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A CROSS SECTION ESTIMATE OF TRANSLOG PRODUCTION FUNCTION: JORDANIAN MANUFACTURING INDUSTRY

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ABSTRACT

The objective of this paper is to examine the substitutability or complementary of labor, capital and materials in four digits, seventy seven Jordanian manufacturing industries by estimating homothetic and nonhomothetic transcendental logarithmic production functions. We find this manufacturing production function to be well-behaved and appropriate for the Jordanian manufacturing sector. The estimated Allen partial elasticities of substitution (AES), and own and cross price elasticities for the three factors show varying degrees of substitutability between them in this sector. Capital-labor substitutability is larger than that for capital-materials and labor-material input mixes. The price elasticities of factor inputs show that capital and labor demands are also more elastic than demand for materials.

Keywords: *Translog function, Substitutability, Factor inputs, Manufacturing*

JEL Classification: *E44, E50, 016*

I. INTRODUCTION

Technology can be represented by production function. Cobb-Douglas and Constant Elasticity of Substitution (CES) production functions place a restriction on elasticity of substitution (Cobb and Douglas 1928), (Arrow, et al. 1961). Alternatively, the generalized Leontief, generalized Cobb-Douglas and Translog functions all are sufficiently flexible. The Translog function allows for variability of Allen partial elasticities of substitution and for using any number of inputs (Berndt and Christensen 1973), (Caves and Christensen 1980). Bernd and Wood, in their estimate of a homothetic, constant returns-to-scale cost function, show that Allen elasticities of substitution (AES) are stable over time, but they are different from one (Berndt and Wood 1975). Christensen and Greene, estimate a nonhomothetic cost function (Christensen and Greene 1976). Bbani Hani and Shamia estimated two-input Cobb-Douglas production functions for the Jordanian industrial sector for the period 1967-86 and found that these functions exhibited decreasing returns to scale over the period of study (Bani Hani and Shammia 1989).

In this paper we introduce the results of an attempt to characterize the structure of technology in the Jordanian manufacturing sector in 2002. The Jordanian manufacturing industries can be considered as the fourth largest sector in Jordanian economy. This paper can be considered as a first attempt to estimate the three-input translog production function for four digits, seventy seven Jordanian manufacturing industries in 2002. In addition, we estimate the partial elasticities of substitution, and own and cross price elasticities of factor inputs. The homothetic and nonhomothetic cost functions had been estimated. Then, our estimates of partial elasticities of substitution and factor cross price elasticities are based on IZEF estimates of a homothetic, symmetric translog cost function and the fitted cost shares of factor inputs.

II. PRODUCTION FUNCTION

The transcendental logarithmic or there-after the translog function is an attractive flexible function. This function has both linear and quadratic terms with the ability of using more than two factor inputs. This function can be approximated by second order Taylor series (Christensen, et al. 1973). The three-input translog production function can be written in terms of logarithms as follows,

$$\begin{aligned} Ln\,Q = \; & \alpha_o + B_K\,Ln\,K + B_L\,Ln\,L + B_M\,Ln\,M + \\ & \tfrac{1}{2}\,B_{KK}\,Ln\,K^2 + B_{KL}\,Ln\,K\,Ln\,L + B_{KM}\,Ln\,K\,Ln\,M \\ & \tfrac{1}{2}\,B_{LL}\,Ln\,L^2 + B_{LM}\,Ln\,L\,Ln\,M + \tfrac{1}{2}\,B_{MM}\,Ln\,M^2 \end{aligned} \tag{1}$$

where Q is the gross manufacturing output, K is real stock of capital input, L is labor input, and M is material input. The parameter α_o is the intercept or the constant term, B_K, B_L, and B_M are first derivatives and B_{KK}, B_{LL}, and B_{MM} are own second derivatives. B_{KL}, B_{KM}, and B_{LM} are cross second derivatives.

Under perfect competition assumption, output elasticity with respect to an input equals to cost share of that input. Thus, we can get a system of equations from differentiating the translog production function with respect to each factor input,

$$\begin{aligned} \partial\,Ln\,Q/\partial\,Ln\,K &= B_K + B_{KK}\,Ln\,K + B_{KL}\,LnL + B_{KM}\,Ln\,M \\ \partial\,Ln\,Q/\partial\,Ln\,L &= B_L + B_{LK}\,Ln\,K + B_{LL}\,LnL + B_{LM}\,Ln\,M \\ \partial\,Ln\,Q/\partial\,Ln\,M &= B_M + B_{MK}\,Ln\,K + B_{ML}\,LnL + B_{MM}\,Ln\,M \end{aligned} \tag{3}$$

where B_K represents the average cost share of capital, B_{KK}, B_{KL}, and B_{KM} represent constant capital share elasticity with respect to capital, capital share elasticity with respect to labor, and capital share elasticity with respect to material input, respectively. B_{MK}, B_{ML}, and B_{MM} are constant material share elasticity with respect to capital, with respect to labor, and with respect to materials, respectively.

The translog production function can be estimated under different nested hypotheses. Therefore, to choose among nested models, we use log of likelihood ratio that approximated by Chi-square, with the number of degrees of freedom equals to number of parameter restrictions (Norsworthy and Malmquist 1983). The hypotheses to be tested are: $H_0: P_{1's} = P_{2's}$ and $H_1: P_{1's} \neq P_{2's}$, where H_0 and H_1 represent the null and the alternative hypotheses, respectively, and $P_{1's}$ and $P_{2's}$ represent parameter estimates from unrestricted and restricted model, respectively. The test statistic is based on the likelihood ratio. This ratio is the maximum value of the likelihood function for the restricted production function to the maximum value of the likelihood function for the unrestricted one. However, this test statistic is based on minus twice the logarithm of the likelihood ratio, -2Ln (R-U), where, Ln R and Ln U represent restricted and unrestricted log of likelihood production function respectively. [1] However, under the null hypothesis, this test statistic is distributed asymptotically as Chi-square distribution with degrees of freedom equal the number of restrictions that we are testing. To choose among nested model we calculate Chi-square. Then, if we obtain a calculated Chi-square less than tabulated one, we accept the null hypothesis and we conclude that restricted model is appropriate to our data. But, if test statistic is greater than critical value of Chi-Square, we reject the null hypothesis and we conclude that the restricted model is inappropriate to our data.

However, we check for symmetry, constant returns to scale, existence of separability, and even for Cobb-Douglas hypothesis (Berndt and Wood 1975), (Norsworthy and Malmquist 1983). Thus, we impose symmetry restriction on parameters,

$$B_{KL} = B_{LK,}$$
$$B_{KM} = B_{MK}$$
$$B_{ML} = B_{LM}\ .$$

For constant returns to scale, we impose the following restriction:

$$B_K + B_L + B_M = 1,$$
$$B_{KK} + B_{LK} + B_{MK} = 0,$$
$$B_{KL} + B_{LL} + B_{ML} = 0,$$
$$B_{KM} + B_{LM} + B_{MM} = 0.$$

And for weak separability, we check whether the linear separability restrictions are satisfied with Jordanian manufacturing data. The linear restriction might be:

$$B_{LM} = B_{MK} = 0$$

Finally, we impose restrictions for existence of Cobb-Douglas,

$$B_{KK} = B_{KL} = B_{KM} = B_{LL} = B_{LM} = B_{MM} = 0.$$

However, if log of maximum likelihood ratio is greater than critical value of Chi-square weak separability is rejected, and we conclude that value added specification is inappropriate to our data. After choosing the appropriate model for our data, we check for positivity of the function. Positivity is satisfied when the fitted cost share of capital, labor and materials are positive. Then, concavity of the function should be checked. Concavity of the function is satisfied if the Hessian determinant of IZEF parameter estimates is negative semidefinite (Berndt and Wood 1975).

Finally, we can measure the curvature of isoquant by estimating Allen partial elasticities of substitution (AES). However, it is possible to get AES for pair of factor inputs. It will be estimated from translog production function by the formula,

$$\sigma_{ij} = \frac{\sum f_i \ x_i \ |B_{ij}|}{x_i \, x_j \quad |B|} \qquad (4)$$

Where i and j represent inputs and they are different, $i \neq j$. f_i,| B | is and $|B_{ji}|$ are the first derivative, the determinant of bordered Hessian of the estimates, and the cofactor of the B_{ji}

parameters respectively. By Shephard duality, we can get ASE from estimated parameters of cost function and fitted estimated cost share of inputs as follows,

$$\sigma_{ij} = (\gamma_{ij} + S_i S_j) / (S_i S_j)$$
$$\sigma_{ii} = (\gamma_{ii} + S_i^2 - S_i) / (S_i^2). \quad (5)$$

where γ_{ii} represent the estimated second order derivatives on the diagonal of Hessian Matrix. γ_{ij} is parameter estimated of constant elasticities of cost share with respect to price of factor input service; and S_i and S_j represent fitted cost share of inputs (Christensen, et al. 1971), (Diewert 1971), (Uzawa 1962). Thus, we can recognize the existence of complementary or substitutability among factor inputs of production.

Factor price elasticities are related to AES as we see below:

$$\zeta_{ij} = (\gamma_{ij} + S_i S_j) / S_i$$
$$\zeta_{ii} = (\gamma_{ii} + S_i^2 - S_i) / S_i \text{ where } _{i \text{ and } j} \text{ are } _{K,L,} \text{ and } _{M.} \quad (6)$$

We should remember that, in general, $\zeta_{ij} \neq \zeta_{ji}$.

III. THE CROSS SECTION DATA

The main sources of data for Jordanian manufacturing are the Department Of Statistics (DOS), and the Central Bank Of Jordan (CBJ) (Office of Industrial Statistical-DOS 2002), (Office of Studies and Research -CBJ 2002). However, we have got data on gross output, which is the sum of output from main activity and subsidiary activities. The output from main activity is the sum of domestic sales, exported output, and inventory change. Output from subsidiary activities includes trade margins, and services rendered to others such as industrial services, men taints, building rents, machines and equipment rents, transportation services and other services. We have also obtained gross value added by economic activity which is included, and taxes on production in thousands of Jordanian Dinar (JD). Additionally, we have obtained data on number of workers, capital stock, depreciation of capital, and total fixed capital formation. Furthermore, we received data on compensation of employees by economic activity which included wage and salaries, enterprise contribution to social security and other benefits. We derived the operating surplus by subtracting compensation of employees from gross value added minus tax.

Data on intermediate goods and services used in production have been obtained. The intermediate goods data include the raw materials, water, electricity, fuel, spare parts packing materials, disposable tools, oil and lubricants, stationery and other goods. The intermediate service data include building rent, machinery and equipment rent, telecommunications, computer services, maintenance of transport vehicles, advertisement, accounting services and other services.

Data on price of labor can be obtained from dividing compensation of employees on number of workers. Then, by dividing the operation surplus on stock of fixed capital, we derive the price of capital services. Finally, we obtained a price index for material input from DOS.

IV. ESTIMATION OF PRODUCTION FUNCTION

To obtain the values of estimates for three-input manufacturing symmetric translog production, we have to estimate the system of share equations (3). This can be done by OLS, whereas a greater efficiency might be obtained by using Zellner Efficient (ZEF) estimation. Therefore, we drop one of the three equations and we estimate only two equations. But the problem with ZEF arises when we arbitrarily drop one of the equation in system (3), where the estimates may not be invariant with respect to the deleted equation. Thus, to avoid this problem we iterate ZEF until the estimates converge to the maximum likelihood ML estimates (Kmenta and Gilbert 1968).

However, we use IZEF to estimate the symmetric translog production function. Then, we check for various hypotheses such as constant returns to scale, weak separability with linear separability restrictions, and Cobb-Douglas hypothesis. We find that log of likelihood ratios to equal to 54.34, 70.70, and 100.14 for constant returns to scale, weak separability and Cobb-Douglas hypotheses, respectively. While, the 0.01 critical values of Chi-square are 13.24, 11.34 and 16.81 for constant returns to scale, weak separability, and Cobb-Douglas hypotheses, respectively. Thus, we reject the null hypotheses, and we conclude that constant returns to scale, value added specification, and Cobb-Douglas hypothesis are not satisfied with Jordanian manufacturing data.

Table 1 shows IZEF estimates of three-input Jordanian manufacturing symmetric translog production function. The raw moment R-squares for capital and labor cost share are 0.87, and 0.94 respectively. The estimates of translog production and cost functions, under different hypotheses, have been introduced in Tables 4 and 5 located in the appendix.

Table 1
IZEF estimates of Jordanian Manufacturing Translog Production Function*

Parameter	*Estimates*	*Parameter*	*Estimates*
B_K	0.1778	B_{KM}	-0.0237
	(14.498)		
B_L	0.0810		0.0198
	(13.291)	B_{LL}	(2.883)
B_M	0.7413	B_{LM}	-0.0253
B_{KK}	0.0181	B_{MM}	0.0490
	(2.812)		
B_{KL}	0.0056		
	(1.018)		

(*) asymptotic t-ratio in parentheses

Now, let us check for *positivity* and *concavity* of the function. For positivity, we find that fitted cost shares of capital, labor and materials are all positive at each data point. Next, we check for concavity of production function, and we find that Hessian matrix, based on IZEF parameter estimates, is negative semidefinite (Berndt and Wood 1975). Thus, we can say that production function is well behaved for manufacturing industrial data of 2002.

In measuring substitutability of factor inputs, we compute AES by using (5). In addition, we calculate factor cross price elasticities by using (6), where we use fitted cost share of inputs and estimates of symmetric translog cost function in our estimations. However, our estimates of AES and ζ_{ij} and ζ_{ji} are presented in Tables 2 and 3. Some important conclusions can be drawn from these tables. (i) The negative sign of AES 's ($\sigma_{KK,}$ σ_{LL} and σ_{MM}) at each data point indicates that isoquant is convex to the origin, and there is no problem with concavity of the function. (ii) The arithmetic mean of seventy seven estimates of σ_{KL} between capital and labor in Jordanian manufacturing industry is 1.25 with absolute variance equals to 0.030 and coefficient of variation of 0.139 (Norsworthy and Malmquist 1983). So, σ_{KL} is close to be constant but it is significantly different from one. This result is similar to that of Berndt-Wood, where the estimated σ_{KL} are rather stable over the time period 1947-71. We also find that factor input cross price elasticities, ζ_{KL} and ζ_{LK}, are about 0.17 and 0.25, respectively. (iii) Capital and material are slightly substitutive. Where, average σ_{KM} is 0.82 with variance and coefficient of variation equal to 0.001 and 0.035, respectively. Factor input cross price elasticities ζ_{KM} and ζ_{MK} are 0.53 and 0.17 respectively. (iv) The average of σ_{LM} is equal to 0.70 with variance of 0.009 and coefficient of variation equals to 0.139. The factor input price elasticities, ζ_{LM} and ζ_{ML}, are 0.45 and 0.10, respectively. (v) It is clear, that σ_{KM} is less variant than σ_{KL} and σ_{LM}. (vi) σ_{KM} is about two thirds of σ_{K}, and σ_{LM} is about eighty five percent of σ_{KM} and about fifty five percent of σ_{LM}. However, in Table 6 we introduce only thirty estimates of AES out of seventy seven estimates. In Table 7, we also introduce estimated cross price elasticities for selected manufacturing industries.

Table 2
IZEF Allen Elasticity of Substitution for Jordanian Manufacturing Industry(*)

Elasticity	*Estimate*	*Elasticity*	*Estimate*
σ_{KK}	-3.62	σ_{KL}	1.25
σ_{LL}	-5.55	σ_{KM}	0.82
σ_{MM}	-0.43	σ_{LM}	0.70

(*) Each estimate represents an arithmetic average of 77 estimates of Elasticity of substitution.

Table 3
IZEF Factor Input Price Elasticity for Jordanian Manufacturing Industry(*)

Elasticity	*Estimates*	*Elasticity*	*Estimates*
ζ_{KK}	-0.70	ζ_{LK}	0.45
ζ_{LL}	-0.70	ζ_{LM}	0.26
ζ_{MM}	-0.27	ζ_{MK}	0.17
ζ_{KL}	0.17	ζ_{ML}	0.10
ζ_{KM}	0.53		

(*) Each estimate represents an arithmetic average of 77 estimates of own and cross price elasticity of factor inputs.

V. SUMMARY AND CONCLUSIONS

Our objective has been to estimate a translog production function and show its internal structure for four digits Jordanian manufacturing industries in a point of time. We estimate parameters that represent the average cost share of inputs and the elasticities of cost share of input with respect inputs. In addition, we have checked for positivity, concavity, substitutability and separability of inputs. Our main conclusions are: (a) After testing for different hypotheses we find that three-input symmetric tanslog production function is appropriate for examining Jordanian manufacturing industry in 2002. (b) The Jordanian translog production function is well-behaved. (c) Capital-labor substitutability is larger than that for capital-materials and labor-material input mixes. (d) Allen partial elasticities of substitution are almost constant, but they are significantly different from one.

APPENDIX

Table 4
IZEF Translog Production Function Estimates-Jordanian Manufacturing 2002(*)

Parameter	*Unrestricted*	*CRS*	*Weak Separability*	*Cobb-Douglas*
B_K	0.1778	0.026	0.2062	0.20561
	(14.498)	(14.149)	(12.375)	(19.139)
B_L	0.0810	0.1377	0.0966	0.1377
	(13.291)	(14.073)	(10.600)	(17.666)
B_M	0.7413	0.6567	0.6972	0.6567
B_{KK}	0.0182	0.0512	0.01575	
	(2.812)	(3.683)	(2.170)	
B_{KL}	0.0056	0.0112	-0.0319	
	(1.018)	(1.990)	(-6.246)	
B_{KM}	-0.0237	-0.0624		
B_{LL}	0.0198	0.0264	0.0182	
	(2.883)	(5.918)	(2.825)	
B_{LM}	-0.0253	-0.0376		
B_{MM}	0.0490	0.10000		
$R^2_{K.}$	0.8679	0.8640	0.8175	0.8282
$R^2_{L.}$	0.9354	0.8766	0.8784	0.8042
LLF	224.85	197.68	189.50	172.78

(*) asymptotic t-ratio in parentheses

Table 5
IZEF Translog Cost Function Estimates-Jordanian Manufacturing 2002(*)

Parameter	*Unrestricted*	*CRS*	*Weak Separability*	*Cobb- Douglas*
γ_K	0.1383	0.2056	0.1859	0.2056
	(11.079)	(8.957)	(12.532)	(19.139)
γ_L	0.0808	0.1377	0.1022	0.1377
	(8.025)	(11.621)	(10.628)	(17.667)
γ_M	0.7809	0.7413	0.7119	0.6576
γ_{KK}	0.0705	0.0501	0.0072	
	(7.710)	(5.320)	(1.407)	
γ_{KL}	0.0223	0.0037	-0.0072	
	(3.377)	(0.538)	(-1.407)	
γ_{KM}	-0.0929	-0.0537		
	(-8.552)	(-4.303)		
γ_{LL}	0.0170	-0.0033	0.0072	
	(1.439)	(-0.255)	(1.407)	
γ_{LM}	-0.0393	-0.0033		
	(-2.974)	(-0.027)		
γ_{MM}	-0.0971	0.0496		
γ_{YK}	0.0827	0.0602	-0.0090	
	(7.054)	(4.082)	(-1.416)	
γ_{YL}	0.0144	-0.0106	-0.0248	
	(1.120)	(-0.705)	(-6.069)	
γ_{YM}	-0.071	0.0496		
R^2_K	0.9140	0.8755	0.8428	0.8282
$R^2_{L.}$	0.8776	0.351	0.8623	0.8042
LLF	215.88	192.17	189.159	172.77

(*) asymptotic t-ratio in parentheses

Table 6
IZEF Estimated Elasticities of Substitution Translog Cost Function for Thirty Selected Jordanian Manufacturing Industry

Economic Activity	*ISIC*	σ_{KK}	σ_{LL}	σ_{MM}	σ_{KL}	σ_{KM}	σ_{LM}
Production, Processing, and Preserving of Meat and Meat Product	1511	-3.70	-7.51	-0.30		0.83	0.62
Manufacturing of Soft Drink; Production of Mineral Water	1554	-2.86	-5.25	-0.48	1.19	0.84	0.70
Preparation and Spinning of Textile Fibber; Weaving of Textiles	1711	-3.59	-6.55	-0.34	1.29	0.82	0.67
Manufacturing of Made-up Textile Articles,	1721	-4.40	-3.50	-0.46	1.19	0.77	0.80
Manufacturing of Wearing Apparel, Except Fur Apparel	1810	-3.16	-3.51	-0.58	1.14	0.81	0.78
Manufacturing of Luggage, Handbags and the Like, Saddler and Harness	1912	-3.26	-2.59	-0.72	1.11	0.79	0.81
Manufacturing of Footwear	1920	-2.29	-3.95	-0.57	1.15	0.83	0.76
Sawmilling and Planning of Wood	2010	-3.84	-4.63	-0.41	1.22	0.80	0.75
Manufacturing of Wooden Containers	2023	-2.86	-3.24	-0.67	1.12	0.82	0.78
Manufacturing of Pulp, Paper and Paperboard	2101	-3.62	-6.01	-0.36	1.27	0.82	0.69
Manufacturing of Publishing of Newspapers Journals and Periodicals	2212	-3.25	-4.75	-0.46	1.19	0.82	0.74
Manufacturing of Refined Petroleum Product	2320	-9.91	-7.76	0.07	2.04	0.65	0.72
Manufacturing of Basic Chemicals, except Fertilizers and Nitrogen Compounds	2411	-2.70	-7.54	-0.41	1.27	0.85	0.59
Manufacturing of Fertilizer and Nitrogen Compounds	2412	-6.19	-6.55	-0.08	1.49	0.77	0.73
Manufacturing of Plastic in Primary Forms and of Synthetic Rubber	2413	-3.02	-5.75	-0.43	1.22	0.84	0.69
Manufacturing of Rubber Tires and Tubes; Retreating and Rebuilding of Rubber Tiers	2511	-3.29	-4.94	-0.44	1.20	0.82	0.73
Manufacturing of Plastic Products	2520	-3.85	-6.54	-0.32	1.31	0.82	0.67
Manufacturing of Glass and Glass Products	2610	-2.91	-4.86	-0.50	1.18	0.83	0.72
Manufacturing of Non-structural and Non-refractory Ceramic Ware	2691	-2.76	-4.26	-0.57	1.15	0.83	0.74
Manufacturing of Structural Non-refractory Clay and Ceramic Product	2693	-2.88	-4.39	-0.54	1.16	0.83	0.74
Manufacturing of basic iron and steel	2710	-4.09	-8.97	-0.25	1.48	0.82	0.55
Manufacturing of Structural Metal Products	2811	-3.93	-4.10	-0.44	1.20	0.80	0.77
Treatment and Coating of Metals, General Mechanical Engineering on a Fee or Contract Basis	2892	-2.23	-2.91	-0.89	1.09	0.83	0.77
Manufacturing of Agricultural and Forestry Machineries	2921	-6.36	-7.90	-0.18	1.63	0.74	0.64
Manufacturing of Domestic Appliances,	2930	-3.57	-5.43	-0.39	1.24	0.82	0.72
Manufacturing of Electronic Motors	3110	-3.62	-6.36	-0.34	1.28	0.82	0.67
Manufacturing of Medical and Surgical Equipments and Orthopedic Appliances	3311	-2.70	-4.08	-0.59	1.14	0.83	0.75
Building and Repairing of Pleasure and Sporting Boats	3512	-3.15	-4.01	-0.53	1.16	0.82	0.76
Manufacturing of Furniture	3610	-3.53	-3.99	-0.49	1.18	0.81	0.77
Manufacturing of Jewelry and Related Articles	3691	-4.48	-4.95	-0.34	1.27	0.79	0.75

Table 7
IZEF Estimated Cross Factor Price Elasticities Translog Cost Function for Selected Thirty Jordanian Manufacturing Industries

Economic Activity	*ISIC*	ζ_{KL}	ζ_{KM}	ζ_{LM}	ζ_{LK}	ζ_{MK}	ζ_{ML}
Production, Processing, and Preserving of Meat and Meat Product	1511	0.12	0.59	0.44	0.25	0.16	0.06
Manufacturing of Soft Drink; Production of Mineral Water	1554	0.16	0.52	0.44	0.28	0.20	0.10
Preparation and Spinning of Textile Fibber; Weaving of Textiles	1711	0.14	0.57	0.46	0.25	0.16	0.07
Manufacturing of Made-up Textile Articles,	1721	0.24	0.49	0.51	0.19	0.13	0.16
Manufacturing of Wearing Apparel, Except Fur Apparel	1810	0.23	0.47	0.45	0.25	0.18	0.16
Manufacturing of Luggage, Handbags and the Like, Saddles and Harness	1912	0.28	0.42	0.43	0.24	0.17	0.21
Manufacturing of Footwear	1920	0.20	0.48	0.44	0.27	0.20	0.14
Sawmilling and Planning of Wood	2010	0.19	0.53	0.49	0.22	0.15	0.12
Manufacturing of Wooden Containers	2023	0.24	0.45	0.43	0.27	0.20	0.17
Manufacturing of Pulp, Paper and Paperboard	2101	0.15	0.56	0.47	0.24	0.16	0.08
Manufacturing of Publishing of Newspapers, Journals and Periodicals	2212	0.18	0.52	0.47	0.25	0.18	0.11
Manufacturing of Refined Petroleum Product	2320	0.17	0.67	0.74	0.13	0.04	0.07
Manufacturing of Basic Chemicals, Except Fertilizers and Nitrogen Compounds	2411	0.12	0.56	0.38	0.31	0.21	0.05
Manufacturing of Fertilizer and Nitrogen Compounds	2412	0.16	0.67	0.64	0.17	0.09	0.08
Manufacturing of Plastic in Primary Forms and of Synthetic Rubber	2413	0.15	0.54	0.44	0.27	0.19	0.09
Manufacturing of Rubber Tires and Tubes; Retreating and Rebuilding of Rubber Tiers	2511	0.17	0.53	0.47	0.25	0.18	0.11
Manufacturing of Plastic Products	2520	0.14	0.58	0.47	0.24	0.15	0.07
Manufacturing of Glass and Glass Products	2610	0.17	0.51	0.44	0.27	0.20	0.11
Manufacturing of Non-structural and Non-refractory Ceramic Ware	2691	0.19	0.49	0.43	0.28	0.21	0.13
Manufacturing of Structural Non-refractory Clay and Ceramic Product	2693	0.19	0.50	0.44	0.27	0.20	0.12
Manufacturing of Basic Iron and Steel	2710	0.11	0.61	0.41	0.25	0.15	0.04
Manufacturing of Structural Metal Products	2811	0.21	0.51	0.50	0.21	0.15	0.14
Treatment and Coating of Metals, General Mechanical Engineering on a Fee or Contract Basis	2892	0.25	0.39	0.37	0.31	0.24	0.18
Manufacturing of Agricultural and Forestry Machineries	2921	0.14	0.59	0.51	0.18	0.09	0.06
Manufacturing of Domestic Appliances,	2930	0.16	0.55	0.48	0.24	0.16	0.10
Manufacturing of Electronic Motors	3110	0.14	0.57	0.47	0.25	0.16	0.08
Manufacturing of Medical and Surgical Equipments and Orthopedic Appliances	3311	0.20	0.48	0.43	0.28	0.21	0.13
Building and Repairing of Pleasure and Sporting Boats	3512	0.20	0.49	0.46	0.25	0.18	0.14
Manufacturing of Furniture	3610	0.21	0.50	0.48	0.23	0.16	0.14
Manufacturing of Jewelry and Related Articles	3691	0.18	0.55	0.52	0.20	0.13	0.11

Note

1. There are two alternative tests that can be used for testing hypotheses, Wald test, and Lagrangian Multiplier test.

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