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Estimation of Rural-Urban Migration in Iran (An Auto-Regressive Distributed Lag Approach)

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Rural inhabitants' perception of better life changes when observing the success of other people, and hope to emulate their success. They know that University degree can lead to a higher expected income. In fact urbanism has some benefits but the costs (pollution, congestion, and crime) are also pervasive in developing countries. In order to better understand the problem, and examine policy measures for controlling its negative externalities, it is of importance to study and analyze the factors which may affect migration. Therefore, in this study we investigated this important issue with emphasis on the effect of rural literacy level on rural-urban migration by using an Auto-Regressive Distributed Lag (ARDL) model utilizing time-series data related to the years 1959-2005 in Iran. Results indicate that in long term, rural literacy level has the most effect on this function. It was also found that, 1% increase in rural wage, urban wage, rural value added and rural literacy level can cause 0.25% decrease, 0.32% increase, 0.16% decrease and 0.32% increase in migrant's number, respectively.

Keywords: Migration, Urbanism, Auto-Regressive Distributed Lag, Iran.
JEL Classification: C_{22}, J_1, J_6.

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1. Introduction

Rural-urban migration can be initiated by voluntary forces or involuntary forces. Involuntary forces are assumed as those factors which may cause a forced migration. A so called forced migration that takes place when the migrant has no choice whether or not to move. Examples include political strife, serious family disagreements, and conflicts with neighbors, and major local disputes.

Voluntary movement covers all migrations by choice. There are many factors that cause voluntary rural-urban migration, such as better urban job opportunities; improved housing conditions; problems in rural land tenure, inheritance patterns, and dissatisfaction with rural social structure, can be named among other factors (Nelson, 1979).

Rural inhabitants' perception of a better life changes when observing the success of the people from their communities. Rural dwellers can then analyze how these people have achieved such positions, and hope to emulate their success. They know what it takes to achieve a more prosperous living condition they have been exposed to. They know that a high school education or a University degree can lead to a much higher expected income, thereby increasing their future wealth.

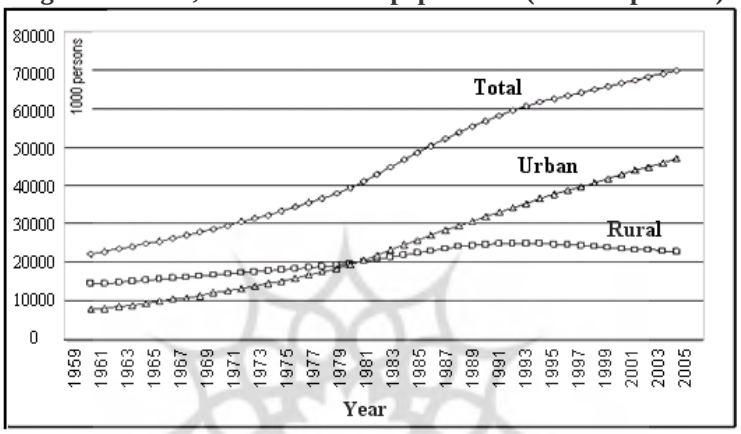
Also, empirical studies have documented that large proportions of migrants are young, skilled, and have relatively high levels of education. They migrate to urban areas because of the higher probability of finding employment, and at higher wages than in the rural areas (McCatty, 2004). Finally, the benefits and costs of urbanization indicate that although there are benefits that can arise from rural-urban migration, the costs are also pervasive in developing countries. This can be explained by putting excessive urbanization and the problems associated with it (pollution, congestion, and crime) in the context of negative externalities (Gilbert and Gugler, 1992).

Therefore, in order to better understand the problem, and consider policy measures for controlling some of the negative externalities of rural-urban migration, it is of a significant importance to study and analyze the migration function and factors affecting it. In this study we investigate these issues in Iran. We propose a migration function with emphasis on the role of literacy. Following demonstrates the statistical information about, urban and rural population: of Iran.

According to 2006 census data, the country's population was recorded at 70,049,262. Out of which about 68.4 percent were

inhabitants of urban areas, and the rest were living in rural communities. Although the rate of growth of population has shown some declining trend in recent years, but the rate itself is still considered rather high. The recent rate of growth of total population in Iran has been recorded at about 1.4 percent per annum. While the rate in developed countries, is in a range of less than one percent. (Figure 1.)

Figure 1. Rural, Urban & Total population. (At 1000 persons)



Source: FAO organization

The high rate of population growth and the expectation of active population growth, and it are potential problems in the future. This indicates the necessity of studying various dimensions of this issue, and planning for the control of its unpleasant results. The main rural activities are in agriculture sector and related industries. Therefore, rural migration can reduce the agriculture work force.

Figure 2 shows the dispersion of country's agriculture and non-agriculture active force:

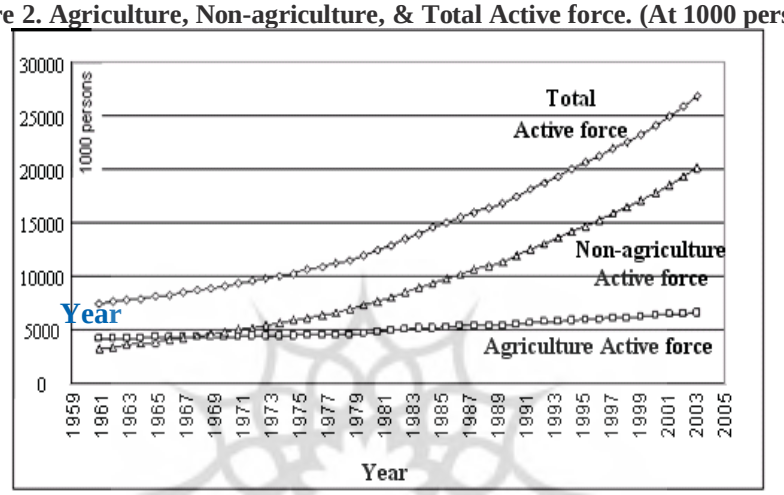
As figure 2 shows, we see a rapid growth in non-agricultural sector's active population and a slower growth in agricultural sector's active population during 1961-2005 periods.

2. Literature Review

McCatty (2004) investigated the process of Rural-Urban migration in some developing countries. He reported that in the period 1994-1997 Peru experienced an increase in economic growth and this growth benefited from more educated Peruvians relative to the less educated

ones, and this has led to an increase in income inequality as well. An increase in regional income inequality has a tremendous impact on migration decisions, influencing migrants to move to the areas with higher incomes. Also, he found that by deciding to increase spending on education, there was no evidence of an increasing spending on housing and job creation.

Figure 2. Agriculture, Non-agriculture, & Total Active force. (At 1000 persons)



Source: FAO organization

Studies indicate that Bolivia has also experienced the problems associated with excessive urbanization.

Goldsmith *et al*, (2003) started to survey the relationship between rural-urban migration and agricultural productivity in Senegal during the years 1961-1996. The survey results showed that there is a positive relationship between rural-urban migration and the per capita urban to rural income ratio. So that with an increase in the per capita urban income, or by a decrease in rural income, the number of migrants will increase. They also indicated that increase in the level of investment in agricultural section can have a restrictive effect on migration process, by reducing the ratio of urban-rural income. Then they estimated the migration function according to variables like ratio of urban-rural income, age structure and agriculture production in Senegal.

Migration function estimators for the ratio of urban-rural income and age structure were 0.64 and 6.8 respectively which show that there is positive relationship among the migration, their younger age and income level. The production function estimators also showed that

the agriculture sector's production has a positive elasticity for the quantity of fertilizer used per hectare and has a negative elasticity for other inputs.

Huang *et al*, (2002) began to study the rural population growth and the role of human capital, industrial structure and governmental policies during the years 1950 -1990 in United States of America. They stated that human capital causes an increase in rural income, but higher productivity of human capital in urban job market may cause some problems, such as reduction of human capital in rural region. It was also indicated that as a result of high rate of population growth in rural regions, population of agriculture sector grew more rapidly than other sectors, and human capital in cities increased. Therefore it was concluded that a higher income in agriculture sector can lead to a reduction in non-agricultural population growth rate, and vice versa.

Mills and Hazarika (2001) began to survey the factors affecting of migration among youths form rural region and towns to big cities in USA. The results of this study showed that the expected income is one of the important factors in youth's decision to migrate to big cities. They found that migration trend is sensitive to migration costs and also has a relationship with social culture, family's level of literacy and family dimension.

Mehrgan and Sadeghi (2000) studied the source of economic growth in agriculture sector of Iran. The results indicated that some problems in the agriculture sector's productive system like management deficiency and unsuitability of exploitation system; causes the agriculture sector's economic growth rate to slow down. It was also indicated that the vast migration of work force, especially young workers, which continued from the years 1971 to 1976, was one of the effective factors on reduction of agricultural sector's value added and declining growth rate during those years.

Sadeghi (2000) studied the comparative advantage of agriculture in terms of its employment capacity relative to the other sectors, and suggested that with paying due attention to the high share of employment in agriculture and the comparative advantage of agriculture in 18 provinces of the country, the agriculture section should become the axis for economic development in these provinces. Where, in addition to preventing rural migration, this can help increase the national per capita income by increasing agricultural productions and export.

Chizari and Khaledy (2000) studied the role of effective factors in income distribution indexes in rural regions of Iran during the years1971-1996. The results indicated that the population growth rate and the actual per capita income in rural regions during the studied period have a positive and significant correlation with rural Gini coefficient. It was also found that no significant correlation could be established between the proxy variables for the occurrence of revolution and war, and the rate of growth of agriculture, and Gini index in rural sector of the economy.

It was also indicated that the variables representing the Tax Revenue and the proxy variable for war had a positive relationship with income disparity, as indicated by an increase in the ratio of income in richest and poorest groups in society. Where, government current spending has had no significant effect in controlling this gap. There was also an indication that public subsidy and tax exemption policy have had a rather significant role in widening the gap between urban and rural consumption expenditures.

Shi (1999) studied the effects of labor out-migration on income growth and inequality in rural china. The results of his study indicate that rural migration makes a contribution to the growth of rural income, not only by raising labor productively by migrant workers but also by permitting more efficient allocation of the remaining, non-migrating workers. Also, he concludes that rural migration at least does not cause deterioration in income distribution, and might improve it. His simulation analysis also indicates that the distribution of rural household income in 1995 was more equal than it would have been in the absence of rural out-migration. However, at the provincial level, he found some evidence that rich and poor provinces experience quite different effects of rural migration on income inequality, while in relatively backward Sichuan; it appears to increase income inequality, mainly due (we suspect) to the lack of mobility of workers in very low-income households.

Findings from most rural-urban migration studies, prove this fact that migration is similar to a two-edged blade, that in case of moving in the correct direction, it can cause improvement in social condition and in case of moving in the wrong direction, it may lead to unpleasant results. Therefore, in this study we investigate the Iranian rural- urban migration function with emphasis of the effect of literacy on it.

3. Methodology

Whereas, statistical sources related to the number of rural migrants is not currently available, for counting the number of migrants, there are some indirect methods of estimation used. The following method is one of the methods for indirect estimation of the rural migrant's number (Goldsmith *et al*, 2003):

(1) $$M_t = P_{U_t} - (1+g) \times P_{U_{t-1}}$$

Variables of equation (1), are as follow:

M_t**:** The number of rural migrants in the year *t.*

P_{Ut}**:** The urban population in the year *t.*

P_{Ut-1}**:** The urban population in the year *(t-1).*

g :The natural growth rate of country's population in the year *t.*

The above equation assumes that the number of migrants in each year is equal to the yearly increase of urban population minus urban population increase with natural growth rate of society.

For surveying the economic effects of migration, a migration model was designed including the effective factors on migration. The introduced theoretical model is as follow:

(2) $$M_t = f(W_{Rt}, W_{Ut}, Y_{Rt}, Y_{Ut}, E_t)$$

In above equation, variables M_t, W_{Rt}, W_{Ut}, Y_{Rt}, Y_{Ut} and E_t are the number of migrants, rural wages, urban wages, value added of rural, value added of urban and the percent of literate rural older than 6 years in the year *t*, respectively.

The number of migrants in each year is measured in thousand people, urban and rural wages are at million Rials in each year, agriculture and urban value added is at million Rials and the rural literacy level is at percent. The rural (or urban) value added can be calculated as follow:

(3) $$Y_{Rt\ or\ Ut} = \Sigma \alpha_{it} Y_{it} \quad , \quad i = Agriculture, Industry, Services$$

Which, $Y_{Rt\ or\ Ut}$ is rural (or urban) value added, α_{it} is portion of rural (or urban) population in employment of each economic section (Agriculture, Industry and Services), and Y_{it} is value added of each

economic sector. The rural and urban wages are approximated by the average productivity of family labor force and per capita urban output, respectively and can defined as the ratio of rural/urban value added to the total rural/urban employment:

$$W_{Rt} = \frac{Y_{Rt}}{EM_{Rt}} \qquad and \qquad W_{Ut} = \frac{Y_{Ut}}{EM_{Ut}} \tag{4 \& 5}$$

Which, in above relations, the Y_{Rt}, Y_{Ut}, EM_{Rt} and EM_{Ut} are rural value added, urban value added, rural and urban employment, respectively. It should also be noted that, in order to yield a better explanation for the findings of the model, a logarithmic form of the model is usually used (Schultz, 1977). The logarithmic form of equation 2 is as follow:

$$\begin{aligned} LnM_t = \alpha_0 + \alpha_{WR} \quad & LnW_{Rt} + \alpha_{WU}\, LnW_{Ut} \\ & + \alpha_{YR} LnY_{Rt} + \alpha_{YU} LnY_{Ut} + \alpha_E LnE_t \end{aligned} \tag{6}$$

Which in the above model α_0 is intercept and α_{WR}, α_{WU} , α_{YR} , α_{YU} and α_E are elasticity of migration at rural payment, urban payment, rural value added, urban value added and literacy, respectively.

In order to study the long-term and short-term relationship between depended and independent variables of model, the cumulative methods like Engel-Granger and Error correction (ECM) models are used. But because of the existence of limits in the application of the Engel-Granger and ECM models, and also in order to avoid the deficiencies in these models, like existing bias in small samples and inability in testing statistical hypotheses, more suitable methods are suggested to analyze the long-term and short-term relationships between variables, which in this regard we can point to ARDL method (H. M. Pesaran & B. Pesaran, 1977).

In this method, equality of the variables' cumulative degree is not essential, while in Engel-Granger method, it is necessary (yusefi, 2000). The other ARDL advantages are the possibility of estimation of the long-term and short-term patterns simultaneously, and alleviation of such problems as elimination of variables and autocorrelation.

According to this, the estimators in this method are efficient and unbiased because of alleviating some of the problems like

autocorrelation and inter-production (Sidiki, 2000). Considering these advantages, the ARDL method is used in this study. Augmented ARDL model is shown as follow:

$$\alpha(L,P)y_t = \alpha_0 + \sum_{i=1}^{k}\beta_i(L,q_i)x_{it} + u_t \quad ; \quad i = 1,2,\ldots,k \tag{7}$$

Which, in above relation, α_0, y_t, L, P and q are intercept, dependent variable, lag factor, lag number of dependent and independent variable, respectively. And L is explained as follow:

$$L^j y_t = y_{t-j} \tag{8}$$

Therefore:

$$\alpha(L,P) = 1 - \alpha_1 L^1 - \ldots - \alpha_p L^p \tag{9}$$

$$\beta_i(L,q_i) = \beta_{i0} + \beta_{i1}L + \beta_{i2}L^2 + \ldots + (\beta_{iqi}L_i^q) \tag{10}$$

Therefore the dynamic ARDL model for migration function will be in this form:

$$\begin{aligned}\ln M_t = {} & \alpha_0 + \sum_{i=1}^{m}\beta_i \ln M_{t-1} + \sum_{i=1}^{n}\gamma_i \ln WR_{t-1} + \sum_{i=1}^{o}\lambda_i \ln WU_{t-1} \\ & + \sum_{i=1}^{p}\omega_i \ln YR_{t-1} + \sum_{i=1}^{q}\sigma_i \ln YU_{t-1} + \sum_{i=1}^{r}\tau_i \ln E_{t-1} \\ & + \gamma_0 \ln WR_t + \lambda_0 \ln WU_t + \omega_0 \ln YR_t + \sigma_0 \ln YU_t \\ & + \tau_0 \ln E_t + u_{it}\end{aligned} \tag{11}$$

In the above relation *m, n, o, p, q* and *r* are the numbers of best lags for the variables lnM_t, $lnWR_t$, $lnWU_t$, $lnYR_t$, $lnYU_t$, and lnE_t respectively.

For estimating long-term relation the following two-step method can be used: In the first step the existence of long-term relationship between considered variables will be tested. In this relationship if the total estimated coefficient related to the dependent variable lags, are smaller than one, the dynamic pattern will tend towards the level of its

long-term balance. Therefore, it is essential to perform the following hypothesis testing for the co-integration test. (Noferesti, 1999):

$$H_0 : \sum_{i=1}^{m} \beta_i - 1 \geq 0$$
$$H_1 : \sum_{i=1}^{m} \beta_i - 1 < 0 \quad (12)$$

The quantity of *t* statistic for this test is estimated as follow:

$$t = \frac{\sum_{i=1}^{m} \hat{\beta}_i - 1}{\sum_{i=1}^{m} S\hat{\beta}_i} \quad (13)$$

By comparing calculated *t* statistic with offered critical quantity by Banejee, Dolado and Mastre in the considered significance level, we can test the existence or non-existence of long-term balanced relationship among variables of the pattern. If the existence of long-term relationship between variables of the model is established, in the second step the estimation and analysis of long-term coefficients and drawing a conclusion about their amounts will be performed. There will be following relations for variables of model in long-term:

$$M_t = M_{t-1} = \ldots = M_{t-m}$$
$$WA_t = WR_{t-1} = \ldots = WR_{t-n}$$
$$WU_t = WU_{t-1} = \ldots = WU_{t-n}$$
$$YR_t = YR_{t-1} = \ldots = YR_{t-p}$$
$$YU_t = YU_{t-1} = \ldots = YU_{t-q}$$
$$E_t = E_{t-1} = \ldots = E_{t-r} \quad (14 \text{ to } 19)$$

Therefore the long-term relations can be presented as follow:

$$\ln M_t = \delta_0 + \delta_{WR} \ln WR_t + \delta_{WU} \ln WU_t + \delta_{YR} \ln YR_t + \delta_{YU} \ln YU_t + \delta_E \ln E_t + u_{2t} \quad (20)$$

The existence of co-integration among the economic variables of the model provides the application basis of error correction models (Noferesti, 1999). The ARDL error correction equation can be written like this:

$$\begin{aligned}\Delta \ln M_t = {} & \Delta\alpha_0 + \sum_{i=1}^{m} \hat{\beta}_i \Delta \ln M_{t-i} + \sum_{i=1}^{n} \hat{\gamma}_i \Delta \ln WR_{t-i} \\ & + \sum_{i=1}^{o} \hat{\lambda}_i \Delta \ln WU_{t-i} + \sum_{i=1}^{p} \hat{\omega}_i \Delta \ln YR_{t-i} \\ & + \sum_{i=1}^{q} \hat{\sigma}_i \Delta \ln YU_{t-i} + \sum_{i=1}^{r} \hat{\tau}_t \Delta \ln E_{t-i} + \theta ECT_{t-1} + u_{3t}\end{aligned} \tag{21}$$

In error correction term ECT_{t-1} is as follow:

$$\begin{aligned}ECT_{t-1} = {} & \ln M_t - \hat{\alpha}_0 - \hat{\beta}_1 \ln WR_t - \hat{\gamma}_1 \ln WU_t - \hat{\lambda}_1 \ln YR_t \\ & - \hat{\omega}_1 \ln YU_t - \hat{\sigma}_1 \ln E_t\end{aligned} \tag{22}$$

That in above relations, Δ is the first order difference factor and $\hat{\beta}_i$, $\hat{\gamma}_i$, $\hat{\lambda}_i$, $\hat{\omega}_i$, $\hat{\sigma}_i$ and $\hat{\tau}_i$ are respectively the estimated coefficients from equation 7. Also, θ is the coefficient of error correction term that measures the equilibrium rate. This study was conducted during the period March to November 2010 in Mashhad-Iran.

4. Results and discussion

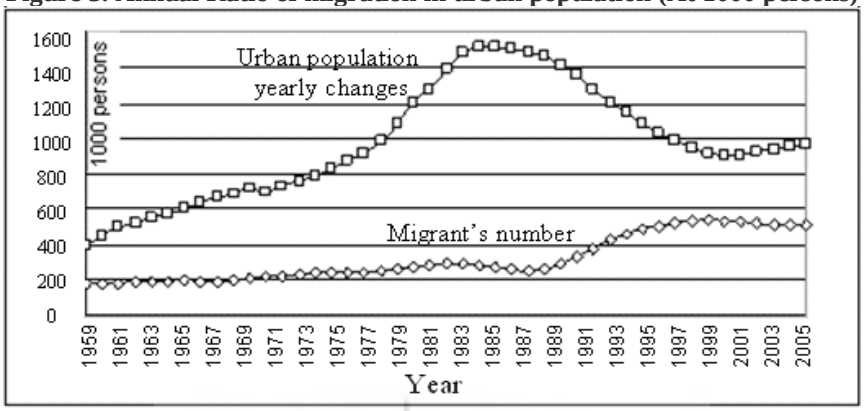
After estimating the number of migrants by the using the equation (1), and specifying the migration model, the estimation of model according to ARDL is performed. The results indicating the number of migrants during the years 1959-2005 are showed in figure 3.

The figure (3) shows that, during the studied period migration has generally increased and only during the periods 1983-1989 and 1999-2005 a decrease has been recorded. Also, this fig shows that the ratio of migration in urban population has been higher during the recent years. The highest levels of increase in urban population observed, was in the early 1980s, mainly because of the unusual growth rate of country's population in these years.

The results of estimating the dynamic migration model which was presented in the form of relation by using of Schwartz-Bayesian

criterion and considering the maximum lag of 2., is presented in table 1.

Figure 3. Annual Ratio of migration in urban population (At 1000 persons)



Source: Research Findings

By using the coefficients of ARDL dynamic model, which is presented in table (1), the existence of a long-term relationship between the variables was tested. For that, with attention to relation 13, since the calculated *t* statistic is equal to 3.77 and the critical quantity suggested by Banerjee, Dolado and Mastre in 10% significance level is equal to -3.66, therefore we can't reject the existence of long-term relationship among the variables of model. The results of estimation of the long-term relationship for migration model are presented in table2.

Table 1. Results of estimated dynamic ARDL (2,0,1,0,1,0)

Repressor	Coefficient	Standard Error	T -Ratio
Log M(-1)	1.35	0.06	22.50
Log M(-2)	0.14	0.07	2.00
Log WR	-0.27	0.06	-4.50
Log WU	0.30	0.08	3.75
Log WU(-1)	0.32	0.07	4.57
Log YR	-0.20	0.07	-2.86
Log YU	0.12	0.07	1.71
Log YU(-1)	0.13	0.07	1.86
Log E	0.34	0.07	4.86
F=4318(0.00) , R^2=0.99			

Source: Research Findings

According to the obtained results from table2, in long-term, all variables except urban value added have significant effect on migration. Also, 1% increase in rural wage, urban wage, rural value added and rural literacy can cause 0.25% decrease, 0.32% increase, 0.16% decrease and 0.32% increase in migrant's number, respectively.

Table 2. Estimated Long-Term Coefficients

Repressor	Coefficient	Standard Error	T -Ratio
Log WR	-0.25	0.07	-3.57
Log WU	0.32	0.06	5.33
Log YR	-0.16	0.07	-2.29
Log YU	0.10	0.06	1.67
Log E	0.32	0.07	4.57

Source: Research Findings

Also, the error correction model that makes the short-term fluctuations related to their long-term amounts for migration equation is presented in table3:

Table 3. Error Correction Results

Repressor	Coefficient	Standard Error	T -Ratio
dLog M	0.81	0.06	13.50
dLogWR	-0.27	0.06	-4.50
dLogWU	0.30	0.08	3.75
dLogYR	-0.20	0.07	-2.86
dLogYU	0.12	0.07	1.71
dLog E	0.34	0.07	4.86
Ecm (-1)	-0.24	0.05	-4.80
F=60.19(0.00) , R^2=0.97			

Source: Research Findings

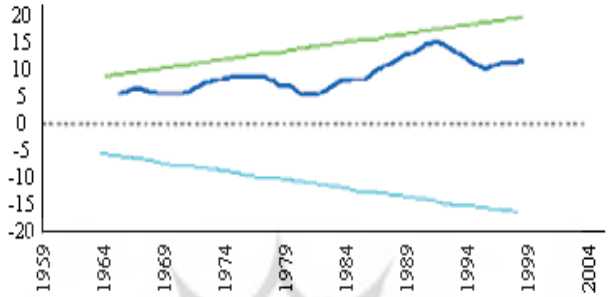
As it is indicated in table 3, in short-term, there is a positive relationship between urban wage and the literacy ratio with migration. The results show that the error correction term coefficient ECT_{t-1}, which is estimated according to equation 10, is significant and its sign is negative, as expected. This coefficient is equal to -0.24, which states that 24% of dependent variable (number of migrants in each year) inequality will be adjusted after one period.

The stability of estimated coefficients during the studied period was tested by Cumulative sum of recursive residuals (Cusum) and

Cumulative sum square of recursive residuals (Cusum Square). The results of these tests were showed in figures 4 and 5.

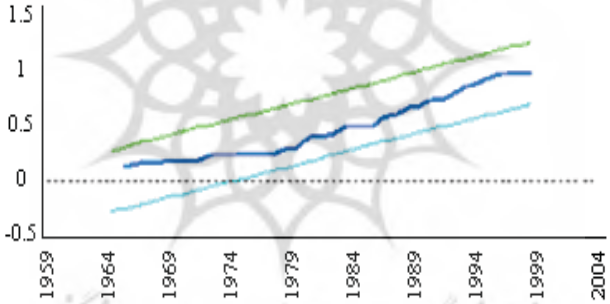
In above figures the straight lines represent critical bounds at 5% significance level. Therefore according to these graphs, the estimated coefficients of model are stable.

Figure 4. Plot of Cusum



Source: Research Findings

Figure 5. Plot of Cusum Square



Source: Research Findings

5. Summary

Rural inhabitants know that a high school education or a University degree can lead to a much higher expected income, thereby decide to migrate to cities. The benefits and costs of urbanization indicate that although there are benefits that can arise from migration, the costs are pervasive in developing countries. This can be explained by the problems associated with it (pollution, congestion, and crime) in the context of negative externalities. Therefore, in order to better understand the problem, and plan to alleviate the negative externalities of rural-urban migration, it is of significant importance to study the

migration function and its effective factors. In this study we investigated this issue with emphasis on the effect of rural literacy level on Iranian rural-urban migration function. We used an Auto-Regressive Distributed Lag (ARDL) model and utilized time series data related to the years 1959-2005. Results of estimated long-term coefficients indicated that in long term, rural literacy level has the most effect on Iranian rural-urban migration and all variables except urban value added have significant effect on migration as well. Also we found that a 1% increase in rural wage, urban wage, rural value added and rural literacy level can cause 0.25% decrease, 0.32% increase, 0.16% decrease and 0.32% increase in migrant's number, respectively. Findings of the error correction model analysis indicated that ECT_{t-1} coefficient is equal to -0.24, which states that 24% of dependent variable (number of migrants in each year) inequality will be adjusted after one period.

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