Testing Regional Convergence in Iran's Economy

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Abstract

Convergence hypothesis is one of the results of neoclassical growth model, which has been examined recently. This hypothesis has two forms of absolute and conditional Beta-convergence and implies that regions with lower per capita output have higher per capita growth rates. Since there is no data for regional GDP in Iran, there has been no study to test convergence hypothesis in Iran. Our main contribution in this paper is testing convergence by using the data of demand deposits of Iran's provinces and examining convergence in per capita demand deposits on the base of endogenous demand deposits creation theory in real business cycles approach. Our empirical results have provided some support for Beta-convergence in Iran's regional growth when OLS is used. But our results do not support Sigma-convergence or decrease in regional inequality.

Keywords: neoclassical growth model, absolute Beta-convergence, conditional Beta-convergence, Sigma-convergence, endogenous demand deposits.

1- Introduction

When Solow (1956) made his contribution to the economic growth models and neoclassical growth models were developed, these growth models were considered as a component of neoclassical synthesis (like the theories of consumption that were developed by Modigliani, Brumberg, Ando, and Friedman; the theories of money demand that were developed by Tobin, Baumol, and Friedman; and the theories of investment that developed by

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Jorgenson and others). Therefore, although neoclassical growth models prepared microeconomic foundation for this field of macroeconomics, they did not received much attention until mid 1980s,and especially in policymaking. It was partly because economic growth was not a problem in developed countries until 1970s.Also neoclassical growth models did not have much policy implications.

As a result of slowdown in economic growth and especially slowdown in the rate of productivity growth in industrial countries after mid 1970s,there has been an increasing interest in economic growth theories since mid 1980s.The renewed interest in economic growth has led to the introduction of new growth models or endogenous growth models, with the original contributions from Romer (1986, 1987, and 1990) and Lucas (1989). It has also encouraged macroeconomists to reexamine the neoclassical growth model of Solow and its implications. One of the most important hypotheses that are derived from Solow's growth model is the convergence. Barro and Sala-i-Martin developed the convergence hypothesis (1990,1991,1995, and 1997). There have been two kinds of convergence in the macroeconomic literature on the subject, Beta-convergence and Sigma-convergence. According to unconditional Beta-convergence, different countries or regions will converge to the same per capita output if they have the same steady state growth path. So countries or regions with lower per capita output will have higher per capita output growth. According to conditional Beta-convergence, since different countries and regions have different steady state growth paths, they will not converge to the same per capita output, but those countries and regions that are further than their steady state per capita output will have higher growth rates compared to their long-run growth rates. According to Sigma-convergence, the variance of per capita output will decrease with the passage of time.

The remainder of this paper is organized as follows. In the next section, the model will be introduced that includes the contribution of the paper to test convergence. In section 3, we present a review of the empirical literature on convergence. In section 4, data that will be used to test convergence in Iran's economy will be described. In section 5, our empirical results will be presented. Section 6 contains our concluding remarks.

2- The Model

Since many studies have analyzed Beta-convergence within the neoclassical context and especially as a feature of neoclassical growth model (for example, Barro and Sala-i-Martin (1990, 1991, and 1995), Swaine (1998), Pontes (2000), Hossain (2000), Mankiw, Romer and Weil (1992), and so on) and since there has not been any study about convergence in Iran's regional growth and development, we focus on the neoclassical growth model as the first study in

this field. As Barro and Sala-i-Martin have pointed out, it is necessary for the production function with a technological progress to be labor augmenting to have appropriate neoclassical growth model properties. Since regions within a country, as a result of more factor mobility, have more similar technologies and are more homogenous than different countries, testing convergence is more appropriate by using data from regions within a country. So we assume the same neoclassical production function in all regions (or provinces) of Iran's economy. More specifically, we assume a production function with a constant return to scale technology:

$$Y = F(K, A(t)L) \tag{1}$$

Where Y is total output in a typical region that can be used for consumption or investment. K is the capital stock in region that is increased as a result of net investment according to the following identity:

$$\frac{dK}{dt} = I - \delta K \tag{2}$$

In which I is gross investment and δ is the depreciation rate of capital stock. L is the labor force that can be measured as the number of labor force or the number of man-hour in production process. The labor force is assumed to grow exogenously at the constant rate of g_L for all regions. A (t) is a measure of technical progress, so A (t) L can be called effective labor force that is well known in the literature. Therefore, our inputs are K and A (t) L, and F is a homogenous function of degree one with respect to these inputs. It is usual to write this production function in intensive form. Since multiplying both K and A (t) L by any factor will multiply Y by the same factor, we can multiply both by the factor $1/A(t)L$. This yields:

$$\frac{Y}{A(t)L} = F(\frac{K}{A(t)L}, 1) \quad \text{or} \quad y = f(k,1) = f(k) \tag{3}$$

Where $Y/A(t)L$ or y is called output per effective labor force and $K/A(t)L$ or k is called capital per effective labor force. Now, the growth rate of k is defined as:

$$g_k = g_K - (g_A + g_L) \tag{4}$$

Where g_K is as follows:

$$g_K = \frac{dK/dt}{K} = \frac{I}{K} - \delta \tag{5}$$

It is assumed that effective labor force will grow at the rate $g_A + g_L$, in which g_A is the rate of exogenous technical progress of Solow's model and g_L is the rate of growth of labor force. So, the rate of growth of capital per effective labor force can be written as:

$$g_k = \frac{I}{K} - (\delta + g_A + g_L) \tag{6}$$

By using neoclassical saving function S=sY and I=S assumption, it follows:

$$I=sY \tag{7}$$

In which s is the rate of saving and is assumed a constant. By substituting (7) in (6) and dividing both numerator and denominator by A(t)L,(6) can be rewritten as follows:

$$g_k = \left(\frac{sy}{k}\right) - (\delta + g_A + g_L) \tag{8}$$

This equation is called the fundamental differential equation of the Solow 's model. For a Cobb-Douglas production function it can be shown (Barro and Sala-i-Martin, 1995) that g_k is as follows:

$$g_k = sk^{-(1-\alpha)} - (\delta + g_A + g_L) \tag{9}$$

In which α is the elasticity of output with respect to capital or the power of K in the Cobb-Douglas production function. Now, a log-linear approximation of equation (9) in the neighborhood of steady state will yield:

$$g_k = d[\log(k)] / dt = -\beta[\log(k / k^*)] \tag{10}$$

Where $\beta = (1-\alpha)(z + g_A + g_L)$ and k^* is the steady state of k. In effect, β determines the speed of convergence from k to k^*. Since for the Cobb-Douglas production function, $g_y = \alpha g_k$ and $\log(y/y^*) = \alpha\log(k/k^*)$, by substituting in (10), it follows:

$$g_y = -(1-\alpha)(z + g_A + g_L)\left|\log\frac{y}{y*}\right|$$ (11)

Therefore, the convergence coefficient β for y and k is the same. In addition, equation (11) is a differential equation in log [y (t)] with the solution

$$\log[y(t)] = [1 - e^{-\beta t}]\log(y^*) + e^{-\beta t}\log[y(\cdot)]$$ (12)

Regarding the speed of convergence, for log [y (t)] to be halfway between log [y (0)] and log [y*], the condition $e^{-\beta t} = \frac{1}{2}$ must hold. Then, for the value β=0.02(the value that Barro and Sala-i-Martin found for the US regions), t=34.5.

Empirically, testing convergence hypothesis has two forms. The first one contends that (with the assumption that all regions have the same steady state value for y) a region with the lower per capita output and further than its steady state has higher per capita output growth rate. This hypothesis is called unconditional Beta-convergence. It is so because increase in capital per effective labor force towards its steady state will increase output per effective labor force but at a decreasing rate. The second one contends that (with the assumption that regions have different structural parameters and therefore different steady state value of y) accounting for different parameter values, the region that is further than its steady state has higher per capita output growth rate. The latter is called conditional Beta-convergence. To test convergence, we need per capita output (or per capita GDP) data during a time period. An inverse relationship between average per capita GDP growth rate and an initial per capita GDP is consistent with convergence hypothesis.

Although regional per capita GDP has been used to test convergence, lack of reliable data is a constraint in developing countries. Therefore, it is necessary to devise a procedure to test convergence hypothesis in the case of nonexistence of per capita GDP. Our contribution concerns with this problem. In line with real business cycle theory and especially endogenous money supply theory of King and Plosser (1984), we assume that transactions services of money supply and especially demand deposits are a kind of factor of production. Then, we can assume that fluctuations in the per capita GDP will cause per capita demand deposits to fluctuate endogenously. In addition to real business cycle theory of endogenous process of creating demand deposits, there is a similar (but with different background) theory of endogenous money supply in post-Keynesian tradition (for example, Palley (1994)). Therefore, we can express the relationship between per capita demand deposits and per capita GDP as follows:

$$dd \propto f(y) \tag{13}$$

If there is a steady state for y, there can be a steady state for dd. Then, it is possible to define convergence hypothesis with respect to per capita demand deposits. Although, it is possible to write a relation like (13) for other monetary aggregates, but equation (13) is based on an endogenous money supply theory. As King a nd P losser p ointed o ut, t he m onetary a ggregate t hat h as the closest relation with real output is demand deposits. Our empirical findings have shown that demand deposits is more correlated with real GDP than any other monetary aggregate and is available from authors on request. So our regression equation is of the following form:

$$agdd = a_1 + a_2 dd0 + a_3 X + u \tag{14}$$

Where agdd is the average growth rate of per capita demand deposits, dd0 is initial per capita demand deposits, and X is a vector of initial regional variables.

Another kind of convergence in literature is called Sigma-convergence. This kind of convergence implies that the variance or standard deviation of regional per capita output will decline with the passage of time. Therefore, the trend in the variance or standard deviation of regional per capita GDP has been used as another test of convergence. However, Quah(1993) has called tests of convergence hypothesis Galton's fallacy and has shown that finding Beta-convergence d oes not n ecessarily i mply S igma-convergence; t hat i s, it can be found that average per capita GDP growth rate is an inverse function of initial per capita GDP at the same time that there is no trend in regional distribution of income. Again, we use the variances of regional per capita demand deposits to test Sigma-convergence.

3- Review of Empirical Literature

In this section, a review of literature concerning convergence hypothesis is provided that can help to conduct and interpret empirical results. As pointed out before, convergence hypothesis was introduced as a result of neoclassical growth model and original empirical studies have been done in that context. But there has been studies concerning convergence in the context of endogenous growth models. Since our main aim is testing convergence property of neoclassical growth model in Iran's economy, our review of empirical literature focuses on those studies that have used neoclassical growth model convergence.

The most important studies concerning convergence were done by Barro and Sala-i-Martin (1990,1991).Originally, they examined convergence across the states of the US economy and found convergence. Then, they extend their empirical research to the EU regions and the regions of Japan. Their main

findings have been summarized in Barro and Sala-i-Martin (1995).They have examined convergence within the US regions (1880-1990), the Japanese Prefectures (1930-1990), the EU regions (1950-1990).As they have suggested, absolute or unconditional Beta-convergence does not hold across all countries or regions of the world because their structural parameters (for example, saving rates) are not the same and therefore they do not possess the same steady state. Unconditional convergence, according to them, does hold within homogenous regions like the US regions or the EU regions. Even within the OECD countries, it is possible that unconditional convergence to hold. They found unconditional Beta-convergence for the US regions with B about 0.02.Meanwhile; they found that with regional dummy variables and regional structural variables B is higher. Also, they found Sigma-convergence; that is a downward trend in the variances of regional per capita incomes. Their results were similar for the Japanese Prefectures and the EU regions; that is, Beta-convergence and Sigma-convergence were found.

Mankiw, Romer and Weil (1992) examined the convergence property of Solow's growth model alongside other empirical findings about this growth model for the time period 1960-1985.They used three sample:(1) all countries for them data were available (countries for them oil was a dominant industry were excluded) and consisted of 98 countries;(2) countries that had more than one million population in 1960 and included 75 countries; and (3) the OECD countries that consisted of 22 countries. They found no indication of convergence for the first and second sample; that is, the countries with lower per capita income did not have higher growth of per capita output. However, they found convergence for the third sample or the OECD countries, which was consistent with Barro and Sala-i-Martin results. Therefore, their study also showed that it is better to examine convergence within similar and homogenous regions.

Swaine (1998) examined whether cross-sectional correlation between initial per capita income and its growth rate can be interpreted as a dynamic speed of convergence. He tested the assumptions that are necessary for such an interpretation and concluded that the estimated cross-sectional relationship is not appropriate as a speed of convergence.

Terrasi (1999) analyzed regional convergence in Italy for the time period 1953-1993 by using Theil coefficient of concentration that can be interpreted as a kind of Sigma-convergence. He found that after a period of convergence, regional convergence in Italy has stopped and a period of divergence has begun after 1975. It implies that at least there is no continuous Sigma-convergence in Italy.

Lopez-Bazo et al (1999) examined regional convergence in the European Union for the time period 1981-1992 by using spatial association tests and

relating them to convergence analysis. They concluded that convergence process ended in the late seventies and there is no decrease in regional inequalities in the EU.

Jian et al (1996) have examined regional convergence among provinces of China during time period 1952-1993.They found that during the initial phase of central planning (1952-1965), there was some weak evidence for convergence; there was strong evidence of divergence during cultural revolution (1965-1978); and there was strong evidence for convergence during the reform period after 1978.But t hey found that there has been divergence in the regional per capita incomes as a result of variance between the coastal provinces(where liberalization and capital inflows have caused a rapid growth) and interior provinces. This can be interpreted as an indication of different steady states for different regions of China.

Drennan and Lobo (1999) examined convergence of metropolitan income in the United States for the time period 1969-1995.They mentioned Galton's fallacy that had been developed by Quah (1993) as a critique for Beta-convergence. Therefore, they devised a test for Beta-convergence that did not suffer from the above criticism. They used this test to all metropolitan areas of the US and employed two measures of income: per capita personal income and average wages. They concluded that there is support for absolute and conditional convergence, but there is no support for Sigma-convergence.

Pontes (2000) analyzed sources of convergence in the European Union and especially in the case of Portugal for the time period 1980-2000.He pointed out that i ncome c onvergence h as b een s topped a cross t he E uropean r egions s ince 1980, although it has continued between countries of the EU. He has analyzed sources of income convergence by decomposing per capita income to labor productivity and employment rate. He found that Portugal has converged to the European average as a result of the flexibility of its labor market, but there will be limited convergence due to labor productivity in the future.

Andres and Bosca (2000) studied the homogeneity of the technological parameters among the OECD countries, which is a presumption of empirical literature of neoclassical growth model and especially Beta-convergence. Their study covered the time period 1960-1990.They found significantly different technologies within the OECD, with fast convergence within e ach group with the same technology.

Hossain (2000) examined Beta-convergence or convergence of per capita output levels across regions of Bangladesh during 1982-1997. His approach was the method suggested by Barro and Sala-i-Martin. The main finding of his study was strong convergence for most of the regions of Bangladesh during 1982-1991.But there was no indication of convergence for a few poorer regions during the whole time period and for the whole regions during 1991-1997.

Petrakos and Saratsis (2000) examined regional inequalities in Greece on the basis of Sigma-convergence and Beta-convergence during 1971-1991.They showed that regional inequalities declined in the 1970s and 1980s, implying convergence. They also found that regional inequalities had a pro-cyclical behavior, and the structure of local industry, the process of the EU integration, the quality of human capital and some other factors have influenced regional growth and convergence.

Azzoni (2001) studied the evolution of regional inequality in Brazil during 1939-1995.He used indicators of per capita income dispersion among states and regions and its evolution to test Beta-convergence and Sigma-convergence. He found regional income convergence but with important oscillations.

Karras (2001) analyzed the growth effects of European economic and monetary integration and the progress of regional convergence across Europe by using annual data for the time period 1950-1992 and 20 European countries. He concluded that evidence is consistent with the neoclassical growth theories. Therefore, there is convergence in per capita income across these economies.

Cuadrado-Roura (2001) examined regional convergence within EU countries and regions during 1960-1997 by using the Sigma-convergence concept. He found evidence showing regional convergence both in terms of per capita GDP and labor productivity for a relatively long period, which has ended in the mid seventies. Therefore, there has not been convergence during 1980s and 1990s.

Nakamura (2001) re-examined Beta-convergence by using panel data instead of cross-country data, which covered the time period 1965-1990. He divided the sample into three sub samples: high initial income sub sample; low initial income and high growth rate sub sample; and low initial income and low growth rate sub sample. He concluded that just for the second sub sample economic growth could be explained as the result of convergence towards steady state.

What has been reviewed does not include all studies concerning regional convergence. The review just focuses on some of the studies that have examined Beta-convergence or Sigma-convergence and mainly within the neoclassical growth context. Although there are studies, which have extended this subject to endogenous growth models or to spatial economics, there are mixed findings even in studying convergence within neoclassical growth models. Therefore, examining regional convergence in Iran's economy can shed light on this issue that is done in the next section.

4- Data

As noted before, there is no reliable data for GDP of regions or provinces in Iran. There are some estimates for some provinces but not for a time period appropriate to test convergence, although these estimates are not reliable and are doubtful. To solve this problem, it is necessary to find another regional variable with the following properties: first, its data are available for a time period; second, its data are reliable; and third, it has a similar dynamics as GDP through growth process. We showed that demand deposits of regions or provinces could be used to test convergence. There is no data for currency holdings in provinces, so instead of money supply we use demand deposits. Moreover, demand deposits are used to facilitate transactions and can be used as an index of transactions services in line with endogenous demand deposits creation theories. There is no published data for demand deposits in provinces. The only data that are published are total demand deposits in Iran. But there are internal reports in Central Bank of Islamic Republic of Iran that contains information about demand deposits in provinces that are held in commercial banks. We have collected this information for the time period 1990-2000.Since demand deposits and in general monetary aggregates are derived from balance sheets of banks, they are the most reliable data in Iran's economy.

To deflate demand deposits, which are available in nominal terms, we need a price index for any province. Central Bank of Islamic Republic of Iran publishes the consumer price index (CPI) for provinces and these price indexes are available for the same time period. The base year is 1990 for some years and 1997 for others .The CPI data are transformed to the base year 1990 for all years.

Since convergence has been examined by using per capita GDP, it is necessary to have data of population for provinces. Then, we can use per capita demand deposits to test convergence in Iran's economy. Census is done in Iran in ten years intervals. So, there is no data for other years. We have used the data of population growth rates to estimate population of each province.

Now, Iran has 28 provinces, which we have used as regions of Iran's economy. Since some of the provinces did not exist in 1990, we included their data in the previous provinces that they were a part of them before. Therefore, our empirical study is done for 24 provinces which are as follows: Tehran, Esfahan, Khorasan, Mazendaran, Gilan, Zanjan, Hamadan, Kermanshah, Kurdistan, Lorestan, Khozestan, Fars, Kohkiloyehoboyerahmad, Chharmahalobakhtiyari, Markazi, Hormozgan, Bosher, Sistanobalochestan, Kerman, Yazd, Semnan, Azarbayejanshrqi, Azarbayejanghrbi, Ilam.

5- Empirical Results

To test regional convergence in Iran's economy, a simple regression like (14) has been used. This equation has been regressed both for nominal and real demand deposits. Table 1 shows the results for nominal demand deposits. The left hand side variable ANDDG is average growth rates of per capita nominal demand deposits of provinces for the time period 1990-2000, which is regressed on the log of per capita nominal demand deposits of provinces NDD90 in 1990. In addition to initial demand deposits, we have included two regional variables for those data are available. Including these variables means that we examine conditional convergence; that is, different provinces have different steady states. These variables are illiteracy rates IL0 in 1990, and percentage of university students to population PPS0 in 1990.

The results are consistent with Beta-convergence because there is an inverse relationship between average growth rates of per capita nominal demand deposits a nd i nitial p er c apita n ominal demand deposits a nd t he c oefficient is significant. Although the positive coefficient of PPS0 is consistent with conditional convergence that implies higher growth rates for provinces with higher human capital, the positive coefficient of IL0 is not consistent with it that implies higher growth rates for the provinces with higher illiteracy rates.

In addition, a non-linear regression has been done for per capita demand deposits by using the following equation

$$(1/10) \log (ddn00/ddn90) = a_0 + ((1\text{-exp} (- \beta (10)))/10) \log (ddn90) + u$$

In which ddn00 and ddn90 are per capita nominal demand deposits in 2000 and 1990 respectively. So, instead of coefficient of NDD90 we have shown the value of B for the above equation. Also, the two regional variables PPS0 and IL0 are included in regression, although the results are the same with or without them. As is clear B is negative but not significant. Therefore, NLS does not support Beta-convergence. At the same time the coefficients of PPS0 and IL0 are not significant.

Since Iran has had two-digit inflation rates during the time period under study, the price increases might distort the data of demand deposits. Therefore, we repeated the above regressions with substituting real or deflated per capita demand deposits of provinces. The results are reported in Table 2.The only difference is that ARDDG i s average growth rates of per capita real demand deposits over 1990-2000 and RDD90 is the log of per capita real demand deposits in 1990. As the table shows, the results are similar with the results of Table 2; that is, there is an inverse relationship between average growth rates of per capita real demand deposits and initial level of per capita real demand deposits i mplying c onvergence. As before, t he p ositive coefficient o f P PS0 i s consistent w ith c onditional c onvergence, b ut t he p ositive c oefficient o f I L0 i s

not. The same NLS regression has been done for per capita real demand deposits in table 2.The results show that B is negative but not significant. So there is no support for Beta-convergence by using NLS.

Table 1: Testing convergence per capita nominal demand deposits (1990-2000)

Dependent variable	Explanatory variables						
ANDDG	C	NDD90	IL0	PPS0	R2	F	DW
	-0.55	-0.59	3.62	56.67	0.45	5.65**	1.97
	(-1.18)	(-3.62)**	(2.02)*	(2.58)*			
$\frac{1}{10}Log(\frac{ddn00}{ddn90})$	0.11	β=-0.08	0.24	3.76	0.17	1.39	2.01
	(1.33)	(-1.21)	(0.76)	(0.94)			

Figures in parentheses are t-students
*Significant at 5% level,   **significant at 1% level

Table 2-Testing convergence per capita real demand deposits (1990-2000)

Dependent Variable	Explanatory Variables						
ARDDG	C	RDD90	IL0	PPS0	R2	F	DW
	-0.15	-0.07	0.39	6.59	0.45	5.57**	1.75
	(-2.83)**	(-3.67)**	(1.95)**	(2.58)*			
$\frac{1}{10}Log(\frac{ddr00}{ddr90})$	-.11	β=-0.09	0.23	3.86	0.18	1.51	1.94
	(-1.28)	(-1.24)	(0.72)	(0.99)			

Figures in parentheses are t-students
*Significant at 5% level, ** Significant at 1% level

Note that results are consistent with Beta-convergence just for OLS regressions, but the results must be interpreted with much caution. The following problems might have distorted the results: first, estimation of population by extrapolating the previous trend might be misleading; second, development of banking in some underdeveloped provinces might cause the demand deposits to increase more rapidly than developed provinces and has led to convergence and also has led to significant coefficient of IL0; third, there may

be spurious convergence (Quah, 1993) due to applying OLS estimation. Meanwhile, the results of NLS do not support Beta-convergence.

As pointed out, the existence of Beta-convergence does not necessarily imply Sigma-convergence and declining income inequality. To examine this issue, we have plotted the variances of per capita nominal demand deposits and per capita real demand deposits for the time period 1990-2000 in Figures 1 and 2, respectively. As Figure 1 shows, the variance of per capita nominal demand deposits has an upward trend, which is not consistent with Sigma-convergence. Figure 2 shows that there is no significant trend in the variance of per capita real demand deposits for the whole period, although there is a downward trend for the first years and an upward trend for the last years. Therefore, there is no support to Sigma-convergence even when we use real per capita demand deposits.

It must be added that our goal is not obtaining the parameter of convergence, but just examining the inverse relationship between growth rates of per capita demand deposits and the initial per capita demand deposits. Analysis of speed of convergence needs more theoretical and empirical investigation about the dynamics of demand deposits. Also, there was no significant change in the results when the variance of log of per capita demand deposits was used instead of variance of per capita demand deposits. In addition, the inverse relationship between average per capita demand deposits and initial per capita demand deposits was obtained when initial per capita demand deposits was the only explanatory variable.

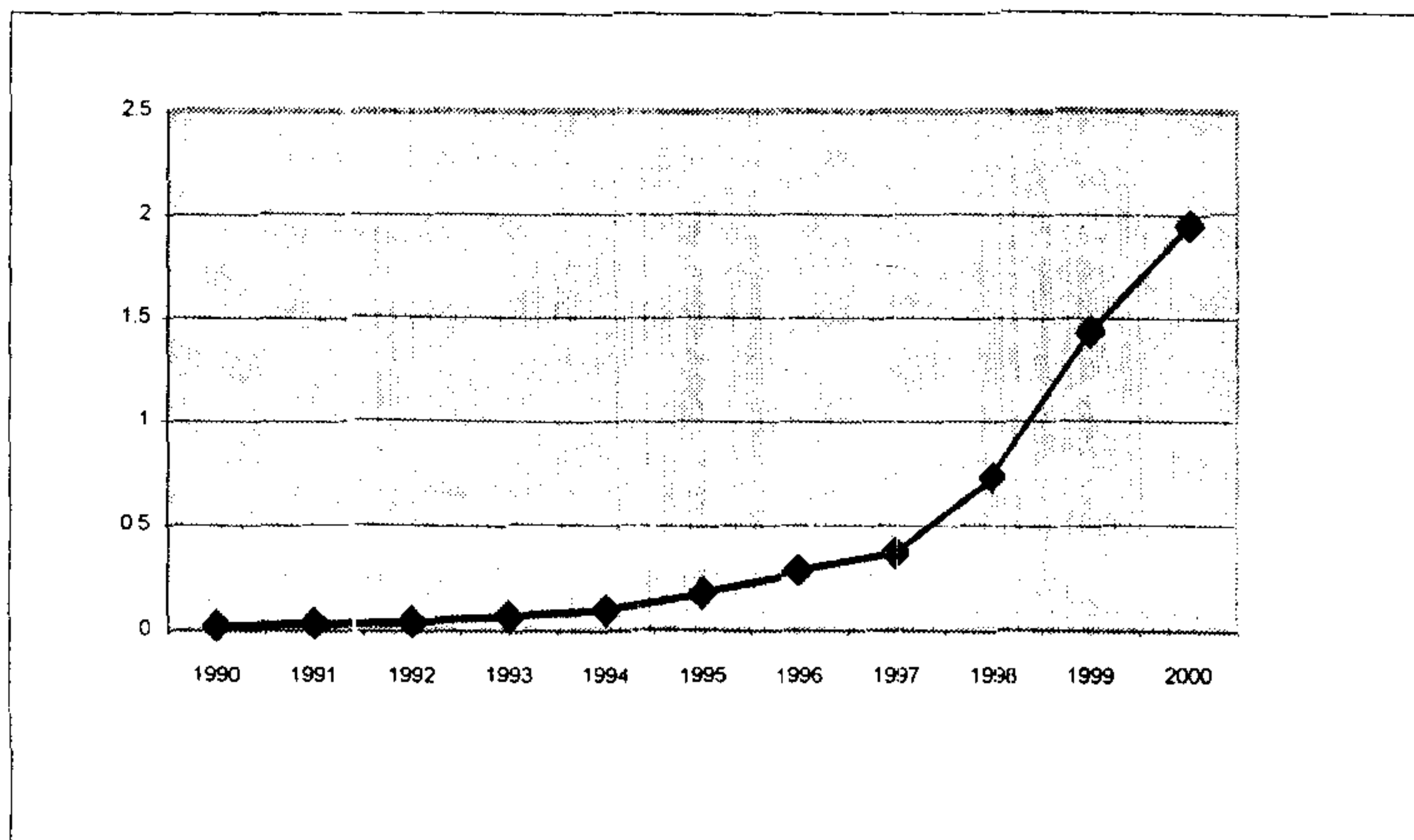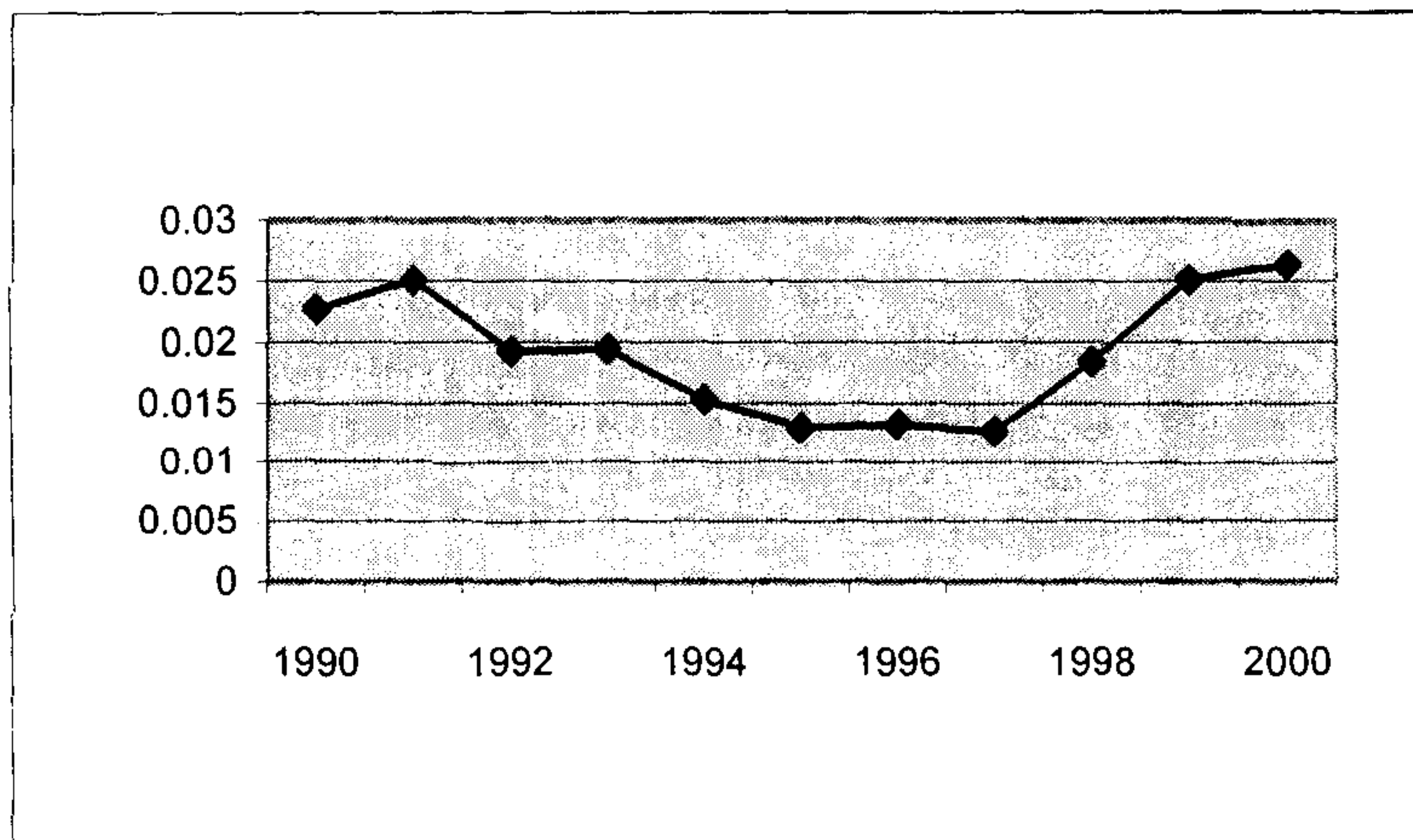**Figure 1:Variances of per capita nominal demand deposits (1990-2000)**

Figure 2-Variances of per capita real demand deposits (1990-2000)

6- Conclusion

One of the most important hypotheses, which have been derived from neoclassical growth model, is convergence hypothesis. This hypothesis is called Beta-convergence and has been examined empirically after the outstanding work of Barro and Sala-i-Martin(1990).The conventional method to test this hypothesis is a regression of per capita GDP average growth rate over a time period on the log of initial per capita GDP. Unconditional or absolute Beta-convergence implies that regions with lower per capita GDP have higher growth rates of per capita GDP and will catch up to richer regions. Conditional Beta-convergence implies that regions have different steady states of per capita GDP, so after accounting for different structural parameters or initial conditions, regions with lower per capita GDP will have higher per capita growth rates of per capita GDP. Original empirical work by Barro and Sala-i-Martin showed absolute convergence for the US regions and also for homogenous regions of the EU. But other studies showed mixed empirical findings about convergence. Especially, most of studies have shown that a long period of convergence has ended after mid seventies, even for industrialized countries.

We have examined convergence for Iran's economy. Since there are no GDP data at regional level for Iran's economy, there has been no study about this issue. We have devised a method to test convergence when data on regional GDP are not available. This method is based on the endogenous money supply theory of real business cycles school, although it can be also based on the post-

Keynesian theory of endogenous money supply. According to this theory, changes in demand deposits are an endogenous response to changes in economic activity (which is measured by GDP). Therefore, convergence in per capita GDP implies a similar convergence in per capita demand deposits. Our empirical results provide some support for Beta-convergence because provinces with lower per capita demand deposits have higher growth rates of per capita demand deposits, but only when OLS is used. By using NLS there is no support for Beta-convergence. Also, there is no support for Sigma-convergence. In other words, there is no continuous downward trend in the variance of per capita demand deposits of Iran's provinces. Therefore, our results will not predict a decrease in regional inequality in Iran.

References

1- Andres J., Bosca J.E.(2000).Technological Differences and Convergence in the OECD, Spanish Economic Review 2,11-27.

2- Azzoni,. R.(2001).Economic Growth and Regional Income Inequality in Brazil, The Annals of Regional Science 35,133-152.

3- Barro R.J., Sala-I-Martin X.(1990).Economic Growth and Convergence across the United States, NBER Working Paper 3419.

4- Barro R.J., Sala-I-Martin X.(1991).Convergence across States and Regions, Brookings Papers on Economic Activity 1.

5- Barro R.J., Sala-I-Martin X.(1995).Economic Growth, The MIT Press.

6- Barro R.J., Sala-I-Martin X.(1997).Technological Diffusion, Convergence, and Growth, Journal of Economic Growth 2,1-27.

7- Cenral Bank of Islamic Republic of Iran, Price Indexes and Household Budget Survey (In Persian), Different Years (1990-2000).

8- Center of Iran Statistics, Statistical Yearbook (In Persian), Different Years (1986-2000).

9- Central Bank of Islamic Republic of Iran, A Report on Socio-Economic Situations of Provinces, Internal Report (In Persian), Different Years (1990-2000).

10- Cuadrado-Roura,J.R. (2001). Regional Convergence in the European Union: From Hypothesis to the Actual Trends, The Annals of Regional Science 35,333-356.

11- Drennan, M.P. and J.Lobo (1999). A Simple Test for Convergence of Metropolitan Income in the United States, Journal of Urban Economics 46, 350-359.

12- Hossain, A.(2000).Convergence of Per Capita Output Levels across Regions of Bangladesh: 1982-97,IMF Working Paper WP/00/121.

13- Jian T.,Sachs J.D.,Warner A.M.(1996).Trends in Regional Inequality in China, NBER Working Paper Series, WP 5412.

14- Karras, G.(2001).Long-Run Economic Growth in Europe: Is it Endogenous or Neoclassical?, International Economic Journal 15(2),63-76.

15- King R.G., Plosser C.I.(1984).Money, Credit, and Prices in Real Business Cycle, The American Economic Review 74(3),363-380.

16- Lopez-Bazo E., Vaya E.,Mora A.J., Surinach J.(1999). Regional Economic Dynamics and Convergence in the European Union, The Annals of Regional Science 33, 343-370.

17- Lucas, R. E. Jr.(1988).On the Mechanics of Economic Development, Journal of Monetary Economics 22(1),3-42.

18- Mankiw N.G., Romer D., Weil D.N.(1992).A Contribution to the Empirics of Economic Growth, Quarterly Journal of Economics 107,407-437.

19- Nakamura, H.(2001).An Empirical Reexamination of the Solow Growth Model, Journal of the Japanese and International Economies 15,323-340.

20- Palley T.I.(1994).Competing Views of the Money Supply Process: Theory and Evidence, Metroeconomica 45(1),67-88

21- Petrakos G., Saratsis Y.(2000).Regional Inequalities in Greece, Papers in Regional Science 79,57-74.

22- Pontes, J.P.(2000).Sources of Convergence in the European Union: The Case of Portugal, Institutor Superior de Economia e Gestao, Rua Miguel Lupi, 20, 1249-078, Portugal.

23- Quah, D. (1993). Galton's Fallacy and Tests of the Convergence Hypothesis, Scandinavian Journal of Economics 95(4), 427-443.

24- Romer, P. M.(1986).Increasing Returns and Long-Run Growth, Journal of Political Economy 94(5),1002-1037.

25- Solow, R. M. (1956).A Contribution to the Theory of Economic Growth, Quarterly Journal of Economics 70(1),65-94.

26- Swaine, D.G. (1998).What do Cross-Sectional Growth Regressions Tell Us about Convergence? Federal Reserve Bank of Boston, Working Paper 98-4.

27- Terrasi, M.(1999).Convergence and Divergence across Italian Regions, The Annals of Regional Science 33,491-510.