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Structural Changes and Productivity Trends: Evidence from Jordan's Manufacturing

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Abstract

This paper examines the impacts of innovations, structural changes, technological changes, FDI, investment, and the effect of treaty and regulations of World Trade Organisation (W.T.O) on economy in an Arab country: Jordan. The data series were collected from different sources for the period from 2001 to 2014. The data of inputs and outputs were transferred to logarithm. Translog (Transcendental Logarithmic) method used an estimated series by least square time series (LST), once with dummies of industries and other times, without a Translog production function. The other model is utilised in the analysis of data such as fixed effects and random effects to estimate the (KLAMS) function. Then, LML (Limited Maximum Likelihood) method to capture the coefficients of productivity manufacturing industries in Jordan and estimate the coefficients of independent variables such as chemical and fertilizer, petroleum and service sectors among other variables of production function. Positive relationship remarked the signs of innovation and technology. Total Factor Productivity (TFP) and W.T.O. were tagged time.(t-1) is used to show the impact of the total gross productivity on these variable, the elasticity for these variables sometimes is too weak and in some cases, close to one. It means that capital and labour demands are more elastic than demand of materials, foreign direct investment (FDI) and innovations and structural changes. Hence, the paper presents an alternative set of estimates of TFP growth of Jordan manufacturing industry, the water demand increased in the period of the study within 8 percent while the industrial productivity increased 5.5 percent as a compound average. To sum up, fixed effects are acceptable more than random effects in Jordan industries series.

Keywords: Total factor productivity, Translog production function, Jordan.

Jell classification: D_2 / D_{24}.

1. Introduction

Productivity signifies the measurement of how well an individual entity uses its resources to produce outputs from inputs. Productivity, as suggested by Portas and AbouRizak (1997), focuses on the individual labour productivity which is estimated by using combination of analytical techniques and personal judgment. Workers, on the other hand, have other estimates which are obtained through direct interaction with a scheduler, the site manager or related sub contractors who are knowledgeable enough to reflect the actual condition of project and its constituent. The productivity growth rates in services industries in the period 1947 to 1974, as found by Griliches (1994), were higher than productivity growth rates in manufacturing industries. This can be attributed to innovation. Innovation means some improvements in productivity and organisations' input and output based on acts. Kongsamut, *et al*. (1997) confirmed that innovative organisations have introduced improvements to existing products rather than entirely new goods and services. Kongsamut, *et al*. (1997) found positive relationship between the per capita income and the intensity of use of services in manufacturing industries. In the production organisations, process service depends on: a) the relative cost of in –house provision of service as against their procurement from outside agencies which in the organisations, culture of employment and type of technology; b) the pressure on the organisation to rise affected reduction in cost and improved competitiveness which depends on the domestic and international competition; and c) available services which depend on the level of development of the service sector in the economy beyond the management plans of the organisations.

Flores, *et al*. (2004) suggested new characteristic of the service economy; a) the analysis represents the major share of developed economies and are increasingly integrated in the overall production system; b) the creation of employments added value and income is increasingly related to good performance of economies of services; and c) they played a more active role in market integration and globalisation. This means that there is a role of services in economic growth and productivity. Nowadays, all highly industrialised countries have become service economies. Some researchers (e.g., Schettkat, 2004; Tocarini, 2005; Bosworth and Tripeltt, 2001; Rubaicaba, 2007) suggested that Baumol's hypothesis may still hold validity for the service sectors as such. Growth and development of services, as suggested by Messina (2004) and OCED (2005a), might be based on human capital. OCED (2005a) added that production in the tertiary sector has a higher amount of qualified labour than in manufacturing sector. Stanback (1979) explained that management consultants have been associated with the accumulation of expertise and specialisation processes. Wood (1991) added that competitive pressures associated with market globalisation have changed the relationships among organisations, thereby increasing the need for modernisation and promoting interaction.

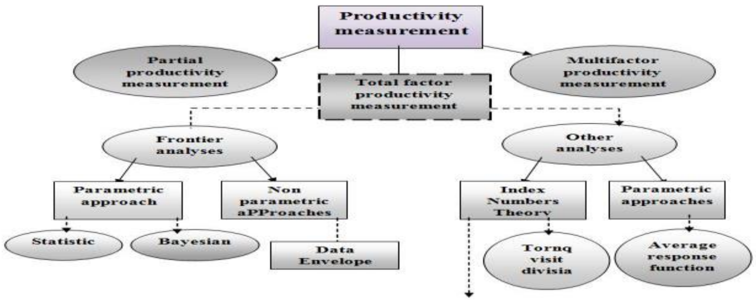
Echevarria (1979); Kongssamut, *et al*., (1997); Xu (1994) and Kozicki (1997) assumed a standard in multi-sector growth models that service sector exhibits lower productivity growth than other manufacturing industries. Bontelsman, *et al*., (2005) and Hsieh and Klenow (2009) focused on the dispersion in TFP across organisations; the former for the arrangement of advanced and semi industrial economies and the latter for China and India. Hsieh and Klenow (2009) found that 50 percent of the gap in manufacturing TFP, would be closed the excess dispersion in plant productivity were removed. There is a parallel between many studies, they attempted to capture the finer details of misallocation with individual sectors and cross organisations but a compensating variable may able to track the general equilibrium effects of reallocation. Diewert and Nakamura (2009) suggested that the bias to the input price index will be proportional to the growth in share captured by the low cost supplier and the percentage discount offered by the low-cost supplier. Diewert and Nakamura (2009) continued that growth in the input price index is overstated, productivity and real value added will also be observed.

Feenstra, *et al*., (2009) who documented the effect of various biases in published statistics for aggregate output of measurement problems, which are tantamount to under reported term of trade gains, create a significant upward bias to measured output and TFP growth in the U.S.A. Changes in the industrial activity (production effects), changes in the structural of production output over time (the structural effects), and changes in energy efficiencies of individual industries. Comparison the linkages between decomposition methods and economic index number can be stated for Jordan that analysed current and future energy requirement for different sectors and industries (Abdalat, *et al.*, 2011). When investigating the consumption of energy of Jordanian industrial sector, the paper showed that the main driver behind the energy demand increase between 1998 – 2005 was the rapid increase in industrial production output. However, implying innovation, technical changes, diffusion and adaptability to more efficient technologies and the structural changes in the industrial sector have been countered this rapid increase. Hanibbaani and Shania (1989) estimated two inputs, Cobb-Douglas production function for Jordanian industrial sector 1957 – 1985. Hanibbaani and Shania found that production function were decreasing returns to scale over the period of study.

2. Literature Review

Productivity is defined as the quantity of output that can be produced by using a given level of inputs (Goldar and Anita, 2004). Despite that such a definition has no presumption of efficiency in production, the relationship between output and the level of inputs using a production function can be express as: $Q= AK^{a} L^{B}$ (1): Where: Q is output, K is the capital stock level and L is labour. A is the overall level of productivity which may vary a cross entities. Total Factor Productivity (TFP) is expressed as: TFP = $a_{it} = a_{it} + ac_{it} + Bl_{it}$ (2); (i= entity, t= time). Two approaches are used to estimate the parameters A and B. The first assumes the input markets are competitive, which implies that the coefficients are the share of revenue received by each variables. The second assumes that coefficients are constant across entities and is estimated via regression. Innovation, meanwhile, is transformed from TFP to its input. Universal productivity indicators have aimed to work out with concept of TFP measures; partial and TFP measures are represented in Figure (1).

Figure (1):Measures of Productivity Methodological Approaches



Source: Growth and productivity in the service sector the state of the art Universidad de Al Calâ - Andtes moroto-sanchez working paper 07/2010.

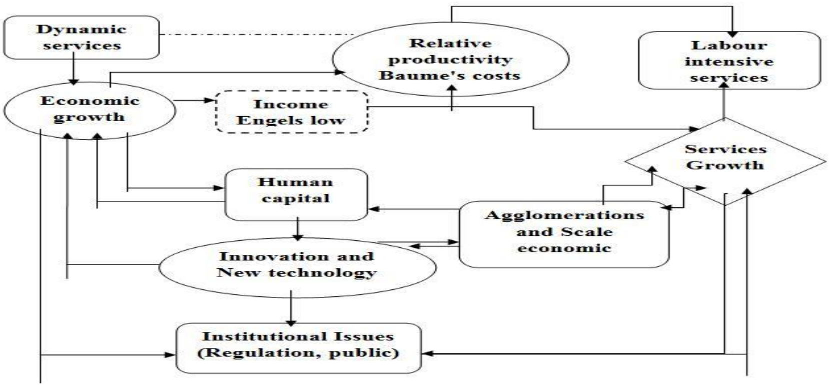
The innovation activity is calculated through directed towards new products and product improvement, the demand equation to allow the knowledge stock to shift the demand curve facing the organisation is: Qit = APit + π kiţ π > 0. Assuming the knowledge stock has a positive coefficient implies that the effect of increased knowledge or innovative activity. Two channels can be measured productivity growth, one is directly increasing the efficiency of production, and indirectly shifting the demand curve for the organisations products outward (η is negative). The analysis of supply side sources of growth of Jordan manufacturing is based on a KLEMS production function estimated by panel data procedure. The equation is: Qit = f(kit, Lit, Eit, M it, Sit; Ait,). Where: E: energy, M: material, S: services, i: industry, t: time and Ait represents technology. Inter industrial and inter temporal aviation in total (factor productivity are incorporated into the production function a Cobb-Douglas term represents the efficiency Ait has been specified as exp (Ci) + exp (Nt), then logarithmic transformation is used.

Therefore the production function can be as follows: $L_n (Q_{it}) = a_{it} + a_1 Ln (L_{it}) = \varsigma t + a_2 \ln k_{it} + \propto \ln M + \sigma \ln E_{it} + \theta \ln S_{it} + \sum_{it}$ (5). As depicted, the aggregate share of imported intermediate goods has increased in Jordan trade from 20 percent to 45 percent over the period of this study, driven up largely by increasing the detailed product data underlying the aggregate shares. Thus, the share of countries accruing is determined at which countries expense through the data of Jordanian trade, intermediate share is growing faster than domestic share. Implying that advanced input share is falling as well as other developing countries after 2007, most of the actions involve the shifting from domestic sources to developing and intermediate foreign sources. Since there are no direct data sources for this discount spanning the large number of industries of Jordan. Specifically, the price changes were computed when a given organisation switches providers to a new source country of imported goods and services, the structural approach is to adjusted the relative prices for compositional quality differences and the true rate of price increase at the elemental level may be combined.

The services sector in Jordan has grown faster than the tradable goods sector (manufacturing, agriculture and mining) during the last 30 years. This growth is attributed to traditionally slower of the agriculture sector that underlies the conventionally excepted structural transformation from agriculture to manufacturing. However, the rate of growth of services accelerated above that the manufacturing and the growth rate; gap has widened in 2005 – up to 2009. In this study, the aspects analysed are the prospects of a sustained, rapid growth of the service sector, and put forward arguments in favours or against that possibility of an empirical assessment of the growing importance of service input in manufacturing sector, and the contribution made by services to manufacturing output growth and productivity.

The growth rate, as reported by Chenery (1950), is associated with increasing share of services in GDP, investment and employment. The growing recognition that services procured organisations is increasingly becoming an important input to manufacturing industries. Apart from the existence of public services and the management of services in liberalisation processes, public regulations in Jordan can be recreated, then, set a growth variable for some services, such as professional services and the private organisations which have also undergone social changes that have boosted the growth of specific services. To sum up, four types of essential changes are distinguished as group variables affecting the growth of productivity; a) changes in production variables mainly labour and human capital, b) changes in productive system such as flexibility and integration goods and services), c) changes in markets and income and d) changes in institutional systems (public services, regulations, cultural and social changes). For each of these variables, three decisive elements of current societies interact. The relationship between services and economic growth is shown in Figure (2).

Figure (2):The relationship between economic growth and the services



The Figure can become standard in multi-sector growth model to assume that the service sector exhibits lower productivity growth than the manufacturing one. The effect of an expansion of the services sector depends on which services are expanding; such as personal and social services.

Industry plays a key role in the process of modernisation and economic development as it provides the frame work within which national resources and variables of production are utilised. Jordanian industry has also developed a significant degree of diversity. Amman Chamber of Commerce classifies it as associate range of productive activities in to 10 subsectors, such as; the mining of national resources, engineering and manufacturing industries that provide products to meet consumer needs and other requirements. The used industrial water includes water used to manufacture products such as steel, chemical, and paper, as well as water used in petroleum and metals refining. Industrial water use activities include water with drawls from ground and surface water and deliveries from public water suppliers. The total gross output in the industrial sector was estimated at about J.D 10 bn. The intermediate consumption is about is about J.D 5.5 bn, therefore the estimated gross value added is about J.D 4.9 bn, the operation surplus of Jordanian industries amounted to about J.D 1.9 bn in the average period of 2009-2010.

Table (1): Economic indicators for Jordanian industries in 2014

Economic indicators	Mining and quarrying	Manufacture of food products	Industries	Total Economy
• Gross output (MD)	895	1.489	10.174	20.854
• Intermediate consumption	277	1.055	5.500	11.011
• Gross value added (TUD)	519	424	4574	9.852
• Compensation of employees	74	111	744	2.719
• Intermediate consumption of goods (MD)	145	970	5.941	8.254
• Other production expenditure (MD)	141	95	585	2.815
• Depreciation (MD)	44	44	442	947
• Taxes on production	58	92	578	1.444
• Net value added (MD)	577	480	4.441	8.905
• Operation surplus (MD)	445	177	1.908	4.754
• No of employees	7.444	44497	182.880	749.271
• No of paid employees	7.150	40.445	158.544	590.970
• Water costs (1000JD)	8.595	5.579	48.041	59.545

Source: CBJ (2014). Monthly Statistical Bulletin.

As shown in Table (2), Jordan's industries consumed approximately 47.4 mcm of freshwater according to an estimation based on water bills and a tariff of JD 1/m^2 in 2011. The water price in mining and quarrying is JD 0.48/m^4 and for chemical and fertilizer is 0.25 JD/m^4 which is equivalent to ground water abstraction costs.

Table (2): The usage of water in industries

Economic Activity	Water usage /m4
• Manufacture of tobacco	142.044
• Manufacture of machinery for food beverage	844
• Manufacture of machine tools	1.500
• Manufacture of Agriculture and forestry machinery	4.457
• Manufacture of other non metallic mineral products	85.257
• Cutting, shipping and finishing of stone	1.214.900
• Manufacture of articles of concrete and plaster	4.580.400
• Manufacture of fertilizer and nitrogen compounds	4.512.944
• Quarrying of stone and clay	2.414.744
• Extraction of cruds petroleum	8.900

Source: CBJ 2014. Monthly Statistical Bulletin

By assuming no intervention to curtail water demand

Table (3) showed that the future water demand of industry increased by 24 percent in 2030 and 19 percent in 2040 while Jordan was suffering from shortening of water in 2014.

Table (3): The demand of water in future in mn/m^4

Sector	2020	2030	2040
• Agriculture	10.149	1.155	1.245
• Industry	58	214	272
• Truism	9	11	17

Source: Analysis of data

The sheer scale of the contribution of structural changes to this reversal of fortune has been marked by microeconomic research that record significant productivity gains for individual plant or industries. Law structural changes has made also little contribution to the overall growth in labour productivity in high income countries. The curious pattern of growth-reducing structural changes that was observed for Latin America, however, was reported in the case of Africa and Asia. This becomes from flows of labour from traditional to modern parts of the economy to be an important driver of growth. There is, however, a large gap in labour productivity between the traditional and modern parts of the economy are a fundamental reality of the society in Jordan. They key promise of globalisation was that access to global markets and increased competition would drive an economic resources towards more productive use, enhance a locative efficiency, as trade barriers have come down, industries have rationalised, up graded and become more efficient. Table (4) reveals three observations in Jordan's economy.

Table (4): Trends of the economy of Jordan

	Economic wide labour productivity	Sector with high labour productivity	Compound annual Growth %
• 1990-2005	19.735	Min/services	3.2
• 2006-2014	21.584	Min/services	2.5

Source: CBJ (2015)

The results suggest that the labour production growth has increased from 2.4 in 2013 to 4.1 in 2014. The compound annual growth, on the other hand, has grown from 0.52 in 2013 to 0.71 in 2014. Energy consumption in Jordan was 4.802 x 10^5 To E, and distributed between three major sectors, transportation, industrial and residential, the consumption is shown in table (5), which shows that industrial sector has the second largest consuming sector.

Table (5): Sectoral distribution of the final energy consumption (2001-2019)

Year	Final energy Transport %	Consumption industrial %	House hold %	Other %
2001	48.2	22.4	24	15.4
2005	47	22.1	21.7	15.7
2009	45	24.5	24.2	17.2
2011	45	24.8	24.8	15.4
2014	44.2	25.2	25.1	15.5

Source: Analysis of data

As shown in the table, the consumption was distributed mainly between three sectors whose growth rate of consumption with low movements ratio percentage is slow moving but the quantity of energy consumption growth by 5.9 percent the growth in energy demand can be decomposed into production, structural, and efficiency variable, these variables vary with time.

Table (6): Energy demand decomposition in industrial sector

Effects	2005	2010	2014
• Production	51.554	59.847	54.941
• Structural	- 14.514	- 12.415	- 14.548
• Efficiency	- 27.512	- 24.544	- 22.415

Source: Analysis of data

The most important variable that has shaped the industrial energy demand in Jordan was the production effect. However, the decrease in the energy intensity countered this increase in demand.

Table (7): Share of energy use and annual growth rate of industries

Industry	2001	2005	2009	2014	Compound annual growth %
• Mining	15.7	19.4	17.4	15.5	- 0.44
• Paper	4.3	4.5	3.9	3.5	- 0.45
• Plastic	3.4	3.4	3.1	1.9	1.3
• Petroleum	15.4	15.4	17.9	15.4	1.4
• Iron and Steel	4.5	4.7	4.5	5.4	4.1
• Cement	35.1	35.2	27.4	35.1	3.5
• Others	44.4	39.5	3.5	37	---

Source: Analysis of data

As the results, Table (7) shows that all types of industries have a low annual growth in the period of this study; this means that many technical adaptations have been pointed out and industrial sectors gained improvements in energy efficiency over time in Jordan industries.

Table (8): Shares of value added and Average annual growth (%)

Industry	2001	2005	2009	2014	% Average annual growth
• Mining	14.5	12.4	14.2	11.8	7.8
• Paper	2.4	2.2	2.4	2.1	11.5
• Plastic	2.5	2.4	2.1	1.9	10.5
• Petroleum	4.9	4.1	5.2	5.8	5.2
• Cement	5.8	5.2	5.8	5.4	4.9
• Iron and steel	2.5	4.1	4.7	4.9	5.2
• Other	59.4	59.7	55.7	58.2	7.47

Source: Analysis of data

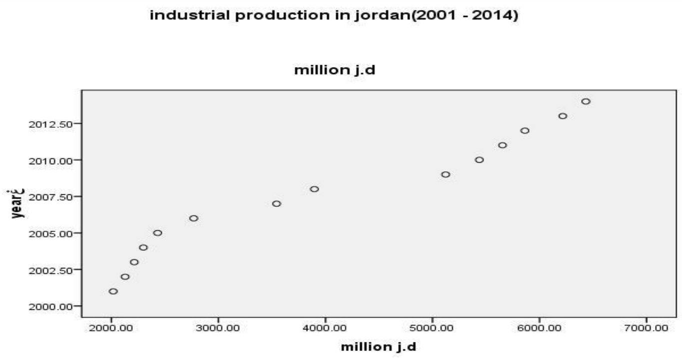
As shown in Table (9), the share of value added and average annual growth rate of the chemical manufacturers and tobacco products were among the largest contribution to the intensive industries, where the added value increased due to the structural changes and globalisation and internationals.

Table (9): Average output variables and TFP to economic growth

Period	Output growth	TFP growth	Contribution	Labour	TFP%
1995 – 2001	10.21	0.84	74.29	5.51	7.84
2001 – 2005	11.54	2.07	75.12	4.47	10.51
2005 – 2009	12.15	1.57	72.44	9.85	11.74
2009 – 2014	10.45	2.01	78.29	10.15	14.05

Source: Analysis of data

The results provide evidence about the existence of TFP gain under the government planned economy which encouraged the investment. It also illustrates the TFP growth figures which remained positive in the overall reform period despite some decline in some years. Furthermore, Jordanian industry recorded good TFP between 2005-2009 and 2009-2014, these results supported Jordanian ability to sustain the high rates of industrial growth in the future. Figure (4) shows the improvement in Jordanian industrial growth, the compound growth in this sector of Jordan economy is 9.74 percent.



3. Research Methodology

The study uses two data sets. One is at a more aggregated level for the industrial sector in Jordan from 1998 – 2014 while the other is at a more aggregated level for three main divisions covering 120 digit levels of industries for the period of 2001 to 2014. Data have been drawn mainly from Amman Chamber of Commerce. The other sources of data is the Central Bank of Jordan (CBJ). Concordance has been done between the industrial classification used for data, comparable series for the digits have been prepared, the nominal price have been used on data to obtain the series for 120 industry groups, the series at nominal prices have been deflated to obtain real output and input series, then logarithm has been calculated to the series. The used measurement of inputs and outputs are: 1) output: for all series of industry group has been obtained by deflating the nominal figures by whole sale price index; 2) net Capital Net: fixed capital stock at a constant price; 4) labour: total number of workers who are engaged including workers' properties; 4) material input: series of deflated materials to obtain materials input at constant prices and 5) energy: input at constant price by using price of energy then deflated by the number of consumer.

4. Findings

The analysis of supply side sources of growth of Jordan manufacturing is based on: $Q_{it} = f\,(k_{it}, L_{it}, E_{it}, M_{it}, S_{it}\,;\,A_{it})$ (7). The Cobb–Douglas function was chosen for estimation, logarithm, then, was obtained. The equation preformed as: $\ln_{(Qit)} = C + N_t + a(n(L_{it}) + BLn(k_{it}) + \Psi Ln(M) + \sigma Ln(E_{it}) + \mathrm{V}\ln(S_{it}) + \sum_{it}$ (8). The results are reported in table (10) by panel data fixed effects model and the random effects model.

Table (10):The supply side sources of growth of manufacturing

Variables	Fixed coefficients	Effect t-static	Random coefficients	Efface t-stat
• Ln(k)	0.0415**	4.282	0.0449*	4.547
• Ln(L)	0.0252*	2.144	0.0411*	4.855
• Ln (E)	0.0541*	9.077	0.0547*	8.442
• Ln(M)	0.475*	52.144	0.429*	51.892
• ln(S)	0.094*	12.451	0.144*	11.571
• t (time)	0.002*	1.854	0.001*	4.54
• R^2 (overall)	0.758	---	0.751	
• Statics	---	---	5.814	
• Chi^2				

Source: Analysis of data
*** Statistically significant at 5 percent level. Q: real value of gross output.**

As shown in Table (10), a rejection of the null hypothesis implies that the random effects correlated with the other regresses, enhance the estimates from the random effect specification are biased. Two (2) coefficients estimated are statistically significant at 5 percent level and all of them have positive signs and less than one which is consistent with the underlying theory of producers' behaviour. The hypothesis of constant returns scale is not rejected through these results where the determinant R^2 (0.758) is for fixed effect and the case of random effects is 0.751 which in general made good interpretation the changes in dependent variable by explanation. Results of estimation are reported in Table (11).

Table (11): Estimation of Translog estimated by theRLS

• $_0$	- 0.9475	(- 5.454)*	- 0.5754	(- 4.59)
• B_L	0.5487	(5.984)	0.59921	(4.45)
• B_k	0.1844	(2.145)	0.1758	(1.497)
• B_T	0.0758	(2.447)	0.1941	(2.45)
• $^B kk$	- 0.08992	(- 2.194)	0.5972	(-1.248)
• $^B LL$	- 0.07574	(- 2.084)	- 0.0545	(- 1.415)
• $^B Lk$	0.1445	(2.812)	0.00545	(- 1.455)
• $^B LT$	- 0.0294	(4.245)	- 0.004	(- 1.454)
• $^B kT$	0.0294	(4.245)	- 0.0004	(- 1.45)
• R^2	0.845		0.915	
• $^B TT$	-(0.2754)	(-4.897)	- 0.0052	(- 2.54)

Source: Analysis of data
***in between parentheses is t – static.**

As shown in Table (11), the parameters are estimated by restricted least square (R.L.S) in both cases, one with dummies and other without, both of them based on panel data. The mono tonicity and concavity conditions are satisfied at the sample mean., However, the fixed effect model with dummies may regarded as less satisfactorily than without dummies, because several estimated coefficients are statistically insignificant. Hence, the electricity of outputs is derived of output from the first set of results. The parameters of the Translog production function indicates that B_L, B_k, B_T, B_{Lk}, B_{kT} are positive signs. Where in the second model with dummies B_L, B_k, B_T, B_{LL}, B_{kk}, B_{LT} are positive signs, also there is no indication of a growing divergence between labour income and elasticity as use in all the period trends.

The production function of Cobb–Douglas, as suggested by (Hanel, 2000), is used. Production function consists of two equations; function of technical progressive and input use function which are as follows: ^{Q}it $_{+\ Ait\ +\ Fit}$ $_{(10).}$ Where: A_{it}: technical progressive function, F_{it}: input function $A_{it} + ak_{it}^{-\psi}$ $L^{Nt \text{ and}}$ $F_{it} + \alpha X_{mt}^{+m.}$ Where a: Constant, L: labour Number in t period, ψ : electricity of capital variable, N: the direction of technical changes. Xm: productivity of capital and labour. If the substitute in the first equation results is $Q_t = ak\psi_{it} L^{Nt} \Pi X_{mt}^{am.}$ Inventory of capital by is obtained via: $K_t = k_t + 1 - \sigma)k_{t-1}$. Where: k_t: changes in capital in period t. σ: depreciation average. If the annual growth average of production is used, the result is: $Q_t / Q_t = \lambda + \sum am\, X_{mt}{}^{/} X_{mt} + \Psi\, k_t / k_t$ (12). In order to use the TFP, the following equation is used: $TFP_{it} = Q_0 + B_1\, Qinov_{\,j}\, (t - 1) + B_2\, I_{\,j}\, (t - 1) + B_4 TFP_i$ (t -1) $+ B_4 WTO + B_5 WTO + B_5 Tech_{\,j}\, (t - 1) + \sum it$. Where: $TFP_{j(t-1)}$: lagged time of labour productivity TFP. TFP_{jt}: annual average growth of productivity in industries j.$I_{j(t-1)}$: lagged of investment in industries. $Inniv_{j\,(t-1)}$: innovation activities of local industrial sectors. In this phase, the expense of improvement and scientific research in industries was is used.

WTO: Liberalisation of trade of Jordan, the trade balance of each industry is used. Technj (t-1): the effect of technical changes in the past year. Ψ can be considered as effect of the year technology productivity. a1, B1, B2, B4, B4, B5 are parameters of the econometric c model. Σ it : Error term. I : The LML (Limited it for mation maximum likelihood Method) is used to estimated the slopes of the model using the data (2001 - 2014). Finally, LML to series of industrial manufacturing are represent d in table (12).

Table (12): Effects of growth of manufacturers' productivity

Variables	Coefficients'	St / error	t – stat	Prob. value
Constant	21.475	25.785	- 5.159	0.475
Innova	1529.7	9585.4	2.017	0.0492*
TPF_j (t-1)	7.4441	5.1425	-0.875	0.0249*
I_j (t-1)	0.01542	-0.01241	1.954	0.0145*
$Techn_j$ (t-1)	9874.4	48772.4	2.428	0.009*
W.T.O	1.2457	2.241	1.954	0.0455*
D.W .d*	2.759			
R^2	0.782			
R^{-2}	0.714			

Source: Analysis of data
*** Significant statistically at 5 percent level.**

As shown in Table (12), the effects of W.T.O being statistically significant at 5 percent level and has a positive sign. $I_{j\ (t-1)}$ has few effects, the impact is 0.015 and statistically, this appears as macro economic theory of investment where the effect of research and innovation of inside country and outside is high and statistically significant. According to Durbin-Watson test, null hypothesis can not be rejected of reject multi-collinearly and serial correlation according D.W.H. 1.554. II: the second application of LML is to check the effect of output growth in chemicals and fertilizers. Table (14) shows the results of the impact.

Table (13): The impact of growth of productivity in chemicals and fertilizers industries

Variables	Coefficients'	St / Error	t – stat	Prob. Level
• Constant	- 158.57	549.451	- 4.0911	0.004*
• Innovation	0.00574	0.02555	2.1444	0.015*
• TPF_j (t-1)	0.5229	0.00144	-0.551	0.782*
• I_j (t-1)	0.452	0.0029	2.924	0.005*
• $Techn_j$ (t-1)	0.794	0.1048	4.214	0.019
• W.T.O	1.827	10.5571	0.2785	0.574
• D.W.d*	2.15442			
• D.W (h)	0.755			
• R^2	0.5454			
• $_R$-2	0.5277			

Source: Analysis of data
*** Statistically significant 5 percent level.**

It is noted that the effect of $\mathbf{I_{t-1}}$ on productivity 0.452 the relation is proportional with $\mathbf{TFP_j}$ all coefficients are statistically significance at 5 percent level, all coefficients have a positive sign, D.W(h) lies in acceptable area, thus the null hypothesis is accepted due to D.W(h).

Table (14): The impact of TFP on growth of petroleum

Variables	Coefficients'	St / Error	t–stat	Prob. Level
• Constant	- 4.5725	5.549	- 0.495	0.705
• Innovation	- 0.4575	0.00444	- 0.454	0.549
• ^{TPF}j (t-1)	0.02554	0.00198	2.2505	0.045*
• ^{Techn}j (t-1)	0.00421	0.001	2.487	0.012*
• W.T.O	0.5784	0.0714	2.754	0.554
• D.W.d*	2.1514			
• D.W (h)	0.8752			
• R^2	0.554			
• $_R$-2	0.549			
• I (t-1)	0.00257	0.00149	1.8795	0.045*

Source: Analysis of data

All coefficient are positive but TFPj (t - 1) and technology changes and investment I (t – 1) are statistically significant, due to entry of F.D.1, F.P.I. the FDI increased in the period of study. With regard to service sector, the series were analysed by LML method and panel data due to the importance of this sector in GDP in Jordan and the employee of this sector, LML analyses of data series are in table (15).

Table (15): Results of LML to the service sector

Variables	Coefficients'	St / Error	t–stat	Prob. Level
• Constant	54.557	12.557	5.418	0.515
• Innovation	1.5451	2.514	1.149	0.047*
• TPF_j (t-1)	49.522	1.772	0.915	0.018*
• I (t-1)	4.871	0.0149	0.087	0.007*
• $Techn_j$ (t-1)	0.9524	0.001	0.0075	0.001*
• W.T.O	1.492	0.0224	0.081	0.021
• D.W.D*	2.117			
• D.W (h)	1.155			
• R^2	0.7557			
• $_R$-2	0.7442			

Source: Analysis of data
*** Significant statistically at 5 percent level.**

As shown in Table (15), all coefficients are positive and statistically significant the service sector consist at least not less than 57 percent of industry and not less than 50 percent of employee in Jordan. Durbin-Watson (h) indicates that the null hypothesis is accepted when R2 is good, that let us considered that these explanatory interpretation the changes in GDP of service sector as 75 percent. The estimation with other method by panel data analyses (fixed effects and random effects) results are available in table (15).

Table (16): The impacts of services productivity

Explanatory variables	Fixed coefficients	Effects t-statics	Random coefficients	Effects t-stat
• Ln (service / output)	0.1459*	2.274	0.1224**	2.785
• Ln (Tech)	0.0157	1.484	0.0051*	1.447
• Ln (FDI)	0.1228	1.981	0.1491*	1.884
• Ln (export intensity)	0.001	0.0947	0.1214*	4.052
• Overace R^2	0.274	0.001	0.0075	0.001*
• $_{R}$-2	1.492	0.0224	0.081	0.021
• Hausman statistic			0.149	
• X^2			14.272	

Source: Analysis of data
**** Statistically Significant at 10 percent, * Significant statistically at 5 percent level.**

As shown in Table (16), coefficient of service variable is positive and statistically significant at 10 percent, all other coefficients are found to be statistically significant at 5 percent level. It seems reasonable to interpret the results as suggestive of appositive relationship between services and industrial productivity. It seems that the growing use of services in manufacturing industries in the post-reforms period might have contributed to better productivity performance due to improvement in services sector in Jordan services industries.

5. Conclusions and Implications

In this paper, data series included all sectors of industries in Jordan, the period of data series extended from 2001 to 2014. Multi-econometric models are used to analyse the data series in pre and post reform period using capital, labour energy material and services as production function as Cobb–Douglas as a sample to analyse the series explicitly recognising services as an input to production panel data for 120 industrial groups for the period from the year 2001 to 2014. The findings suggest the importance of technological changes in improvement of productivity. The competition increased in the domestic market were found to be responsible to a certain extent for the increase in the intensity of use of services in manufacturing sector. Movements in growth rate in index number of industrial production vary. The results, furthermore, suggest that the movement in growth rate in TFP as (real value added) increasingly diverged from the movements in growth rate of industrial production index number, and the largest discrepancy gives a sign that there is impact of technology and increased investment, even FDI or domestic innovations has a positive relationship with TFP.

Ultimately, the W.O.T has a broader and statistically significant overall productivity trends evaluations, the overall impacts of procession innovation requires consideration of its impacts on prices as well as quantity. Hence, one of the main consequences of innovation is likely to be the exit of some inefficient organisations and the entry of new innovative organisations. The demand of energy increased between 2001 to 2014. The whole demand was a rapid increased in the industrial productions output. However, these results according to implying technological changes and diffusion and adaptability to more efficient technologies and the new structural changes in Jordan industries, also implying innovation, all these variables has countered this rapid increase. In addition, the water demanded is increasing due to the uses of water for many purposes in manufacturing industries in Jordan. The paper has established the demand of water in the future. Finally, Translog production function as an appropriate production as a well-behaved panel data estimation has used as enhance the results differs. To sum up, fixed effects are acceptable more than random effects in Jordan industries series.

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