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Estimating and Analyzing Men's Labor Force Supply Function in Khuzestan

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Labor force as a factor of production has always been the concern of economists. The importance of analyzing labor market in Iran, due to having young and cheep labor coverage, is extremely necessary. Making use of statistics of participation rate, educational level as well as that of unemployment in Khuzestan during 1966-2003, we have tried to obtain men's supply function in this paper using Juhansen's approach to estimate the error correction model. Results of the study show that in low age groups, educational variables such as educational coverage and the ratio of college-graduates adequately explain labor force participation rate. Unemployment rate is another variable that is crucial in labor force supply. This variable and its lags are generally positive for low age groups.

1. Introduction

Labor market is an important market of economy. In production context, labor force is the most important factor of production and is used to a great extent to fulfill the shortages of all other factors of production. Nowadays, appreciating labor market as well as software-based management of human force for increasing production in developed countries are of great importance. A great deal of studies have been done on labor market most of which normally suggest unemployment investigations of population in Iran showing that in recent three decades,

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especially during 1946 - 1986, population has increased at a high rate. This is due to the enhancement of public health level, decrease in the rate of death, the traditional view of having a child as a labor force in agriculture and the encouraging policies for establishing large families in the initial years of post-revolution period. Of course, during the execution of the first and the second development plans, helpful policies concerning the decreas of population growth were adopted and are still being used.

According to the high surplus value, the amount and percentage of high population growth and high unemployment rate in Khuzestan, this paper is intended to estimate man's labor force supply function and analyze its influencing factors in Khuzestan. The method of this study, on the one hand, is causal which examines the relationships among the variables concerning men's labor force supply function in Khuzestan. On the other hand, this is an applied study whose outcomes can be used in government policies for the sake of improving the situation and influencing the leading factors of men's labor force in labor market of Khuzestan. The data used in this research are based on existing date of public census results and sample statistics of employment and unemployment. Annual time-series for the period 1966 - 2003 and new methods of econometrics including unit root test, co-integration and error correction model using Johanse approach for estimating men's labor force supply function and its influencing factors in the short run and its relation with the long run balance are used in this research.

This paper involves 13 sections. Section 2 examines briefly the population structure in Khuzestan. In section 3, there is a review of labor force supply. Section 4 is devoted to the theoretical principles of the research and section 5 to the background of the research. Introducing and estimating the model as well as testing for its validity are the subjects of sections 6 to 12. Finally, section 13 presents the summary and conclusion.

2. Population Structure in Khuzestan

According to the investigations, labor force supply in Khuzestan in the year 2003 was about 1,169,000 people and the estimated participation rate is 64.34 percent (Management and Planning Organization, 2003A, pp. 9-10).

In the sample census of Statistics Center of Iran, the population of Khuzestan in the year 2003 was 4,350,000 people. Population estimate shows that population of Khuzestan will approximately reach 4.6 million in 2006. The sex ratio of Khuzestan is 103; that is, there are 103 men for each 100 women. (Management and Planning Organization, 2003B, pp. 9-10).

If the age medium in the year 1996 is true for the recent period, half of the population of Khuzestan is below 17.4 year (Management and Planning Organization, 2003C, p. 3).

By adopting population control policies and instructing families to prevent unwanted fertilities, the rate of population growth has decreased noticeably. However, it is higher than the rate of population growth of the country, so an increase in unemployment rate in the future is expected.

3. Analyzing Men's Labor Force Supply in Khuzestan

During 1966 - 2003, the difference of men's and women's labor force supply[3] was very high. In 1966, the active population of women was 16,000 people that reached 170,000 in 2003 at annual average growth rate of 41,000 while in 1966 the active population of men was 382,000. This average growth rate of 194,000 increased to 1.1 million people in 2003. During all those periods, the ratio of women's labor supply to men's had been very low. The following table illustrates the participation rate of Khuzestan according to sex and separation of rural and urban districts.

Table 1: Participation Rate According to Sex and Regional Separation in 2003 (Percent)

Title	The whole province	Men	Women	Urban	Rural
Population rate	34.6	61.9	8.1	34.3	35.1

Source: From sample census of employment and unemployment of households in 2003

As shown, men's participation rate in the year 2003 was eight times that of women's. Besides, 34 percent of the population of ten-year-old ones

[3] The proportion of active male population to the total male population times one hundred.

and above in Khuzestan in 2003 was active and 66 percent was passive (Management and Planning Organization of Khuzestan, 2003, p. 10). During the period under discussion, the distribution of active population of Khuzestan differs according to rural and urban areas. In the year 1966, rural participation rate was about 43.4 percent while this rate was 35.6 percent in urban areas in the same year (Statistic Center of Iran,1966)

In 2003, participation rate for urban and rural areas was 34.3 and 35.1 perecent, respectively (Management and Planning Organization of Khuzestan, 2003, p. 10). The difference between women's and men's labor force supply during this period is noticeable. In the year 1966, women's participation rate was 3.2 percent which reached 8.1 percent in 2003. The corresponding rates for men in the year 1966 and 2003 were 9.57 and 61.9, respectively (Management and Planning Organization of Khuzestan, 2003 B).

As mentioned earlier, men's participation rate is eight times that of women's.

4. Theoretical Principles of Labor Force Supply

To obtain labor force supply, the individual's utility function should be maximized on the basis of budgetary and non-budgetary restrictions. Budgetary restrictions generally include income resulting from work and autonomous income, goods, household's time and production technique. Here, at first, a static model and then a dynamic one will be introduced:

4.1. Static Model

Well-behavior utility function is a static model which is;

$$U=U(x, H, A, \varepsilon) \tag{1}$$

where x is goods consumption and services, H is working hours, A is individual's specifications such as age and education, and ε is a function of individual abilities for house production or any other variable that is not visible and cannot be measured. In this function, MU_h, the marginal utility of working hours and MU_x, the marginal utility of goods are supposed negative and positive, respectively. The ratio of these two functions is defined as marginal rate of substitution of working hours. In this model, budgetary restrictions are considered as follows:

$$P_x = wh + y \tag{2}$$

where P is the index of goods price, w is the wage rate and y is the income that does not depend on work (autonomous income). If we satisfy the optimum condition then:

$$\frac{W}{p} = \frac{-MU_h}{MU_x} \tag{3}$$

This equation shows that the real wage $\frac{W}{p}$ is equal to marginal rate of substitution of working hours for goods. The form of reduced equations that is the goods supply function and working hours supply is obtained by solving equation 2 and equation 3 as follows:

$$X = x\,(p, w, y, A, e) \tag{4}$$

$$H = h\,(p, w, y, A, e) \tag{5}$$

This is a static model where behavior is defined during a period. Defining and estimating a dynamic model is an important progress, which has emerged since the recent two decades.

4.2. Dynamic Model

The model of life cycle is a dynamic one. In this model, decisions for goal and labor force supply in a definite period are based on price and wage in long life. *Similarly, budgetary restriction is presented as follows:*

$$Max\ \Sigma(1+\rho)\ -t\ U(x_t\ , H_t, A_t, e_t) \tag{6}$$
$$s.t.:\ \ k_0 + \Sigma(1+\rho)_t + (w_t h_t\ -\ p_t x_t) = 0 \tag{7}$$

where ρ is time- preference rate and k_0 is the initial wealth.
h_t and x_t are obtained in each period by maximizing utility function in proportion to restriction. Consequently, equations of supply for goods x_t and labor force supply h_t for men will be:

$$X_t = (\lambda_0 \theta_t p_t, \lambda_0 \theta_t w_0, ..., A_t, e_t) \tag{8}$$
$$H_t = h(\lambda_0 \theta_t p_t, \lambda_0 \theta_t w_0, ..., A_t, e_t) \tag{9}$$

where θ=(1+ρ)/(1+r) and r is the interest rate and λ is Lagrange's coefficient which Macurdy (1982) defined endogenously and inserted as an independent variable into the labor force supply function.

The experiential model of labor force supply according to the above consideration is presented as follows:

$$H_t = \alpha_0 + \alpha_1 (\frac{w}{p})_t + \alpha_2 (\frac{y}{p}) + \alpha_3 A_t + e_t \tag{10}$$

where $\frac{w}{p}$ is the income resulting form work, $\frac{y}{p}$ is real income not resulting from work (autonomous income) and A_t indicates all other visible variables that affect men's labor force supply.

In various studies on men's labor force supply, variables such as men's literacy level, men's working hours, the paid tax and the number of persons under man's guardianship are usually used instead of variable A.

5. Literature Review

Sprague (1988) in an essay examined woman's participation and fertility rate in England. In his essay, the model of women's participation rate is presented as follows:

$$Log \frac{L}{1-L} = a_0 + \sum a_{1j} LogWF_{ti} + \sum a_{2i} + LogWM_{ti} + \sum a_{3i} LogV_{ti} +$$
$$\sum a_{4i} R_{ti} + a_5 ED_t + a_6 STK_5 + a_7 STK_{10} + a_8 STK_{15} \tag{11}$$

where L indicates woman's participation rate, WF is women's real net income average based on hours, WM is men's real net income average, V the rate of unappointed posts, R the real interest rate, STK the number of children aging 1 to 5, STK 10 the number of children aging 6 to 10 and STK10 is the number of children aging 11 to 15.

The results revealed that with increasing men's income average, women's participation rate decreases while their fertility rate increases. However, increasing women's income average decreases their fertility rate and increases their participation rate. Women's participation rate is directly related to the number of unappointed posts and indirectly relates to the number of children at different ages (1 to 15). Education variable has two effects. The first is enhancing women's literacy level regarding time allocation for work and children. If women prefer more work to having children, they will enhance their literacy level and, as a result, their participation rate will increase. The second effect will appear as an enhancement of women's literacy level as increasing the efficiency of taking care of children as well as a decrease in expenditures of keeping children and also an increase in fertility.

Kottis (1984) analyzed women's participation rate in Greece. In his model, women's participation rate depends on men's unemployment rate, women's unemployment rate, the percentage of those employed in agriculture section, urbanization rate, rate of population growth, the percentage of women aging 10 and above who are illiterate, the ratio of women aging 10 and above to the total population, the percentage of women aging 10 and above who has no husband and the percentage of men aging to and above who are not involved in labor force population. The result demonstrated that women's participation rate is related directly to the portion growth of those employed in agriculture section, urbanization rate, rate of population growth, the ratio of women aging 10 and above to the total population, the percentage of illiterate women aging 10 and above, the percentage of single women aging 10 and above and the percentage of men aging 10 and above who are not involved in labor force population, while it is inversely related to the percentage of under-10- year- old population.

Clark and Anker (1990) examined old men and women's labor force participation rates internationally. In their article, labor force participation rate depends on the GDP *per capita*, urbanization rate, the ratio of men (or women) aging 65 and above to men (or women) aging 15 to 64 and the ratio of old women to old men minus one. The research, according to the replacement and income effects, shows that higher income per capita can lead to a decrease in old individuals' participation rate. Moreover, agriculture section provides more job opportunities for old individuals and in case of emigration from villages to cities, old individual's labor force participation rate decreases.

Brisco and Wilson (1992) exemined the state of labor force participation rates according to sex and different age groups in England. In this research, participation rate is defined logistically and depends on gross domestic production, unemployment rate and a vector of population variables. The conclusion revealed that women's participation rate is directly related to the gross domestic production whereas men's participation rate varies according to gross domestic production. Unemployment rate in all models is negative and indicates lack of encouragement effect. The sign of coefficient of real wage varies in different models.

Tanda (1994) analyzed the influencing factors of women's participation rate. In his research, he studied women's labor force participation rate as well as fertility rate in 19 E.U. member countries rate, in this research, is also defined logistically and depends on the ratio of women's hourly wage to men's, woman's unemployment rate, men's unemployment rate, secondary education rate, higher education rate, marriage rate, the ratio of the population of 4-year-old and below to the total population, the medium of pre-divorce marriage period and divorce rate. The conclusion of this research indicates that women's participation rate is inversely related to women's wage, unemployment rate, the ratio of urban population to the whole population, marriage rate, and pre-divorce marriage period, which is directly related to all other variables.

Leoni (1994) by examining labor force supply in Italy analyzed and tested labor force supply from Keysians and neo-classics viewpoint. Labor force supply, in this research, is investigated with regard to labor force participation rate (not the supplied working hours). According to neo-classic theory, participation rate depends on unemployment rate, net migration stream, fertility rate, real wage and real income not resulting from work. Leoni proved that the coefficient of the variable of unemployment rate is positive in some functions and negative in some others. However, participation rate relates directly to the rest variables in Keynsisns theory, and depends on nominal wage, nominal income not resulting from work and the index of consumer's price. The result demonstrated that the coefficients of the variables of unemployment rate and the index of consumer's price are negative whereas all of the other variables are positive. Testing these models suggests that labor force participation rate reacts well according to both groups of coefficients, so one model cannot be preferred over the other.

Elhorst (1996) exemined men's and women's participation rate in 12 E.U. member countries. Participation rate, according to this definition, depends on unemployment rate, the percentage of under- 25 years- old population, the percentage of the population of 25 to 44 years old, employment portion of service department, average wage, and educational enhancement of the population in working years. The result revealed that participation rate is inversely related to the unemployment rate and is directly related to the variables. Elhorst believed that this model agrees with Keynsisns theory.

Zarra Nezhad (1998) analyzed women's labor force supply in Iran during 1956-1996. The results demonstrate that women's participation rate, except for the year 1956, was very low in comparison to that of men, and that there has been no appropriate emphasis regarding the importance of women's participation in economic activities in order to provide the appropriate motivation and conditions for women's employment.

Farjadi and Falihi (1998) estimated women's and men's labor force supply model using econometric method for the first time in Iran and labor force supply until the end of the Iranian Third Development Plan. In these models, labor force participation rate depends on education covarge, unemployment rate, real wage, social security expenditures per capita, inflation rate, the percentage of college- gradates, the portion of these employment in different economic section and the GDP *per capita*.

Falihi (2000) believes that labor force supply function, which is based on separation of sex and age groups, depends on education coverage, value of added agriculture sector, the number of college- graduates, inflation rate, the index of wage, unemployment rate and social security expenditures *per capita*. In this essay, in addition to recognizing the leading factors of supply and demand of rural labor force, there is a comparative analysis of rural and urban labor markets.

6. Introducing the Variables

Since the influencing factors of labor force are different according to sex and age groups, in this article men's labor force supply is dealt with on he basis of different age groups. Labor force participation rates are also used in this paper because there is no exact information about individuals' supplied hours in market.

Many factors influence women's labor force participation rate, of which the most important ones are used in this research. The GDP rate is one of the most fundamental variables in labor force participation rate model. The coefficient of this variable may be positive or negative according to different age groups and separation of men and women. Brisco and Wilson (1992) believed, on one hand, that the GDP, on the one hand, indicates the effect of autonomous income on participation rate and is expected to be related to participation rate inversely. ; and on the other hand, it explains the effect of economic and social transformations on participation rate, so it has no definite sign. Kottis (1990) believes that the effect of GDP on participation rate appears as U. Such an effect is expected for any developing country that establishes a quick modification on its industrial basis.

Real wage is another chief variable affecting participation rate. The effects of real wage on participation rate can be negative or positive, since the changes of wage have two substitution and income effects, the result of which determines the coefficient of wage.

Another key variable that is often used in experiential studies on labor force participation rate is unemployment rate. Unemployment has two different effects as lack of worker encouragement and extra worker. According to the first effect, unemployment rate lessens the probability of job opportunities for individuals, and as a result, participation rate decreases. The second effect appears as more members of a household become unemployed, in which case labor force participation rate increases to fulfill the least necessaries. Therefore, in this case, extra worker effect dominates lack of worker encouragement effect.

Educational coverage is another essential variable which affects labor force participation rate. In young age groups, a huge part of potentially active population usually leaves labor market to pursue their education. Therefore, it is expected that with increasing educational coverage in an age group, its participation rate decreases.

7. Men's Labor Force Supply in 10-14 Age Group

MM1014 variable is men's labor force in 10-14 group as a dependent variable, *PCML* is men's educational coverage log in 10-14 age group, WL is real wage rate log and *UMAL* is unemployment rate log of men as independent variables. In addition to these variables, variables *DU53* (oil shock in year 1974) and *DU57* (Islamic Revolution Shock in year 1978) are used as dummy variables.

7.1. Testing for the Non-Stationary of the Variables

Before we analyze the data sets using econometric methods, the first step is to investigate whether the data are stationary or not. The estimated results have no meaning if we use non-stationary time series data. It is so-called the problem of a spurious regression. To test for the stationarity, this study uses the methodology of an *ADF* test (Dickey and Fuller, 1979; Said and Dickey, 1984) with four lags. According to the ADF tests[4], the variables have unit roots because the absolute value of t statistic in each variable is less than that of critical values. So, we cannot reject the null hypothesis for testing a unit root at the MacKinnon's (1991) critical values of 1-10 *per cent* levels.

Table 2: Rsults of Stability Test of Variables

Variable	ADF statistics	Result
DMM2024	-3.067	Stationary
DMM2554	-8.0125	Stationary
DMM5564	-10.011	Stationary
DMM64	-2.947	Stationary
DUMOL	-2.735	Stationary
DUMAL	5.362	Stationary
DPCML	-1.870	Stationary
DACML	-7.811	Stationary
DPGML	-3.666	Stationary
DCGDPML	-3.451	Stationary
DWL	-4.257	Stationary

Source: From *ADF* tables obtained via Eviews

Due to the non-stationary data, we have to change the form of data differently. In Table 2, the variables are stationary because the absolute

[4] To avoid prolixity, we did not include here the related tables.

value of each t statistic is greater than that of the critical values. Therefore, we can see that the transformed data are stationary after appropriately changing the data.

Since all the variables are integrated of order one, there may exist a long run equation if the residuals of this equation estimated by *OLS* are integrated of order zero. The Johansen approach for testing co-integration has been applied in order to investigate the existence of such co-integration.

7.2. Testing Contegaration (the Johansen Approach)

Using Microfit, the correct *VAR* order is $k = 4$, according to *AIC* and *SBC* criteria. The following table presents the related models along with lag lengths according to Johansen test based on the λ_{trace} *LR* statistic.

Table 3: Co-integrating Vectors

Models					Lag length
V	IV	III	II	I	
3	3	2	2	1	4
2	2	2	2	1	3
2	3	2	3	2	2
1	2	2	2	3	1

Sours: From trace tables obtained via Microfit

Now it is necessary to examine these models by the following criteria:

1. Being consistant with theories.
2. The error term has normal distribution.
3. There exists no auto-corrolation.
4. There exists no heteroscedasticity.

Taking into account only the vectors which are consistant with theories, on the basis of the critical values for the 5 percent significant level, we see that the hypothesized cointegration equations are at most two, and the time series have no intercept and trends, nor does the cointegration equation. Table 4 shows this result.

Table 4: Testing Concistant Vectors

Tests	Model I	
	Vector 1	Vector2
LM [F (2, 23)]	0.39(0.702)	0.235(0.792)
ARCH [F (2, 23)]	3.066(0.267)	1.470(0.052)
Normality	Yes	No

As can be seen, the first vector of the first model is accepted.

7.3. Specifying the Model

Considering that the optimum co-integration vector is among the variables of the model, labor force supply function of men aging 10 to 14 is specified as follows:

$$MM1014 = \alpha_1 PCML + \alpha_2 UMOL + \alpha_3 WL + U \tag{12}$$

where α_2, α_3 and α_3 are fixed variables and U is the disturbance term of the model.

The equation above is estimated by Microfit using *OLS* method:

$$MM1014 = -14.5136\ PCML + 22.5392\ UMAL + 6.3658WL \tag{13}$$

$$(-\ 2.16) \qquad (3.07) \qquad (3.12)$$

$R^2 = 0.98$ $\quad DW = 2.07$ $\quad$ F=121.14(0.000)

Having found the long run equation, the *ECM* model is estimated. To obtain this model, the long run regression residual with one lag should be inserted into the model as an independent variable (that is *ECT*(–1)) in addition to all other independent variables.

To define *ECM* model, we insert all the independent variables with the most possible length of lag (here is 4) as well as lags of dependent variables and variable *ECT*(–1) into the model. Then, using *OLS* method, we estimate the model. According to t-statistic, the insignificant lags are left out of the model.

$$DMM1014 = -13.70DPCML + 3.92DUMAL + 0.151DWL - 1.039C$$
$$(-\ 2.4) \qquad (3.51) \qquad (1.87) \qquad (-\ 8.22)$$
$$+\ 0.02986T - 0.16348ECM(-1)$$
$$(10.42) \qquad (-2.59)$$
$$R^2 = 0.979 \qquad DW = 2.13 \qquad F = 205.75(0.00) \qquad (14)$$

According to t-statistic (the number in the parenthesis), all the parameters are significant, and R^2, which is very high, denotes the highly comprehensive power of the model. F-statistic is also very high and suggests the significance of the model.

7.4. Testing for the Validity of the Model

To test the validity of the model, we use LM test to distinguish autocorrelation of disturbance terms, ARCH test to distinguish Homoscedsitcity variance of the terms, and Normality test to distinguish the problems of lack of distribution of disturbance terms. Results of the mentioned tests are briefly presented in the following table.

Table 5: Results of Different Tests for Validity of the Model

Test	F(prob)	χ^2 (prob)	Result
LM	1.4104(0.267)	3.4611(0.177)	No autocorrelation
ARCH	0.88029(0.430)	2.2654(0.322)	No hetroscedasticity
Normality	−	0.21077(0.900)	Normal

Source: From test table of LM, ARCH and Normality tests via Eviews

As shown, the assumption of existence of autocorrelation of disturbance terms is violated, so is the assumption of existence of homoscedasity variance. Besides, disturbance terms have normal distribution.

8. Introducing, Testing and Estimating Men's Labor Force Supply Function in 15 to 19 Age Group

8.1. Introducing the Variable

Variables used in this model are: MM1519: men's labor participation rate in 15 to 19 age group as a dependent variable, PCML: men's educational coverage log in 15 to 19 age group -an independent variable, UMALL: men's unemployment rate as an independent variable as well as variables DU53 and DU57 with the same definitions as for men's supply in 10 to 14 age group.

As table 2 shows all these variables are I(1); that is, first rank difference of these variables is I(0). Therefore, since all the variables are cointegrated, there may exist long term equation.

8.2. Estimating the Model

In this case, similar to the process of testing cointeration based on Johansen approach, the correct VAR order has been determined according to AIC and SBC criteria. Then the appropriate model based on trace LR statistic hase been chosen.

The long run equation of men's labor supply in 15 to 19 age group is estimated by Microfit using OLS method:

$$MM1519 = -40.068PCML + 3.5177UMALL \qquad (15)$$
$$(-5.17) \qquad (4.71)$$
$$R^2 = 0.91 \quad DW = 1.97 \quad F = 531.10\ (0.000)$$

According to this equation, we can deduce that in 15 to 19 age group the extra worker effect dominates lack of worker encouragement effect, since the coefficient of the variable of men's unemployment rate (UMALL) is positive. We can also observe that one percent increase of educational coverage decreases the participation rate of this age group to 40 percent in the long run.

To determine the ECM model, labor force supply is estimated on all independent variables with the most possible length of lag (here is 6) as well as lags of independent variables and variable ECT(–1) using OLS method. According to t-statistic, all insignificant lags are omitted. Consequently, the ECM model is estimated as follows:

$$DMM1519 = -1.77DMM1519(-1) - 2.10DMM1519(-2)$$
$$(-7.41) \qquad (-5.58)$$
$$-1032.7DPCML(-2) - 898.18DPCM(-3) + 264.72DUMALL(-2)$$
$$(-2.66) \qquad (-5.19) \qquad (2.64)$$
$$+235.030UMALL(-3) + 4.74Du53 - 48.19DU57 - 0.12ECT(-1)$$
$$(4.61) \qquad (3.42) \qquad (-4.72) \qquad (-4.14)$$
$$R^2 = 0.766 \quad DW = 2.59 \quad F = 7.365(0.000) \qquad (16)$$

As shown above, all coefficients are significant and have the expected signs. Moreover, all coefficients are confirmed by F-statistic.

8.3. Testing for Validity of the Model

To test the validity of the model, ARCH and LM tests as well as χ^2 distribution of disturbance terms are used. The results are presented in the following table:

Table 6: Results of Different Tests for the Validity of the Model

Test	F(prob)	(prob) χ^2	Result
LM	2.3950(0.123)	6.2208(0.450)	No autocorrelation
ARCH	0.81742(0.495)	2.5030(0.286)	No hetroscedasticity
Normality	–	2.2802(0.202)	Normal

Source: From tables of LM, ARCH and Normality tests obtained via Eviews

As shown, the assumption of existence of autocorrelation of disturbance terms and hetroscedasticity of variance is violated. Besides, disturbance terms have normal distribution.

9. Introducing, Estimating and Testing Men's Labor Force Supply Function in 20 to 24 Age Group

9.1. Introducing the Variables

Variables used in the above model are: MM2024, men's labor force participation rate in 20-24 age group as a dependent variable, PCML, men's educational coverage log in 20-24 age group as an independent variable, PGML log of ratio of collge-gradutes to literate population in 20-24 age group as an independent variable, WL real wage log as an independent variable as well as DU53 and DU57 with the previous definitions as dummy variables.

As table 2 shows all these variables are I(1); i.e. the first rank difference of these variables is I(0). Therefore, since all variables are a first rank co-integration, there may exist long run equation.

9.2. Estimating the Model

In this case, like section 8.3 the co-integration test, based on Johansen approach has been determined. Using AIC and SBC criteria. Finally, the appropriate model based on λ_{trace} has been chosen. The results of estimating long run equation of men's labor supply in 20 – 24 age group using OLS method yield:

$$MM2024 = -10.83PCML + 1.41PCML + 1.50WL$$
$$(-4.13) \qquad (1.9) \qquad (2.0)$$
$$R^2 = 0.94 \qquad DW= 2.11 \qquad F =172.36\ (0.000) \qquad (17)$$

As shown above, the long run elasticity of men's labor force participation rate in 20 –24 age group in proportion to educational coverage is –10.83. According to the result of long run model, if there is 1 percent increase in the ratio of college graduates, the labor force participation rate of this group increases by 1.41 percent. On the other hand, young men's sensitivity toward real wage , as can be observed, is about 1.5.

ECM model is estimated as follows:

$$DMM2024= -1.06DMM2024(-1) - 0.56DMM2024(-2)$$
$$(-6.94) \qquad (-3.3)$$
$$-0.47DMM2024(-3) -16.41DPCML \pm 11.86DPCML(-1)$$
$$(-3.46) \qquad (-9.74) \qquad (-5.15)$$
$$\pm 22.59DPCML(-2) +8.26DPCML(-3)+7.95DPCML$$
$$(-7.51) \qquad (-3.96) \qquad (4.43)$$

$+6.65DPGML(-1)+28.72DPGML(-2)+7.39DPGML(-3)$

$(3.33) \quad (6.34) \quad (4.16)$

$-0.4DW(-1)+0.47DWL(-2)-0.19Du53+1.39Du57-0.02ECM(-1)$

$(-2.81) \quad (-3.68) \quad (3.29) \quad (5.012) \quad (-9.05)$

$R^2 = 0.99 \quad DW=2.2 \quad F=82.23(0.000) \qquad (18)$

As shown above, all coefficients are significant and have the expected signs. Besides, all coefficients are confirmed by F-statistic.

9.3. Testing for Validity of the Model

To test the model, LM and ARCH tests as well as χ^2 distribution of disturbance terms are used.

Table 7: Results of Different Tests for Validity of the Model

Test	F(prob)	(prob) χ^2	Result
LM	1.342(0.394)	5.0458(0.080)	No autocorrelation
ARCH	0.091407(0.913)	0.53752(0.764)	No hetroscedasticity
Normality	–	0.33895(0.844)	Normal

Source: From tables of LM, ARCH and Normality teots obtained via Eviews

According to the content of table 7, we can observe that the assumption of autocorrelation of disturbance terms and homoscedasticity of variance of disturbance terms is violated at above 90 percent level.

10. Introducing, Estimating, and Testing Men's Labor Force Supply Function in 25–54 Age Group

10.1. Introducing the Variables

Variables used are ACML: active population log in 25–54 age group as dependent variable, GDPML real gross production log, PGML log of ratio of college graduates to total literate population in 25–54 age group of men, and WL real wage log as an independent variables. Moreover, DU53 and DU57, as mentioned before, are inserted into the model as dummy variables.

As table 2 shows all these variables are I(1); i.e. the first rank difference of these variables is I(0).

10.2. Estimating the Model

Similarly the long run equation of men's labor supply in 25–54 age group is estimated by Eviews using OLS method.

$$\underset{}{ACML} = \underset{(3.11)}{0.80PGML} \underset{(-1.97)}{+0.04GDPML} \underset{(2.01)}{+0.01WL} \underset{(2.10)}{+0.02T} \quad (19)$$

$R^2 = 0.791$ DW=2.12 F=8.521(0.000)

As shown above, the coefficient of gross income is negative; that is the income effect dominates the substitution effect in the long run. Furthermore, the elasticity of labor supply in this age group in proportion to higher education is 0.8, which is a small number. The important point concerning long run supply in is this group has very little sensitivity toward real wage price. The elasticity of men's labor supply in proportion to real wage is only 0.01.

Having determined the long run equation, the ECM model is determined as follows:

$$DACML = \underset{(2.54)}{0.32DACML(-1)} \underset{(4.39)}{+0.60DACML(-2)} \underset{(6.54)}{+ 0.53DPGML}$$
$$\underset{(7.34)}{-0.9223DPGML(-2)} \underset{(-5.42)}{- 0.08DGDPML(-1)} \underset{(-3.61)}{- 0.06DGDPML(-2)}$$
$$\underset{(2.45)}{+0.03DWL} \underset{(-7.86)}{-0.05DU53} \underset{(-8.88)}{-0.10DU57} \underset{(80.46)}{+1.18C} \underset{(-17.6)}{-0.05ECT(-1)}$$

$R^2 = 0.963$ DW=1.617 F=32.796(0.000) (20)

10.3. Testing for Validity of the Model

To test the validity of the ECM model, LM and ARCH tests as well as χ^2 distribution of disturbance terms are used. The results are presented in the following table:

Table 8: The Results of Different Tests for Validity of the Model

Test	F(prob)	χ^2 (prob)	Result
LM	0.39978(0.677)	1.4110(0.492)	No autocorrelation
ARCH	0.96044(0.405)	3.1786(0.204)	No hetrosedasticity
Normality	–	0.2453(0.161)	Normal

Source: From tables of LM, ARCH and Normality tests obtained via Eviews

According to the results in the table, the assumption of existence of autocorrelation and hetroscedasticity variance of disturbance terms is violated. Besides, the distribution of disturbance terms in the short run is normal.

11. Introducing, Estimating and Testing Men's Labor Supply Function in 55– 64 Age Group

11.1. Introducing the Variables

Variables used in this model are: MM5564, participation rate log of men in 55–64 age group as dependent variable, WL real wage log as in independent variable as well as DU53 and DU57 as dummy variables.

As table 2 shows all these variables are I(1), while the first difference of this variable is I(0), and there may exist a long run equoation.

11.2. Estimating the Model

Similarly, the long run equation of men's labor supply in 55– 64 age group is estimated by Eviews using OLS method:

$$MM5564 = \underset{(4.01)}{0.52WL} + \underset{(3.30)}{0.09T} \quad (21)$$

$R^2 = 0.987$ DW= 2.01 F= 62.110(0.000)

where T indicates the trend rate.

As this equation demonstrates, the elasticity of labor force participation rate in 55– 64 age group is 0.52. To obtain the ECM model, all independent variables with the most possible length of lag (here is 6) as well as lags of dependents variables and variable ECT(–1) are estimated using OLS method.

$$\underset{}{DMM5564} = \underset{(4.80)}{0.64DMM5564(-1)} - \underset{(-\ 4.48)}{0.87DMM5564(-5)} - \underset{(-\ 3.27)}{0.49WL(-2)}$$
$$\underset{(1.85)}{0.10DU57} - \underset{(-\ 4.19)}{0.03T} - \underset{(-\ 4.32)}{0.003ECT(-1)}$$
$$R^2 = 0.93 \qquad DW=2.09 \qquad F=22.24\ (0.000) \qquad (22)$$

As shown above, all coefficients are significant and have the proper signs. Besides, all coefficients are confirmed by F-statistic.

11.3. Testing for Validity of the Model

The result of LM and ARCH tests as well as χ^2 distribution of disturbance terms are explained briefly in the following table:

Table 9: Result of Different Tests for the Validity of the Model

Test	F(prob)	χ^2 (prob)	Result
LM	0.327(0.725)	0.927(0.629)	No autocorrelation
ARCH	0.235(0.889)	0.235(0.889)	No hetroscedasticity
Normality	–	0.497(0.521)	Normal

Source: From tables of LM, ARCH and Normality tests obtained via Eviews

As shown in table 9, the assumption of existence of autocorrelation and hetroscedasticity variance of disturbance terms is violated. Distribution of terms is normal in the short run.

12. Introduction, Estimating Labor Supply Model of Men Aging 64 and Above

12.1. Introducing the Variables

In this model the men's active population log in above 64 year age group, and ACML65 are dependent variables, and real wage log is an independent variable. Besides, DU53 and DU57 with the same definitions as before are used as dummy variables.

As table 2 shows ACML65 is I(1) and its first rank difference is I(0), so there may exist a long run equation.

12.2. Estimating the Model

Similary, the short run model of labor supply of men aging 65 and above is estimated by Eviews using OLS method:

$$DACM65 = 1.89WL$$
$$(5.72)$$
$$R^2 = 0.97 \qquad DW = 2.03 \qquad F=571.21(0.000) \tag{23}$$

As shown above, labor supply elasticity of men aging 65 and above in proportion to real wage is about 1.9 in the long run. To obtain ECM model, all independent variables with the most possible length of lag (here is 6) as well as dependent variables are estimated as follows:

$$DACM65L = 0.8DACM65L(-1) + 0.05DWL - 0.01DWL(-1) - 0.03ECM(-1) \tag{24}$$
$$(10.4) \qquad (-4.96) \qquad (-2.6) \qquad (-5.13)$$
$$R^2 = 0.799 \qquad DW = 1.29 \qquad F = 17.54(0.0000)$$

All coefficients are significant and have the expected signs. Moreover, all coefficients are confirmed by F-statistic.

12.3. Testing for Validity of the Model

To test the validity of the model, LM and ARCH tests as well as χ^2 distribution of disturbance terms are used. The results are summarized in the following table.

Table 10: Result of Different Tests for Validity of the Model

Test	F(prob)	(prob) χ^2	Result
LM	1.087(0.354)	2.519(0.284)	No autocorrelation
ARCH	0.0367(0.964)	0.0932(6.954)	No hetroscedasticity
Normality	–	0.2759(0.610)	Normal

Source: From tables of LM, ARCH and Normality tests obtained via Eviews

As shown, there is no autocorrelation or hetroscedsticity of variance. Besides, χ^2 distribution of disturbance terms is normal.

13. Conclusion

The results of the estimation demonstrate that in low age groups, educational variables such as educational coverage and the ratio of college graduates explain fully well the transformation of labor force participation rate in these groups. At teen and young ages, educational coverage and all its lags with large and negative coefficients are inserted into the equation. In other words, increasing educational coverage decreases teenagers participation rate strongly. At elder ages, the effect of the ratio of college graduates, variable and its lags generally increases the participation rate of this group.

Another variable that influences labor force supply is unemployment rate. This variable and its lags are generally positive in low age groups. That is, with increasing unemployment and more members of households becoming unemployed, children and teenagers enter the labor market. This variable has inserted into the models with different effects at elder ages.

According to these results, it seems that with regard to the rapid population growth in Khuzestan, which is higher than the population growth of the country, the press for labor force supply increases, and we will witness an increasing unemployment in the future years. Adopting proper policies for making use of the potentials of Khuzestan in agriculture or industrial production can lead to utilizing the abundant labor force of Khuzestan, specially the young labor force.

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