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Estimation of Employment and Labor Demand Function in Agronomy and Horticulture Sector of Iran

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Abstract: Increasing growth of population and shortage of producing capacity in Iran have caused serious unemployment crisis in the recent decades and has forced the authorities to look for ways to reduce unemployment rate. Due to difference of structure and technology used in economic sectors and activities, the effects of factors on employment are different, especially over long periods of time. So, for the purpose of finding alternatives to reduce unemployment rate in Iran, it is necessary to estimate employment function in all sectors and activities, analyze the most important factors and variables on these functions and predict the employment creation of all sectors and activities. In this study we are going to estimate labor demand function in agronomy and horticulture sector of Iran, which are one of the most important sectors that has formed meaningful percent of country employment and gross national production. In this paper it is assumed that employment is equal to labor demand. On the basis of this assumption the empirical model for labor demand function has estimated. Empirical models of labor force were used, with labor being a function of Investment, Value added, Acreage and Labor Wage Indicator. Time series analysis was used to estimate empirical function of labor demand. Stationary and determining of integration order of variables were tested by unit root tests. Johansen and Juselius co-integration method and Vector Auto-Regressive (VAR) conception were used to analyze the existence of long-run relationship between variables and Vector Error Correction Model (VECM) was also utilized to perform policy analysis. Results showed that attention to increase acreage of agricultural productions can considerably adjust labor demand vacillations and can reduce unemployment rate in the short-run.

Key words: Labor demand function · Employment · Time series analysis · Vector error correction · Vector autoregressive · Agronomy and horticulture

INTRODUCTION

Increasingly growth of population and shortage of producing capacity in Iran has caused serious unemployment crisis in the recent decades and has forced authorities to look for ways to reduce unemployment rate. In this situation various activities and sectors with different potential of employment creation, have set numerous alternatives for authorities and politicians to consider. To identify the best alternative for employment creation, by attention to incredible role of capital investment and other factors on employment opportunities, the employment function must be analyzed. Due to difference of structure and technology used in economic sectors and activities, the effect of factors on employment is different, especially over long periods of time [1, 2]. So for the purpose of finding alternatives to reduce unemployment rate in Iran, estimation of employment function in all sectors and activities, analyzing most important factors and variables and prediction of employment creation of all sectors and activities is necessary. This study is going to estimate labor demand function in agronomy and horticulture sector of Iran, which is one of the most important sectors that have formed meaningful percent of country employment and gross national production.

MATERIALS AND METHODS

In the situation that labor market is on disequilibrium, employment is equal to minimum of labor demand and supply. So in the case of demand precedence from

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labor supply, we will encounter with extra and empty employment opportunities. But, if labor supply takes the lead of demand, there will be unemployment crisis [3]. Therefore in the case of supply precedence from labor demand, we can use labor demand function to analyze and identify employment. In this case employment level is determined through maximization of net income functions of firms, with the assumption that labor demand (N^d) is equal to employment. Actual net income function in this method is determined as $R(N_t, D_t, \frac{P_{mt}}{P_t}, K_t)$ while, N_t: employment, K_t: capital stock, P_m: input price, P_t: output price, D_t: demand transferor variables [4, 5]. Firms identify their employment or labor demand (N_t) in the level that causes net income maximization. Labor demand function in this method is:

$$N_t = \sum_{j=1}^{J} ?_j(C_t, q_t) N_{t-j} + \sum_{j=0}^{J}\sum_{k=1}^{K} \beta_{kj}(C_t, q_t) X_{kt-j} + e_t \quad (1)$$

This model with few changes could be presented as: [4, 5].

$$\Delta N_t = \theta_0 N_{t-1} + \sum_{j=1}^{J} \theta \Delta N_{t-j} + \sum_{k=1}^{K} \left[\varphi_{k_0} X_{k_{t-1}} + \sum_{j=1}^{J} \varphi_{k_{j+1}} \Delta X_{kt-j} \right] \quad (2)$$

or as:

$$\Delta N_t = \theta_0 \left[N_{t-1} + \sum_{k=1}^{K} \Pi_k X_{kt-1} \right] + \sum_{j=1}^{J} \theta_j \Delta N_{t-j} + \sum_{j=1}^{J}\sum_{k=1}^{K} \varphi_{k_{j+1}} \Delta X_{k_{t-j}} \quad (3)$$

While: $\Delta = (1-L)$, $\Pi_k = \frac{\varphi_{k_0}}{\theta_0}$, $\theta_0 < 0$, L: lag operator

The derived model for labor demand is nearly similar to Error Correction Model and could be estimated by econometric methods. In this model X_t indicates on independent variables such as real wage of labor, capital price (interest), capital stock, value added, while C_t is adjustment costs relative to labor wage and Q_t is quit rate (losing cost of employment).

Due to non-existence of labor real wage and capital price (interest) time series data, we estimated empirical function of labor demand to consist of investment (Billion Rials), acreage (Hectare) and labor wage indicator in addition to employment (Thousand Man) and value added (Billion Rials) variables during the period of 1966 to 2002 in agronomy and horticulture sector of Iran. For the estimation of labor demand function we used Time Series Analysis and co-integration concepts. Stationary and determining integration order of variables is tested by unit root tests such as ADF (Augmented Dickey-Fuller) and Peron test. The long-run equilibrium relation between variables is analyzed by Johansen and Juselius method. In this method identification and estimation of co-integration sectors (long-run equilibrium relationship) of variables, were accomplished by using of Vector Auto-Regressive (VAR) model. Error Correction Model (ECM) was also utilized in this research to perform policy analysis [1, 6].

RESULTS AND DISCUSSION

Stationary Test of Variables: The first stage of co-integration and equilibrium relation analysis between variables will determine integration order of variables [5, 7]. Table 1 shows the results of stationary tests on the basis of ADF. Clearly the variables of investment (K), Value added (Y), acreage (Land) and wage indicator (W) are integrated of order one, I(1). About variables of employment (L) results of ADF, the test showed that it is integrated of order two, or I(2). But Peron test as a complementary test [6, 8] indicated that employment time series have constant Variance, Covariance and Mean over long periods of time and is considered I(0). So it is possible to use Time Series Analysis to investigate the long-run equilibrium relationships between the variables considered in empirical labor demand function.

Specifying the VAR order and VECM: The second stage of Johansen and Juselius method for co-integration analysis specifies the suitable order of Vector Auto-Regressive (VAR) model and consequently the Vector Error Correction (VEC) model [4, 9, 10]. To select the VAR Order the Schwarts (Sc), Akaike (AIC) and Likelihood Ration (LR) methods are used in this research. The Sc test that usually shows VAR order with high care selected one order for variables [8]. But AIC criterion and LR test selected respectively 2 and 3 order for VAR model of variables. To confirm if the results are reliable and to confide in the findings, according to empirical researches the significance of entrance for each order of variables has also been analyzed by F criterion test. For this purpose, the whole equations of vector error correction model, estimated with one lag by using OLS method and the necessity of second lagged variables used in model, tested by F criterion. Table 2 shows the estimation results of the vector error correction model equations in the short-run with one lag. Table 2 indicates that there are

Table 1: The results of ADF and Peron Stationary tests on time series of variables

Variables	No. of lags	Integrated Order
L	1	I (2) ADF
DL	0	I (1) ADF
DDL	0	I (0) ADF
L	0	I (0) Peron
K	1	I (0) ADF
Y	0	I (0) ADF
Land	1	I (1) ADF
DLand	0	I (0) ADF
W	1	I (1) ADF
DW	1	I (0) ADF

D: First difference operator form of variables

DD: Second difference operator of variables

Table 2: The results of residual tests of estimated VECM equations in the short-run with one lag

Equations	DL	DK	DY	DLand	DW
$F_{ac}(1,22)$	1.9	2.96	0.12	0.17	2.67
$F_{fu}(1,22)$	2.25	5.34	0.009	2.55	0.99
$F_{het}(1,26)$	0.26	*7.60	0.50	0.138	1.90
X^2_{nor}	3.56	0.95	1.55	**14.8	*6.10

* The null hypothesis is refused at 1% level of significance.

** The null hypothesis is refused at 5% level of significance.

Table 3: The quantities of F test results by entering second lagged variables in VECM equations in short -run

Equations	DL	DK	DY	DLand	DW
F(17,5)	2.8	1.56	0.23	1.01	1.78

no serious econometric problems in vector error correction equations, especially in the DL equation that will be applied in this paper to analyze labor demand function while:

F_{ac} : Serial Autocorrelation test of residuals.
F_{fu} : Function Specification Error test of residuals.
F_{het} : Heteroscedasticity test of residuals.
X^2_{nor} : Normal Distribution test of residuals.

The results of entering of second lagged variables in error correction equations on the basis of F test are shown in Table 3.

As it is shown, all quantities of F test are not statistically significant. Consequently we selected order 2 for VAR model so that variables would appear with one lag in VECM.

Table 4: The results of specification of co-integration vector by using Maximal Eigenvalue and Trace tests

	H_0	H_1	I	II	III	IV	V
λ_{max}	$r=0$	$r=1$	*39.22	*39.40	*38.32	*40.20	*38.21
	$r\leq1$	$r=2$	*21.24	**21.40	*28.09	35.14	29.01
	$r\leq2$	$r=3$	14.10	14.20	14.23	18.96	18.84
	$r\leq3$	$r=4$	2.29	6.29	6.03	11.08	7.87
λ_{trace}	$r=0$	$r=1$	*81.80	*82.10	*87.01	*109.97	*94.04
	$r\leq1$	$r=2$	*42.57	**42.57	*48.69	58.90	55.83
	$r\leq2$	$r=3$	21.16	21.16	20.59	34.31	26.83
	$r\leq3$	$r=4$	7.06	7.60	6.35	15.35	7.97

* The null hypothesis is refused at 1% level of significance.

** The null hypothesis is refused at 5% level of significance.

While:

I: Alternative with no intercepts and no trends.
II: Alternative with restricted intercept and no trends.
III: Alternative with unrestricted intercepts and no trends.
IV: Alternative with unrestricted intercepts and restricted trends.
V: Alternative with unrestricted intercepts and trends.
r: Vector or long-ran relation between variables.

Table 5: The results of estimated long-run relationship or co-integration vector in both actual and normalized form

Variables	Actual vector	Normalized vector On the basis on L
L	0.4166E-2	-1.0000
K	-0.649E-6	0.000155
Y	-0.658E-6	0.000157
Land	-0.103E-3	0.0248
W	0.703E-5	-0.0016
Trend	0.128	-30.798

Specification of Co-Integration Vectors: On the basis of Johansen and Juselius method of co-integration for specifying the co-integration vector and VAR model, all alternatives about the existence of intercept and trend in both, long and short-run relationships between variables are tested by using Maximal Eigenvalue (λ_{max}) and Trace (λ_{trace}) criterions [6, 8, 11].

As Table 4 shows, the test quantities of λ_{max} and λ_{trace} in the first row where the H_0 is, r=0 and H_1 is, r=1 are bigger than Johanson critical quantities and so are statistically significant. Therefore, the null hypothesis (r=0) is refused in all alternatives that are from I to V. Then the null hypothesis of the existence of one co-integration vector (r=1) versus the alternative hypothesis (r=2) is examined in all forms. The results of λ_{max} and λ_{trace} showed that there is a co-integration vector between variables in the fourth alternative, that is a long-run relation with unrestricted intercepts and restricted trends. The

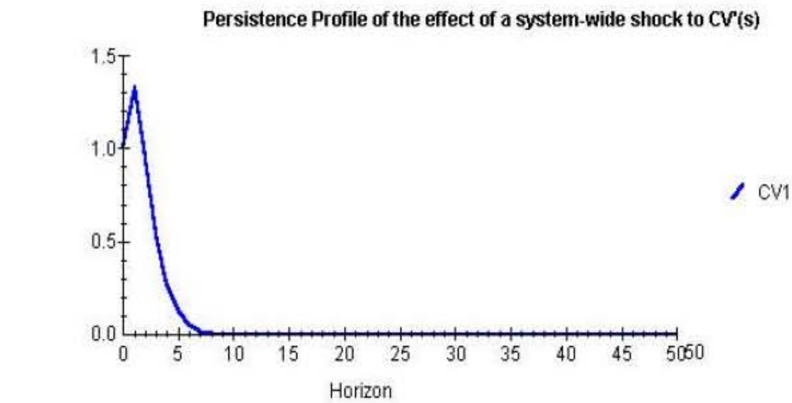

Fig. 1: Persistence profile of the effect of a system-wide shock to co-integration vector

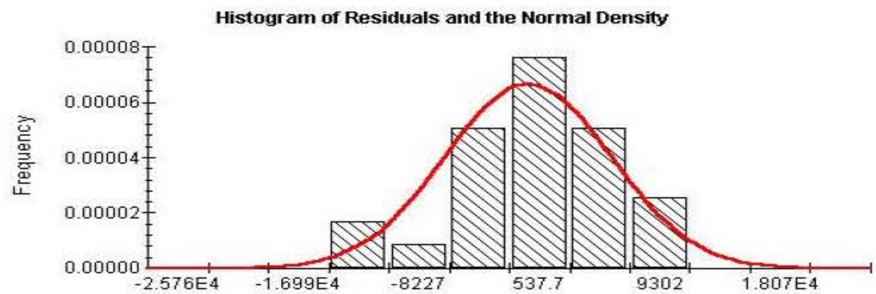

Fig. 2: Histogram of residuals and the normal density

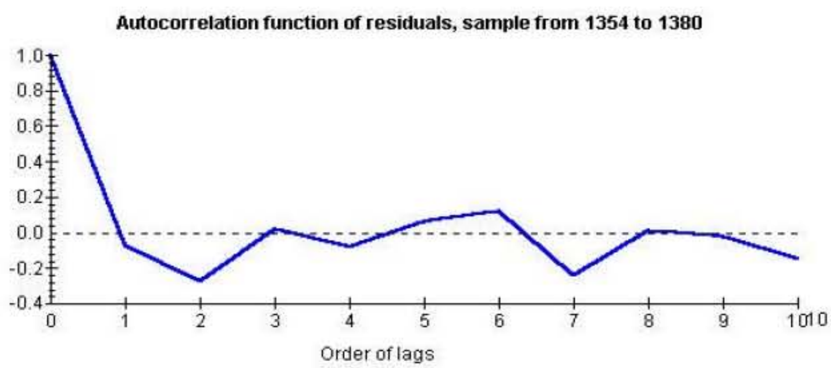

Fig. 3: Autocorrelation function of residuals, sample from 1966 to 2002

estimated long-run relationship or co-integration vector is shown in Table 5, in both actual and normalized forms on the basis of employment (L) variable.

Estimated vector indicates that there is a long-run relationship between model variables and could be rewritten according to L (employment) as:

$$L = 0.000155K + 0.000157Y + 0.0248Land - 0.00168W - 30.798t \quad (4)$$

In this long-run equilibrium, investment (K), value added (Y) and acreage (Land) have positive effects on labor demand (L), which on the basis of our assumption is equal to employment in agronomy and horticulture sectors in Iran. But according to theoretical expectations the labor wage indicator (W) has negative relation with labor demand and employment. Figure 1 shows the effect of exertion of one shock on the whole system of the estimated vector. As clearly seen, after the impact of any

Table 6: The results of residual tests of estimated error correction model

$F_{ac}(1,18)$	$F_{fu}(1,18)$	$F_{het}(1,18)$	X^2_{nor}
0.243	2.2	1.3	0.836

economic shock, the considered vector is coming back again towards long-run equilibrium.

Specification Vector Error Correction Model: According to the Granger representation theorem, there are long-run relationships between variables that are co-integrated [12, 13, 4]. Of course in the short-run these variables may be in disequilibrium. The dynamics of these short-run disequilibrium relations between variables can always be described by Error Correction Model (ECM), which contains the short and the long-run behavior of the co-integrated variables [13, 15]. Error correction model of this long-run relationship of labor demand function is estimated as:

$$DL = 54.245 + 0.668DL(-1) + 0.00077DK(-1) - 0.00078DY(-1) - 0.004917DLand(-1) - 0.00119DW(-1) - 0.314ECM(-1) \quad (5)$$

$R^2 = 0.913$, $D.W = 2.12$, $F = 35.33$

Table 6 shows the residual tests of estimated error correction. Figures 2 and 3 indicate that the residuals do not have any statistical and econometrical problems of heteroscedasticity, specification, serial correlation and normal distribution.

In this model ECM (-1) coefficient is negative and indicates an intention toward equilibrium in the short-run. That is about 31.4 percent of disequilibrium and vacillations of labor demand, prompted by factors expectation of investment (K), value added (Y), acreage (Land) and labor wage indicator (W), are adjusted in short-run in agronomy and horticulture sectors of Iran. In the estimated ECM equation, the differential variables of value added and investment, on the basis of T test are not statistically significant. So they do not have any role in the adjustments of short-run vacillations of labor demand and employment. Coefficient of differential variable of acreage is negative and indicates that attention to increased acreage of agricultural productions can considerably adjust labor demand vacillations; therefore, it can reduce unemployment in the short run.

CONCLUSION

The results of this research show that, Investment (K), Value added (Y), Acreage (Land) and Labor Wage indicator (W) have important effects on labor demand function and employment. In the estimated function for labor demand, investment has direct and positive effect on employment in Agronomy and Horticulture sectors in Iran. On the other hand, the structure of this sector has formed so that investment has complementary role on labor demand and has caused increased employment. The positive relation of investment and employment can be attributed to allocation of capital in the fields where application of labor in agricultural activities will be increased.

Value added and acreage variables also have positive effects on employment, that is to increase acreage and prepare more land for agricultural activities by using technology and structure can reduce unemployment rate by attracting more labor in the studied sector. According to theoretical expectations the labor wage has negative relation with employment and indicates that relative increase of labor wage in comparison with substitution factors such as machinery, or decreasing of these factors cost compared by labor wage has negative effect on labor demand and employment in the long run. So decisions related to policies which regulate correctly producing factors prices that can be substituted by labor in agriculture sector, can reduce considerably vacillations of unemployment crisis and keep it under control. In the estimated Error Correction Model, the ECM (-1) coefficient is negative and indicates that there is also an intention toward equilibrium in the short-run. The differential variable acreage (Dland) in this model has important and significant effect on differential variable of employment (DL). So attention to increase acreage of agricultural productions in authority's decisions can adjust labor demand vacillations and can reduce unemployment rate in the short-run.

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