to provide some evidence of the instruments' validity. In the GMM context, Hansen (1982) show if the equation is overidentified then we can test whether the

instruments are uncorrelated with the error process. This test can and should be performed as a standard diagnostic in any overidentified instrumental variables estimation.

The results show the two growth resources in Iran cause, in the early stages, CO₂ emission decreases until turning point where the pollution increases with the economic growth but beyond this level of income per capita, economic growth leads to environmental degradation, modeling a U shape function (See the Tables 2 and 3).

6. Conclusions

This paper investigates the relationship between two growth sources and environmental quality. I basically use two types of two important growth sources in Iran. The first group is a measure of trade (the sum of export and import divided to GDP) and the second group is FDI. I examine what is the role of growth sources such as openness and FDI in the relationship between economic growth and environmental quality? Can I find the inverted-U-shaped relationship between environmental degradation and economic growth (the environmental Kuznets Curve) in Iran as the growth source is openness or FDI?

The results show the relationship between economic growth and environmental quality, whether positive or negative, is not fixed along Iran's development path; indeed it may change sign from positive to negative as this country reaches a level of income turning point but after this level of income, environmental quality decreases. This implies U relationship between environmental degradation and economic growth in Iran.

References

- Abdulai, Awudu, and Peter Rieder.** 1995. "The Impact of Agricultural Price Policy on Cocoa Supply in Ghana: An Error Correction Model." *Journal of African Economies*, 4(3): 315-335.
- Abdulai, Awudu, and Wallace E. Huffman.** 2000. "Structural Adjustment and Efficiency of Rice Farmers in Northern Ghana." *Economic Development and Cultural Change*, 48(3): 503-521.
- Amoateng, Kofi, and Ben Amoako-Adu.** 1996. "Economic Growth, Export and External Debt Causality: The African Case." *Applied Economics*, 28(1): 21-27.
- Begum, Shamshad, and Abul F. M. Shamsuddin.** 1998. "Exports and Economic Growth in Bangladesh." *Journal of Development Studies*, 35(1): 89-114.
- Bhagwati, Jagdish.** 1988. *Protectionism*. Cambridge: MIT Press.
- Borensztein, Eduardo, Jose De Gregorio, and Jong-Wha Lee.** 1998. "How Does Foreign Direct Investment Affect Economic Growth?" *Journal of International Economics*, 45(1): 115-135.
- Carkovic, Maria V., and Levine Ross.** 2002. "Does Foreign Direct Investment Accelerate Economic Growth?" http://www.worldbank.org/research/conferences/financial_globalization/fdi.pdf.
- Chenery, Hollis B., Hazel Elkington, and Christopher Sims.** 1990. "A Uniform Analysis of Development Patterns." Economic Development Report 148.
- Dawson, Philip J.** 2006. "The Export-Income Relationship and Trade Liberalization in Bangladesh." *Journal of Policy Modeling*, 28: 889-896.
- Dhawan, Uravashi, and Bagala Biswal.** 1999. "Re-examining Export-Led Growth Hypothesis: A Multivariate Cointegration Analysis for India." *Applied Economics*, 31(4): 525-530.
- Dodaro, Santo.** 1991. "Comparative Advantage, Trade and Growth: Export-Led Growth Revisited." *World Development*, 19(9): 1153-1165.
- Dollar, David, and Aart Kraay.** 2001. "Trade, Growth, and Poverty." World Bank Policy Research Working Paper 2615.
- Dollar, David.** 1992. "Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985." *Economic Development and Cultural Change*, 40(3): 523-544.
- Dunning, John Harry.** 1993. *The Globalization of Business - The Challenge of 1990s*. London: Routledge.
- Dutta, Dilip, and Ahmed Nasiruddin.** 2001. "Trade Liberalization and Industrial Growth in Pakistan: A Cointegration Analysis." Australia South Asia Research Centre Working Paper 2001-01.
- Fosu, Augustin Kwasi.** 1990a. "Export Composition and the Impact of Exports on Economic Growth of Developing Economies." *Economics Letters*, 34(1): 67-71.
- Fosu, Augustin Kwasi.** 1990b. "Exports and Economic Growth: The African Case." *World Development*, 18(6): 831-835.
- Ghatak, Subrata, Chris Milner, and Utku Utkulu.** 1997. "Exports, Export Composition and Growth: Cointegration and Causality Evidence for Malaysia." *Applied Economics*, 29(2): 213-223.
- Grossman, Gene M., and Alan B. Krueger.** 1995. "Economic Growth and the Environment." *Quarterly Journal of Economics*, 110(2): 353-377.

- Grossman, Gene M., and Elhanan Helpman.** 1990. "Comparative Advantage and Long-Run Growth." *American Economic Review*, 80(4): 796-815.
- Grossman, Gene M., and Elhanan Helpman.** 1991a. "Quality Ladders in the Theory of Growth." *Review of Economic Studies*, 58(1): 43-61.
- Grossman, Gene M., and Elhanan Helpman.** 1991b. "Endogenous Product Cycles." *Economic Journal*, 101(408): 1229-1241.
- Hansen, Lars P.** 1982. "Large Sample Properties of Generalized Method of Moments Estimators." *Econometrica*, 50(3): 1029-1054.
- Harrison, Ann.** 1996. "Openness and Growth: A Time-Series, Cross Country Analysis for Developing Countries." *Journal of Development Economics*, 48(2): 419-447.
- Henriques, Irene, and Perry Sardosky.** 1996. "Export-Led Growth or Growth-Driven Exports? The Canadian Case." *Canadian Journal of Economics*, 29(3): 540-555.
- International Monetary Fund - IMF.** 2004. *Country Report 04/308*. Washington, DC: International Monetary Fund.
- Kolstad, Tøndel.** 2002. "Social Development and Foreign Direct Investments in Developing Countries." Chr. Michelsen Institute Report 2002/11.
- Kruger, Anne O.** 1984. "Comparative Advantage and Development Policy Twenty Years Later." In *Economic Structure and Performance: Essays in Honor of Hollis B. Chenery*, ed. Moshe Syrquin, Lance Taylor, and Larry E. Westphal, 135-156. New York: Academic Press.
- Kwan, Andy C. C., John A. Cotsomitis, and Benjamin K. C. Kwok.** 1999. "Exports, Economic Growth and Structural Invariance: Evidence from Some Asian NICS." *Applied Economics*, 31(4): 493-498.
- Lucas, Robert E.** 1988. "On the Mechanics of Economic Development." *Journal of Monetary Economics*, 22(1): 3-42.
- Matsuyama, Kiminori.** 1992. "Agricultural Productivity, Comparative Advantage and Economic Growth." *Journal of Economic Theory*, 58(2): 317-334.
- Nair-Reichert, Usha, and Diana Weinhold.** 2001. "Causality Tests for Cross-Country Panels: A New Look at FDI and Economic Growth in Developing Countries." *Oxford Bulletin of Economic and Statistics*, 63(2): 153-171.
- Ndulu, Benno J., and Njuguna Ndungu.** 1998. "Trade and Growth in Africa." In *Trade Reform and Regional Integration in Africa*, ed. Iqbal Zubair and Mohsin Khan. Washington, DC: International Monetary Fund.
- Pagan, Adrian R., and Anthony D. Hall.** 1983. "Diagnostic Tests as Residual Analysis." *Econometric Reviews*, 2(2): 159-218.
- Rama, Martin.** 2001. "Globalisation, Inequality and Labour Market Policies." Paper presented at the DPRU/FES Conference on Labour Markets and Poverty in South Africa, Muldersdrift.
- Rivera-Batiz, Luis A., and Xie Danyang.** 1993. "Integration among Unequals." *Regional Science and Urban Economics*, 23(3): 337-354.
- Rivera-Batiz, Luis A., and Paul M. Romer.** 1991a. "Economic Integration and Endogenous Growth." *Quarterly Journal of Economics*, 106(2): 531-555.
- Rivera-Batiz, Luis A., and Paul M. Romer.** 1991b. "International Trade with Endogenous Technological Change." *European Economic Review*, 35(4): 971-1004.
- Rodriguez, Francisco, and Dani Rodrik.** 2001. "Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence." *NBER Macroeconomics Annual 2000*, 15: 261-338.

- Romer, Paul M.** 1990. "Endogenous Technical Change." *Journal of Political Economy*, 98(5): S71-S102.
- Ruiz, Estrada, Mario Arturo, and Su-Fei Yap.** 2006. "The Openness Growth Monitoring Model (OGM-Model)." *Journal of Policy Modeling*, 28(3): 235-246.
- Sachs, Jeffrey D., and Andrew M. Warner.** 1995. "Economic Convergence and Economic Policies." National Bureau of Economic Research Working Paper 5039.
- Salehi-Esfahani, Djavad.** 2008. "Iran's Economy: Short Term Performance and Long Term Potential." <http://www.brookings.edu/research/speeches/2008/05/23-iran-economy-salehi-isfahani>.
- Stern, David I.** 1998. "Progress on the Environmental Kuznets Curve?" *Environment and Development Economics*, 3(2): 173-196.
- UNCTAD.** 1998. *World Investment Report 1998: Trends and Determinants*. New York and Geneva: United Nations.
- Williamson, Robert B.** 1998. "The Role of Exports and Foreign Capital in Latin American Economic Growth." *Southern Economic Journal*, 85: 410-420.
- Winters, Alan L., Neil McCulloch, and Andrew McKay.** 2002. "Trade Liberalization and Poverty: The Empirical Evidence." Credit Research Paper 02/22.
- Young, Alwyn.** 1991. "Learning by Doing and the Dynamics Effects of International Trade." *Quarterly Journal of Economics*, 106(2): 369-405.