

## Human capital in the manufacturing sector from 1972 to 2015 and its association with economic growth of Pakistan



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### ARTICLE INFO

#### Article history:

Received 9 January 2019

Received in revised form

2 April 2019

Accepted 4 April 2019

#### Keywords:

Human capital

Manufacturing sector growth

Pakistan

Autoregressive distributed lag

### ABSTRACT

The manufacturing sector has been a large contribution towards promoting economic growth, generating employment, competitiveness and trade development in the world. Human capital plays a significant role in the growth of the manufacturing sector, while its determination on manufacture sector growth in Pakistan has remained unexplored in literature. The main objective of this study is to define the proxy role of human capital formation (e.g., secondary school enrolment, infant mortality rate, and life expectancy) and their direct impact on manufacturing sectors in Pakistan for the period of 1972–2015. An autoregressive distributed lag (ARDL) bounds testing approach was applied to investigate and co-integrate the causality link between the study variables. These tests put a spotlight on the long-run connection among the variables, while in addition, the results revealed that human capital, employed labor force, gross fixed capital formation, inflation rate, energy consumption, tax on GDP, domestic credit had a positive impact on the manufacturing growth in Pakistan.

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### 1. Introduction

Manufacturing sector has been playing an essential role in the economy of Pakistan. Its contribution to GDP and employment amounted to 18% and 14% individually in 2005-06. It also plays an energetic role in exports whose structure after some time has changed fundamentally from primary commodities to manufactures and semi-manufactures with their share in total exports having almost tripled, from 28% 1972-73 to 79% in 2004-05 (GOP, 2006). The importance of human capital cannot be overemphasized for economic growth. Human capital is essential for development and plays a significant role at macro and micro level. In 1960s concept of human capital was perceived by Schultz provided. Human capital is a prime component to increases employs productivity and raises the worth of a firm (Schultz, 1961). Human capital isn't controlled to formal education, experience, practical learning, as well as non-traditional technical training procedures that enhance skills are also part of human capital

(Davidsson and Honig, 2003). Human capital used as a proxy in a production function (Mankiw et al., 1992). Skills, schooling, practice and experienced actions that all is part of human capital which rise knowledge level, standards, capabilities of an employee that increase the performance of firms and improve their satisfaction level as well (Marimuthu et al., 2009). Human capital significantly linked firm's performance because educated, skilled and experienced workers can significantly affect the performance of firms. Human capital hypothesis depends on schooling, capacity, and experience. Firms can increase workers efficiency through mechanism called PRP (performance related pay). Firm's without PRP system have less productivity than those who adopt this tool (Gielen et al., 2010). Literature has recognized the significance of human capital in efficiency and empirical work which has shown that education, capital work proportion, wages of workers have higher return to profitability. Owners and directors with advanced education and experience create more development in manufacturing sector which builds productivity. Number of studies with respect to human capital inferred that educated and experienced people gain more profitability (Lebedinski and Vandenberghe, 2014).

Competitive benefits of firms can improve through human capital in any industry. Firms who give attention on human capital development from side to side making a genuine procedure can gain

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<https://doi.org/10.21833/ijaas.2019.06.007>

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more profit. An action of human cash to learning practices makes essential cost purposes of intensity for a firm (Hatch and Dyer, 2004). Skills upgrade productivity by investing comprehensive profit in self-processed part of an economy, which helps to control unemployment and neediness. Generally record of Pakistan’s manufacturing sector has been truly satisfying. However, Pakistan’s manufacturing industries, mainly large-scale manufacturing units facing problem of slow growth. Economic growth can promote through technological improvement. The experimental examinations separate development of profit into two parts. The primary input factors are labor and capital for growth. The other segment (the remaining) is recognized to innovative change (Solow, 1956). In endogenous development models long run economic growth is determined by assembling of human and physical capital and innovations. The accumulation of education is essential for economic growth and the level of advancement action in a country.

As indicated by Lichtenberg (1992) there is the generous rate of return in R&D, adding to "intellectual capital" development. He resists that the rate of return to interest in R&D is higher than relating return to substantial assumption. Romer (1986) emphasized that a load of human capital leads expanding return to scale. Long run economic growth in new endogenous growth model based on human capital that led to improving technology. A country can improve level of innovation and increase economic growth by increasing education. Investment in R&D is effect technological progress in a country. Human capital also increases the return to scale that has social pay off rather than private returns. The percentage share of manufacturing sector in Pakistan illustrated in Fig. 1.

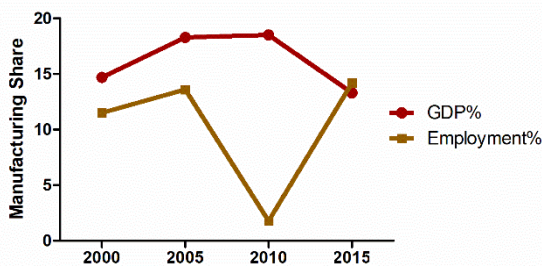


Fig. 1: Share of manufacturing sector in GDP and employment in Pakistan

Manufacturing sector contains two sub segments as large scale manufacturing and small scale manufacturing. Small scale producing covers all assembling foundations that not held in large scale manufacturing. Industry alludes to that section of economy which is linked with assembling and generation of various items. Manufacturing sector is of grand significance for economic improvement of nation. It is valid truth that nations with solid modern division have indicated more economic development and advancement industrial section have reveal change in national salary and advanced

expectation for everyday comforts of population. Manufacturing growth during the period of time 2009-10 to 2014-15 is showed in Fig. 2.

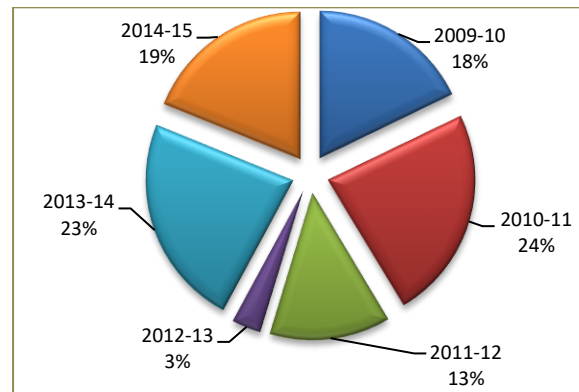


Fig. 2: Manufacturing sector growth during the period of 2009-10 to 2014-15

The manufacturing sector is the largest sector of the economy of Pakistan and its contribution to GDP is 19.1%. Manufacturing growth assumes an urgent part in economic support. It raises the beneficial limit of the general population and makes always expanding livelihood opportunities. A significant group of research has likewise thought on the part of a human capital interest in clarifying the level and variety in creation and profit in the manufacturing sector. The growth of large-scale manufacturing goods is presented in Fig. 3. While there has been a significant measure of writing inspecting commitment of human cash-flow to firm development and efficiency, we don't know about any examination that has endeavored to break down commitment of human capital index (life expectancy rate, secondary school enrolment, mortality rate) on profitability development of the manufacturing sector in Pakistan, particularly at the subnational (state) level.

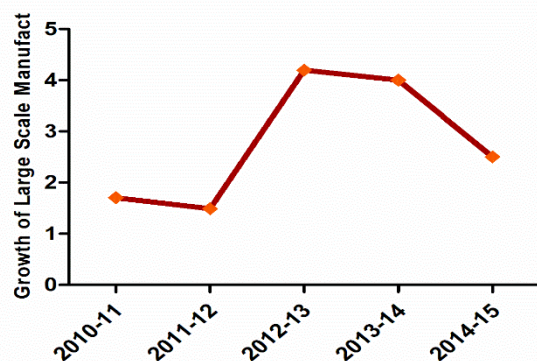


Fig. 3: Growth of large-scale manufacturing goods

An industrialized country is consistently increased economic stranded and ready to operate for protection itself against any hostility. Energy consumed in two ways for manufacturing: material inputs to a final good (fuel or feedstock). The equal importance of small and large firms, Tsang (1987) concluded that both small and medium enterprises

and large scale enterprises contribute to employment and output; (1) In fuel process all energy utilized for heat and power; (2) In feedstock it is utilized for raw material other than generation of heat or power.

## 2. Literature review

Human capital plays a very important role in the growth of manufacturing sector of any country. There are many functions through which human capital promote manufacturing performance of a country. The manufacturing sector is an important source of intermediate for services inputs. Educated workforce and technology has a positive effect on manufacturing growth. It found that share of manufacturing sector significant impact on GDP. The coefficient of GDP was negative and significant (Szirmai and Verspagen, 2015). Human capital positively affects the sectoral growth in Pakistan (Hena et al., 2018). Hausman and Taylor (1981) technique was used to examine the relationship between manufacturing sector and economic growth in 88 developing countries and declared significant and positive relationship on growth of developing countries in the post-war period (Hausman and Taylor, 1981). The result of Granger causality and Toda and Yamamoto (1995) causality tests indicated that there is long run unidirectional causality relationship between sectoral growth with energy consumptions and GDP (Toda and Yamamoto, 1995). Health is basic component of output, whereas developing countries mostly depend on physical capital and favored the healthy individuals to achieve an optimum output (Hena et al., 2019). Sectoral growth of Malaysia depends on energy consumption explored positive relationship between disaggregated energy and economic growth. Human capital with important determinants as education, skills, labor productivity, technology and knowledge has significantly affected overall productivity (Rahman et al., 2015).

Large sample of manufacturing and services sectors in 14 countries were used to examine the positive and negative impact of human capital on employment protection and growth in Europe. Human capital used as independent variable average growth rate, degree of employment protection research and development (R&D), riskiness intensity and physical capital were used as dependent variables. The result of OLS method indicated the strong and statistically significant negative relationship between human capital with research and development (R&D), riskiness intensity and employment protection legislation (EPL) (Conti and Sulis, 2016). To check the impact of human capital on labor productivity in manufacturing industries of Sub-Saharan countries agricultural firms from Kenya, Uganda and Tanzania for the period of time 2002-03 were used. The results of Generalized Least Square (GLS) showed that in Kenya and Uganda labor productivity positively linked with capital labor ratio, average education and training furthermore,

external proprietorship, size; skilled workers ratio had also positive impact on labor productivity. Although, ratio of skilled workers and manger education positively linked in manufacturing sectors labor productivity in Tanzania (Aggrey, 2010).

To examine the impact of underutilization education on productivity in 22 US Bell companies. Productivity of educated workers significantly linked with employment level and capital stock. Education increase output cost that causes low productivity so results show that there is negative and significant relationship between education firms output (Tsang, 1987). Manufacturing sector contributes 65%, human capital 14% and technological change and technical efficiency 22% in total factor production. Results of Tsang (1987) production indicated the positive relationship between human capital, technical efficiency and technology with manufacturing sector (Hamid and Pichler, 2009). An increase in foreign investment and human capital (education) increase manufacturing value added. The results of Johansen's method found the statistically Co-integrated relationship between human capital, foreign investment and value-added in manufacturing growth in Singapore. Singapore gain comparative advantage in human capital-intensive goods through increased spending on research and development and advanced education training that increased the supply of human capital (Anwar, 2008). Manufacturing industries appears stronger effect of human capital on the growth of ICT-intensive industries rather than services industries. There is positive and significant relation between initial human capital accumulations on labor productivity growth on information communication technology (ICT) intensive industry in all models (Safdari, 2011). Initial firms positively affected by education, insignificant with technical education. Education, work experience and personal wealth to finance significantly increased the firm size (Colombo et al., 2004).

Different parametric and non-parametric approaches were used to examine the technical and scale efficiency of production exerts a differential effect of manufacturing firm's growth in the area of Gujranwala. Moreover, specialization and human capital positively affect the efficiency of firms or firms raise output 6 to 29% by improving overall efficiency. Firm's efficiency may improve and decreased cost in industries (Heshmati, 2003). Educated and experienced firms owner positively effects technical and scale efficiency of firms and enhance the growth of firms. Specialization and human capital positively affect the efficiency of firms or firms raise output 6 to 29% by improving overall efficiency. Firm's efficiency may improve and decreased cost in industries. Research and development (R&D) directly and positively affects the cost and productivity growth used (Burki and Terrell, 1998). Technical changing, labor, capital, research and development (R&D), human capital effect the productivity growth in both manufacturing and services sector (Baltagi and Griffin, 1988).

Technological changes, physical capital, infrastructure, research and development (R&D), labor, capital positively affect the performance and productivity in South Korean manufacturing sector (Kwon, 1986). Total factor productivity and public sector capital positively related to the performance of twelve two digit manufacturing.

**3. Model, data, and methodology**

**3.1. Sources of data**

Time span data from 1972-2015 was used this study, which was collected from various issues of Pakistan Economic Survey and World Development

Indicators. The variables used in this study presented in Table 1.

Data on human capital index was generated through principal component analysis (PCA) by using secondary school enrolment, infant mortality rate, and life expectancy data. Average or general pattern of change in a time series data (information in series over time) characterized by an upward, downward, or level direction from 17972 to 2015 is presented in Figs. 4-7, and data was taken from WDI.

Figs. 4-9 represent the percentage manufacturing value added employed labor force, gross fixed capital formation, inflation rate, energy consumption, tax on GDP, domestic credit in Pakistan, respectively.

**Table 1:** Explanation of variables and data sources. WDI: World development indicators

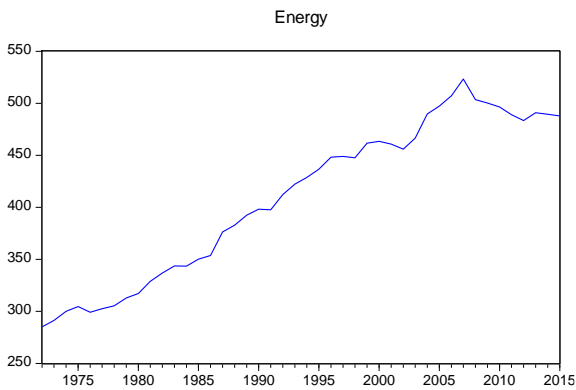
Variables	Descriptions	Data Sources
ELP	Employed Labor Force	WDI
GFCF	Gross Fixed Capital Formation	Various Issues of Pakistan Economic Survey
INF	Inflation	WDI
ENERGY	Energy Consumption	Various Issues of Pakistan Economic Survey
TAX	Tax on GDP	Various Issues of Pakistan Economic Survey
CREDIR	Domestic Credit	WDI
HCI	Human Capital Index	Various Issues of Pakistan Economic Survey

Note: Units of the variables are in millions and %

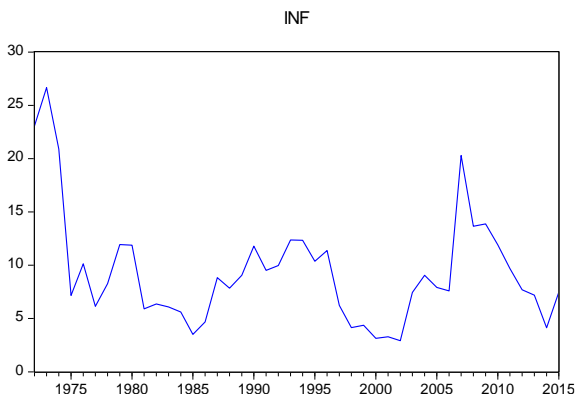
**4. Model specification**

The functional form of manufacturing growth model is specified as follows:

$$MVA = f(ELP, GFCF, INF, ENERGY, TAX, CREDIT, HCI) \tag{1}$$



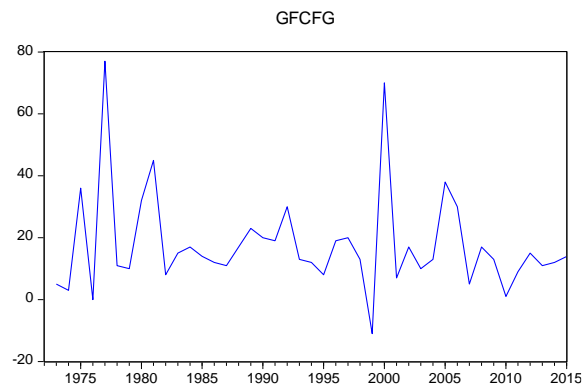
**Fig. 4:** Trends of energy consumption (ENERGY) in Pakistan (%)



**Fig. 5:** Trends of inflation in Pakistan (%)



**Fig. 6:** Trends of taxes in Pakistan (%)



**Fig. 7:** Trends of GFCF in Pakistan (%)

In Eq. 1 MVA indicates the manufacturing value added, EPL represents the employed labor force, GFCF indicates the gross fixed capital formation, INF indicates the inflation rate, ENERGY illustrates the energy consumption, TAX represents tax on GDP, CREDIT represents domestic credit HCI and indicates human capital index. The econometric equations of manufacturing sector growth model are specified as follows:

$$\Delta(MVA)_t = \alpha + \delta 1(ELP)_{t-1} + \delta 2(GFCF)_{t-1} + \delta 3(INF)_{t-1} + \delta 4(ENERGY)_{t-1} + \delta 5(TAX)_{t-1} + \delta 6(CREDIT)_{t-1} + \sum_{i=1}^{\rho 1} \gamma \Delta(MVA)_{t-1} \tag{2}$$

ELF

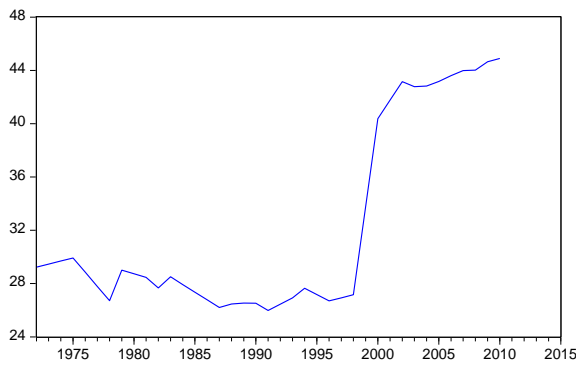


Fig. 8: Trends of employed labor force of total population (ELP) in Pakistan (%)

MVA

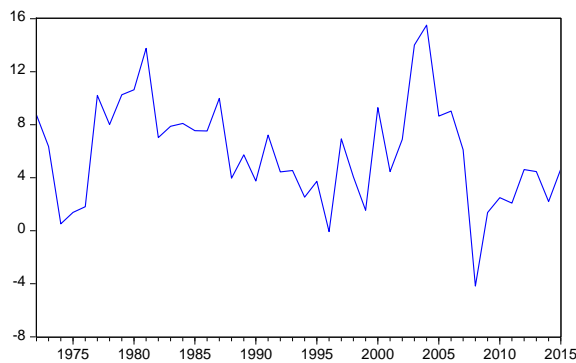


Fig. 9: Trends of manufacturing value added (MVA) in Pakistan

In case long run relationship is present, the long run parameters can be surveyed by Eq. 2.

$$MVA_t = \alpha + \sum_{i=1}^{\rho 1} \tau 1(MVA)_{t-1} + \sum_{i=0}^{\rho 2} \tau 2(ELP)_{t-1} + \sum_{i=0}^{\rho 3} \tau 3(GFCF)_{t-1} + \sum_{i=0}^{\rho 4} \tau 4(INF)_{t-1} + \sum_{i=0}^{\rho 5} \tau 5(ENERGY)_{t-1} + \sum_{i=0}^{\rho 6} \tau 6(TAX)_{t-1} + \sum_{i=0}^{\rho 7} \tau 7(CREDIT)_{t-1} + \sum_{i=0}^{\rho 8} \tau 8(HCI)_{t-1} + \epsilon t \tag{3}$$

In the Eq. 3 the parameters connected with the summation signs talk about short run parameters and the coefficient of ECM in both comparisons address to  $(\omega)$  demonstrates the velocity of variation towards the long-run equilibrium. Modification coefficient has to be negative and exactly critical for union.

$$\Delta(MVA)_t = \alpha + \sum_{i=1}^{\rho 1} \tau 2 \Delta(MVA)_{t-1} + \sum_{i=1}^{\rho 2} \tau 2 \Delta(ELP)_{t-1} + \sum_{i=1}^{\rho 3} \tau 3 \Delta(GFCF)_{t-1} + \sum_{i=1}^{\rho 4} \tau 4 \Delta(INF)_{t-1} + \sum_{i=1}^{\rho 5} \tau 5 \Delta(ENERGY)_{t-1} + \sum_{i=1}^{\rho 6} \tau 6 \Delta(TAX)_{t-1} + \sum_{i=1}^{\rho 7} \tau 7 \Delta(CREDIT)_{t-1} + \sum_{i=1}^{\rho 8} \tau 8 \Delta(HCI)_{t-1} + \omega ECM_{t-1} + \epsilon t \tag{4}$$

#### 4.1. Bound testing procedure

The most important task before estimating the long run coefficients and error correction models is to ensure the existence of long run relationship. OLS method is applied to find the value of F or Wald statistics for the significance of the parameters of the lagged variables. At first step, we have applied bound test to check the existence of long run relationship between human capital and manufacturing sector growth. The F-statistics for Co-integration we present the findings of the test in Table 2. The calculated value of F-statistic is 8.171425 which are greater than the upper bound at 1%, 5% and 10%. These results show that we are unable to accept the null hypothesis of no co integration. So long run relationship exists in industrial model.

Table 2: Results of autoregressive distributed lag (ARDL) bounds test for co-integration

F statistics	1% Critical Value Bounds		5% Critical Value Bounds		Conclusion
	I(0)	I(1)	I(0)	I(1)	
8.171425	3.07	4.23	2.5	3.5	Co-integration exists

F- Stat > upper critical bound = 8.171425 > 4.2

#### 4.2. Long-run estimating results

Now, we explain the empirical results of human capital and manufacturing sector performance of Pakistan. Now the following step is to discover the

long run coefficients of ARDL models for the manufacturing sector growth. The consequences of the evaluated long run coefficients are exhibited in Table 3.

Table 3: Long run analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Labor	41.136097	27.413884	1.500557	0.1443
Gross fixed capital formation	0.071255	0.037328	1.908886	0.0662
Inflation	0.108477	0.172012	0.630632	0.5332
Energy	0.164253	0.068145	2.410332	0.0225
Tax	-1.827486	0.644321	-2.836296	0.0082
Credit	0.001798	0.152384	0.011800	0.9907
Human capital	2.935527	1.188229	2.470506	0.0196

The dependent variable is manufacturing value added (MVA). For manufacturing value added, we have indicated seventh variables. The dependent variable is manufacturing value added growth. Employed labor force, inflation, energy consumption,

taxes, human capital index and credit are use as independent variables. All outcomes uncover that all variables have positive effect on industrial growth in this model except taxes on GDP. The estimated parameter of Employed labor force (ELP) is positive

and statistically insignificant at level 1% significance. If ELP rises by one unit, manufacturing growth will increase by 41.136097. Similar results about this variable are found in these studies (Kaboski, 2009; Aggrey 2010) found positive impact of EPL on manufacturing growth.

The second determinant of manufacturing sector is GFCF demonstrates the positive impact on manufacturing output. The estimated parameter of GFCF is positive and statistically significant at level 1% significance. If GFCF rises by 1 unit, manufacturing growth will increase by 0.071255. It incorporates spending land improvements, plant size extension, machinery maintenance, equipment purchases, and transportation development, creating mechanical and business structures. GFCG is used to investigate the extension of the profitability supply of the economy. It demonstrates the expansion in the efficiency limit. Inflation (INF) is most important determinant of the manufacturing sector that is positively influencing the growth of this sector. INF was statistically insignificant at 1% level of significance and these outcomes are predictable with (Ali et al., 2012; Chaudhry et al., 2013; Evangelista et al., 2013). If INF rises by 1 unit, manufacturing growth will increase by 0.1084770.

ENERGY is the main and significance input of this sector growth. Our study expose that accessibility of ENERGY is directly influence the manufacturing growth. Other conventional inputs like labor, machinery all the more properly use if energy supply rises. If ENERGY rises by 1%, manufacturing growth will increase by 0.164253. The same positive results also predicted by (Rahman et al., 2015). Taxes (TAX) we have found in our analysis that, taxes has negative impact on manufacturing output. The reason is that in the short run, both spending increases and tax cuts are projected to increase employment and output in an underemployed economy. These effects operate through the demand side of the economy. In general, the largest effect is

from direct government spending and transfers to lower-income individuals, whereas the smallest effects are from cutting taxes of high-income individuals or businesses. This means that 1% increase in taxes cause -1.827486 decrease in manufacturing sector growth. The result is supported by the findings of (Balta and Mohl, 2014; Poterba, 2004).

CREDIT (in million) accessibility is extremely and exactly significant for manufacturing sector. We calculate CREDIT is insignificant at 1% means one present increment in CREDIT prompted raise output of this area 0.001798. Due credit availability suppliers are able to utilize those inputs which they are denied off due to absence of resources. Credit is fundamental for costly inputs that efficiently affect the output. Comparative results about this variable are found in these studies (Raheman et al., 2008; Ayaaz et al., 2011; Anwar, 2008). Human capital index (HCI) is taken main independent variable. In human capital index; we use infant mortality rate, secondary school enrollment and life expectancy rate. On the basis of our result HCI positively and statistically significant affect the manufacturing output. Many factors like better health facility and education plays very important role for growth. If HCI rises by one present, manufacturing output increases by 2.935527. The results of this study are consistent with the studies of Smolny (2000), Broadberry and Gupta (2010), and Ogunade (2011).

#### 4.3. Error correction estimating (Stability condition)

Table 4 represents short-run analysis results. Among the connection of variables co-integration presence requires an error correction model (UECM) to imprison the dynamics of the short-run relation with its coefficient, which measures the adjustment speed.

**Table 4:** Short-run analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Labor)	32.492290	27.368971	1.187194	0.2448
D(Gross fixed capital formation)	0.072442	0.014554	4.977571	0.0000
D(Inflation)	0.030990	0.116920	0.265049	0.7928
D(Energy)	0.074630	0.050897	1.466307	0.1533
D(Tax)	1.187549	0.445292	2.666896	0.0124
D(Credit)	-0.122691	0.107866	-1.137443	0.2647
D(Human capital)	-2.567032	1.913586	-1.341477	0.1902
C	335.247241	50.708898	6.611211	0.0000
CointEq(-1)	-0.844095	0.127169	-6.637601	0.0000

Along with long run, short term estimates are also important for comprehensive analysis. Short run results help us in constructing response mechanism for any shock or irregularly fluctuation in time series variables. These estimates assist in compensating the occurred errors by utilizing error correction term in short run and thus stabilizing long run relation of variables. The signs of short run dynamic associations are enduring with that of long run relationship. The evaluated error correction coefficient of -0.844095 (0.0000) is strongly

significant, has right sign, and suggest a genuinely rapid of change in equilibrium with balance after a shock. Negative and significant value of error correction justifies the existence of long run relationship.

#### 5. Conclusion

Human capital is generally professed as the most vital resource that people hold but unfortunately, it isn't considered specifically. This study highlighted

the importance of human capital in term of manufacturing sector in Pakistan. The said literature estimated the proxy work of human capital on the observed sectors such as secondary school enrolment, infant mortality rate, and life expectancy. An autoregressive distributed lagged (ARDL) model was developed that covers the dependent variables of 1972-2015 years, whereas estimated the manufacturing value added, through employed labor force, gross fixed capital formation, inflation rate, energy consumption and tax on GDP domestic credit that encouraged the productivity of manufacturing sector. The estimated results conclude that human capital and other components have significant impact on manufacturing sector growth, while as long term period confirmed the neo classical and modern growth theories that labor (employment) is an important inputs besides capital in production output.

Growth in employment of labor force can reduce production cost whereas increase the domestic credit and investment that improves manufacturing growth. It is important to make some policy measures on the bases of our finding that further improve the manufacturing sector performance of Pakistan. This specific study suggests that well-developed human capital and components of manufacturing sector (e.g., labor force, credit, energy consumption, and taxes on GDP are essential for further improvement in manufacturing sector growth of a country.

### Compliance with ethical standards

### Conflict of interest

The authors declare that they have no conflict of interest.

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