LEARNING BY DOING AS A HUMAN CAPITAL FACTOR: CASE OF ESKISEHIR FURNITURE MANUFACTURING SECTOR

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ABSTRACT

This study seeks to determine the impacts of learning by doing, human capital and R&D factors on firm's output by using simultaneous equations system. In this study, medium and large-sized companies from furniture manufacturing sector in Eskisehir, Turkey are selected as the research domain and a database is generated based on the information collected through face-to-face interviews with company executives (or with officials designated by them), the financial statements of researched companies, and the records of Eskisehir Chamber of Industry. According to the estimation results obtained, the human capital stock, learning by practice phenomenon and the research and development expenditures have a linear impact on the company's total output. It is understood that, fixed capital stock and size of company become prominent in terms of their impact on the human capital, and the mentioned variables demonstrate a positive relation with the output. Likewise, the linear relationship between learning by practice and company size as well as wage level; and between research & development expenditures and company size are the factors that come forth in the explanation of the dependent variables.

INTRODUCTION[1]

The relationship between technology and economic growth has been captured in a vast number of formal models for almost half a century. Early neoclassical models like Solow (1956) treated technical change as an exogenous variable, illustrating how long-run economic growth only depended on (exogenous) technical change. In this model Solow argued that due to the law of diminishing returns, developed countries, in the long term, will enter into a stationary state with zero-growth and developing countries will catch the developed ones in

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time. Arrow (1962), who endogenized technology by assuming learning by doing, stated that it grew at a constant rate, and found that long-run economic growth crucially depends on population growth. Other important contributions in the 1960s were made by Uzawa (1965), Phelps (1966), Conlisk (1967, 1969) and Shell (1967) among others, who all related technological growth to some specification based on labor resources devoted to development of new technologies and ideas.

On the other hand, the more recent type of models of the endogenous growth literature by Romer (1990), Grossman and Helpman (1991a, 1991b) and Aghion and Howitt (1992) all share the characteristic that a continued increase in the level of resources spent on the creation of new technologies leads to a continued increase in economic growth (Loo and Soete, (1999)). These new endogenous growth models, which arose as a reaction to early neoclassical growth model's forecast, were the sources of inspiration for this study.In contrast to early model's stationary state forecast, long term continuation of growth in the developed countries, triggered re-examination of the sources of growth. As the sources of growth, the new growth models that emerged in this process featured concepts such as learning by doing, human capital, R&D, distribution of work and specialization, economies of scale and spillover effects, which are based on micro economic foundations.

As argued in several studies (Lucas, 1988, 1993; Romer, 1986, 1990; Rivera-Batiz and Romer, 1991a,b; Mankiw, Romer and Weil, 1992; Williamson, 1996; Pritchett, 1997; Ventura, 1997), the underlying factor for fast development of countries such as South Korea, Taiwan, Singapore and Hong Kong after the World War II is the aforementioned advantages. The common arguments of these studies include the facts that in the countries with high accumulation of human capital, for many centuries, qualified and unqualified labor has been migrating from east to west, where any kind of input earns more thanks to positive externalities that originate from human capital; that the international capital generally circulates between the developed countries; and that the countries that attach great importance to learning by practice, human capital accumulation, R&D and foreign trade can succeed in the aforesaid fast development process. Another argument demonstrated in these studies is an expectation, which can be expressed with higher efficiency and profitability in companies with higher human capital accumulation, in both macro and micro levels. This may be due to circumstances such as on-the-job training provided to workers by educated employees in the

workplace; innovation in machines, equipments and products, and rationalization of work system, etc.

In the models developed Romer (1986, 1990), Rivera-Batiz and Romer (1991a,b), the production activities are carried out in two sectors; manufacturing and R&D. In the manufacturing sector, where consumer and investment goods are produced, human capital, unqualified labor and physical capital are employed. In R&D sector, there are two types of manufacturing: design production and prototype production of designed goods. While design production can only be done with human capital and scientific knowledge, in prototype production, just as in the manufacturing sector, both unqualified labor and physical capital are employed. In this model, as the innovations presented in the R&D sector turn into serial production in manufacturing sector, efficiency and competitive strength of a company increase. Unlike other inputs, constant use of the same knowledge in multiple work shows that innovative companies' competitive power may be relatively higher.

This study intends to investigate the influence of learning by doing, human capital and R&D factors on output of furniture manufacturing sector in Eskisehir, Turkey and also analyze the factors that influence these variables. For this purpose, medium and large-sized companies from furniture manufacturing sector in Eskisehir are selected as a research domain and a database generated based on the information collected through face-to-face interviews with company executives (or with officials designated by them), the financial statements of researched companies, and the records of Eskisehir Chamber of Industry. The remainder of the paper is organized as follows: The following section provides a review of the related literature. Section three discusses the methodological issues and section four presents the empirical results. Finally, section five includes some final remarks and future extension proposals.

METHODOLOGICAL ISSUES

Study Area and Sampling Procedure

In this study, medium and large-sized companies from furniture manufacturing sector in Eskisehir are selected as a research domain. Located on the cross-road of railways and motorways, with developments in agriculture and industry, as well as rich underground sources, Eskisehir has become an important center of Turkish economy. Certainly the most

important share of the recent dynamism in Eskisehir's financial life belongs to industry. Fast growth of urban population compared to rural population, presence of educated workforce, proximity to markets, relevance of energy and raw material resources and sufficiency of required infrastructure for industry helped the regional industry to achieve a gradual development.

However, the furniture sector, which is one of Eskisehir's most common and deep rooted sectors, has recently entered a challenging bottleneck. Particularly, the rapid fall in market shares and much lower jobs and profits obtained by many small industrialists', compared to previous years, explain the significance of the situation. A database generated depending on the information collected through face-to-face interviews with company executives (or with officials designated by them), the financial statements of researched company, and the records of Eskisehir Chamber of Industry. Studied companies' answers as of the end of 2008 are taken as basis while creating the database.

Data Description and Transformation

Among the 43 companies interviewed, 4 abstained from giving certain information needed within the scope of the study due to commercial secrets, thus these companies are excluded from the database because of "lack of information". On the other hand, data given by 5 interviewed companies seemed to lack consistency (especially due to extreme statements on company capital, average wage and research and development expenditures). Therefore, the mentioned companies are also excluded from the database. Four other companies, which showed significant inconsistencies between the data collected by Eskisehir Chamber of Industry and data provided to us, are also excluded due to significant changes such data might cause biased estimation results. Therefore, the number of companies that remained in the scope of the research after required arrangements fell down to 31. Following is the brief description of each of the variables used in this study.

Output Amount (Y_i): Each company's annual endorsement represents that company's total output amount. The data crated within the framework of answers collected from the companies were compared with the data obtained from Eskisehir Chamber of Industry in order to maintain consistency of data.

Fixed Physical Capital Amount (K_i): This variable generated based on the depreciation figures collected from the companies using average depreciation rate, represents the value of total

fixed capital assets of a company. The theoretical expectation is that total physical capital will have a positive influence on the production volume and company's sales.

Number of Employees (L_i): It should be underlined that the total number of employees in a company is included to the model in order to express the workforce variable within the growth models. The workforce's contribution to the company output will vary under predictive nature of the law of diminishing returns.

Human Capital (H_i): The study measures companies' human capital stock based on numbers of university, vocational school of higher education, and vocational high school graduate employees within the company. It should be also noted that the factors that determine human capital within the simultaneous variable system are the total physical capital amount owned by the company, company's size, amount of expenditures made in research & development activities, and the wage level. With this aspect, the study differentiates from other models with its endogenous inclusion of human capital stock to the model. First of all, the human capital stock possessed by a company is expected to have a positive influence on the company's total output. On the other hand, physical capital, company size, research & development expenditures and wage level, which are predicted to be among the factors that determine the human capital, are also theoretically expected to influence the human capital in the same manner.

Learning by Doing (LBD_i): Learning by doing variable is defined as average number of years worked in a company. The reason for defining learning by doing variable as average years worked in a company instead of years worked in a sector is inclusion of the variable, which is mentioned in the simultaneous equation system, to the model with a separate equation. By this means, the factors that determine learning by doing variable can be identified. Naturally, the model's theoretical expectation is outcome of a direct relation between learning by doing and company output.

R&D Expenditures (RD_i): Expenditures made for research and development are defined as total of expenditures aimed at new product development, expenditures aimed at research and investment expenditures aimed at application of new technologies in production. Based on this definition within the context of endogenous growth models, existence of a direct relation between total R&D expenditures and company's output level is one of the model's theoretical expectations.

Scale of the Company (SC_i): The variable related to the scale of the company is included to the model expressed with simultaneous equation system based on the idea that company size is among the variables that may possibly influence a company's human capital stock, learning

by doing level and its research & development expenditures, and thus it will have an influence on the company outputs. However, the said variable is not in the position of being directly observable or allowing direct data collection at company basis. Therefore, mentioned variable must be generated. While generating this variable, a company's endorsement, physical capital stock, human capital stock and amount of funds spent on research & development are considered as factors that determine a company's size. In order to avoid any possible bias, the said variables are equally-weighted (0,25) to produce a series and then, in order to standardize this series, a new series is generated through its division to arithmetic average. This new series offers us the company's size weighted according to various criteria. In other words, it is possible to say that the bigger this values is, the larger the scale of the company will be.

Average Wage (W_i): The real wage, which is obtained from the data taken from researched companies and made net of inflation using Producer Price Index takes place within the simultaneous equation system in two equations. The said equations are those that represent human capital (H_i) and learning by doing (LBD_i). In both equations, direct influence of reel wage on dependant variables may be expressed as theoretical expectations of this model.

Education Level (TR_i): This variable, which represents yearly basis average education level of company employees, is the most important variable that seems to have the greatest influence particularly on learning by doing process. With the increase in average education level, acceleration in learning by doing process and both variables' movement in the same direction are expectations of the theoretical model.

Method of Estimation

System of Simultaneous Equation Model

As result of the fact that every worker in a workplace constantly does the same task, it is expected that all the works will turn into simple operations; time loss due to change of work will be prevented; the workers will see the deficient aspects of the machines and equipment they use better; technological developments will accrue by transfer of this knowledge to machine/equipment manufacturers through feedback; and that efficiency and profitability will thus increase. The above defined process is briefly called as learning by doing. In order to examine whether learning by doing, human capital and R&D are influential on a company’s outputs and also the factors that influence these variables, the following systems of simultaneous equations will be used in this study.

Output Eq : $\ln Y_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 \ln H_i + \beta_4 \ln LBD_i + \beta_5 \ln RD_i + \varepsilon_1$

Human Capital Eq : $\ln H_i = \alpha_0 + \alpha_1 \ln K_i + \alpha_2 \ln SC_i + \alpha_3 \ln RD_i + \alpha_4 \ln W_i + \varepsilon_2$

Learning by Doing Eq : $\ln LBD_i = \varphi_0 + \varphi_1 \ln TR_i + \varphi_2 \ln SC_i + \varphi_3 \ln W_i + \varepsilon_3$

Re *search* & *Developmen t Eq* : $\ln RD_i = \psi_0 + \psi_1 \ln K_i + \psi_2 \ln H_i + \psi_3 \ln SC_i + \varepsilon_4$

where *i* denotes firm subscript, the endogenous variables in this system of equations are; output level (*Y*), human capital (*H*), Learning by Doing Input (*LBD*), R&D Expenditures (*RD*). The predetermined variables in this system of equations are listed as following; Fixed Physical Capital Output (*K*), Number of Employees (*L*), Scale of the Company (*SC*), Average Wage (*W*) and Education Level (TR). The ε_1, ε_2, ε_3 and ε_4 terms given in the foregoing equations, in term, represent error terms with independent and identical distribution.

Each variable within the model is in logarithmic level in order to maintain required standardization in metrics and estimated through least squares method, which produced the following results. Since simultaneous equation system is used as a model, in order to avoid any bias based on estimation method, the same equation system will also be estimated with 2 stage least squares method in the following pages.

Data Envelopment Analysis and Efficiency Scores

In addition to systems of simultaneous equations model, Data Envelopment Analysis (DEA) will be used to analyze the relative efficiency of furniture manufacturing firms included in the study. This approach, also known as frontier analysis, is a mathematical programming technique that measures the efficiency of a decision-making unit (DMU) relative to other similar DMUs with the simple restriction that all DMUs lay on or below the efficiency frontier (Seiford and Thrall, 1990). It was first introduced by Charnes, Cooper and Rhodes in 1978. Since then its utilization and development have grown rapidly including health care, agricultural production, banking, armed forces, sports, market research, transportation and many other applications.[2]

This analysis is concerned with understanding how each DMU is performing relative to others, the causes of inefficiency, and how a DMU can improve its performance to become

[2] For a detailed review of these extensions and developments in DEA, see Charnes, Cooper, Lewin and Seiford, (1994) and Seiford, (1994, 1996).

efficient. In that sense, the focus of the methodology should be on each individual DMU rather than on the averages of the whole body of DMUs. DEA calculates the relative efficiency of each DMU in relation to all the other DMUs by using the actual observed values for the inputs and outputs of each DMU. It also identifies, for inefficient DMUs, the sources and level of inefficiency for each of the inputs and outputs (Charnes, Cooper, Lewin and Seiford, 1994).

DEA measures the efficiency of each DMU which obtained as a maximum of a ratio of total sum of weighted outputs to total sum of weighted inputs. Suppose that there are *n* DMUs, each with *m* inputs and *j* outputs, relative efficiency score of a given DMU is obtained by solving the following linear programming model.

$$h_n = \max \sum_{i=1}^{M} u_i y_{in} \Big/ \sum_{j=1}^{J} v_j x_{jn} , \qquad \text{for} \quad n=1,.....N$$

subject to

$$\sum_{i=1}^{M} u_i y_{in} - \sum_{j=1}^{J} v_j x_{jn} \le 0 , \qquad \text{for} \quad n=1,.....N \quad \text{and} \quad \sum_{j=1}^{J} v_j x_{jn} = 1 , \qquad \text{for} \quad u_i : v_j \ge 0$$

where

h_n = efficiency score for *n*th DMU,

u_i = weight given to *i*th output,

y_{in} = the amount of output *i* produced by the *n*th DMU,

v_j =weight given to *j*th output,

x_{jn} = the amount of output *j utilized by n*th DMU.

The weights for each DMU are assigned subject to the constraint that no other DMU has efficiency greater than 1 if it uses the same weights, implying that efficient DMUs will have a ratio value of 1. The derived weights, *u* and *v* are not negative. DEA can be either input- or output-orientated. The input-orientated DEA method defines the frontier by seeking the maximum possible proportional reduction in input usage, with output levels held constant, for each firm. The output-orientated DEA method seeks the maximum proportional increase in output production with input levels held fixed. This paper assumes constant returns to scale (CRS) technology and selected an output orientation because the concern is to maximize

output from a given set of inputs, rather than the converse. The data were analyzed using a program called EMS - Efficiency Measurement System version 1.3. The type of analysis is input oriented, with radial distance and constant returns of scale. In this paper the input-output data was treated as follows;

The Output: Output amount. **The Inputs:** Fixed physical capital amount, number of employees, human capital, learning by doing input, R&D expenditures, and education level.

The summary statistics for variables used in empirical analysis are shown in Table 1.

Table 1: Summary Statistics of Variables Used in Empirical Analysis

	K	H	L	LBD	RD	SC	TR	W	Y
Mean	1078326.	33.516	51.322	9.2580	112580.6	61.032	8.8064	913.5484	361600.0
Median	550000.0	26.000	42.000	9.0000	65000.00	34.000	9.0000	915.0000	215000.0
Maximum	8250000.	124.00	140.00	14.000	1000000.	458.00	11.000	1200.000	2403600.
Minimum	215000.0	9.0000	14.000	5.0000	15000.00	11.000	6.000	700.0000	48000.00
Std. Dev.	1529959.	26.8047	28.489	2.2944	179173.4	85.762	1.4472	116.3772	496312.1
Sum	33428100	1039.0	1591.0	287.00	3490000.	1892.0	273.00	28320.00	11209600
Sum Sq. Dev.	7.02E+13	21553	24348.7	157.93	9.63E+11	220657	62.838	406309.7	7.39E+12
Observations	31	31	31	31	31	31	31	31	31

ESTIMATION RESULTS

The results produced with OLS estimation method are presented in Table 2.

Output Equation: Based on the output equation that represents a company's total output, all the coefficients estimated in the equation have expected signs. The numerically largest variable effective on a company's production scale is that company's total fixed capital stock. A significant proximity of the coefficient to 1 indicates that the companies are working close to a fixed return level based on physical capital. Another notable point in the equation is significant lowness of the estimated coefficient of labor (L) variable, compared to the fixed physical capital (K). This is a phenomenon that indicates significant lowness of the workforce efficiency. On the other hand, contribution of research & development expenditures (LRD), human capital (LH) and learning by doing phenomenon (LLBD), which constitutes this study's major point of interest, on the company output is positive. Among these variables, the coefficients associated with human capital and learning by doing variables are quite close to each other. This situation indicates that a 1 percent increase in the number of vocationally trained employees and in their average stay in the company will mean a 0.5 percent increase in that company's output. Since we defined company output as a company's year-end endorsement in this study, this contribution should be considered as a factor that will have a positive impact on the profitability. Despite its positivity in accordance with theoretical

expectations, research & development expenditures' contribution to company outputs, in turn, is below expectations. However, positive indications of the coefficient suggest that the production process and the company's profitability will be seriously affected if the sector increases its activities in research & development area.

Table 2: Results for Least Square Regressions

Variable	Eq: LY		Eq: LH		Eq: LLBD		Eq: LRD	
	Coefficient	S. Error	Coefficient	S. Error	Coefficient	S. Error	Coefficient	S. Error
Constant	-1,18	0,77	-29,16	22,35	-1,33	2,77	52,24	11,32
LK	1,02	0,08	3,34	2,04	--	--	4,51	1,15
LL	0,47	0,17	--	--	--	--	--	--
LH	0,26	0,15	--	--	--	--	0,04	0,13
LLBD	0,27	0,13	--	--	--	--	--	--
LRD	0,12	0,07	0,07	0,24	--	--	--	--
LSC	--	--	2,96	2,17	0,08	0,06	5,31	1,11
LW	--	--	0,34	0,87	0,57	0,41	--	--
LTR	--	--	--	--	0,03	0,30	--	--
AdjR^2	0,96	--	0,21	--	0,09	--	0,84	--
S. Error of Reg.	0,18	--	0,54	--	0,26	--	0,36	--
Log Likelihood	12,25	--	-21,97	--	0,45	--	-10,23	

Human Capital Equation: Also within the second equation aimed at explaining companies' human capital stock (LH), it should be initially highlighted that the coefficients that have the marks in line with our theoretical expectations are produced. As we have seen before, among the explanatory variables, the company's fixed capital stock and accordingly the company's scale becomes prominent. The additions to fixed physical capital used in companies create a quite strong human capital, which -according to our previous equation- creates a positive influence on the company output. On the contrary, height of the coefficient taken by the variable that indicates company scale is intriguing. This may be a result of this variable's creation method, which have explained in the section where we observed the creation of database. However, as seen below, statistical reliability of this coefficient is limited. The expenditures made for research & development has a positive yet quite low influence on a company's human capital.

Learning by Doing Equation: When we analyze the results from learning by doing equation, learning by doing phenomenon is becomes immediately conspicuous that it is the weakest equation in the model in terms of estimation strength. Adj-R^2, representing an equation's determination power, is the lowest value in the model with the 0.09 value it took. On the other hand, all the variables that are thought to influence learning by doing, i.e. the company scale (LSC), employees' average education level (LTR) and average real wage (LW) demonstrate indications in expected directions. In other words, any increment to be observed in the values of these variables strengthen learning by doing phenomenon, which creates positive influence

on the company's total output, to an extent we have previously discussed. With its size, the variable that becomes the most prominent among these variables is real wage level. When our method of defining the learning by doing variable is considered, this fact is not intriguing. As is may be remembered, we have measured learning by doing variable as employees' average seniority. It is obvious that the increases in employees' real wages will extend the time to stay in the company.

Research & Development Equation: The last equation within the model is the LRD equation specified in order to explain research & development expenditures. As it may be remembered, fixed physical capital stock (LK), human capital stock (LH) and company scale (LSC) were included to explanatory variables, thinking that they would influence this variable in companies. The produced coefficients have expected signs supporting the relations we have argued during development of the model. In this context, the most important variables that positively influence the funds allocated for research & development are company scale and the company's fixed capital stock. Accordingly, the larger the companies and the wider their production scales, the bigger funds they allocate for research & development. Both coefficients being higher than 1 indicate that this influence is stronger than expected. However, it should be noted that, although a company's human capital stock (LH) directly influences its research & development expenditures, the coefficient is at a significantly low level in terms of its size and it is problematic in terms of statistical reliability.

The foregoing model estimated using least squares method is also estimated separately using two-stage least squares (2SLS) method in order to prevent any bias that may arise from the estimation method. The results produced show significant similarity, and above all, entire of the estimated coefficients have indications in accordance with theoretical expectations, as we have already seen before. Therefore, in order to avoid reiteration, the results of 2SLS method will only be given in form of a table. In the light of these explanations, the results produced with 2SLS estimation method are presented below.

Table 3: Results for Two-Stage Least Square Regressions

Variable	Eq: LY		Eq: LH		Eq: LLBD		Eq: LRD	
	Coefficient	S. Error	Coefficient	S. Error	Coefficient	S. Error	Coefficient	S. Error
Constant	2,38	4,49	-57,10	62,28	1,73	14,64	23,37	36,16
LK	0,83	0,26	5,65	5,25	--	--	1,53	3,69
LL	1,33	0,91	--	--	--	--	--	--
LH	1,11	0,81	--	--	--	--	0,06	0,29
LLBD	0,83	1,22	--	--	--	--	--	--
LRD	0,17	0,36	0,60	1,14	--	--	--	--
LSC	--	--	5,72	6,14	0,13	0,16	2,33	3,51
LW	--	--	0,20	0,97	0,38	2,43	--	--
LTR	--	--	--	--	0,82	1,41	--	--
AdjR^2	0,90	--	0,10	--	0,32	--	0,79	--
S. Error of Reg.	0,30	--	0,57	--	0,29	--	0,41	
Log Likelihood	--	--	--	--	--	--	--	--

Data Envelopment Analysis and Efficiency Scores: Results of Table 4 show that 6 companies were found to be fully efficient. These 6 companies defined the efficient frontier and represent the best practice companies for combining fixed physical capital amounts, **n**umber of employees, human capital, learning by doing input, R&D expenditures, and education level to produce maximum output. Almost 80% of furniture manufacturing firms in the sample are inefficient. Only 2 companies showed a performance below 0.60. Predicted technical efficiencies differ substantially among sample inefficient companies, ranging between 0.46 and 1. Almost 80% of the sample companies are inefficient. These results indicate that efficiency of furniture manufacturing companies in Eskisehir can be considerably improved. The mean efficiency level of 0.8302 implies that, on average, the respondents are able to obtain around 82% of potential output from a given mix of inputs. This also implies that around 17% of production, on average, is foregone due to technical inefficiencies.

TABLE 4: Distribution of Technical Efficiency Scores (Maximal potential output from a given input)

Efficiency Score	All Firms Frequency	Percent	Minimum	Maximum
1	6	19.3	1	1
0.90-0.99	6	19.3	0.9004	0.9896
0.80-0.89	8	25.8	0.8012	0-8901
0.70-0.79	5	16.1	0.7084	0.7689
0.60-0.69	4	12.9	0.6103	0.6974
0.50-0.59	1	3.2	0.5023	0.5907
0.40-0.49	1	3.2	0.4601	0.4601
Total	31	100		
Mean	0,8302			
Median	0,8105			

T-test for equality of means shows that the output differences between efficient and inefficient firms are significant at the *p=0.01* level (Table 5). In terms of input use, on average, technically inefficiently firms used lesser learning by doing inputs than efficient ones. The difference in fixed capital amount is highly significant while less significant in the research & development expenditures. There was no significant variation in the inputs of education level and number of employees.

TABLE 5: Comparison of Input and Output Data: Purely Technical Efficient and Inefficient Firms.

Firm Class	Output***	Fixed Phy.Cap. Amounts**	Number of Employees	Human Capital**	Learning by Doing Input***	R&D Expenditures	Education Level
Efficient	1057733	3076733	82	67	9,5	321666,7	9,833333
Inefficient	194528	598708	63,96	25,48	9,2	62400	8,56

*** significant at 1% level, ** significant at 5% level, * significant at 10% level,

CONCLUSIONS

In this study, medium and large-sized companies from furniture manufacturing sector in Eskisehir are selected as the research domain. This preference was influenced by domination of local production in the sector and its high potential of foreign expansion. Within the scope of the research, a database generated based on the information collected through face-to-face interviews with company executives (or with officials designated by them), the financial statements of researched company, and the records of Eskisehir Chamber of Industry. From the companies included into research, the information on year-end endorsement, year-end reserve for amortization, average monthly wage, product development, amount of R&D and technology investment expenditures, total number of employees; numbers of university, vocational school of higher education and vocational high school graduate employees, average number of years worked and average education level of employees are collected as of the end of 2008. The companies were asked to reply the questions on their monetary sizes as of their nominal values, which we later transformed into real values.

In the developed model, a company's total output (endorsement) is given as a function of its total physical capital, total workforce, human capital stock, learning by practice phenomenon, and finally, of its research and development expenditures. On the other hand, while total human capital stock is included into the model through an equation where total physical capital, company size, research & development expenditures and real wage are taken as explanatory variables, the explanatory variables taken for the equation that explains learning by practice phenomenon are the average education level, company size and real wage. At the last equation in the model, research and development expenditures are taken as a function of total physical capital stock, human capital stock and the size of the company. As it may be seen; the human capital stock, learning by practice phenomenon and research and development expenditures, which take place as dependent variables in the model, are given as independent variables in the output function. This indicates that the model is determined simultaneously.

The model that consists of simultaneous equation system is estimated respectively by using least squares (LS) and two-stage least squares (2SLS) methods, in order to avoid any bias that may arise due to the estimating method. According to the estimation results acquired, the human capital stock, learning by practice phenomenon and the research and development expenditures have a linear impact on the company's total output. In this context, the order of learning by practice, human capital, and research and development expenditures, which emerges when sorted by size of coefficients, supports the basic hypothesis of this study. On the other hand, it is understood that, fixed capital stock and size of company becomes prominent in terms of their impact on the human capital, which takes place within simultaneous equation system, and the said variables demonstrate a positive relation with the dependant variable. Likewise, the linear relationship between learning by practice and company size as well as wage level; and between research & development expenditures and company size are the factors that come forth in the explanation of the said dependent variables. The diagnostic tests related to associated equations and estimated coefficients often indicate the statistical consistency of the estimations and statistical reliability of the coefficients. Thus, it is possible to suggest that the hypotheses argued by the model are also statistically supported.

When the foregoing argument and general intensity of small sized enterprises in the furniture sector in our country, as a fact, are combined, based on the example of Eskisehir, a concrete suggestion surfaces: By enabling multiple companies that manufacture a single product to meet with large manufacturers, a main industry - subsidiary industry organization must be made and collaborations must be started with large manufacturers or large marketing companies. It is obvious that this situation will make a crucial contribution to the current ineffectiveness in the research and development expenditures. The said marketing companies must perform the required market research for the product to be manufactured, and ensure presentation of the right product to the right audience by orientating the production planning. For small sized manufacturing companies, partnering to such marketing companies will facilitate the system's functioning and the small sized companies, which typically cannot move alone due to the sectoral structure, will achieve a more effective overseas expansion.

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