An Empirical Analysis of the Determinants of Private Investment in South Korea: using Nonlinear Model Analysis

دراسة تحليلية حول محددات الاستثمار الخاص في كوريا الجنوبية: باستخدام نماذج التحليل اللاخطي

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Abstract:

This paper investigates the determinants pattern of the private investment as an attempt to discover why the level of private investment is relatively high in South East Asia using South Korea as a case study. The study exploits nonlinear autoregressive distributed lag model as method of analyses. The empirical result indicates that the positive shock of inflation is becoming more influential on private investment promotion than the negative shock in the long-run. Furthermore, this study has confirmed the crowding-in relationship between the public spending and the private investment in south Korea. Since the crucial role of credit for the private sector, the credit provided for the private sector shows a negative linkage with private investment in the long-run, while the short-run analysis indicates a positive effect on the private investment. The implications from this study are the government should pay attention to the public expenditure issue, and ensure that spending is more productive in form of investment.

Key words: Economic Growth; Private Investment; Credits; Tax Burden.

JEL Codes: G0, F18, H29, O40.

الملخص:

تبحث هذه الورقة في نمط محددات الاستثمار الخاص كمحاولة لاكتشاف سبب ارتفاع مستوى الاستثمار الخاص نسبيًا في جنوب شرق آسيا باستخدام كوريا الجنوبية كدراسة حالة. تستخدم الدراسة نموذج التأخر الموزع غير الخطي كأسلوب للتحليل .تشير النتيجة التجريبية إلى أن الصدمة الإيجابية للتضخم أصبحت أكثر تأثيرًا على تشجيع الاستثمار الخاص من الصدمة السلبية على المدى الطويل . علاوة على ذلك، أكدت هذه الدراسة علاقة الازدحام بين الإنفاق العام والاستثمار الخاص في كوريا الجنوبية .نظرًا للدور الحاسم للائتمان للقطاع الخاص، يُظهر الائتمان المقدم للقطاع الخاص ارتباطًا سلبيًا بالاستثمار الخاص على المدى الطويل، بينما يشير التحليل قصير المدى إلى تأثير إيجابي على الاستثمار الخاص .نستنتج من خلال هذه الدراسة أن الحكومة يجب أن تهتم بوضع سياسات متعلقة بالإنفاق العام، والتأكد من أن الإنفاق أكثر إنتاجية في شكل استثمار.

الكلمات المفتاحية: النمو الاقتصادي؛ الاستثمار الخاص؛ الديون؛ العبء الضريبي.

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1. INTRODUCTION

The private investment is regarded as an important issue in countries' macroeconomic performance and economic development process and implementing policies. Promoting investment could boost the capacity of absorbing a large number of unemployed people. Overall, the private investment in South Korea is considered the most considerable portion that contributes to GDP. South Korea is chosen as a proper case study for the subject of this study for three reasons. Firstly, during the past four decades, Korea has exhibited a cyclic growth of private investment. Aftermath the financial crisis in 1997 and 2008, the private investment in South Korea has a relatively fast recovery compared with other crisis-affected countries in the Southeast Asian region. Hence, the analysis of the private investment patterns in Korea would contribute to highlight some relevant macroeconomic factors and policies circles. Second, South Korea seemed to implement successful macroeconomic policies to recover and promote the private investment involving several factors such credit availability, stabilized inflation rate and government spending orientation which are still theoretically unclear and debatable of the effect on the private investment. Third, there has been any specific study up to the date of the private investment determinants in South Korea as a single case. The existing empirical studies general involved a number of countries with a panel model which had a limitation to analyse the nature structural features of each country in term of private investment behaviour and policy. According to the classic and neoclassic school, the investment as an expenditure to possess the capital assets is one of the most critical factors of production that leads to a fast and stable economic growth based on Solow, Lucas and Ramsy models. In the case of South Korea, according to World Bank (2022), the private investment in term of the capital formation reached 26.579 % of GDP. Chaebols are contributing actively to Korean economic growth as well as attract a vital investment from the global capital market. Historically, the Korean government had executed some policies to stabilise business and investment environment and gave the priority for the private investor by giving more incentives especially that related to a financial institution, tax burden and trade. So the study aims to highlight empirically the most critical factors that affect the private investment in South Korea and drow results from Korean experience that helps to provide recommendations for policymakers in developing countries to implement effective policies to promote investment and business environment.

1.2 Study Problematic:

The Common long-standing question of what policy can affect the private investment of countries to be better receives excellent attention from Academia as well as policymakers. Many countries aim to increase their private capital formation as a critical factor to reach a high level of development and sustain the proper business environment for investment. Despite a decade of debate, The subject of policy and the role of government in promoting investment and what boost the economic development to be more stable by focusing on the public spending on investment gives a chance for the private sector to grow is still unclear**.**

1.3 Hypothesis:

The study hypothesises that the inflation rate, Government expenditure, Financial credit provided for the private sector, Tax burden, all these variables have an asymmetrical effect on private capital formation as a private investment indicator. The utility of this model is giving the ability to test the hypothesised nonlinear relationship of the research, testing the asymmetricity of the nonlinear relationship is done by dividing the effects of the regressors into positive and negative values. Based on the economic literature; the study hypothesises the existence of a positive relationship between private investment and government expenditure, gross domestic product, financial credit for private sector tax burden, trade openness. As another hypothesis, there is a negative relationship between private investment inflation. The study exploits a published data from bank world database and statistics Korea during the period from 1972 to 2019.

1.4 Study contribution:

The contribution of this study although the considerable number of research in the field, is exploiting Nonlinear autoregressive Distributed lags (NARDL) which developed by Shin et al. (2014). The NARDL model is one of the most useful analytical frameworks that provides a new perspective to use a supportive analysis of economic theories by integrating the asymmetric analysis with the ARDL model. The main contribution of the research is to analyse these effects quantitatively across a specified period and draw policy recommendation based on the significance of variables influence on the private from Korean model which gives lessons for developing countries to develop the private investment sector.

2. THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1.Macroeconomic key-Factors and private capital:

It is well known that slow-growing private investment afflicted countries' macro-economy during the Last Decade. Previous research has not achieved a clear consensus on what affected the investment being sluggish. Motegi and Sadahiro (2018) examine what caused the private investment slowdown. Including stock prices, bank loans and firms' profit to explain the change in private investment growth volatility. The study concludes that the decrease in stock prices, profit, caused by the stagnation of bank loans and lead the private investment to be sluggish. Teimouri and Zietz (2018) examine the surges in net private capital inflows on the output and employment shares of manufacturing, the investment-output ratio, and the unemployment rate. Including high-income countries and emerging economies, both from Asia and Latin America. The study finds that surges in high-income countries do not extend deindustrialisation. However, surges may negatively drive long-run growth prospects and employment, while in middle-income Asian countries, surges in net private capital tend to persuade deindustrialisation in both output and employment in the short-run. In middle income Latin American countries, surges speed up deindustrialisation. In developing countries, Governments and non-governmental entities have long struggled to implement some effective policies to reach the economic development. In some countries in south-east Asia, levels of private investment have not yet fully recovered especially after the shock of the recent financial crisis. That is due to the low performance of the financial sector which leads to deaccelerating the

investment growth. Jongwanich and Kohpaiboon (2008) found that the shortages in capital funds hindered short-run private investment recovery. Many empirical studies concerning the determinants of private investment in developing countries have demonstrated that the high inflation's rate has a negative impact on investment.

2.2.The effectiveness of the Tax Policy

Sineviciene and Railiene (2015) assessed the link between the tax burden government size and private investment. The research concluded the government size and the tax burden have a different effect depends on whether the country in advanced or developing economy. Tax burden and government as explanatory variables are not enough to determine the private investment. The quality of the governance and macroeconomics key-factor should be considered into account. Sarkar (2012) examined the government policy by providing incentive as a tax cut form and investment subsidy forms to encourage the private investment instantaneously. The findings suggested that it might be the optimal policy for the government to implement the two forms of incentives simultaneously by providing an investment subsidy as well as charge a favourable tax rate on the profits. It is observed that many governments adopt a policy with the combination of subsidy and tax cut like when the government decrease the tax burden, and when it provides a financial credit for private investors but in many cases, the investment subsidy dominates tax cut. Also, Barbosa, Carvalho, and Pereira (2016) examined various financial policies that can motivate private investment by including some relevant macroeconomic factors like taxes, public inefficiencies and asymmetric investment multipliers. The study found that the optimal incentives that stimulate the private investment must be the government's tax-related benefits and reduced the government behaves as a competitor the private investment. The result of the study suggests the optimal policies to reduce the public expenditure and adopts subsidy policy more than reducing the tax burden to achieving a high level of economic growth. In another hand, Alstadsæter, Jacob, and Michaely (2017) found that the decrease in dividend tax cut has not any impact on the aggregate investment, but it affects the allocation of corporate investment and the private capital formation. Decrease the tax burden will increase the investment in the private firm that has a liquidity constraint. The private re-investment tends to be stronger among the firms that experience a more substantial tax cut. This assumption might be explained by higher external equity in the firms that have a cash-constrained or cash-rich firm after the tax cut.

2.3.Credits and Financial Development

The examination of the relationship between the elements of the financial development and the private investment in developing countries such sub-Saharan Africa confirmed the existence of a negative relationship between interest rate and private investment, and the provided credit to the private sector has significant relationships with private investment (Misati & Nyamongo, 2011). As a result, the low stage of financial development affects the private investment negatively and contribute to enlarging the informal sector. In the case of the Greek economy, for example, the recession drives the government to adopt very severe tax measures that lead to shrink the domestic demand and increase the unemployment. Besides the fall in productivity of the private sector makes the situation even worst. According to the study of Chatzitheodoridis, Kontogeorgos, and Loizou

(2014) the weak financial system growth and the lack of liquidity hinder the recovery of countries that shocked by the financial crisis, they concluded that private approved investment showed harsh liquidity problem that contributes to weaken the private investment and cause a failure of many projects. Ang (2009) examined how financial policies determine the private investment in the economies of India and Malaysia. The results indicated that significant directed credit programs for the favour of specific sectors are probably discouraged the private investment in both countries. In other side, Sovereign credit rating variations affect macroeconomic conditions and capital market precisely, a real private investment. Chen et al. (2013) found that considerable growth in private investment against the progress in the country's sovereign ratings. The study assessed re-rated sovereign credit rank and the countries' private investment growth. When the country improves the ability to repay its sovereign credit will attract more private capital from the international capital market as an investment which means the physical capital investment is strongly related with the adjustment in sovereign credit ratings. Agostino (2008) examined the effects of this conditional loan on reform the structure of the private investment. The results indicate that structural change in policy due World Bank loans is related with lower private investment rate in the short-run.

3. METHODOLOGY

This study uses Nonlinear Autoregressive Distributed Lags (NARDL) approach which developed by Shin et al. (2014). This approach allows testing the nonlinear hypothesis of the relationship between the macroeconomic variables of the study and the private investment in South Korea in the short and long run. NARDL approach dedicated to detecting the effect of nonlinearity on the dependent variable in the short and long run in one equation. Also, it is considered as an extension to the Autoregressive Distributed Lags (ARDL) which is developed by Pesaran, Shin, and Smith (2001). The characteristics of the model that it does not require a long time series compared with the Nonlinear Cointegration approach. The model provides a flexibility to use a variety of variables with different level of integration, whether the time series is stationary at level or first difference or both of them, In addition, the variables with an integration in the second difference cannot be included in the model (Shin et al. 2014) and (Shahzad et al. 2017). NARDL model allows to detect the hidden Cointegration as it called by Granger and Yoon (2002), that means NARDL model includes all the intangible relationships between the dependent variable and its explanatory variables with the assumption of the linear relationship between the variables. Exploiting NARDL approach requires a careful check of the stationarity of time series that are included in the study. There are some unit root tests. Dickey-Fuller test (ADF), Philip Perron (PP) and KPSS test are the practical and famous tests. Perron (1989) confirmed the importance of unit root with breakpoint test, which detects the structural change. He suggested that ignoring the structural transformation in time series would provide a false result regarded the acceptance or rejection of the existence of unit root for a specific variable. Narayan and Popp (2010) developed a Dickey-Fuller unit root test that contributes to determining the stationary level and the structural change in time series.

3.1.Model Specification

The private investment is the function of inflation, Credit provided to the private sector, government expenditure and tax burden.

$$PCF = f(INF, CR, GOV, TXB) \quad (1)$$

The general equation of ARDL for the long-run can be written as

$$Log(PCF)_t = \alpha_0 + \alpha_1 Log(INF)_t + \alpha_2 Log(CR)_t + \alpha_3 Log(GOV)_t + \alpha_4 Log(TXB)_t + \varepsilon_t \quad (2)$$

Where the equation (1) refers to the private investment as a dependent variable yit is the dependent variable which is the function of the inflation rate, government spending and tax burden. ε_t Represents the error term that capturing the idiosyncratic errors.

Given the above general equation (2) of ARDL, the equation for the ordinary error correction model takes the following form:

$$\begin{aligned}\Delta Log(PCF)_t = \beta_0 &+ \sum_{i=1}^{p} \beta_1 \Delta Log(PCF)_{t-i} \\ &+ \sum_{i=0}^{q} \beta_2 \Delta Log(INF)_{t-i} + \sum_{i=0}^{q} \beta_3 \Delta Log(CR)_{t-i} \\ &+ \sum_{i=0}^{q} \beta_4 \Delta Log(GOV)_{t-i} + \sum_{i=0}^{q} \beta_5 \Delta Log(TXB)_{t-i} \\ &+ \theta \varepsilon_{t-1} + e_t\end{aligned} \quad (3)$$

Where Δ refers to the first differences of variables or initial differences where the variable is stationary, (p,q) is the number of lags for dependent variable and independent variables respectively, and ε_{t-1} is the error correction term that results from the long run regression process in equation (2). When the equation (2) and (3) are combined, a new ECM equation will be produced as following:

$$\begin{aligned}\Delta Log(PCF)_t = \delta &+ \gamma_0 Log(PCF)_{t-1} + \gamma_1 Log(INF)_{t-1} \\ &+ \gamma_2 Log(CR)_{t-1} + \gamma_3 Log(GOV)_{t-1} \\ &+ \gamma_4 Log(TXB)_{t-1} + \sum_{i=1}^{p} \beta_{1\mathrm{i}} \Delta Log(PCF)_{t-i} \\ &+ \sum_{i=0}^{q} \beta_{2\mathrm{i}} \Delta Log(INF)_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta Log(CR)_{t-i} \\ &+ \sum_{i=0}^{q} \beta_{4\mathrm{i}} \Delta Log(GOV)_{t-i} \\ &+ \sum_{i=0}^{q} \beta_{5\mathrm{i}} \Delta Log(TXB)_{t-i} + e_t\end{aligned} \quad (4)$$

Where:

$\delta = \beta_0 - \theta\alpha_0,\ \gamma_0 = \theta, \gamma_1 = -\theta\alpha_1,\ \gamma_2 = -\theta\alpha_2,\ \gamma_3 = -\theta\alpha_3,\ \gamma_4 = -\theta\alpha_4$

$\gamma_0, \frac{\gamma_1}{\theta}, \frac{\gamma_2}{\theta}, \frac{\gamma_3}{\theta}, \frac{\gamma_4}{\theta}$ are the long run coefficients of PCF, INF, CR, GOV and TXB variables, while $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are the short run coefficients of the variables, while γ_0 is the error correction term that is expected to be negative. $\Delta Log(.)$ refers to the first differences of the natural logarithm of the variables and it represent also the growth rate of the variable. The purpose of using the Nonlinear Autoregressive Distributed lag (NARDL) is to estimate the asymmetrical impacts of explanatory variables. This approach is developed by Shin et al. (2014) that is a result of combination of the nonlinear long-run relationship and nonlinear error correction with partial sum decompositions. For this aim, the asymmetrical partial sum decomposed all the explanatory variables based on the negative and positive changes. The asymmetrical relationship can be written as following:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + \mu_t \qquad (5)$$

Where $x_t = x_0 + x_t^+ + x_t^-$ and μ_t is the equilibrium error (Schorderet, 2003) The partial sum decomposition techniques, which is developed by Schorderet (2003) and Shin et al. (2014), allows the variables to be decomposed into negative X_t^+ and positive X_t^-shocks. The calculation of the partial sum of positive and negative changes helps to catch the effect of inflation, Credit for private sector, government expenditure and tax burden on the change in private investment. The equations show as following:

$$\begin{aligned}
&Log(INF)_t^+ = \sum_{i=1}^{t} \Delta\log(INF)_i^+ = \sum_{i=1}^{t} Max(\Delta Log(INF_i, 0);\\
&Log(INF)_t^- = \sum_{i=1}^{t} \Delta\log(INF)_i^- = \sum_{i=1}^{t} Min(\Delta Log(INF_i, 0);\\
&Log(CR)_t^+ = \sum_{i=1}^{t} \Delta\log(CR)_i^+ = \sum_{i=1}^{t} Max(\Delta Log(CR_i, 0);\\
&Log(CR)_t^- = \sum_{i=1}^{t} \Delta\log(CR)_i^- = \sum_{i=1}^{t} Min(\Delta Log(CR_i, 0);\\
&Log(GOV)_t^+ = \sum_{i=1}^{t} \Delta\log(GOV)_i^+ = \sum_{i=1}^{t} Max(\Delta Log(GOV_i, 0);\\
&Log(GOV)_t^- = \sum_{i=1}^{t} \Delta\log(GOV)_i^- = \sum_{i=1}^{t} Min(\Delta Log(GOV_i, 0);\\
&Log(TXB)_t^+ = \sum_{i=1}^{t} \Delta\log(TXB)_i^+ = \sum_{i=1}^{t} Max(\Delta Log(TXB_i, 0);\\
&Log(TXB)_t^- = \sum_{i=1}^{t} \Delta\log(TXB)_i^- = \sum_{i=1}^{t} Min(\Delta Log(TXB_i, 0)
\end{aligned} \qquad (6)$$

The equations (6) represent the negative and positive changes decompositions. As a result of substituting the equations (6) in the equation (3.4), the asymmetric equation can be expressed as follows:

$$\begin{aligned}\Delta Log(PCF)_t = {} & \delta + \gamma_0 Log(PCF)_{t-1} + \gamma_1^+ Log(INF)_{t-1}^+ \\ & + \gamma_1^- Log(INF)_{t-1}^- + \gamma_2^+ Log(CR)_{t-1}^+ \\ & + \gamma_2^- Log(CR)_{t-1}^- + \gamma_3^+ Log(GOV)_{t-1}^+ \\ & + \gamma_3^- Log(GOV)_{t-1}^- + \gamma_4^+ Log(TXB)_{t-1}^+ \\ & + \gamma_4^- Log(TXB)_{t-1}^- \\ & + \sum_{i=1}^{p} \beta_{1i} \Delta Log(PCF)_{t-i} + \sum_{i=0}^{q} [\beta_{2i}^+ \Delta Log(INF)_{t-i}^+ \\ & + \beta_{2i}^- \Delta Log(INF)_{t-i}^-] + \sum_{i=0}^{q} [\beta_{3i}^+ \Delta Log(CR)_{t-i}^+ \\ & + \beta_{3i}^- \Delta Log(CR)_{t-i}^-] + \sum_{i=0}^{q} [\beta_{4i}^+ \Delta Log(GOV)_{t-i}^+ \\ & + \beta_{4i}^- \Delta Log(GOV)_{t-i}^-] + \sum_{i=0}^{q} [\beta_{5i}^+ \Delta Log(TXB)_{t-i}^+ \\ & + \beta_{5i}^- \Delta Log(TXB)_{t-i}^-] + e_t \end{aligned} \quad (7)$$

Where: $\delta = \beta_0 - \theta\alpha_0, \gamma_0 = \theta, \gamma_1^+ = -\theta\alpha_1^+,\ \gamma_1^- = -\theta\alpha_1^-, \gamma_2^+ = -\theta\alpha_2^+, \gamma_2^- = -\theta\alpha_2^-, \gamma_3^+ = -\theta\alpha_3^+, \gamma_3^- = -\theta\alpha_3^-,$ $\gamma_4^+ = -\theta\alpha_4^+,\ \gamma_4^- = -\theta\alpha_4^-$ and $\theta = \gamma_0,\ \alpha_1^+ = \frac{-\gamma_1^+}{\theta}, \alpha_1^- = \frac{-\gamma_1^-}{\theta}, \alpha_2^+ = \frac{-\gamma_2^+}{\theta}, \alpha_2^- = \frac{-\gamma_2^-}{\theta}, \alpha_3^+ = \frac{-\gamma_3^+}{\theta}, \alpha_3^- = \frac{-\gamma_3^-}{\theta}, \alpha_4^+ = \frac{-\gamma_4^+}{\theta}, \alpha_4^- = \frac{-\gamma_4^-}{\theta}$

are the long run coefficients for positive and negative changes of the private investment, inflation rate, credits for private sector, government spending and tax burden respectively. The equation (7) represents the asymmetrical relationship in the long run and short run. According to Shin et al. (2014) and Karamelikli (2016), the asymmetrical equation for both short and long run can be divided into long run asymmetric and short run symmetric or long run symmetric and short run asymmetric. When the asymmetrical effect exists only in the short run, the equation can be expressed as follows:

$$\begin{aligned}\Delta Log(PCF)_t = {} & \delta + \gamma_0 Log(PCF)_{t-1} + \gamma_1 Log(INF)_{t-1} \\ & + \gamma_2 Log(CR)_{t-1} + \gamma_3 Log(GOV)_{t-1} \\ & + \gamma_4 Log(TXB)_{t-1} \\ & + \sum_{i=1}^{p} \beta_{1i} \Delta Log(PCF)_{t-i} + \sum_{i=0}^{q} [\beta_{2i}^{+} \Delta Log(INF)_{t-i}^{+} \\ & + \beta_{2i}^{-} \Delta Log(INF)_{t-i}^{-}] + \sum_{i=0}^{q} [\beta_{3i}^{+} \Delta Log(CR)_{t-i}^{+} \\ & + \beta_{3i}^{-} \Delta Log(CR)_{t-i}^{-}] + \sum_{i=0}^{q} [\beta_{4i}^{+} \Delta Log(GOV)_{t-i}^{+} \\ & + \beta_{4i}^{-} \Delta Log(GOV)_{t-i}^{-}] + \sum_{i=0}^{q} [\beta_{5i}^{+} \Delta Log(TXB)_{t-i}^{+} \\ & + \beta_{5i}^{-} \Delta Log(TXB)_{t-i}^{-}] + e_t \end{aligned} \quad (8)$$

In another hand, when the asymmetrical effects of variables exist in the long run, the equation can be written as follows:

$$\begin{aligned}\Delta Log(PCF)_t = {} & \delta + \gamma_0 Log(PCF)_{t-1} + \gamma_1^{+} Log(INF)_{t-1}^{+} \\ & + \gamma_1^{-} Log(INF)_{t-1}^{-} + \gamma_2^{+} an\ Log(CR)_{t-1}^{+} \\ & + \gamma_2^{-} Log(CR)_{t-1}^{-} + \gamma_3^{+} Log(GOV)_{t-1}^{+} \\ & + \gamma_3^{-} Log(GOV)_{t-1}^{-} + \gamma_4^{+} Log(TXB)_{t-1}^{+} \\ & + \gamma_4^{-} Log(TXB)_{t-1}^{-} + \sum_{i=1}^{p} \beta_{1\mathrm{i}} \Delta Log(PCF)_{t-i} \\ & + \sum_{i=0}^{q} \beta_{2\mathrm{i}} \Delta Log(INF)_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta Log(CR)_{t-i} \\ & + \sum_{i=0}^{q} \beta_{4\mathrm{i}} \Delta Log(GOV)_{t-i} \\ & + \sum_{i=0}^{q} \beta_{5\mathrm{i}} \Delta Log(TXB)_{t-i} + e_t \end{aligned} \quad (9)$$

The equations (7), (8) and (9) show the long run asymmetrical and symmetrical Cointegration between the private investment and other explanatory variables that are included in the study. According to Banerjee et al. (1998), the process of testing the long run Cointegration can be determined by using t-statistics, while Pesaran et al. (2001) proposed F-statistics to test for the Cointegration. The long-run asymmetrical Cointegration can be determined by bounds test which is used to include all variables lags for ARDL approach. By this way, Shin et al. (2014) suggested bounds test detect Cointegration in term of an asymmetrical long-run for all legged level variables, and in some cases, t-statistics is favorably recommended. When F-statistics is used to test for the

Cointegration in asymmetric long-run, the null hypothesis is shown as $H_0: \gamma_0 = \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$ against the alternative hypothesis where at least one long run coefficient does not equal to zero $H_1: \gamma_0 \neq 0 \; or \; \gamma_1 \neq 0 \; or \; \gamma_2 \neq 0 \; or \; \gamma_3 \neq 0 \; or \; \gamma_4 \neq 0$. For testing the existence of symmetrical long-run, the null hypothesis$H_0: \gamma_0 = \gamma_1^+ = \gamma_1^- = \gamma_2^+ = \gamma_2^- = \gamma_3^+ = \gamma_3^- = \gamma_4^+ = \gamma_4^- = 0$, which are represented alternatively with the null hypotheses$H_0: \alpha_1^+ = \alpha_1^- = \alpha_1$,$H_0: \alpha_2^+ = \alpha_2^- = \alpha_2$, $H_0: \alpha_3^+ = \alpha_3^- = \alpha_3$, $H_0: \alpha_4^+ = \alpha_4^- = \alpha_4$ and tested using t-statistics. To test the short-run symmetry, these null hypothesis $H_0: \sum_{i=0}^{q} \beta_{2i}^+ = \sum_{i=0}^{q} \beta_{2i}^-$, $H_0: \sum_{i=0}^{q} \beta_{3i}^+ = \sum_{i=0}^{q} \beta_{3i}^-$, $H_0: \sum_{i=0}^{q} \beta_{4i}^+ = \sum_{i=0}^{q} \beta_{4i}^-$, $H_0: \sum_{i=0}^{q} \beta_{5i}^+ = \sum_{i=0}^{q} \beta_{5i}^-$ should be tested separately to determine whether the effects of variables are symmetric or asymmetric on the private investment. all previous joint hypothesis should test with F-statistics using the Wald test, and the value should be compared with the F-value table that is determined the by Pesaran et al. (2001). The model of study which presented through equations (7) and (8) permit to analyze the asymmetrical effects of regressors if the late-mentioned null hypothesis of symmetrical short-run and long-run are rejected (Shin et al. 2014), (Karamelikli, 2016). Also, Shin et al. (2014) suggested that in the case when the asymmetrical relationship in long-run exists, the dynamic cumulative multiplier effect of positive and negative decomposition can be assessed. The evaluation of the dynamic multiplier impacts can be calculated by deriving the dependent variable in term of decomposed positive and negative regressors' value respectively. The dynamic multiplier effect can be calculated as follows:

$$
\begin{aligned}
m_h^+ &= \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(INF)_t^+} \; ; \; m_h^- = \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(INF)_t^-} \\
&\lim_{h\to\infty} m_h^+ = \alpha_1^+ \qquad\qquad \lim_{h\to\infty} m_h^- = \alpha_1^- \\
m_h^+ &= \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(CR)_t^+} \; ; \; m_h^- = \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(CR)_t^-} \\
&\lim_{h\to\infty} m_h^+ = \alpha_2^+ \qquad\qquad \lim_{h\to\infty} m_h^- = \alpha_2^- \\
m_h^+ &= \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(GOV)_t^+} \; ; \; m_h^- = \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(GOV)_t^-} \\
&\lim_{h\to\infty} m_h^+ = \alpha_3^+ \qquad\qquad \lim_{h\to\infty} m_h^- = \alpha_3^- \\
m_h^+ &= \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(TXB)_t^+} \; ; \; m_h^- = \sum_{i=0}^{h} \frac{\partial Log(PCF)_{t+i}}{Log(TXB)_t^-} \\
&\lim_{h\to\infty} m_h^+ = \alpha_4^+ \qquad\qquad \lim_{h\to\infty} m_h^- = \alpha_4^-
\end{aligned}
\tag{10}
$$

4. EMPIRICAL ANALYSIS

4.1 Statistical Properties and Data Characteristics:

Table-1 provides an overview of the statistical characteristics of the annual data using the initial data and the descriptive statistics with logarithm. According to Granger and Hallman (1991)

using a logarithm might cause an over-rejection for the null hypothesis while it is true. Also, Kramer and Davies (2002) used Monte Carlo simulation to conclude that using logarithm can generate two type of rejection, over-rejection and under-rejection for the null hypothesis of the unit roots test, and this effect of logarithm cannot allow the Dickey-fuller test to provide real output about whether the null hypothesis of unit roots is true or not. .

Table-1: Descriptive statistics of the variables under the study

	Mean	Max	Min	Std. Dev	Skew	Kurt	JB stats	Obs
PCF	1.52E+1	4.15E+1	3.08E+1	1.29E+1	0.47986	1.9530	3.445956 [0.160702]	42
INF	5.95581	28.7001	0.70696	5.91688	2.16201	7.6256	68.49452 [0.0000]***	42
CR	79.9321	148.340	30.2273	42.3370	0.45195	1.4577	5.459452 [0.059998]*	42
GOV	7.47E+10	2.15E+11	3.24E+09	6.87E+10	0.77177	2.2251	5.095931 [0.067470]*	42
TXB	3.65439	8.17001	0.49028	2.25303	0.27787	1.8550	2.766922 [0.239158]	42
Log(PCF)	32.0074	33.6581	28.7549	1.40948	-0.7229	2.2761	4.467022 [0.097891]*	42
Log(INF)	1.42144	3.35690	-0.34677	0.85091	0.1571	2.8852	0.191350 [0.834432]	42
Log(CR)	4.24154	4.99951	3.40874	0.53582	0.1960	1.4608	4.309846 [0.109329]	42
Log(GOV)	24.4468	26.0926	21.8976	1.24962	-0.401	1.9480	2.993953 [0.221961]	42
Log(TXB)	1.04481	2.10047	-0.71276	0.79028	-0.620	2.2910	3.486016 [0.137208]	42

***Source**: Authors' computation based on data collected from the World Bank (2022).*

Table-2 shows the correlation results among the variables of the study. The private investment is linked positively with the credit provided for the private sector, government spending, tax burden. This result in table-2 also depicts that all variables shift in a similar direction with the exception of the inflation rate that shows a negative correlation. Also, there is no presence of multicollinearity among all regressors.

Table-2: Correlation matrix for the variables

	PCF	INF	CR	GOV	TXB
PCF	1.000000 (--------)	-	-	-	-
INF	-0.56681 [0.000]***	1.000000 (--------)	-	-	-
CR	0.947921 [0.000]***	-0.53587 [0.0003]***	1.00000 (--------)	-	-
GOV	0.985493 [0.000]***	-0.52992 [0.004]***	0.939369 [0.000]***	1.00000 (--------)	-
TXB	0.987597 [0.000]***	-0.59471 [0.000]***	0.944289 [0.000]***	0.969627 [0.000]***	1.00000 (-------)

Note: This table indicates the correlation among private investment, Government spending, Credits provided to the private sector, tax burden. The first values are for the covariance, and those in brackets are the p-value.

***Source**: Authors' computation based on data collected from the World Bank (2022)*

Table-A1 illustrates the results of the stationarity of the time series and unit roots test using Augmented Dickey-fuller (ADF) test. It is apparent from Table-A1 below that all variables are not stationary at the level I (0), and all of them are stationary at the first difference. According to Shin et al. (2014), the nonlinear autoregressive distributed lag cannot be built with variables that are stationary at the second difference I(2) and should be dropped from the model or replaced. He also concluded that all variables should not be integrated in the same order to run the cointegration analysis. This result provides more incentives to use the variables of study in NARDL approach to testing the asymmetric effect on private investment.

Table-A2 represents the result for the unit roots test with structural change. Phillip Perron (PP) approach is used to test the unit roots hypothesis with constant and trend. Also, to determine the number of lags, the Schwarz criterion is selected to run the test with an optimal number of lags. As can be seen from the table-A2 in Appendix A, the results divided vertically into intercept minimize break and intercept maximise break. The reason behind including the min and max breaks is to check the potential asymmetric behaviour. As the time series experiment structural breaks over time, One of the critical features of unit roots test with the structural transformation is that test does not necessitate any prior knowledge about the possible time of the structural break.

Table-A2 shows that the variables are not stationary at level for the intercept minimize break but, it is apparent from the intercept maximise break column that only the credits provided for the private sector are stationary at a level in 2002, with a significant negative coefficient. The variables are integrated at the first level I (1). The bottom half of table-A2 shows some main characteristics of the structural change in the time series. The variables are likely to have two structural break-points in term of minimum and maximum divergence in the time series, which indicate the potential asymmetric behaviour except government spending that showed only same year for break-point.

5. MODEL ESTIMATION AND FINDINGS

The study models were estimated by employing the nonlinear autoregressive distributed lag to determine the effect of the most important macroeconomic factors on the private investment in South Korea. In order to test the hypothesis of the nonlinear effect, table-A3 and table-A4 show the results of the inflation rate, government spending, financial credits and tax burden for the first regression, The analysis in both tables is based on the equations (7), (8) and (9). For the first model, it was estimated by the ARDL approach, and other models were estimated by NARDL approach to testing the asymmetric impact hypothesis.

From the diagnostic test of the first group of variables, Table-A3 can be divided horizontally into long-run and short-run for the symmetric, asymmetric and partial asymmetric models. The result in models (02) to (05) obtained from the preliminary analysis of NARDL approach, which was estimated by using stepwise least squares which allowed to estimate the coefficients with a p-value up to 10% as the level of significance, taking into account the optimal number of lags for all included models. The top half of Table-A3 illustrates the existence of long-run relationship presented by models (02), (03), (04) and (05) between the private investment and other independent variables, where the values of t-statistics for error correction coefficients in the models (02), (03), (04) and (05) are smaller than 1% as a level of significant. In table-A3, the study applied Jaque-Bera test for normality, Breusch-Pagan-Godfrey test for heteroscedasticity and Lagrange multiplier test for residual serial correlation. Overall, JB test indicated that all models in table-A3 are normally

distributed, while in result in table-A4 showed that partial asymmetric for long-run model (04) and asymmetric model (03) have the highest value of (14.30) and (5.66) respectively, which refers that the residual is not normally distributed because of the effect of the nonlinear asymmetric relationship in long-run. By using breusch-Pagan-Godfrey for heteroscedasticity presence test, all models in table-A3 reported the absence of heteroscedasticity.

Table-A4 in appendix A shows the result of the cointegration test for the symmetric model (02), asymmetric model (03) and partial symmetric for long-Run (LR) model (04) and the Short-Run (SR) model (05). By using critical value from Pesaran et al. (2001) to compare the calculated F-statistic joint value that generated from the long-run coefficients, the calculated F-statistics of the symmetric model (02), asymmetric model (03) and the partial asymmetric for SR model (05) are (5.82), (4.544) and (5.31) respectively, which provided a larger values than the critical value (5.06). This fact provides strong evidence of cointegration at 1% significance level. Surprisingly, the partial asymmetric model (04) does not appear any evidence of cointegration. On the other hand, the long-run coefficients are generated and tested by Wald-test, where the comparison between the result of the model (02) and (05) showed similar coefficients values with minimal differences. Credits seemed negatively significant at 5% and 1% significance level while tax burden has positive coefficient which is significant at 5%, 10% and 1% significance level. The presence of the long-run asymmetric linkages between the private investment and inflation, credits, government spending, tax burden is confirmed by cointegration test which is recommended by Shin et al. (2014).

Table-A5 illustrates the result of the long and the short-run asymmetries examination for each variable using Wald-test for the asymmetric model (03), partial asymmetric for the long-run model (04) and partial asymmetric for the short-run model (05) outcome estimations.

The inclusion of these models in table-A5 provides an optimal frame to examine and compare the asymmetry effect in both long- and short-run simultaneously, or only with the consideration of one period term as it is presented by the model (04) and (05). Inflation, credits and tax burden in the asymmetric model (03) show a consistent rejection for symmetry effect in the long and asymmetry effect in the short-run, Government spending has a symmetric relationship with private investment in long-run and asymmetric linkages in short-run.

5.1.Result Discussion

The asymmetrical analysis was employed in the frame of NARDL approach to examine the possible nonlinearity relationship between the private investment and other variables in the study. The full asymmetrical model (03) in Tables-A3, Table-A4 and Table-A5 (appendix A) that represented the equation (7) shows the existence of symmetry effect in the short-run for and asymmetry for inflation rate, credits, tax burden, , and the asymmetry in long-run for inflation rate, credits, tax burden were accepted. The partial asymmetrical model for the long-run and the short-run models that encompass the symmetry alternatively in the long and short-run have not revealed any econometric issue except the model (04) that does not show any significance in term of cointegration. The long-run coefficients in tablA4 carried difference signs for the variables that can refer to the general direction of the relationship with the private investment, which allows

concluding whether the relationships among variables are positive or negative. According to the result in both symmetric model (03) and partial asymmetric model (05), it can be seen that there is a negative relationship between credit provided for private sector and private investment, while the inflation rate does not reach a statistical significance in both models. On the other hands, a positive direction of relationships is to be observed when the government spending, tax burden are set in contrast to the private investment.

Interestingly, In the asymmetrical model (03), both positive and negative values of inflation show significant coefficients which drive the private investment to increase by 0.45% and 0.18% when the positive value of inflation increase by 1% and the negative values decrease by 1% respectively in the long-run. On the other hand, in the short-run, the increase in the positive value the inflation rate by 1% leads to 0.197% decrease the private investment, and when the negative inflation rate value increases by 1%, the private investment responds positively with 0.112%. Clearly, from table 4.7, the null hypothesis of symmetry is rejected as p-value is less than 1%, which indicates that there is an asymmetry impact in long-run of inflation rate on the private investment in South Korea. In the case of the short-run, there is strong statistical evidence at 1% significance level to conclude that the effect of inflation rate on the private investment is symmetric and equal. Despite the result in table-A3, the asymmetric examination leads to say that any change or shock of the inflation rate in the long-run can affect the private investment growth, while the shock of inflation in the short run has not any significant effect on the private investment growth in South Korea. The inflation rate is a good indicator of economic stability. The positive inflation rate is not favourable because it has an adverse impact on the poverty level, price stability, the value of financial assets and exchange rate. In South Korea the results showed that the private investment in the long-run responds more positively (0.45%) when the inflation rate is positive, that can be explained through two reasons in term of policy. First, the high inflation volatility contributes to increasing the inflation uncertainty which has a related to the substantial decrease in the private investment, in developed economies the inflation volatility tends to be low (Fischer et al., 2013). According to Kim and Park (2006), the monetary policy that aimed process the inflation targeted framework in Korea led the inflation expectations to be less sensitive to the inflation shocks and maintain a low inflation volatility. This fact generated an adequate environment for private investment to develop. Second, to increase the economic growth which is inductive to the size of the private capital formation, the government deficit tends to be increased to stimulate the aggregate demand for consumption or investment. it is necessary to control the government deficit shift the public spending from consumption to investment which hinders unproductive government expenditure will small rise in inflation rate. That led to say the associated positive value of inflation with private investment results from the crowding-in relationship between public and private investment (Patnaik & Joshi, 1998).

The credits provided for the private sector has an adverse effect on the private investment in the long-run. From the asymmetric model (03), the results provided that when the positive value of credits provided for the private sector increased by 1%, the private investment decreases by 1.23% with significant statistical evidence at 1% significance level. On the contrary, in the short-run, the credit for the private sector has a positive effect on the private investment where the increase in the

credit by 1% leads the private investment to grow by 0.29% with t-value less than 5% level of significance. Taken together, the results in table-A3 concludes the existence of asymmetry impact of the credit for the private sector on the private investment in the long-run. For the short-run, the partial asymmetrical for the SR model (05) also showed an asymmetry effect of the credits for the private sector on the private investment. The reason of the negative linkage of credits with the private investment could be related to the behaviour of the financial institutions in term of the credit policy that becomes more market-based allocation (Borensztein & Lee, 2002). The decrease in the private investment could be affected by the asset-oriented system for the private sector in South Korea where the Chaebols tend to boost their financial assets rather than liabilities, this behaviour provides another financial resource (Kim 2017). As result, the cumulative capital of chaebols does not show a positive relationship with the credit provided for the private sector in the long-run. for non-chaebols (SMEs) that considered as a recipient of financial subsidies, in Korea, some firms in certain industries shown a high probability of survival accompanied with weak productivity and low re-investment ability in long-run (Chang, 2016). That could be a result of the credit policy allocation that based on survival not on the productivity performance. As another form of government incentives, the results suggested – from table-A3 and table-A4 that the tax burden has an adverse relationship with the private investment in the long and the short-run. According to table-A5, when the negative values of tax burden increase by 1%, the private investment responds by 3.53% decrease with less than 1% level of significance, also, the asymmetry impact on the private investment has been proven statistically at 10% level of significance. In the short-run, the tax burden also has a negative impact with 1.15% rise of the private investment growth against 1% fall in tax burden. As result, the tax cut in South Korea stimulates the private investment by allowing the private sector to re-invest their profit. Also, the reducing of the tax burden is more effective than the financial subsidy such financial loans unlike the findings for other countries in the previous literature (Chen et al. 2013; Misati and Nyamongo 2011; Sarkar 2012)

6. CONCLUSION AND POLICY IMPLICATIONS

The study attempted to investigate the effect of the most macroeconomic factors on private investment in South Korea. The nonlinear autoregressive distributed lag was used to test a number of hypotheses related to the nature of the relationship between the private investment and each of the inflation rate, credits provided to the private sector, government spending, tax burden. The study exploited annual data from the World Bank during the period of 1975-2019, where the statistical analysis showed that all variables were stationary at first level. Also, the use of structural breakpoint test provided initial signs of the asymmetry effect through the structural change in the time series. Also, the estimation consisted of ARDL and NARDL approach that included the symmetric model, asymmetric model and partial asymmetric model for the long-run and the short-run to cover all possible paths to the real cases.

In the contract with the research in the same field, the key findings of the inflation rate show the effectiveness of the monetary policy and how the Korean economy is stable. With accelerated economic growth, the inflation rate tends to be positive in the long-run which make the value of money less attractive to the real capital. That leads to reduce savings and increase the aggregate

demand. Also, the positive response of the private investment to the positive value of inflation can be explained by the private sector investment behaviour that orientated toward physical capital more than a financial asset. The effect of government spending drives private investment to be more promoted. The government expenditure in South Korea tends to be more productive where the concentration of the public spending located in developing some productive fields such as the infrastructure and R&D. Hence, the government investment could have an effect in reducing the investment uncertainty for the private sector and enhance the business opportunity and investment decision for domestic firms in the short-run.

Regarding the subsidies forms, the statistical significance of coefficients corresponding to the credit availability for the private sector pointed a positive linkage to the private investment in the short-run as a sign of using the loans to acquire a capital. That short-run positive effect might accelerate the investment recovery in the case of crisis. In the long-run, the credit shows an ineffectiveness in promoting the private investment. That findings illustrated the weakness the modality of financing in South Korea that should be processed in the frame of the productivity performance and the degree of firms' maturity not survival especially for SMEs that rely mainly on the bank loans. On the other hand, the reduction of tax burden contributed significantly to the private investment development in the short and the long-run that gives the chance to enhance the business environment for investment and re-invest the extra income.

A number of policy inferences can be drawn to promote the private investment. Firstly, the government should pay attention to the public expenditure issue to ensure that spending is more productive such infrastructure, R&D and other productive sectors in the form of investment. Also, in order to conduct the investment climate to promote private investment in the long-run, the monetary policy especially the inflation rate should be under control with less uncertainty and low volatility. Secondly, the financial development and credit are very crucial to support the private sector investment especially SMEs. Hence, the credit availability and allocation issue should be taken into consideration by providing a priority to private agents based on the productivity performance and market indications. Thirdly, the government must be kept the openness issue in check in term of capital mobility and inward FDI. It is necessary to limit the negative impact of trade openness on the domestic private investment by improving the business and investment environment by enhancing the infrastructure, R&D and human resource capacity, and reviewing the concerned regulation of the FDI and the domestic firm's overseas expansion. That will help to attract more FDI inflow and limit the outward capital mobility.

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APPENDIX A:

Table –A1: Augmented Dickey-Fuller Test for Unit Roots

Variables	*With constant*		*Constant and trend*		*Without constant and trend*	
	t-stats	**p-value**	**t-stats**	**p-value**	**t-stats**	**p-value**
At Level						
Log(PCF)	-4.323558	0.0013***	-2.234234	0.4591	2.175817	0.9919
Log(INF)	-2.171096	0.2194	-3.441807	0.0594*	-1.862663	0.0602*
Log(CR)	-0.081569	0.9448	-2.55143	0.3034	2.766832	0.9982
Log(GOV)	-2.148906	0.2274	-2.078130	0.5426	2.417148	0.9955
Log(TXB)	1.162699	0.9974	-3.215736	0.0952*	4.012060	1.0000
First Difference						
ΔLog(PCF)	-3.804181	0.0058***	-5.341765	0.0004***	-2.935401	0.0043***
ΔLog(INF)	-8.387888	0.0000***	-8.201659	0.0000***	-8.358187	0.0000***
ΔLog(CR)	-4.647027	0.0005***	-4.610394	0.0033***	-4.149739	0.0001***
ΔLog(GOV)	-4.239820	0.0017***	-4.618834	0.0032***	-3.200878	0.0020***
ΔLog(TXB)	-8.715552	0.0000***	-8.967013	0.0000***	-6.395565	0.0000***

***Source**: Author's computation based Eview.9 Output*

Table-A2: Unit root test with a structural breakpoint

variable	*Constant and trend*			
	Min intercept break		**Max intercept break**	
	t-stats (p-value)	**Structural break year**	**t-stats (p-value)**	**Structural break year**
			At Level	
Log(PCF)	-2.897921 (0.7321)	1997	-3.723814 (0.3390)	1987
Log(INF)	-3.432611 (0.4801)	2012	-3.622473 (0.3881)	1987
Log(CR)	-1.674853 (0.9617)	2009	-6.263040 <(0.01)***	2000

Log(GOV)	-2.810677 (0.7629)	2007	-2.810677 (0.7629)	2007
Log(TXB)	-3.595698 (0.3989)	2008	-4.592782 (0.0573)*	1989
			First difference	
∆Log(PCF)	-5.506241 <(0.01)***	1996	-5.528835 <(0.01)***	2006
∆Log(INF)	-8.246154 < (0.01)***	2011	-8.332706 <(0.01)***	1985
∆Log(CR)	-3.235127 (0.5811)	2002	-5.007534 (0.0171)***	1995
∆Log(GOV)	-6.627766 < (0.01)***	1998	-6.627766 <(0.01)***	1998
∆Log(TXB)	-9.381744 <(0.01)***	1990	-9.639512 <(0.01)***	2002

***Source**: Authors' computation based Eview.9 Output*

Table-A3: Estimation of Dynamic Models ARDL and NARDL (INF, CR, GOV, TXB)

Dependent variables	ARDL Model Model(01)	Symmetric Model (LR-SR) Model(02)	Asymmetric Model (LR-SR) Model(03)	Partial Asymmetric Model (LR) Model (04)	Partial Asymmetric Model (SR) Model (05)
Constant	-0.010815 (-0.563396)	3.992546 (2.302897)**	11.82771 (4.686666)***	8.156685 (3.610687)***	4.182346 (2.125286)**
$Log(PCF)_{t-1}$		-0.226209 (-3.635023)***	-0.424535 (-4.665841)***	-0.285256 (-3.561911)***	-0.231426 (-3.268713)***
$Log(INF)_{t-1}$		-0.008975 (-0.531824)			-0.006638 (-0.364443)
$Log(CR)_{t-1}$		-0.105461 (-2.153066)**			-0.121089 (-2.256028)**
$Log(GOV)_{t-1}$		0.147408 (2.116739)**			0.147938 (1.782908)*
$Log(TXB)_{t-1}$		0.162968 (1.501980)**			0.185993 (1.472539)
$Log(INF)^{+}_{t-1}$			0.192968 (2.593383)**	0.047677 (0.708435)	
$Log(INF)^{-}_{t-1}$			-0.078063 (-2.531428)**	-0.037680 (-1.172503)	
$Log(CR)^{+}_{t-1}$			-0.522633 (-	-0.202553 (-1.493986)	

			3.289769)***		
$Log(CR)^{-}_{t-1}$			0.420069 (0.874490)	0.414408 (0.812143)	
$Log(GOV)^{+}_{t-1}$			0.168009 (1.220061)	0.240527 (1.609636)	
$Log(GOV)^{-}_{t-1}$			-0.098713 (-0.422195)	0.209642 (0.923200)	
$Log(TXB)^{+}_{t-1}$			0.263466 (1.182974)	0.082882 (0.359609)	
$Log(TXB)^{-}_{t-1}$			1.500372 (2.815763)***	0.510600 (1.037678)	
$\Delta Log(PCF)_{t-1}$	0.476399 (4.233712)***	0.307007 (2.709160)***	0.468086 (3.489050)***	0.286363 (2.018007)*	0.325835 (2.792252)***
$\Delta Log(PCF)_{t-2}$		-0.256363 (-2.084283)**	-0.421894 (-2.932713)***	-0.307864 (-2.129835)**	-0.236833 (-1.908401)*
$\Delta Log(INF)_{t}$	-0.024413 (-1.079991)				
$\Delta Log(INF)_{t-1}$	-0.062015 (-3.16234)***				
$\Delta Log(CR)_{t}$	0.027904 (0.185726)				
$\Delta Log(GOV)_{t}$	0.467647 (4.623557)***	0.493067 (5.873390)***		0.489738 (5.091173)***	
$\Delta Log(TXB)_{t}$	-0.034499 (-0.268792)				
$\Delta Log(TXB)_{t-1}$	0.220665 (2.004354)*				
$\Delta Log(INF)^{+}_{t-1}$			-0.194777 (-3.261819)***		-0.053335 (-1.289109)
$\Delta Log(INF)^{-}_{t-1}$			0.122648 (2.587124)**		
$\Delta Log(CR)^{+}_{t-1}$			0.298996 (2.096850)**		0.217654 (1.466775)
$\Delta Log(GOV)^{+}_{t}$			0.349027 (2.606620)**		0.483853 (3.691310)***
$\Delta Log(GOV)^{-}_{t}$			0.600902 (2.774668)**		0.614811 (2.915559)***
$\Delta Log(TXB)^{-}_{t-1}$			-1.153350 (-2.386748)**		
R^2	0.759820	0.9027	0.903124	0.842443	0.850883
$\bar{R}^2$	0.707280	0.810521	0.828265	0.772418	0.794321
S.D	0.111817	0.093265	0.111817	0.111817	0.113234
σ	0.060497	0.040598	0.046338	0.053343	0.051354
JB	2.602207 [0.72231]	1.068308 [0.586165]	4.131826 [0.126703]	2.705540 [0.258523]	0.114708 [0.944260]
F_H	0.821829 [0.5765]	0.760185 [0.6394]	0.472284 [0.9406]	0.697432 [0.7400]	1.554431 [0.1658]
ML test	7.793464 [0.0203]**	1.203907 [05477]	24.95191 [0.3491]	1.802786 [0.4060]	2.178763 [0.3364]

Note: This table reports the results of the estimation of ARDL and NARDL models for the private investment adjustment. The superscript + and - refers to the positive and negative partial sum decomposition. S.D and σ refer to the standard deviation of the dependent variable and standard error of regression. F_H , ML and JB

denote heteroscedasticity, Lagrange multiplier to test serial correlation and Jaque-Bera normality test. Stepwise least squares are used to estimation the model with 10% as p-value backwards.

***Source**: Authors' computation based Eview.9 Output*

Table-A4: Cointegration test and the estimation of long-run coefficients

Long-run Coefficient	Symmetric Model (02) (LR-SR)	Asymmetric Model (03) (LR-SR)	Partial Asymmetric Model (04) (LR)	Partial Asymmetric Model (05) (SR)
$FP_{Nonlinear}$	5.820739***	4.544666**	3.277633	5.310468***
$L_{INF_{t-1}}$	-0.039677 (-0.54978)			-0.028683 (-0.37891)
$L_{CR_{t-1}}$	-0.466213 (-2.438)**			-0.533199 (-2.533)**
$L_{GOV_{t-1}}$	0.561645 (2.4449)**			0.639244 (2.0766)**
$L_{TXB_{t-1}}$	0.720431 (1.8440)*			0.803679 (1.77383)*
$L_{INF^{+}_{t-1}}$		0.454541 (2.633987)**		
$L_{INF^{-}_{t-1}}$		-0.183878 (-2.871928)***		
$L_{CR^{+}_{t-1}}$		-1.231073 (-4.087525)***		
$L_{CR^{-}_{t-1}}$		0.989480 (0.916702)		
$L_{GOV^{+}_{t-1}}$		0.395748 (1.275854)		
$L_{GOV^{-}_{t-1}}$		-0.232520 (-0.416462)		
$L_{TXB^{+}_{t-1}}$		0.620599 (1.273937)		
$L_{TXB^{-}_{t-1}}$		3.534154 (2.852052)***		

Note: This table reports the results of the estimation of long-run coefficients. L_x^+ And L_x^- are estimated long-run coefficients linked to positive and negative changes in variables. $FP_{nonlinear}$ refers to F-statistics proposed by Pesaran et al. (2001) and used to test the null hypothesis of no cointegration in NARDL model. Also, the critical value for this F-statistics has been obtained from Pesaran et al. (2001). ***, ** and* correspond a rejection of the null hypothesis of cointegration and long-run coefficients at the level of significance at 1%, 5% and 10% respectively.

***Source**: Authors' computation based Eview.9 Output*

Table-A5: testing the presence of asymmetry in the long and the presence of symmetry in the short-run

Wald-test	Asymmetric Model (03)(LR-SR)	Partial Asymmetric Model (04) (LR)	Partial Asymmetric Model (05) (SR)
$\mathbf{W}_{LR}(INF)$	0.638419 (2.989975)***		
$\mathbf{W}_{SR}(INF)$	-0.317425 (-3.329623)***		-0.053335 -(1.289109)
$\mathbf{W}_{LR}(CR)$	-2.220553 (-1.851925)*		
$\mathbf{W}_{SR}(CR)$	0.298996		0.217654

	(2.096850)**		(1.466775)
$\mathbf{W_{LR}(GOV)}$	0.628269		
	(1.003301)		
$\mathbf{W_{SR}(GOV)}$	-0.251876		-0.130958
	(-0.842869)		(-0.450445)
$\mathbf{W_{LR}(TXB)}$	-2.913555		
	(-1.901170)*		
$\mathbf{W_{SR}(TXB)}$	-1.153350		
	(-2.386748)**		

Note: This table reports the results of the Wald test for long-run and short-run symmetry presence. W_{LR} Denotes the Wald statistics for the long-run symmetry, which tests the null hypothesis of $\alpha^{+} = \alpha^{-}$ for each regressors in equations (7), (8) and (9). W_{SR} Denotes the Wald statistics for the short-run asymmetry, which test the null hypothesis of $\sum_{i=0}^{q} \beta_i^{+} = \sum_{i=0}^{q} \beta_i^{-}$ for each regressors. ***, ** and* correspond a rejection of the null hypothesis at 1%, 5% and 10% level of significance respectively.

***Source**: Authors' computation based Eview.9 Output*