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MACROECONOMIC DETERMINANTS OF TOTAL FACTOR'S PRODUCTIVITY AND THEIR IMPACT ON ECONOMIC GROWTH OF PAKISTAN: A SECTORIAL ANALYSIS

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Abstract

The study analyzed Pakistan's economy, focusing on value-added or productivity growth across different sectors. Utilizing the ordinary least square (OLS) approach, the researchers examined the macroeconomic determinants and their impact on the value-added growth and productivity of the industry, manufacturing, service, and agriculture sectors from 1990 to 2016. The findings revealed that most of the major macroeconomic determinants (such as macroeconomic stability, the openness of the economy, human sector development, and financial sector depth) significantly influenced the total factor productivity (TFP) of all sectors, except for agriculture. Notably, the study found an insignificant correlation between macroeconomic variables, except for employed labor force, and agriculture productivity.

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Keywords

Trade Openness, Foreign Direct Investment, Population, Inflation.

1. Introduction

Productivity is the efficiency with which an economy transforms or evolves towards development and high economic growth. Therefore, productivity and efficiency have become a matter of specific concentration. Previous research has/have confirmed a mixt reliance concerning definite interests. Despite this, there's a general thread. These studies had documented virtually without enormous, exceptions & tenaciously measured production differences crosswise the producers even, within barely demarcated productions. In sum, productive efficiency which is classically pronounced as an output\input ratio has gained much popularity from researchers, over the past few decades. As Pakistan is one of the developing economies, hence its economic growth accounts for several ups and downs. Since

independence, the economic growth of Pakistan had increased by a standard annual-growth rate of 5% with spacious variation crosswise over the five decades. An average growth rate of 5% with an average annual rate of 17-18% of investment to gross domestic product specifies a comparatively squat increase in a capital-output fraction in Pakistan's case as a contrast to other under-developing countries. Therefore, the significance of total factors productivity analysis is consequently, relatively obvious. When in an entity factor productivity affirms upward trend it may lead towards high income and cause addition in savings and investment levels. High investment levels result in incrimination in available employment opportunities. When investment projects are held at high-level use of modern technology and machinery also higher-up. Via innovation, not only profit margins but also factors productivity exhibits an upward trend. Which in turn again leads towards high income or growth level. Therefore, via examination of this analysis examiner affirms major macro-economic determinants of TFP. In this study examiner not only elaborate on the macroeconomic determinants of factors productivity but may also highlight the impact of these components on Pakistan's different sectors such as on industry, manufacturing, service, and agriculture sector. Traditionally, the economic growth of Pakistan documented, particularly of the manufacturing sector, has been moderately acceptable. Conversely, from the time of the late 1980s, Pakistan's economy has been cladding the dilemma of dawdling augmentation of industrialized units, mainly of the large scale industrialized units. This phenomenon has been escorted by various economists to articulate the hesitation that perchance de-industrialization is occurring in the economy. Currently, worldwide economic variation escorted through the "IMF & WTO" is taking apart the structure of security & legislation. Pakistan's enterprises (both large plus small) are scrambling for improved permission to suitable technologies' to heighten their competitiveness & productivity. Moreover, as the private-sector perceives the world trade organization (WTO) dead-line of the epoch 2004' intimidating, it's clamoring for effectual administration policies to manage with the circumstances. The demand for technical amendment is growing stridently although the vacant discipline plus technical tools (such as S & T) in the economy is ill-equipped to support Pakistan's enterprises to handle the economic difficulties pretense by the altering worldwide economical atmosphere. There've been moderately few estimations of factors-productivity escalation in Pakistan's economy and; yet some efforts to discover the determinant are of factors-productivity at the macro-economic plane. This analysis inserts to the presented guesstimates for Pakistan calculating factors-productivity sectorial vise throughout conservative enlargement calculating procedure, & subsequently instituting the macro-economic determinants of factors-productivity, via analyzing greater time-series records that examined by several types of research. Different components have different roles to play in the determination of TFP (how greatly TFP in an economy is influenced by these components). For instance, factors-productivity like the amount of the labor-force & the capital-stock definitely substance. However, a

great amount of several factors like education & government regulation plus the climate(in which these factors work) have some roles to play in the determination of TFP. Instead, the comparison& evaluation of several theories; might be constructive to have straight support on those factors they're imperative for growth and development.

2. Literature Review

Mahmood and Siddiqui (2000) examined total factors productivity for the manufacturing sector for the time era of 1972-1997 of Pakistan's economy. Researchers originated that augmented expenses on R& D, development of technical & technological manpower, augmentation of information & human capital had a significant plus affirmative effect on total factors productivity in the manufacturing sector. Knowledge & human capital were originated to elucidate 30% and 18% of the variation in total factors productivity, correspondingly. In short, examiners explored that there's affirmative& considerable association between the TFP and trade exposure. Krugman *et al.,* (2007); Jadoon *et al.,* (2015); Javed *et al.,* (2012) argued that trade drastically manipulates the human capital and economic growth of Pakistan.

Aw *et al.,* (2000) examined the effect of trade exposure on the total factors productivity of firms in the case of China. The primary data collection technique was utilized here. Data for the analysis were collected from some micro-level firms in China. Approximation confirmed that high productive firms can stand up in the export market while low productive firms forced to exit the export market. Findings also concluded that the openness of free trade will cause trouble for less productive firms while beneficial for high productive firms. Keller and Stephen (2003); Jadoon *et al.,* (2015) also signifies that trade exposure significantly affect the productivity of the total factors. Marc J Melitz (2002) explored the association of trade & industrial productivity. The estimate provoked that in the long run openness of trade is beneficial or increases the total productivity of high-productive firms while reducing the productivity of less-productive firms in the UK. This study utilized a dynamic industrial model for monopolistic competition. Moreover, this study also exhibited that openness of trade persuades high-productive firms to enter the export-market while persuading less-productive firms to exit from the market. Tybout J.R. (2002); Bernard (2000); Brooks, E. L. (2001); Pavcnik (2002) support his findings. Sabir and Qazi (2003) discussed macro-economic reforms on the total factor's productive capability in Pakistan. Real GDP growth & total factor productivity data were compared throughout the pre-reforms era (1972-73, 1987-1988, and 2001-2002). Results revealed that there is a negative affiliation between total factors productivity and government economic reform policies. The major component responsible for this decline is the decline in human resources development expenditures. Bartelsman *et al.,* (2000) proved this study results in his analysis of understanding productivity. Kruger (2003) considered total factor productivity for 87 countries as a sample. Estimated data was collected for the epoch 1960 to 1990. Approximation concluded that technical improvement affects the total factor's productivity significantly. Technological development contribution was approximately 66% of total

productivity growth in observed countries, although the portion of technological effectiveness was one/third of the total productivity. Rattso and Stokke (2003) support this research finding in their analysis of technology & TFP spillovers. Kemal *et al.,* (2002) analyzed the technological efficiency, technical change as well as total factors productivity of Pakistan's economy. By the analysis approximation, total factors productivity increased by 1.66% for the epoch of 1964-1965 to 2000-2001. Moreover, TFP allocation (share) in enlargement of GDP was approximately 1/3 throughout the era. Total factors productivity in the manufacturing sector proved a usual increase of 3.21% for the epoch of 1964-1965 to 2000-2001. Kruger (2003); Rattso and Stokke (2003) support this research finding in their analysis of technology & TFP growth. Kumbhakar (2003) estimated the impact of technological innovation on total factor productivity. In this study, the examiner wore a panel-data approach. Data were collected for four hundred & fifty (450 manufacturers) industries in the U.S. To evaluate total factor's productivity & technological alteration data collected for 1959–92. Approximation demonstrated that capital efficiency amplified by 6.5% due to technological innovation. Kemal, *et al.,* (2002) analyzed the technological efficiency, technical change as well as total factors productivity of Pakistan's economy. In Accordance, with the analysis, approximation total factors productivity increased by 1.66% for the epoch of 1964-1965 to 2000-2001. Moreover, TFP allocation (share) in enlargement of GDP was approximately 1/3throughout the era. Total factors productivity in the manufacturing sector proved a usual increase of 3.21% for the epoch of 1964-1965 to 2000-2001. Kruger (2003); Rattso and Stokke (2003) support this research finding in their analysis of technology & TFP growth. Zheng, *et al.,* (2003) deliberated the productivity of the total factors in China state-owned enterprise (SOEs) for the epoch of 1980 to 1994. The results of the analysis confirmed that technological improvement contributes to appreciably the total factors productivity augmentation for "Chínese SOEs" throughout the orientation episode. Moreover TFP annual-average augmentation rate was as high as 10%. Technological effectiveness arrays amid 50-80%throughout the examined duration. Total factors productivity increase at a momentous rate of 3%-12%throughoutthe 1980 to 1989, and 3% to 8% throughout 1990–1994. The analysis also affirmed that education plays a momentous role in technological effectiveness. Ruhul (2006) documented the affiliation amid the productivity of the total factors of the food manufacturing sector and technological efficiency. The findings of the analysis confirmed that there is a significant correlation between technical effectiveness and the food manufacturing sector. Approximation signifies that in the food manufacturing sector of Bangladesh effectiveness ranges amid 60-81% which might be augmented by 19-39% through human-capital accretion in the outline of job training & education. Javed *et al.,* (2012); Kim & Lee's (2006) researches affirm that total factors productivity is drastically affected by technical efficiency. He & Liu (2006) deliberated investment-specific technical alteration with the dynamic of skilled accretion for the U.S economy. Data for the period of 1949 to 2000 (post 2nd World War) were approximated. Estimates prove that the U.S positioned an enormous

significance on skilled accretion & job training. Technological change brings a 62% increment in output growth. Kemal, *et al.,* (2002); Kumbhakar (2003) studies also assured that technical efficiency significantly influences TFP. Kim and Lee (2006) deliberated total factors productivity (TFP) technical alteration & technological effectiveness for '49 nations' for the epoch 1965 to 1990. Findings of the study originate that East-Asian nations led the globe in technological effectiveness plus output augmentation foremost to privileged economic growth. Technical improvement, human-capital accretion plus technological effectiveness were the main components in their advanced & continuous growth ratios throughout the mentioned epoch. Nikaido and Yuko (2004) also support estimates of this analysis. Safdar (2006) investigated the determinants of the total Factors of Productivity in Pakistan. In this analysis, the researcher utilized the time series data for the period 1960-2003. The findings of the study explored that macro-economic stability, external (foreign) direct investment& the finance sector's improvement endeavor vital character in the incrimination of total factor's productivity. All variables exert a significant impact on TFP except Expenditure on educational activities. Pasha *et al.,* (2002); Hulten (2000); Basudeb and Bari (2000) favored this research approximation. Hamid and Pichler (2009) explored the affiliation between total factors productivity and human capital spillovers. Data were collected for the period 1972-2005 from Pakistan economic survey. The experimental termination confirmed that the role of productive capability & human capital was approximately 1/3 of the overall value-added growth of the manufacturer segment that was fewer than the involvement endorsed to these components in industrial &various other under-developing nations. Traditional components such as capital & labor were still the foundation in the value-added growth of the manufacturing sector in Pakistan.

3. Theoretical Framework

Many theorists' have been reported with varieties of total factors productivity models and theories. Marxian and neo-classical models of growth allot the utmost importance to productive capability betterments determined through developments in the technical innovations and the organization of production. While, the "New-Growth theory" and one more group of neo-classic-economic "theory of capital and investment" ascribe prime importance to the rise in investment's inhuman-capital, knowledge, and skills, and fixed-capital. The contradiction amid technical betterment and capital-formation transfers over to pragmatic growth examination. Mostly the empiric growth economists have had dual-key targets: firstly, to commence the massive work of erecting historic facts on outputs and inputs; secondly, to examine the extent to which input\output growth is, in fact, due to technical components (productivity) vs. human-capital formations. This previous task is often referred to as 'basis of growth analysis' and is the intellectual framework of the factors productivity residual which is the forming notion of this study. "Single-factor productivity" (SFP) inspects per unit output change due to per unit change in a specific input of a product. 'Labor productivity (per unit change in output due to the change in the ratio of labor employed) is the utmost communal method of this type.

$Y = f(N)$

And,

$\Delta y = f(\Delta N)$

Here 'y' stands for output and 'N' stands for labor. Change in output in this approach is purely due to a change in the number or quantity of labor hired or employed. Yet capital-productivity or even, raw materials-productivity methods are also examined. SFP level & degree is influenced by the strength (intensity) of usage of the excepted inputs of production. Two manufacturers might have relatively dissimilar labor-productivity while they may have identical technology if one ensues to utilize capital more intensively, and they face dissimilar prices of factors. Due to this examiners frequently examine a total-productivity approach that is invariant to the degree of usage of visible factors input. This process is baptized as total factor productivity (TFP) also termed as multi-factor productivity. Factor price discrepancy that causes factor intensity variances doesn't influence TFP as it persuades shift along isoquant somewhat than the shift in isoquant.

$Y = f(N, L, K, E, R, Z)$

And,

$\Delta y = f(\Delta N, (\Delta L, (\Delta K, (\Delta E, (\Delta R, (\Delta Z)$

Here 'y' stands for output and 'N' for 'labor', L for 'Land', 'K' for 'Capital', 'E' for 'Entrepreneurship' 'R' for 'Raw material' and 'Z' for all other remaining input factors. Change in the output according to this approach is due to change in all factors of production (input) employed. "Multi-factor productivity" (MFP) is the outstanding participation to output-growth of an economy or industry, after estimating the participation from overall factor inputs. Edwerd (1997) oriented a theory related to differences in factors productivity. In this theory, the researcher argued that differences in total factor productivity arise not only due to development in technological innovation but also due to the efficacy of resistance to the usage of improved technologies. The basic hypothesis of the neo-classical output function necessitates that the elasticity of production about labor-input (or rate of unemployment) is smaller than one. Okun (1962) although, initiated that this elasticity to be 3 (three) for the U.S economy. Findings turn out to be consequently vigorous that it has ultimately become, known as Okun's Law or law of Okun. Keynes (1936) demonstrated that factors endowment isn't an operative element of demand constrained equilibrium moreover, Factor's productivity varies across firms and industries. In general theory, Keynes introduced the smaller than complete utilization of factors productivity in the attendance of involuntary unemployment. Various theories rotated around the hypothetical vague ideology of "involuntary unemployment". Though, Keynes's presence of involuntary unemployment isn't compulsory. More generally it's appropriate to accept that there's under-employment in the economy. And so; at the highest level, marginal products aren't uniform. Davis *et al.,* (1996) ascribe that dissimilar to job-creation; job-destruction for an economy and industry isn't steadily interrelated to total factors productivity (TFP) growth. Specifically, job destruction transpires in higher total factors productivity (TFP) growth states and industries as normally as in lower total factors productivity (TFP) growth states and industries. This statistic correspondingly advocates the existence of the significant reallocation of demand.

A high level of aggregate demand shows that the state or economy is nearer to the production possibility frontier. Solow (2000) in the theory of growth ascribes that an increment in output is typically defined by pure technical advancement so, that it's directly associated with an investment in 'R & D' (research and development). Though, to acquire the degree (power) of output allocation amid firms analyzers essentially undertake the substantial probability of a decline in production. This advocates sturdily that production changes facing firms are produced not only by technological progress but, also by 'allocated disturbances' to demand. Hideaki Aoyama *et al.,* (2008) in their study validates that the distribution (allocation) of a factor's productivity is a function of aggregate demand in the economy. Productivity possibility frontier set is never-never land. A high ratio of economic demand reflects that economy is nearer to its production possibility frontier set.

4. Methodological Process

4.1 Model Specification

In this analysis researcher utilized four econometrical models. Followings are the model examined in this research:

i. $\mathbf{IVA_t} = \pi_0 + \pi_1$ (Macro-Economic Stability)$_t$ + π_2 (Openness of Economy)$_t$ + π_3 (Human Sector Development)$_t$ + π_4(Financial Sector Depth)$_t$ + μ_t

ii. $\mathbf{MVA_t} = \pi_0 + \pi_1$ (Macro-Economic Stability)$_t$ + π_2 (Openness of Economy)$_t$ + π_3 (Human Sector Development)$_t$ + π_4 (Financial Sector Depth)$_t$ + μ_t

iii. $\mathbf{SVA_t} = \pi_0 + \pi_1$ (Macro-Economic Stability)$_t$ + π_2 (Openness of Economy)$_t$ + π_3 (Human Sector Development)$_t$ + π_4 (Financial Sector Depth)$_t$ + μ_t

iv. $\mathbf{AVA_t} = \pi_0 + \pi_1$ (Macro-Economic Stability)$_t$ + π_2 (Openness of Economy)$_t$ + π_3 (Human Sector Development)$_t$ + π_4 (Financial Sector Depth)$_t$ + μ_t

Here;

π_0 = Intercept

π_1, π_2, π_3, π_4 = slop or coefficient of independent variable

IVA= Industry value added

MVA= Manufacturing value added

SVA= Service value added

AVA= Agriculture value added

Macro-Economic Stability = Expenditure on Education (E.EX), Govt. Final Consumption (G.CN)

Openness of Economy = Trade Openness (TO), foreign direct investment (FDI)

Human Sector Development = Employed Labor Force (EM), Population growth ((POP)

Financial Sector Depth = Domestic Credit allocated to private Sector (DC.PR), Gross total Investment (INV), Inflation ((INF)

μ_t = Error term

4.2 Process of estimation

Firstly data was collected by the sampling process. The "Non-probability convenience sampling" technique was chosen for data collection and range selection. The researcher examines this method because, data for some variables (E.EX, INV, EM) were missing for the case of Pakistan's economy, for some period. Then through descriptive analysis data was summarized. Correlation analysis highlights the cause and effect relationship among

variables. And after that, for all models of the study Regression or ordinary least square (OLS) approach were utilized. In the end, the CUSUM plot signifies the stability of examined models.

4.3 Data Collection

In this research, data for all variables of this study are collected from three different sources, from 1990 to 2016. Data for AVA, IVA, MVA, SVA, too, FDI, INF, DC.PR was collected from the world development index (WDI) while; INV, EM, POP, G.CN data was gathered from the state bank of Pakistan and E.EX data was collected from an economic survey of Pakistan's economy.

4.4 Descriptive Analysis

With descriptive analysis one can describe, present, summarize, and organize the observable data set (population). Either by the examination of numeric calculation or by graphics or tables. A fundamental process that involves the estimation of simple measures of conformation and distribution of variables amongst several population groups. It's all about illustrating inferences from data which is an essential preliminary stage.

Table 1: Descriptive Statistic

	AVA	DC.PR	EM	FDI	E.EX	GV.CN	GRS.IN	IVA	INF	MVA	SVA	TO	POP
Mean	24.79	23.05	42.91	1.159	2.397	10.74	7E+05	23.2	10.38	15.48	52.01	10.75	2.284
Median	24.93	24.08	41.36	0.812	2.534	10.5	4E+05	23.77	8.132	15.5	51.66	8.318	2.125
Maximum	27.31	28.74	57.62	3.668	3.23	15.14	2E+06	27.1	24.89	18.56	56.04	36.33	2.912
Minimum	21.47	15.28	27.47	0.383	1.093	7.781	2581	19.96	2.463	13.39	48.63	4.112	2.041
Std. Dev.	1.526	3.963	10.43	0.883	0.48	1.895	8E+05	2.002	5.585	1.399	2.48	7.2	0.267
Skewness	-0.33	-0.59	0.098	1.765	-1.08	0.428	1.129	0.076	1.016	0.21	0.215	2.062	0.865
Kurtosis	2.303	2.567	1.492	5.03	4.226	2.746	2.987	2.184	3.293	2.172	1.674	7.305	2.489
Probability	0.603	0.428	0.286	1E-04	0.035	0.649	0.063	0.689	0.102	0.627	0.349	0	0.172
Sum	644.4	599.2	1116	30.14	62.32	279.3	2E+07	603.3	270	402.5	1352	279.4	59.37
Sum Sq. Dev.	58.18	392.7	2717	19.5	5.757	89.79	1.51E+13	100.2	779.9	48.91	153.8	1296	1.778

Based on the Author's estimated calculation

The following displayed table exhibits the overall data in a summarizing form. Mean, median, and mode values ascribe us to the central tendency of examined data. While maximum and minimum value tells us the range of the observation via providing the smallest and the largest value of the data set. Std. Deviation shows how much observation deviates from the actual mean value. In this table, gross total investment exhibits a high standard deviation (8E+05) than other variables of the study. The value of skewness proves that either the variable is positively skewed (positive normal distribution) or negatively skewed (negative distribution). Employed labor force, FDI, Govt. consumption, gross total investment, industry value-added, inflation, manufacturing value-added, service value-added, trade openness, and population growth are positively skewed while, Agri. value-added, domestic credit to the private sector and expenditure on education is negatively

skewed. FDI, Govt. expenditure on education, inflation, and trade openness are leptokurtic because their kurtosis value is greater than three (3); while the remaining variables are meso-kurtic because their kurtosis value is Lower than three (3). Here, the actual number of observations is 26.

4.5 Correlation Analysis

Correlation analysis identified the inter-correlation of variables with each other. Correlation analysis may also ascribe the degree of change amid the variables of the study. This technique is useful when one's wants to analyze whether there's a "possible connection" amid variables or not. In short, it initializes the cause and effect relationship among the variables. Usually, it possesses two types; positive correlation (both variables increase simultaneously) and negative correlation (if one increases other variables shows declining trend).

Table 2: Corrélation Matrix

	AVA	DC.PR	EM	FDI	E.EX	GV.CN	GNV	IVA	INF	MVA	SVA	TO	POP
AVA	**1**	-0.3	-0.47	-0.54	0.466	0.603	-0.58	-0.03	0.155	0.016	-0.59	0.223	0.653
DC.PR	-0.3	**1**	-0.45	0.594	0.11	-0.1	0.498	0.554	0.082	0.527	-0.26	0.088	0.141
EM	-0.47	-0.45	**1**	0.246	-0.12	-0.51	0.326	-0.73	0.02	-0.73	0.873	-0.08	-0.87
FDI	-0.54	0.594	0.246	**1**	0.249	-0.21	0.71	-0.19	0.13	-0.16	0.484	0.028	-0.37
E.EX	0.466	0.11	-0.12	0.249	**1**	0.555	-0.01	-0.16	0.189	-0.04	-0.15	0.261	0.34
GV.CN	0.603	-0.1	-0.51	-0.21	0.555	**1**	-0.38	0.089	-0	0.237	-0.44	0.119	0.829
INV	-0.58	0.498	0.326	0.71	-0.01	-0.38	**1**	-0.26	0.278	-0.29	0.566	0.169	-0.47
IVA	-0.03	0.554	-0.73	-0.19	-0.16	0.089	-0.26	**1**	-0.23	0.963	-0.79	-0.11	0.522
INF	0.155	0.082	0.02	0.13	0.189	-0	0.278	-0.23	**1**	-0.25	0.093	0.127	0.007
MVA	0.016	0.527	-0.73	-0.16	-0.04	0.237	-0.29	0.963	-0.25	**1**	-0.79	-0.07	0.602
SVA	-0.59	-0.26	0.873	0.484	-0.15	-0.44	0.566	-0.79	0.093	-0.79	**1**	-0.05	-0.82
TO	0.223	0.088	-0.08	0.028	0.261	0.119	0.169	-0.11	0.127	-0.07	-0.05	**1**	0.102
POP	0.653	0.141	-0.87	-0.37	0.34	0.829	-0.47	0.522	0.007	0.602	-0.82	0.102	**1**

Based on the Author's estimated calculation

The correlation table initiates the relationship or correlation with themselves or with other variables of the study. Highlighted diagonal numbers for all variables identified that all variables are perfectly correlated with themselves. Agri. Value added is negatively correlated with DC.PR, EMR, FDI, INV, IVA, and SVA while positively correlated with E.EX, GV.CN, too, INF, MVA, and POP. Domestic credit to the private sector shows a negative association with AVA, EMR, GV.CN and SVA while, positively with others. Employed labor force affiliated positively with FDI, INV, INF, and SVA moreover, negatively with remaining's. FDI assures a negative relationship with AVA, GV.CN, IVA, MVA, and POP yet, positively with others. Govt. expenditure on education is negatively correlated with EMR, INV, IVA, MVA, and SVA; on the other hand, positively with others. Govt. consumption is positively associated with AVA, E.EX, IVA, MVA, too, and POP furthermore, negatively with remaining's. Gross total investment negatively affiliated with AVA, E.EX, GN.CN, IVA, MVA, and POP furthermore, positively with other variables of the analysis.

Industry value added shows a positive correlation with DC.PR, GV.CN, MVA, and POP. Moreover, inflation assures a negative association with GV.CN, IVA, and MVA and positive others; yet, the manufacturing sector assures positive association with AVA, DC.PR, GV.CN and IVA and, negative with remaining's. SVA is positively correlated with EMR, FDI, INV, INF. TO negatively correlated with EMR, IVA, MVA, and SVA. However, the population is EMR, FDI, INV, and SVA; and positivity with other variables.

4.6 Regression Analysis

Regression is an influential statistic technique that permits one to inspect the association amid two or more variables of concentration. Regression assists one to comprehend how the distinctive unit of criterion variable (dependent variable) varies when any one of the independent variables is varied. Although other autonomous (independent) variables are detained unchanged. Regression approximates the 'conditional expectations' of the dependent variable given the independent variable. That's the mean value of the inter-dependent (dependent) variable; via examining a normality distribution (probability distribution). The procedure of executing a regression let one to significantly examine which variable influence the most and which variable might be ignored.

Table 3: OLS Estimates of Total Factor Productivity Equations (Dependent Variable: TFP)

	Regression-I (Industry)	**Regression-II (Manufacturing)**	**Regression-III (Service)**	**Regression-IV (Agriculture)**
Constant	-6.4492	-11.3731	75.5127	30.9365
	❖ **Macro-Economic Stability**			
Govt. Consumption	[-0.6750]	[-0.4281]	[0.7321]	[-0.0571]
(-0.2124)	(0.0948)	(0.0016)	(0.8582)	
Expenditure on Education	[-0.6550]	[0.4656]	[-0.9902]	[1.6453]
(0.2124)	(0.2713)	(0.0079)	(0.0071)	
	❖ **Openness of Economy**			
Trade Openness	[-0.0185]	[-0.0061]	[-0.0017]	[0.0203]
(0.4609)	(0.7601)	(0.9118)	(0.4447)	
Foreign Direct Investment	[-0.7277]	[-0.3600]	[1.1550]	[-0.4272]
(0.0868)	(0.2817)	(0.0004)	(0.3260)	
	❖ **Human Sector Development**			
Population Growth	[9.9135]	[8.4723]	[-9.3585]	[-0.5549]
(0.0160)	(0.0118)	(0.0012)	(0.8884)	
Employment Labor Force	[0.1413]	[0.1389]	[-0.0470]	[-0.0943]
(0.0499)	(0.0204)	(0.2916)	(0.1995)	
	❖ **Financial Sector Depth**			
Domestic credit to private Sector	[0.5250]	[0.3812]	[-0.3425]	[-0.1824]
(0.0002)	(0.0005)	(0.0002)	(0.1310)	
Gross total Investment	[-9.07E-07]	[-7.24E-07]	[1.06E-06]	[-1.53E-07]
(0.0344)	(0.0368)	(0.0007)	(0.7166)	
Inflation	[0.0594]	[-0.0491]	[0.0181]	[0.0412]
(0.0860)	(0.0802)	(0.4013)	(0.2468)	

R-squared	**0.8970**	**0.8614**	**0.9718**	**0.8017**
Adjusted R-squared	**0.8391**	**0.7835**	**0.9560**	**0.6902**
S.E. of regression	**0.8030**	**0.6507**	**0.5201**	**0.8489**
Durbin-Watson stat	**1.9284**	**1.5887**	**2.2951**	**1.5634**

Based on the Author's estimated calculation

The above-displayed table ascribes the OLS estimates for the impact of major macro-economic determinants of TFP on all sectors of Pakistan's economy, for the period of 1990-2016. Regression-I shows OLS estimates for the industrial sector; while, Regression-for manufacturing sector**,** Regression-III for the service sector, and Regression-Iv for the agriculture sector of Pakistan's economy. In these models selected dependent variable is industry value-added, manufacturing value-added, service value-added, and Agri. Value-added respectively. While, independent selected variables are macro-economic stability, the openness of the economy, human sector development, and financial sector depth. Safdar U. Khan's (2006) study significantly supports the findings of this research.

4.6.1 Regression I

Estimates assured that the impact of macro-economic stability (Govt. Consumption and Govt. Expenditure on education) on industry sector productivity is statistically insignificant. As because, Pakistan is a developing state, here the effect of other factors such as lack of good governance and lack of security to investors, high crime level, inflation, and many other factors affect is much stronger than government expenditures on education and government consumption. Due to this, the case of Pakistan estimates shows an insignificant effect. paovlomouro (1997), affirms the negative and significant effect of govt. consumption and govt. expenditure. Trade openness affirms an insignificant effect on Industrial sector productivity. Because mostly Pakistan's population is illiterate. Moreover, the demonstration effect and spending's on luxurious goods are also common here, which makes the trade openness effect insignificant. Yet, FDI ascribes a negative and significant effect on industrial productivity. In developing nations, dependency theory holds. FDI creates its Monopoly in such states and cuts down the domestic investment share and productivity in both domestic and international markets. Gene M. G and Elhanan H. (2002), Margaret S.M (2003) assured the negative and significant effect of openness of the economy. Population growth (9.913513) and employed labor force (0.141387) positively and significantly influence the industrial sector productivity. An increase in population growth and employed labor force cause an incrementation in the labor force which means more workers and more productivity. Domestic credit allocation to the private sector also positively (0.525014) influence industrial productivity. More capital means more investment, more production, high MEC (marginal efficiency of capital), and high productivity growth. Sanjaya Lall (1992) assured positive and significant effect of population growth. However, gross total investment affiliates the industrial productivity negativity (-9.07E-07) but significantly. As because, mostly investment projects carried a long amount of loan. In developing states, the presence of high-interest rate causes a reduction in MEC and

a decline in investment and production levels. The inflation rate shows significant and positive results (0.059435) which mean high prices and high margin profit. In short, all variables significantly influence industrial productivity except macro-economic stability and trade openness. David A.A. (1988), David A.A. (1990) argued that there's a significant influence of gross investment on economic growth. In last, values of R-square and adjusted R-square exhibits the rate of change in industrial training productivity due to macro-economic determinants of TFP. R^2 and adjusted R-square value for this model is 0.897072 and0.839175 respectively. Which ascribe that 89% change in industrial productivity is due to macro-economic determinants of TFP. Moreover, the Durbin Watson test value is nearer to 2 (1.928424) which reflects that there's no heteroscedasticity in this model. Safdar U. Khan's (2006) study significantly supports the findings of this research.

4.6.2 Regression II

Approximates the effect of macro-economic determinants of TFP on the manufacturing sector. For a few past decades, Govt. of Pakistan is making such policies that promote the manufacturing sector. High Govt. Consumption means a low left amount for manufacturing firms. This analysis also reflects the negative effect of Govt. consumption (-0.428142) on manufacturing production yet, expenditure on education affirms an insignificant association. paovlomouro (1997), affirms the negative and significant effect of govt. consumption and govt. expenditure. The openness of the economy (Trade openness and FDI) demonstrated an insignificant effect on manufacturing sector production. In developing nations, dependency theory holds. Trade openness and FDI create monopolies in such states (because they produce goods at low cost with high technology) and cut down the domestic investment share and productivity in both domestic and international markets. Gene M. G and Elhanan H. (2002), Margaret S.M (2003) assured the negative and significant effect of openness of the economy. Population growth (8.472342) and employed labor force (0.138988) positively and significantly influence the industrial sector productivity. An increase in population growth and employed labor force cause an incrementation in the labor force which means more workers and more productivity. Domestic credit allocation to the private sector also positively (0.381267) influence the productivity levels in an economy. More capital means more investment, more production, high MEC (marginal efficiency of capital), and high productivity growth. SanjayaLall (1992) assured positive and significant effect of population growth. However, gross total investment affiliates the manufacturing sector productivity negatively (-7.24E-07) but significantly. David A.A. (1988), David A.A. (1990) argued that there's a significant influence of gross investment on economic growth. As because, mostly investment projects carried a long amount of loan. In developing states, the presence of high-interest rate causes a reduction in MEC and a decline in investment and production levels. The inflation rate too negatively (-0.049178) influences manufacturing firms' productivity. High inflation means high raw material, machinery prices, and high costs of production cause a reduction in the profit margins of the firms. That's why inflation negatively influences manufacturing productivity.

In the end, values of R-square and adjusted R-square exhibit the rate of change in manufacturing training productivity due to macro-economic determinants of TFP. R^2 and adjusted R-square value for this model is 0.861463 and 0.783536 respectively. Which ascribe that 86% change in manufacturing productivity is due to macro-economic determinants of TFP. Moreover, the Durbin Watson test value is nearer to 2 (1.588791) which reflects that there's no heteroscedasticity in this model. Safdar U. Khan's (2006) study significantly support the findings of this research.

4.6.3 Regression III

Estimates initiated that there's a statistically significant association between the service sector and the macro-economic stability of Pakistan's economy. Such as due to 1 unit change in Govt. consumption service value added increased by (0.732173). Estimates for expenditure on education also affirm a significant effect. Such as due to one unit change in expenditure on education service value added changed by (-0.990285) units. paovlomouro (1997), affirms the significant effect of govt. consumption and govt. expenditure. Estimates for trade openness confirm insignificant affiliation with service value-added. FDI ascribes a positive and significant effect (-0.727785) on the service sector. FDI in developing states may promote technical innovation and provide employment opportunities to domestic workers. That creates productivity spillovers and booster up employment and production levels. High population growth identified that they're more individuals (consumers), which generates the demand for goods to fulfill this incrementation in demand more investment projects will be initiated. Francois (2009) affirms that there's a positive and significant effect of TO and FDI on service sector growth. And for more projects, more labor will be hired that not only creates employment opportunities and income but also again causes an increase in demand. That all works like a circular flow. Approximately half of Pakistan's population consists of women. But due to traditional backwardness and illiteracy; women's employment rate is very low. Moreover, employed women get lower wages (often, didn't get wages such as in Agri. sector) than male party and they have low opportunities (seats) for high post jobs. All this mess up causes the insignificant effect of the employed labor force on service value-added. Financial sector depth demonstrated a significant correlation with the service sector. Domestic credit allocated to the private sector shows a negative (-0.342564) and significant association. Gross total investment displayed a positive (1.06E-06) and statistically significant association with the service sector. While findings for inflation signifies an insignificant correlation. David A.A. (1988), David A.A. (1990) argued that there's a significant influence of gross investment on economic growth. In the end, values of R-square and adjusted R-square exhibits the rate of change in service productivity due to macro-economic determinants of TFP. R^2 and adjusted R-square value for this model is 0.971852 and 0.956019 respectively. Which ascribe that a 97% change in service productivity is due to macro-economic determinants of TFP. Moreover, the Durbin Watson test value is greater than 2 (2.295184) which reflects that there's no heteroscedasticity in

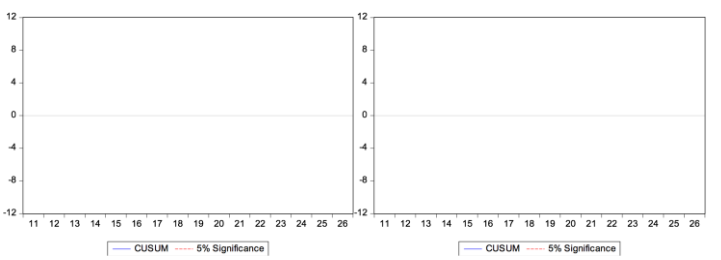
this model. Safdar U. Khan's (2006) study significantly supports the findings of this research.

4.6.4 Regression IV

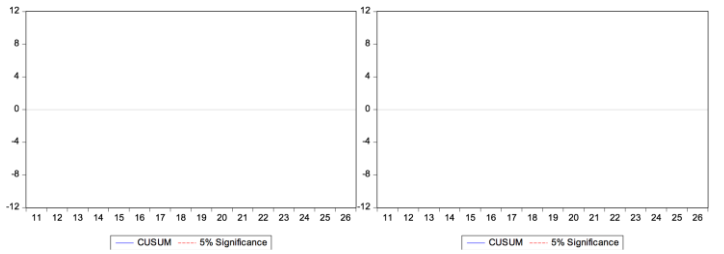
All macro-economic variables except employed labor force assure insignificant association with Agri. value added. Hong-sang *et al.,* also signify the positive effect of expenditure on education. The reason behind this insignificant association is that the agriculture sectors of Pakistan face many problems from the beginning. These problems include; defective tenure system, lords (landholding by big landlords), defective rural socio-economic setup, soil and leakage problem, the weak financial position of farmer's, old production cultivation methods, little usage of machinery, limited cultivated area, lack of cold stores & Warehouses, poor marketing, inadequate public policy, low technical innovation & low research facilities and many others. Government consumption insignificant association attributed to 'lords or jagirdairism'. All benefits attained through Govt. subsidy and consumption are mostly enjoyed by big landlords living tenants gains and profit unchanged. The openness of the economy demonstrates an insignificant association with Agri. productivity because the prices of our goods are high but the quality is low and we may fail if we compete with foreigners or in the open market. Illiteracy, high dependency ratio, the tenure system, forefathers' debts, low technical innovation, and many other components made human sector development and financial market depth impact insignificant. The employed labor force shows positive and significant affiliation with Agriculture productivity. An incrimination in the rate of the employed labor force increases the size of the workforce (more labor), more labor means more production, use of better input, the decline in marginal costs, and addition in marginal profit. So, the employed labor force positively correlates with Agriculture productivity. In the end, values of R-square and adjusted R-square exhibits the rate of change in agricultural productivity due to macro-economic determinants of TFP. R^2 and adjusted R-square value for this model are 0.801775 and 0.690274respectively. Which ascribe that 80% change in agriculture productivity is due to macro-economic determinants of TFP. Moreover, the Durbin Watson test value is nearer to 2 (1.563443) which reflects that there's no heteroscedasticity in this model. Safdar U. Khan (2006), Bruce F.J, and John W.M (1961), Jarrett Hart *et al.*, (2015) affirm the findings of this analysis.

4.7 CUSUM Plot

If the plotted line lies amid two critical boundaries this ascribe, the models examined in this analysis are statistically significant and stable and, might be accepted.



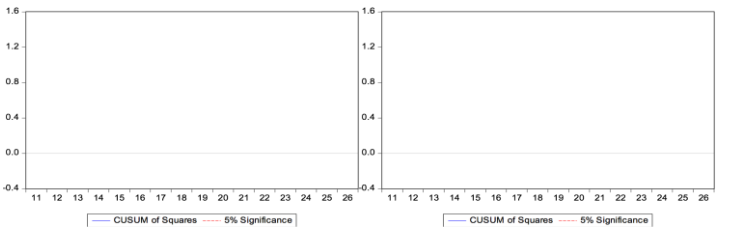
Model: (i) **Model: (ii)**



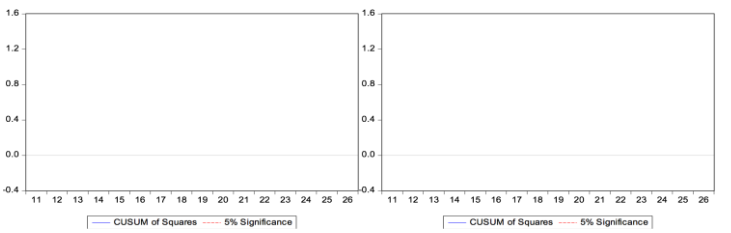
Model: (iii) **Model: (iv)**

Figure 1: CUSUM

The above displayed CUSUM plots signify that the examined models are stable and significant. Because the blue plotted line lies amid the critical boundaries which show that the models are statistically stable and significant.



Model: (i) **Model: (ii)**



Model: (iii) **Model: (iv)**

Figure 2: CUSUM Square

Here, the Blue plotted line lies amid the critical boundaries which exhibit that the models are statistically stable and significant at a 5% level of significance.

5. Conclusion

This research is an attempt to calculate the consistency in the behavior of the entire specified determinant of TFP sectorial vise, by examining four Regression models. It is important to note that mostly many macro-economic determinants initialized in Regression-I, Regression-Il, Regression-Ill exhibit a significant correlation. However, note that the indicators of macro-economic stability, the openness of trade, and financial depth don't remain significant in the encompassing Regression Iv. It implies that the indicators of macro-economic stability, the openness of trade, and financial sector depth are sensitive to determine TFP in the agriculture sector. Moreover, the 'inconsistent behavior' appears to be statistical; that's small degrees of freedom are accessible in the Regression IV. Based on this pragmatic exercise, it might be remarked

that Regression-I, Regression-Il, Regression-Ill is the greatest fit of the determinants of TFP.

6. Policy Implications

To enhance the total factor productivity (TFP) of Pakistan's economy, policymakers may consider the following suggestions:

1. Reduce government consumption: Prioritize spending on developmental projects rather than non-developmental ones. By allocating resources more efficiently, the government can contribute to increased productivity and economic growth.
2. Ensure domestic investor security: Implement measures to protect domestic investors from unfair competition and monopolistic practices by foreign competitors. This can encourage local entrepreneurship and investment, fostering economic development.
3. Promote employment opportunities: Encourage the initiation of new investment projects across all sectors to generate more employment opportunities. This will help utilize the population effectively, leading to higher labor force productivity.
4. Optimize labor force utilization: Develop strategies to fully utilize the potential of the population, such as investing in education and training programs. By enhancing the skills and capabilities of the workforce, overall productivity can be improved.
5. Increase capital allocation to the private sector: Facilitate access to capital for private businesses through financial reforms and incentives. This can stimulate investment, innovation, and productivity growth across various industries.
6. Manage inflation effectively: Implement effective fiscal policies to control inflation rates. Stable and moderate inflation fosters economic stability and provides a conducive environment for businesses to thrive.

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