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(RESEARCH ARTICLE)

Effect of external and domestic Public debt on Private investment (A VAR Model analysis)

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Abstract

The objective of this paper is to examine the relationship between private investment and public external and domestic debt for the period of 1980 to 2021. In this study, we checked the unit-root test by using Augmented Dickey-Fuller (ADF) test and Pillips-Perron (PP) test. Moreover, the result of Johansen test states that there is no long-run cointegration between variables. Therefore, this study used VAR-Model for analysis. Furthermore, different type of tests has been applied such as, Shapiro-Wilk W test, Breusch-Pagan/ Cook-Weisberg Test, Breusch-Godfrey LM test, Impulse response analysis and Ramsey Reset test. The estimated result shows a negative and significant relationship between private investment with credits to the private investments by banks and public external debt. However, there is a positive and significant association between private investment with domestic public debt. The Granger Causality Wald test confirms that the most of the previous value of one variable helps to predict the future value of other variables. Hence, it is concluded that the government should revisit their external debt policy to support the country infrastructure, macroeconomic balance and for other public expenditure because this increasing public debt is detrimental to the private investment.

Keywords: Private investment; Public debt; Infrastructure; Macroeconomic balance; Public expenditure

1. Introduction

Pakistan economy is facing huge public debt since 1947, and this external and domestic debt has put adverse effect on the performance of private investors. According to a macro trend data, Pakistan external debt in 1970 was $3406742576 in 1970 which increased with the passage of time and till 1990s the external debt was risen to $ 20663375832. The public debt process continued increasing during 2000s and reached at $ 63124246854. Besides, till 2021 the report said that the debt upsurged to $ 130433056375. Sameas, as per report by State Bank of Pakistan, the domestic debt of Pakistan during 1971 was 14 billion rupees, which increased constantly during 1970s and 1980s and researched at 381 billion rupees in 1990. The system off Pakistan domestic public debt had further increased during 2000s and 2010s and reached at the level of 1645 billion rupees and 4653 billion rupees respectively. The domestic public debt trend has researched to 28076 billion at the end of march 2022 as per stated by State Bank of Pakistan.

Many believe that the increase in external and domestic public debt causes crowding out effect of private investment. This happens because when the government takes loan from the commercial banks in huge amount then the demand for loanable fund increases, resulting the sharp increase in the interest rate. When interest rate becomes high then, it would be less beneficial for the private investors. Many researchers have estimated the negative association between public debt with private investment. (Emran & Farazi, 2009), (Lau, et al., 2019), Emran & Farazi, 2009 determined the crowding-out effect of public debt on private investment by studing different countries. While, (Kia, 2020) determined

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the effect of government borrowing on private investment in USA. The estimated result highlighted that there is no significance impact of public debt on private investment.

Pakistan economy solely depends on external debt. CEIC data revealed that in 2013 Pakistan external public debt to GDP was 23.5% which increased further to 33% in 2019. During the era of covid 19 due to low financial saving of Pakistan this external debt uprose to 37.5% in 2020. Furthermore, the trend of taking external public debt has reached at 36% in 2023. The low external public debt to GDP in 2021 was 35% which was lowered comparatively to 2020 because of improvement in twin deficit along with appreciation of rupee against dollar.

Pakistan GDP has faced many fluctuations from 1947 to till now, the economy faced budget deficit, balance of payment issue, devaluation of rupee, and inflationary issues. (Manzoor, et al., 2019) highlights that trade deficits directly causes the budget deficit and budget deficit influence trade deficit through many channels. In 1960, Pakistan trade balance was $-0.23 Billion which increased further with the passage of time and reached to $ 18.42 billion in 2008. Due to poor performance of economy and with the opening of the trades after covid 19 the trade balance further worsen to -$42.87 billion in 2022.

Objectives of the study:

- To analyse the association between private investment with domestic public debt
- To analyse the association between private investment with external public debt.

This research paper has further divided into Literature review, Theory and Model, Econometric Model, Estimations and result, Conclusion and Policy implications**.**

2. Literature Review

(Lau, et al., 2019) explored an asymmetric relationship between external public debt and private investment in case of Malaysia. He highlighted that the increase in external public debt will cause hinders private investment because of crowding -out effect. (Thilanka & Ranjith, 2018) determined the impact of public debt on private investment in Sri-Lanka for the time period 1978 to 2015 and he investigated that private investment decreased as a result of public debt due to crowd -out effect. (wara, 2014) explored the relationship between domestic public debt with private investment in the context of Keyna for the time 1967 to 2007. He found the existence of negative association between domestic public debt with private investment, meaning that an increase in the domestic public debt impinged the investment of private. (Mabula & Mutasa, 2019) examined the combined impact of domestic and external debt on private investment, he found that there is significant impact of debt on private investment in the short and long-term in Tanzania. (Akomolafe, et al., 2015) pointed out that the debt that government takes from foreign countries don't cause crowding-out of investment in the long-term because of positive association of external debt and private investment, however, in the short -term it has negative impact on private investment. In addition, domestic debt has an adverse effect on domestic private investment both in the short and long-term. (Penzin, et al., 2022) investigated the impact of public debt on private investment in emerging economies. They determined a threshold point of 3, below this average point increase in public debt encourage private investment.

(Lidiema, 2017) analysed the effect of domestic public debt on the private investment in the long run and short run in the context of Kenya. The estimated result showed that government domestic debt has an adverse impact on the short run private investment, however, this effect wane with the passage of time i.e., in the long-term. (Kamundia, et al., 2015) have investigated the link between private investment and government debt by analysing Kenyia economy for the timer-period of 1980 to 2013.He determined that in Kenyia, government debt has an inverse relation with private investment. (Emran & Farazi, 2009) Pointed out the effect of government debt from the domestic on private investment, they examined the crowding effect of domestic public debt on private investment. They estimated that if government takes one percent dollar loan from the domestic bank, private credits decrease by approximately 1.40 percent in case of 60 third world countries.

(Penzin & Oladipo, 2021) examined the association between debt and private investment in Nigeria by using ARDL Model. Their estimated result confirms an inverse relationship between domestic government debt with private gross fixed capital formation and it was significant. (Fayed, 2013) validated the concept of crowding out effect of private investment as a result of domestic public loans. This study confirms that the existence of the crowding out effect in case of Egypt. (Abubakar & Mamman, 2021) highlighted the reduction of government debt from the domestic source is windfall to investment of private but government debt accumulation from domestic source don't impinge adversely the private investment in case of Nigeria. (Mugumisi, 2021) estimated the effect of government external debt on private

fixed gross formation from the context of Zimbabwe by using VECM model. The estimated outcomes show that external public debt has significantly negative relationship with private investment, meaning that the more public external debt confirms the existence of crowding-out hypothesis. (Haq, et al., 2020) explored the existence of crowding out hypothesis for Pakistan by using time series analysis. The estimated outcomes confirmed that increase in public debt will cause crowding out of private investment.

(Thilanka & Ranjith, 2018) investigated the crowd out hypothesis for Sri-Lankan economy by using VECM model. Their estimated result highlights the adverse effect of public debt on private investment by causing crowding-out effect, meaning that there is negative relationship between government borrowing to private investment. (Kia, 2020) studied this relationship between public debt with private investment from the US economy. The outcomes tell that the existence of external government debt has significantly negative effect on the private investment, showing that the foreign government debt causes private investment to crowding out so it decreases when the public external debt increases. (Bal, 2014) investigated the impact of government borrowing on public and private investment in India for the period of 1998 -2012 by applying VAR model. They determined that government debt has significant and positive relationship with gross capital formation. (Madni, 2014) explored the idea of government borrowing on private capital formation. He estimated that government foreign debt has a significantly negative effect on private investment due to the effect of crowd out of public debt on private investment. (Tariq, et al., 2008) examined the crowding out effect of public debt on private capital formation, meaning that there is negative relationship between government debt and private investment.

(ÖZDEMİR & GOMEZ, 2020) analysed the impact of domestic borrowing on private capital formation, meaning that they found a negative impact of domestic debt on private investment in the long-term for the context of Gambia. (Kia, 2020) determined the effect of government borrowing on private investment in USA. The estimated result highlighted that there is no significance impact of public debt on private investment. (Vanlaer, et al., 2021) indicated that when government takes a lot of debt from the lenders, it left lows level of funds for the investors who are the private investors, resulting the cost of taking debt would be very high and private investment will decrease as a result of this high borrowing cost. (GREEN & VILLANUEVA, 1991) he found that there is negative relationship between private investment and debt service ratio, ration of debt to GDP.

2.1. Theory

2.1.1. Crowding-out Hypothesis

This hypothesis says that when government increases their consumption, private investment will topple. For example, when government increases their spending, they need more money so they will go for borrowing i.e., from domestic and external sources, hence they issue bonds for borrowing money. This increase in the issuance of government bonds will increase demand for loanable funds, which leads to the increase in the interest rate of loanable funds for private investors. Besides, the increase in interest rate of loanable funds will upsurge the cost of borrowing for the private investors, therefore, they start spending less, which in other words called as “crowding-out” of private investment. As a result of this crowding out, private investment will wane and economic activity goes diminished.

3. Methodology

The data for this research has been taken from Pakistan Economic Survey and World Bank. The data for public domestic and external debt are taken from Pakistan Economic Survey , and the data for Private investment is extracted from Pakistan Economic survey. and data for Domestic credit to private sector by banks (% of GDP) is taken from world bank For the time period of 1980 to 2021. The extracted time-series data is then analysed with the help of statistical software Stata. In this study, the dependent variable is private investment, which is taken in Gross fixed capital formation (at constant price 2005-2006) in million rupees. Moreover, the explanatory variables are public domestic and public external debt, which is in the form of (billion rupees). Also, Domestic credit to private sector by banks (% of GDP) is taken as control variable in this study and it is in (at constant price 2005-2006) in million rupees. The model for the relationship between public debt and private investment would be,

$$LNIP_2 = \mathrm{f}\,(LNPE_t\,, LNPC_t\,, LNPD_t) \quad (1)$$

In equation (1), $LNIP_2$ is private investment, $LNPD_t$ is domestic public debt, $LNPE_t$ is external public debt and $LNPC_t$ is domestic credit to private investments by banks, t is the time period from 1980 to 2021.

4. Descriptive statistics

Table 1 Descriptive statistics

stats |	LNIP2	LNPD	LNPE	LNPC
mean	3.501786	7.27689	7.082836	3.081846
sd	.2447163	1.746607	1.503366	.2084501
variance	.059886	3.050637	2.260111	.0434514
max	3.765363	10.17599	9.517899	3.394041
min	3.159214	4.060443	4.454347	2.679586
skewness	-.1758947	-.1008634	-.2017008	-.626076
kurtosis	1.135558	2.056887	1.893648	2.14721
sum	143.5732	305.6294	297.4791	126.3557

4.1. Unit-Root Test

In this study we used ADF and PP unit root test for checking stationarity. We will compare the null and alternative hypothesis i.e., there is unit-root in the series. Both tests have been applied at level and 1st difference. At level only LNPE and LNPD shows stationarity, and other two i.e., LNIP2 and LNPC shows that there is unit-root in the series at level. On the other hand, at 1st difference LNIP2 and LNPC shows that there is stationarity and vice versa.

Table 2 ADF test, PP test at level at critical level 5 %

Variables	ADF level	PP level
LNPE	7.417**	5.904**
LNPD	10.429**	6.791**
LNIP2	1.493	1.625
LNPC	-0.745	-0.643

Table 3 ADF test, PP test at 1st difference at critical level 5 %

Variables	ADF level	PP level
LNPE	-1.905	-2.397
LNPD	-1.602	-1.266
LNIP2	-4.034**	-6.365**
LNPC	-3.334**	-4.692**

4.2. Lag-selection Criteria

The selection criteria are important for the selection of lag length. In this study most of the criteria of lag length falls under the lag length of 3, hence this study will use lag-length of 3 for the remaining calculation.

Table 4 Lag-selection Criteria

|lag |	LL	LR	df	p	FPE	AIC	HQIC	SBIC
| 1 |	109.313		16	.	6.6e-08	-5.18407	-4.93843	-4.48028*
| 2 |	136.905	55.183	16	0.000	3.6e-08	-5.82804	-5.33676*	-4.42047
| 3 |	156.387	38.964*	16	0.001	3.2e-08*	-6.02148*	-5.28456	-3.91012
| 4 |	164.614	16.455	16	0.422	5.7e-08	-5.58967	-4.60711	-2.77453

4.3. Johansen Test for Cointegration

To check the long-term association between explanatory variable and dependent variable, this test is very useful. The hypothesis, says that there no long-run association between these variables, if the trace -statistics at 0 rank, is higher then 5% critical-value then we reject the null hypothesis of no-cointegration. In our case, the trace-statistics is 41.6653 and 5% critical-value is 47.21, so we accept the null hypothesis of no long-run association.

Table 5 Johansen Test for Cointegration

maximum					
rank	parms	LL	eigenvalue	trace- statistic	5% critical- value
0	20	144.1955	.	41.6653*	47.21
1	27	155.87883	0.45072	18.2986	29.68
2	32	161.75973	0.26036	6.5368	15.41
3	35	164.56158	0.13384	0.9331	3.76
4	36	165.02813	0.02364		

4.4. VAR-MODEL ANALYSIS

The 1st table shows the goodness of fit, significance level, Model- selection criteria, and the second table explains the co-efficient.

$$LNIP_2 = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$$

Here,

$LNIP_2$ is the dependent variables, and variables from x1 to x5 are the independent variables. Moreover, a, b1, b2, b3, b4, b5 are the parameters.

Why we used VAR-Model? This study used VAR-Model because the result of Johanson Cointegration test confirms that there is no long-run relationship between dependent and independent variables. The trace value of Johanson-Cointegration test is lower than the critical value. Thus it confirms that because of no long-run cointegration VAR-Model would be the most appropriate model for this study.

The R2 shows the good of fit of the model. For example, in case of LNIP2 the value of R2 is 0.9945, which shows that almost 99.45 percent of the variable in the dependent variable is explained by the explanatory variables in case of our model. Moreover, the p-value which is less than 0.05 suggest the statistically significant.

Table: 6 Equation Parms RMSE R-sq chi2 P>chi2

Equation	Parms	RMSE	R-sq	chi2	P>chi2
LNIP2	5	132.747	0.9945	7012.071	0.0000
LNPC	5	.114275	0.7445	113.657	0.0000
LNPD	5	.100072	0.9964	10737.61	0.0000
LNPE	5	.129856	0.9920	4831.299	0.0000
Log likelihood	-138.9966		HQIC		8.459762
AIC	8.153674		SBIC		9.006783
FPE	0.0410831		Det(Sigma_ml)		0.0146477

5. Results of coefficients

This table shows the coefficients of VAR-Model, in this table LNIP2 is a dependent variable and remaining of the variables are independent. In case of LNPC the coefficient value is -467.5326 and is statistically significant i.e., 0.005. This highlights, there is negative and significant relationship between Private investment and domestic credits to private investment by Banks in case of Pakistan Economy, there can variously reason for this such as high interest rate which makes bank credits less profitable for the private investors. Moreover, due to political and economical uncertainly private investors hesitate to invest in the country even banks provide credits. This can outcome a negative association between private investment and domestic credits to private investment by bank.

Furthermore, the estimated result shows that there is positive relationship between LNIP2 and LNPD, meaning that an increase in the public domestic debt has crowding in effect on private investment. When government takes loan from banks for investment, it increases the confident of private investors so they become willing to invest.

LNPE has negative and significant effect between private investment and external public debt. Our result is in line with the result of (Mugumisi, 2021).This confirms the crowding-out hypothesis in cause of external public debt in Pakistan.

Table 7 Results of coefficients of VAR Model

LNIP2						
LNIP2	**coeff.**	**Std error.**	**z.**	**p-value.**	**[z].**	**5% critical**
L3.	1.044009	.0364233	28.66	0.000	.9726205	1.115397
LN PC						
L3.	-467.5326	166.6206	-2.81	0.005	-794.1029	-140.9622
LNPD						
L3.	317.4336	116.3356	2.73	0.006	89.42003	545.4471
LNPE						
L3.	-251.3085	120.8915	-2.08	0.038	-488.2514	-14.36565
_cons	1160.178	530.7687	2.19	0.029	119.8904	2200.465

5.1. Tests

5.1.1. Shapiro-Wilk Test

This test is important for checking the normality of the data. The null-hypothesis states that the data is normally distributed. If the p-value is less than 0.005 we reject the null hypothesis of normal distribution, but if it is greater than

0.005 then we will fail to reject the null hypothesis. In our case, the p-value is 0.012519 and it is greater than 0.005 so are unable to reject the null-hypothesis, meaning that our data is normally distributed.

Table 8 Shapiro-Wilk Test

Shapiro-Wilk W test for normal data				
Variable	**W**	**V**	**z**	**Prob>z**
residuals	0.95632	1.727	1.149	0.12519

5.1.2. Breusch-Pagan/ Cook-Weisberg Test

This test is important for checking heteroskedasticity. The null-hypothesis states that there is no heteroskedasticity. If the p-value is less than 0.005 we reject the null hypothesis, but if it is greater than 0.005 then we will fail to reject the null hypothesis. In our case, the p-value is 0.5920 and it is greater than 0.005 so are unable to reject the null-hypothesis, meaning that there is no evidence of heteroskedasticity.

Table 9 Breusch-Pagan/ Cook-Weisberg Test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	
chi2(1)	0.29
Prob > chi2	0.5920

5.2. Breusch-Godfrey LM test

For checking auto-correlation in the residuals of the time series, the null hypothesis says that there is no serial correlation. The p-value in our test is 0.2918 which is greater than 0.005 ,therefore, we accept the null -hypothesis of no serial correlation.

Table 10 Breusch-Godfrey LM test

Breusch-Godfrey LM test for autocorrelation			
lags(p)	**chi2**	**df**	**Prob > chi2**
3	1.111	1	0.2918

H0: no serial correlation

5.3. Ramsey RESET test

Table 11 Ramsey RESET test

Ramsey RESET test	
F(3, 33)	0.57
Prob > F	0.6366

Ho: model has no omitted variables

In this test, the p-value is 0.6366, meaning that we cannot reject the null hypothesis. In other word, it states that we did not omit any variables, hence it is correctly specified.

5.4. Granger Causality Wald Tests

Granger causality test is used to check whether the previous value of one variable helps to predict the future value of other variables. In the table, take the example of the first i.e., LNIP2 Granger causes LNPC. In this case the p value is

0.005 which is significant, highlighting that there is robust evidence of suggesting that LNIP2 granger cause LNPC. Sameas, for LNIP2 and LNPD the p-value is again lower than 0.005, indicating LNIP2 granger causes LNPC.

Table 12 Granger causality Wald tests

Granger causality Wald tests				
Equation	**Excluded**	**chi2**	**df**	**Prob > chi2**
LNIP2	LNPC	7.8735	1	0.005
LNIP2	LNPD	7.4453	1	0.006
LNIP2	LNPE	4.3214	1	0.038
LNIP2	ALL	24.129	3	0.000
LNPC	LNIP2	1.1154	1	0.291
LNPC	LNPD	.17045	1	0.680
LNPC	LNPE	.00298	1	0.956
LNPC	ALL	16.868	3	0.001
LNPD	LNIP2	14.909	1	0.000
LNPD	LNPC	2.8638	1	0.091
LNPD	LNPE	1.5243	1	0.217
LNPD	ALL	14.999	3	0.002
LNPE	LNIP2	5.7868	1	0.016
LNPE	LNPC	8.7254	1	0.003
LNPE	LNPD	4.9581	1	0.026
LNPE	ALL	18.073	3	0.000

5.5. Impulse response analysis

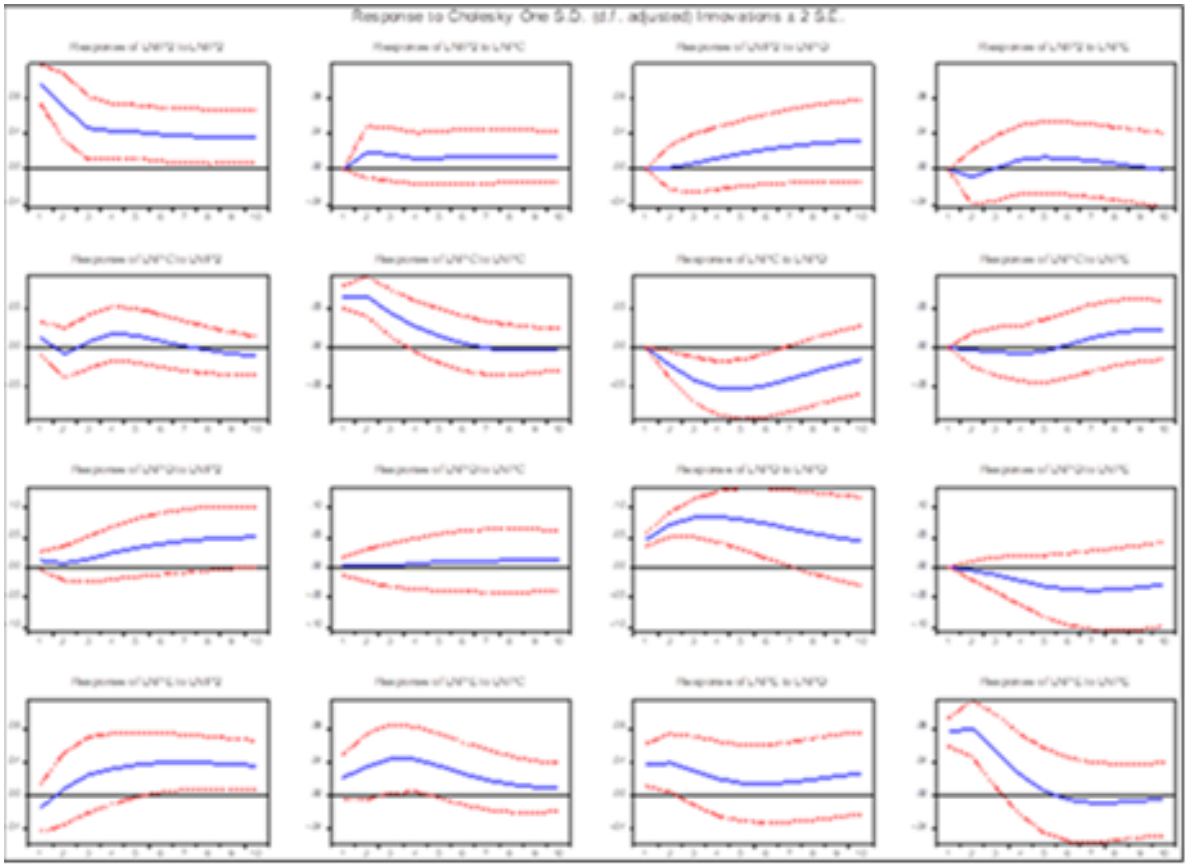

Figure 1 Impulse Response Analysis

5.6. CUSUM and CUSUM-SQ tests

CUSUM and CUSUM-SQ tests help us to check the stability of coefficient in our model over the time period. The CUSUM and CUSUM-SQ has been plotted between critical boundaries at a significant level 5%. If the CUSUM and CUSUM-SQ plots remain inside the critical boundaries, it concludes that the coefficient is stable over time. However, if the plots cross the critical boundaries, it suggests that the coefficients have changed at some point. In our case, the plots did not cross the critical boundaries at significant level 5%, hence concludes that our model is stable.

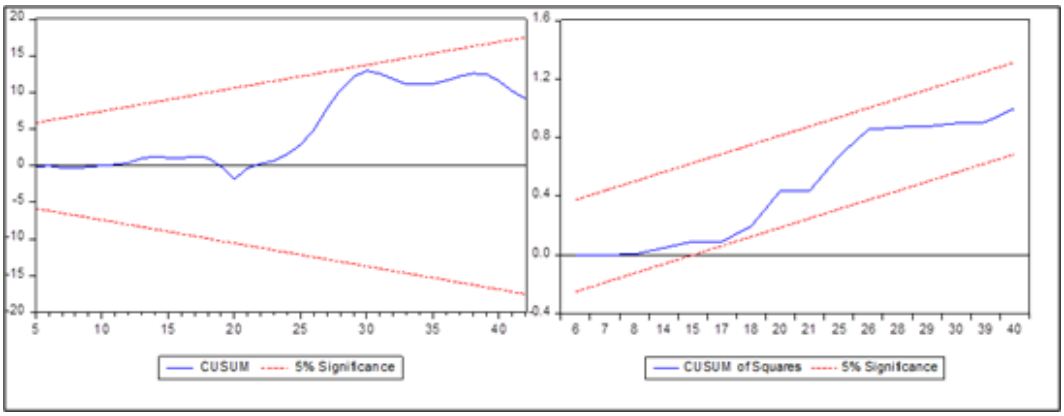

Figure 2 CUSUM & CUSUMSQ

6. Conclusion

This study aims to analyse the effect of public external and domestic debt on private investment in Pakistan for the period of 1980 to 2021. There are different kind of tests are used such as Augmented Dicky-fuller test and Phillip-Parson test for checking the unit-root test. Furthermore, Johanson-Cointegration test are used to check the long-term association between variables. The test confirms that there is no long-run relationship between them, therefore, this study used VAR-Model. The result of the VAR-test shows that LNPC the coefficient value is -467.5326 and is statistically significant i.e., 0.005. This highlights, there is negative and significant relationship between Private investment and domestic credits to private investment by Banks in case of Pakistan Economy, there can variously reason for this such as high interest rate which makes bank credits less profitable for the private investors. Moreover, due to political and economic uncertainly private investors hesitate to invest in the country even banks provide credits. This can outcome a negative association between private investment and domestic credits to private investment by bank.

Furthermore, the estimated result shows that there is positive relationship between LNIP2 and LNPD, meaning that an increase in the public domestic debt has crowding in effect on private investment. When government takes loan from banks for investment, it increases the confident of private investors so they become willing to invest. LNPE has negative and significant effect between private investment and external public debt. Our result is in line with the result of (Mugumisi, 2021).Hence , it is concluded that the government should revisit their external debt policy to support the country infrastructure, macroeconomic balance and for other public expenditure because this increasing public debt is detrimental to the private investment.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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