PAKISTAN ISLAMICUS
(An International Journal of Islamic and Social Sciences)
Volume:04, Issue:02, 2024, Pages:55-65
Journal Website: https://pakistanislamicus.com/index.php/home
Publisher Website: https://www.mircpk.net

PUBLIC-PRIVATE INVESTMENT SUSTENANCE: TIME SERIES EVIDENCE FROM EDUCATION SECTOR OF PAKISTAN

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HEC "Y" Category
HJRS HEC Journal Recognition System

ARTICLE INFO

Article History:

Received: March 10, 2024
Revised: April 05, 2024
Accepted: April 08, 2024
Available Online: April 12, 2024

Keywords:

Private & Public Investment
Time Series Evidence
Education
Sectors of Pakistan
ARDL

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

This study relates with the government and private sector partnership in the education sector of Pakistan. For the analyses, the data ranging from 1980 to 2022 is relied upon. For the regression estimation, Autoregressive Distributed Lag (ARDL) approach is used. The explained variable is Government Education Expenditure (GED). The core explanatory variable is Private Education Expenditure (PED). The results show positive relationship between GED and PED. Therefore, as a policy recommendation, the verdict is to strengthen the bonding of public and private partnership especially in the education sector for the better interest of the aspirants of education in Pakistan.

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INTRODUCTION

Partnership of Public-Private Sector (PPS) has a significant impact on the country's infrastructure development. The collaboration of PPS especially in the education sector of Pakistan is meaningful for better nation. To have a solo role in the education development is not to render plausible outcome. The establishment of universities, colleges, and schools to cover the education needs of the general public is reachable through PPS. Public sector investment initiatives are not for the profit making. Still, the factual point is to in-vision the pose of private sector investment return for carrying out better initiative of investment spending for instance in the education sector. Although there are not hitches of potential profit-

seeking from the side of public sector but in severe economic challenges of heavy debt burden, public sector looks forward to have a fruitful investment collaboration with private sector.

The government of Pakistan believe in PPS. In fact, total investment of $28.4 billion are already invested on 108 projects of PPS from 1990 onwards to 2019. By 2021, the legislative authorities enforced to strengthen PPS for improved country wide physical infrastructure and social sector initiatives especially in education and health sector of the country.

Government of Pakistan is not reluctant in carrying out heavy investment efforts on education sector. Currently, the initiative of schools on wheels is taken to provide education to the children who are located in the rural areas to seek education on their doorsteps. The government of Pakistan aims to expand this program to all the federating units. Also, the initiative is taken to provide online education to the students from grade 1 to 12. That is further supplemented with the introduction of digital support to the teachers for offering quality and modern training and skill to the students. Nevertheless, Danish schools are chained in Province Balochistan for the provision of education skills to across the board (Pakistan Today, 2023). The ministry of education and professional training at federal level is also seen working to improvise the standards of education by revision of the curriculums and grading system at national and provincial level in order to remain in-line with the world growing economies particularly in respect of technology and modern sciences (National Education Foundation, 2024). The evident based decision making in education sector, together with the Hunarmand Pakistan and Kamyab Jawan Youth Development Programs, coupled with radio school and E-Taleem portal are the admirable initiative of the government which persuade the private sector to be there in collaboration with the government for the better future of Pakistan's education sector. PPS in education sector was introduced in 1990s that went as a turning point in improving the quality and realizing growth in this sector. PPS programs such as Punjab Education Foundation facilitates quality and with-in-reach education by the mean of private sector partnership. However, in the presence of current debt portfolio, IMF is stressing the government towards the carefully designed education sector investment.

PPS is popular in Pakistan as a medium of financing and the development of infrastructure projects. However, somewhat often, it is found to have short coming in transpiring the access to ready finance, project scrutiny, risk distribution, legal framework, institutional capacity, and transparency in the fund disbursements.

The issue of project inefficacy, innovation gap are the core concerns while there is found weak regulatory framework to carryout PPS in education sector of Pakistan. According to Ministry of Finance, the figure of enrollment is increased by 6.7 percent by 2020-2021 compared with total investment of 13.5 million students in 2019-2020. Middle education enrollment has also gone up to 8.3 million next to 7.6 million during 2018-2019. Secondary school enrollment is also surged by 12.5 percent from 4.0 million during 2020-2021. Higher secondary school enrollment has gone up to 2.55 million by 2020-2021 which was at 2.14 million by 2018-2019. Technical and vocational institution's enrollments have also swelled to 0.76

million compared with that of 0.74 million during 2020-2021. For boosting students' enrollment and fostering the speed of project completion in education sector at various education levels. The PPS is a key ingredient to achieve the desired outcome.

The government of Pakistan has earmarked PKR 4.5 billion for pre-primary and primary education for the fiscal year 2023-2024 which is 33.33 percent greater than last year. For the secondary education total fund allocation from the public sector side is PKR 8.9 billion. Similarly, for higher education, the allocation of fund is mounted to PKR 44.7 billion (Business Recorder, 2024).

The novelty of this study rests upon the research objective of locating the collaboration of public and private sector investment in education sector. Specifically, the need is to locate if public sector investment spending on education sector is contingent upon the private sector investment on education.

The study is structured in a way that Introduction is given in Section I. The brief summary of precise literature is brought into being in Section II. The Section III goes with the Methodological Issues. Whereas, Section IV and Section V are bestowed for the Results and Discussion and Conclusion and Policy Recommendations.

LITERATURE REVIEW

This study is initiated to explore the collaboration of public and private investment in education sector of Pakistan. However, less than significant number of empirical studies are carried out to highlight this area of study. The research, in recent, that supports this area of study is of Kursheed et al. (2023). Moreover, empirics like Bano (2008), Farooq et al. (2016) together with Awan and Waqar (2019) and Farah and Rizvi (2007) are the prominent studies to highlight the PPS. Nevertheless, Halai (2011), Verger et al. (2017), Irfan (2017), Hassan et al. (2011), Maluleke et al. (2023), Khalid et al. (2016), and Rind (2013) have also examined PPS especially in the education sector related infrastructure and financial support across the sector.

Bano (2008) went with the findings that Pakistan's shift towards PPS is aimed to ease off the access to education and equity. However, according to Bano (2008), the reliance on non-government organizations and trustees and that of insufficient incentives are responsible to hinder the PPS growth. The survey-based study of Bano (2008) showed that mathematic students often fail to meet grade-level expectations. The low-income children face challenges such as non-formal equity programs and thereby lack behind in the pathways towards the better education due to being inaccessible to the nearby located secondary schools. Farooq et al. (2017) also initiated study on preschool system of Pakistan and found that 22.6 million children which is about 44 percent of the total Pakistani children are away from the school. According to Farooq et al. (2017) social connections, teaching experiences, and education to establish a three-factor model for the intellectual capital for Pakistan. The study ascertained the relevance of the model in Pakistan's schools at secondary level and point out that investment capital is essential component for augmentation of formal education sector growth.

The empirical study of Awan and Waqar (2019) explored the effect of ever-expanding private school on the literacy rates by the mean of economic survey ranging from 2000 to 2015. The conclusion of the study of Awan and Waqar (2019) is that performance of private schools is far much better than those of public sector schools in terms of improving literacy. The findings also confirmed the PPS is significant for the prompt growth of literacy and for the development of human infrastructure. The study of Awan and Waqar (2019) emphasizes on academic performance for the growth of education in Pakistan by the private sector so that to cast away the negative effect of administrative and system related deficiencies and corruption with the benches of public sector educational setup.

In the same line of study, Farah and Rizvi (2007) investigated early approach of PPS in the education sector of Pakistan during the era of 1990s. The findings confirmed that the PPS model is successful in the improvisation of the elementary schools which are neglected by the public-private sector for sufficient investment expenditure for hosting state of the art facilities. Though the PPS is challenging due to varied interests of public-private venture but the primary focus is to uplift the education opportunities for the underrepresented population.

Similarly, Halai (2011) considered the emergence of the 60 newly established private universities across Pakistan since 1983, which are expanding the accessible links to the population at large towards higher education. In this regard, Higher Education Commission plays crucial role for the cause of transpiring quality education across the national frontiers. Later to 2002, the enrollment of students in higher education institutes is surged to 0.8 million by the year 2009 having 1.15 million of students engaged with the private sector universities. Still country-wide 1.3 million students require substantial attentions to be got accommodated in higher education.

MacPhail (2013) examined the effect of PPS on the governance in education sector. The research emphasizes that the connection of education and economy is inevitable for the better outlook of education sector together with solid administration policy. The study of MacPhail (2013) highlighted the significance of PPS in education sector even in the developed economies of the world.

Verger et al. (2017) scrutinized the global education market in the lens of profitability. The study dealt with the influence of international education policy, the roles of chartered schools, and the existence of low-cost schools in the globe. The study in-focused that informal governing systems of varied industries, the network of public-private sector serve as an efficient channel towards establishing quality among the education sector.

Irfan (2015) and Rind (2022) investigated role of PPS in the domain of education sector world-wide and on Pakistan. In case of PPS, the role of not-for-profit organizations is not of undue importance. PPS, for instance, entail the involvement of either sector by the mean of legal agreements for the achievement of desired objectives of education for all. Ifran (2015) looked into the public-private partnership at schools' level. However, Rind (2022) located the success of PPS in province Sindh of Pakistan. For reliable cost structure, low paid contractual workers is proposed by Rind (2022).

Khalid et al. (2016) concentrated upon contribution of PPS towards the development of school system in District Bhakkar of province Punjab. The findings approves that PPS type collaboration is active strategy for ornamental resource availability.

Likewise, Hassan et al. (2011) explored the investment sustainability between public and private sector of Malaysia. The panel data research comes up with the findings that public-private sector complement each other in various sectors of Malaysia. On the similar ground, Maluleke et al. (2023) and Khursheed et al. (2023) also ascertained complementary relationship of public-private investment partnership.

METHODOLOGICAL ISSUES

This section gives a brief summary of the source of data collection, construction of model, and steps of computation of ARDL.

Source of Data

This study is reliant upon secondary analyses. For the regression analysis, time series data is collected for the length of 1980 to 2022. The data is out sourced from World Development Indicators, Pakistan Bureau of Statistics, Ministry of Finance, and Handbook of Statistics of State Bank of Pakistan.

Construction of Model

The basic objective of PPS is to cater infrastructure and to be education sector specific, to enhance the quality of education and improve the accessibility of people towards literacy. Precise look of the literature assists to embark for the following model for achieving the objectives of the study

GED = f (PED, EGR, GTR, REM, PVR) [1]

The functional form of the model is given in Equation [2]

$$GED_t = \beta_0 + \beta_1 PED_t + \beta_2 EGR_t + \beta_3 GTR_t + \beta_4 REM_t + \beta_5 POV + \varepsilon_t \quad [2]$$

The $\beta_{1,}\beta_2 \ldots . \beta_5$ represent the coefficients, β_0 is the intercept. The ε_t is the error term.

Descriptions of the Variables

The variables' descriptions are given in Table 1.

Table 1

Descriptions of the Variables

Variable	Notation	Description
Government Education Expenditure	GED	The proportion of GDP that is spend on education (PKR million)
Private Education Expenditure	PED	Expenditure on education by entities other than government (PKR million)
Economic Growth	EGR	GDP calculates at market value on constant price of 2015 in current USD
Tax Revenue of Government	GTR	Percentage of GDP
Personal Remittances	REM	Personal remittances received in current USD
Poverty	PVR	Headcount ratio

Empirical Analyses

The steps involved in the empirical analyses are described below:

Test of Stationarity

It is important to trace the non-stationarity in the time series data. In this regard, Dickey-Fuller (1979) gave analytical test to locate the state of stationarity among the variables concerned. This test is widely used in the research of Mehmood and Hassan (2015) and Kursheed et al. (2023).

The functional form of the Dickey-Fuller (1979) test is given in Equation 3

$$\Delta y_t = \partial_1 + \partial_2 t + \lambda y_{t-1} + \beta_t \sum_{t=1}^{n} \Delta y_{t-1} + \varepsilon_t \qquad [3]$$

The ε_t is a residual term and the sequential predictor is shown by y_t. The λ indicates no any change and therefore, $\Delta y_{t-1} = (y_{t-1} - y_{t-2}), \Delta y_{t-2} = (y_{t-2} - y_{t-3})$. For the verdict, if the test statistic is smaller than the critical value, the variable is said to be stationary and vice versa.

Bound Test

ARDL bound test is a method to locate cointegration of the variables in the specific model. The framework is defined by Pesaran et al. (2001). This approach is used irrespective of order of integration of the series whether at I(0) or I(1). If the computed F-Statistics of Wald Test is greater than I(1), the null hypothesis of no cointegration is rejected (Khursheed et al., 2023).

Autoregressive Distributed Lag

This study ***examines*** the long-term relationship between GED and PED. For the purpose of computing long run and short run coefficients, the un restricted Error Correction Model is given in Equation 4.

$$\Delta GED_t = \alpha + \beta_1 GED_{t-1} + \beta_2 PED_{t-2} + \beta_3 EGR_{t-3} + \beta_4 GTR_{t-4} + \beta_5 REM_{t-5} + \beta_6 POV_{t-6} + \sum_{I=0}^{P_1} \delta_1 GED_{t-i} + \sum_{I=0}^{P_2} \delta_2 PED_{t-i} + \sum_{I=0}^{P_3} \delta_3 EGR_{t-i} + \sum_{I=0}^{P_4} \delta_4 GTR_{t-i} + \sum_{I=0}^{P_5} \delta_5 REM_{t-i} + \sum_{I=0}^{P_6} \delta_6 POV_{t-i} + \varepsilon_t \qquad .[4]$$

The β_1, δ_1 and Δ are the multipliers of long run and error term is given as ε_t.

The long run coefficient estimates are followed by Equation [5a];

$$\Delta GED_t = \alpha + \sum_{I=0}^{P_1} \eta_1 \Delta GED_{t-i} + \sum_{I=0}^{P_2} \eta \Delta PED_{2t-i} + \sum_{I=0}^{P_3} \eta_3 \Delta EGR_{t-i} + \sum_{I=0}^{P_4} \eta_4 \Delta GTR_{t-i} + \sum_{I=0}^{P_5} \eta_5 \Delta REM_{t-i} + \sum_{I=0}^{P_6} \eta_6 \Delta POV_{t-i} + \varepsilon_t \qquad [5a]$$

The short run coefficient are computed next to the long run coefficient estimation. The coefficient of error correction term is significant information at this point. The range of the coefficient of error correction term must by less than zero but greater than minus one. Nevertheless, it must be significant to show the correction of the disequilibrium towards the long run.

The functional form of short run coefficient estimation model is given in Equation [5b]

$$\Delta GED_t = \alpha + \sum_{I=0}^{P_1} \lambda_1 \Delta GED_{t-i} + \sum_{I=0}^{P_2} \lambda_2 \Delta PED_{t-i} + \sum_{I=0}^{P_3} \lambda_3 \Delta EGR_{t-i} + \sum_{I=0}^{P_4} \lambda_4 \Delta GTR_{t-i} + \sum_{I=0}^{P_5} \lambda_5 \Delta REM_{t-i} + \sum_{I=0}^{P_6} \lambda_6 \Delta POV_{t-i} + \partial ECM + \varepsilon_t \qquad [5b]$$

The λ is the representation of short run coefficient and the ∂ shows the coefficient of error correction term.

Diagnostic Checking

For the authenticity of results, Breush-Pagan-Godfrey LM Test of serial correlation, Heteroskedasticity Test, RAMSEY RESET Test for the correctly specified model, Jarque-Bera Normality Test to evaluate the normality of the residuals, and CUSUM and CUSUMsq Test for the accumulated residuals square and the drastic changes in permanence of regression coefficients are incorporated.

RESULTS AND DISCUSSIONS

The key findings on PPS are given in this section. To start with, the descriptive statistics results are given. Subsequently, the correlation analyses are elaborated further. Later to that the regression results are published which are concluded upon the diagnostic checking.

Table 2

Descriptive Analyses Results

	GED	**PED**	**EGR**	**GTR**	**REM**	**PVR**
Mean	3.10	0.87	4.70	554.96	7.69	24.3
Median	1.69	0.31	4.83	463.93	2.94	23.37
Maximum	9.84	3.88	10.22	1355.27	31.31	34.6
Minimum	0	-0.23	-1.27	31.26	1	17.32
Std. Dev.	2.83	1.04	2.21	457.49	8.28	3.6
Skewness	1.07	1.45	-0.14	0.38	1.21	1.2
Kurtosis	2.86	4.22	3.29	1.66	3.24	4.66
Jarque-Bera	8.19	17.68	0.29	4.27	10.62	15.23
Probability	0.02	0.0001	0.87	0.12	0.005	0.0005

Descriptive Analyses

Table 2 provides the descriptive analysis of the variables used in the Equation [1].

The mean value of GED is 3.10 and of PED, it is 0.87. Looking onto the stand deviation, there is less dispersion on these variables. Therefore, both are quite consistent during the era of the recorded observations. Moving onto the control variables, EGR, GTR, REM, and POV are observed for less dispersion from their mean values except POV. The wider breach is also found in the maximum and minimum value of POV, REM, and GTR.

EGR is negatively skewed unlike other variables. furthermore, PED, EGR, and REM are found to be leptokurtic. Rest of the variables are of lighter tail than normal distribution therefore, are detected to be mesokurtic. Finally, the Jargue-Bera probability value confirms that EGR and GTR have normally distribution.

Correlation Analyses

Correlation quantifies the strength and direction of association among variables. The value range if disperses from 0 to +1, it shows perfect positive correlation and vice versa if the correlation value moves towards -1. The results of correlation are given in Table 3.

Table 3

Correlation Results

	GED	PED	EGR	GTR	REM	POV
GED	1.00	0.97	-0.14	0.84	0.81	-0.08
PED		1.00	-0.09	0.78	0.80	-0.15
EGR			1.00	-0.41	-0.25	-0.26
GTR				1.00	0.91	-0.02
REM					1.00	-0.15
POV						1.00

Table 3 is rendered for the correlation results. The findings show that GED and PED are highly correlation and in-positive. GED is also exhibiting strong positive correlation with GTR and REM. The results show the consistency of PPS in the education sector of Pakistan. Moreover, GED and PED are significantly engaged with the investment on education sector in the presence of tax revenue and personal remittances. Among the other variables, weak to moderate correlation is found.

Unit Root Test

The detection of the status of stationarity is done by the mean of Dickey-Fuller (1979) unit root test. Table 4 presents the desired results. The results are published in Table 4. The Conclusion is a mixed order of integration i.e. I(0) and I(1).

Table 4

Test of Unit Root

Variable	t statistic (Computed)	Prob.	Conclusion
GED	-5.811	0.00	I(1)
PED	-8.65	0.00	I(1)
EGR	-4.79	0.00	I(0)
GTR	-5.31	0.00	I(1)
REM	-3.34	0.02	I(0)
POV	-3.06	0.00	I(0)

Bound Test

To confirm the status of long-run relationship between the variables of interest, GED, PED, the Bound Test of cointegration is run. The results are shown in Table 5. The H_0 of no cointegration is rejected since the computed F-Statistic is greater than critical bound value at I(1).

Table 5

Bound Test Result

Test Statistic	Value	K
F-statistic	4.84	5
Critical Bound Value at I(1) is 2.93		

Results of Long Run Coefficients

The long run coefficient estimates are given in Table 6.

Table 6

Results of Long Run Coefficients

Dependent variable (GED)				
Variable	**Coefficient**	**Std. Error**	**t-statistics**	**Prob.**
PED	2.14	0.15	13.78	0.00
EGR	0.09	0.05	1.71	0.09
GTR	0.003	0.0005	5.05	0.00
REM	-0.06	0.02	-2.25	0.03
POV	0.03	0.02	1.34	0.19

The long run coefficient estimates of PED show that one unit increase in private sector expenditure on education favors public sector education expenditure by 2.14 unit. The allocation of funds particularly for the education is indeed a need of time and therefore, this decision is of highest cruciality for the governments of all times. In today's world, private sector alone is least sufficient in the provisioning of education infrastructure to meet the personal needs of the general public. Therefore, a meaningful partnership of public-private sector is a need of time in order to rescue the education needs of citizens at large (Khalid, 2016). The positive association of public and private sector is indicated by this study since the coefficient bears a positive sign. Similar findings are recorded by Khursheed et al. (2023) while tracing the impact of GED on PED. Earlier to that, the significance of this sort of sectoral bonding is indicated by Hassan et al. (2011) and Maluleke et al. (2023). The finding of this study goes in-line with that of Awan and Waqas (2019), Khalid (2016), Irfan (2015), and Maluleke et al. (2023).

In case of control variables, EGR is also recorded to embed positive movement of GED. Any increase in the economic growth initiates the government to carry out the expenditure with ease and particularly on education sector, as highlighted through the results of this study. Nevertheless, tax revenue also holds meek but positive affectation on the education expenditure by the side of the public sector. The coefficient of REM is though positive but negative in sign. This indicates that any increase in personal remittances signals the government to cut back education expenditure. It is also justifiable since the easy money with the households motivate them to move for private sector education rather than public sector (Khursheed et al. 2023). Therefore, overall, this trend cannot be felt harmful for the overall extent of education in Pakistan. However, the coefficient of POV is positive and significant. The increase of one unit in POV is linked with the increase of 0.03 units in GED. Similar findings are got by Khursheed et al. (2023) on POV where the results are captured positive where abouts of private education expenditure on account of any increase in poverty. This study however traces same direction of effects of POV however on GED. The conclusion is quite meaningful in a way that any increase in poverty rate motives the public-private sector to contribute more funds in education sector. It is due to a hope that through seeking education, citizens can have better living than otherwise.

Results of Short Run Coefficients

The short run coefficient estimates are given in Table 7. Based on the coefficient values, the results are not foreign to those found in long run case. Similar state of beings are observed between PED and GED. The complementarity is evident and the results confirm that increase in PED brings initiations GED. In case of EGR, GTR, and REM, the results are akin to those of long run. Economic growth and increase in tax revenue favor the government to carry out furtherance in the education expenditure. The results on POV are significant but negative. The conclusion on REM is negative in impact on GED, as found in long run. In precise, the results in both time horizons are consistent. Importantly, the coefficient of ECM is significant and within the range. The divergence from state of equilibrium is well adjusted in long run.

Table 7

Results of Short Run Coefficients

Dependent variable (GED)				
Variable	**Coefficient**	**Std. Error**	**t-statistics**	**Prob.**
D(PED)	0.003	0.0006	4.62	0.00
D(EGR)	2.24	0.16	14.10	0.00
D(GTR)	0.10	0.05	1.78	0.08
D(REM)	-0.06	0.03	-2.23	0.03
D(PVR)	0.04	0.03	1.36	0.18
ECM	-1.05	0.06	-16.44	0.00

Diagnostic Checking

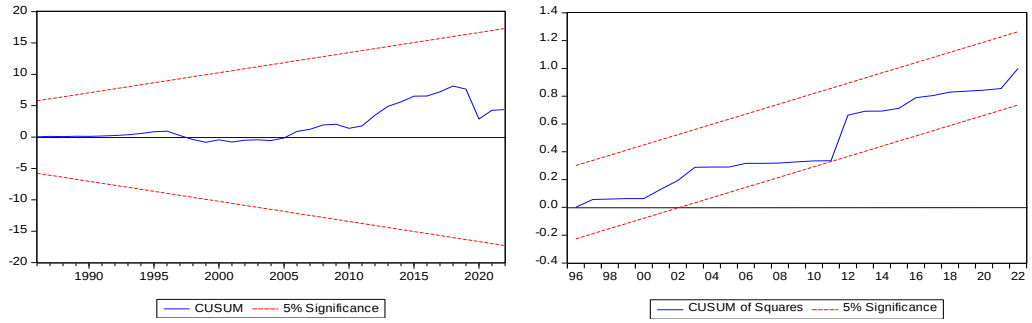
The diagnostic checking is summarized in Table 8. For the authenticity of the regression estimates, the diagnostic checks incorporated on the specific model in Equation [2] are concluded to have no presence of serial correlation and heteroskedasticity. The model is also correctly specified, given the results of RAMSAY RESET Test. The Jarque-Bera statistics also confirm the normally distributed residuals.

Table 8

Results of Short Run Coefficients

Test Type	**F-statistic**	**Conclusion**
Breusch-Godfrey Serial Correlation LM Test	2.27	No issue of serial correlation
Heteroskedasticity Test: ARCH	1.75	No issue of Heteroskedasticity
Ramsey RESET Test	5.64	Correctly specified
Histogram-Normality Test	1.56	Residuals are normally distributed

The accuracy of short run and long run parameters is diagnosed by CUSUM test. the graph of CUSUM is given in Figure 1. The structural stability is concluded at 5 percent significance bound. Similarly, CUSUM squared test reveals n



o sign of structural instability, thus the H_0 is rejected.

Figure 1

CUSUM & CUSUM Square Test

CONCLUSION AND POLICY RECOMMENDATION

This study went with the assessing of sustainability between public and private sector expenditure on education. The objective of the study was to detect if public expenditure on education is complemented with private sector expenditure on education. The ARDL regression analyses was incorporated for the empirical analyses on time series data of the range 1980 to 2022. The outcome assured the positive relationship of the public and private sector education expenditure in both time horizons. Therefore, the verdict is the sustainability of PPS in Pakistan. As a policy option, the study proposes to further strengthen this investment tie-ups for the sufficient and quality education to the citizens at large.

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