AN ASSESSMENT OF PUBLIC CAPITAL EXPENDITURE AND PRIVATE INVESTMENT IN NEPAL

A Thesis

Submitted to the Department of Economics, Patan Multiple Campus,

Faculty of Humanities and Social Sciences, Tribhuvan University, Nepal

In Partial Fulfillment of the Requirements for the Degree of

MASTER OF ARTS

in

ECONOMICS

By

SUDIP SHARMA

Roll No.: 39/076

TU Registration Number: 7-2-25-1218-2014

Patan Multiple Campus

Lalitpur, Nepal

September 2023

DECLARATION

I, hereby declare that this thesis entitled **AN ASSESSMENT OF PUBLIC CAPITAL EXPENDITURE AND PRIVATE INVESTMENT IN NEPAL** which I have submitted to the Department of Economics, Patan Multiple Campus as the partial fulfillment of the requirement for the degree of **MASTER OF ARTS in ECONOMICS,** is entirely my original work conducted under the guidance of my supervisor. I have made due acknowledgements to all ideas and the information borrowed from the different sources in the course of writing this thesis. The results of this thesis have not been presented or submitted anywhere else for the award of any degree. I shall be solely responsible for any evidence found against my declaration.

Sudip Sharma

Date: September 2023

LETTER OF RECOMMENDATION

This thesis entitled **AN ASSESSMENT OF PUBLIC CAPITAL EXPENDITURE AND PRIVATE INVESTMENT IN NEPAL** has been prepared by **Mr. SUDIP SHARMA** under my guidance and supervision. I hereby recommend it in partial fulfillment of the requirements for the degree of MASTER OF ARTS in ECONOMICS for the final examination.

……

Dr. Raghu Bir Bista
Associate Professor

Date: September 2023

LETTER OF APPROVAL

We certify that this thesis entitled **AN ASSESSMENT OF PUBLIC CAPITAL EXPENDITURE AND PRIVATE INVESTMENT IN NEPAL** submitted by Mr. Sudip Sharma to the Department of Economics, Faculty of Humanities and Social Sciences, Patan Multiple Campus, Tribhuvan University, in partial fulfillment of the requirements for the Degree of MASTER OF ARTS in ECONOMICS has been found satisfactory in scope and quality. Therefore, we accept this thesis as a part of the said degree.

Thesis Committee

……

Head of the Department
Dr. Raghu Bir Bista
Associate Professor

……

External Examiner
Dr. Ramesh Poudel
Associate Professor

……

Thesis Supervisor
Dr. Raghu Bir Bista
Associate Professor

Date: September 2023

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude towards my honorable and respected thesis supervisor, Dr. Raghu Bir Bista, Associate Professor of Economics and Head of Department, Department of Economics, Patan Multiple Campus, for his constant support, trust, guidance and constructive insights throughout the course of this research work.

Also, I would like to thank all the current and former faculty members and administrative staff of Department of Economics, Patan Multiple Campus for providing necessary support for completion of my thesis work. I am further indebted towards the entire jury member, including internal and external, of VIVA and proposal defense squad.

Finally, I would like to express my gratitude to my family, friends and Nepal Rastra Bank for the continuous encouragement and cooperation, which helped me in timely completion of this study.

Sudip Sharma

Date: September 2023

ABSTRACT

Public expenditure is an important fiscal policy tool to achieve the macroeconomic objectives. Different forms of public expenditure have different effects on the private sector of a country and in many cases the desired results are not achieved due to the difference between actual and expected effect. In such context, this study is an important attempt to assess the desired effect of public expenditure in Nepal.

The prime objective of this study is to determine the relationship between public capital expenditure and private investment in Nepal. In order to meet its objective, this study uses time series data covering a forty-five years period from 1975 to 2019, employing the ARDL (1,1,1,0) approach of co-integration. The growth trend of the variables revealed that the growth of public capital expenditure and private investment in Nepal is satisfactory during the current Republic System, as compared during the Panchayat Regime and Monarchy.

It was observed that, in the long run, public capital expenditure crowds-in private investment. Other things remaining same, if the public capital expenditure increases by a percentage, the private investment of Nepal increases by 0.10 percentage. The short run dynamics and relationships between the variables were estimated using the Error Correction Model (ECM). However, it was observed that in the short run public investment crowds-out the private investment in Nepal. When real public investment increases by a percentage, change in real private investment is expected to decrease by 0.15 percentage, other things held constant.

The existence of long run relation was further supported by the negative and significant error correction term, which indicated that the system converges to equilibrium at a speed of 38.42 percentage towards the long run equilibrium after a short-term deviation. In order to minimize crowding-out of private investment, the public investment should be concentrated in building quality infrastructures. Government policy should be strictly oriented to minimize the effect on the private sectors as a result of high inflation, exchange rate instability, and fiscal deficits. Policymakers should consider these short-term effects while designing and developing investment and fiscal policies of Nepal.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AIC	Akaike Information Criterion
AR	Autoregressive
ARDL	Autoregressive Distributed Lag
ARIMA	Autoregressive-Moving Average
BLUE	Best Linear Unbiased Estimators
CUSUM	Cumulative Sum
CUSUMQ	Cumulative Sum of Squares
D-W	Durbin Watson
ECT	Error Correction Term
ECM	Error Correction Model
E-G	Engle-Granger
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
JB	Jarque- Bera
HQC	Hannan- Quinn Criterion
KPSS	Kwiatkowski–Phillips–Schmidt–Shin
LM	Lagrange Multiplier
ME	Maximum Entropy
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
PP	Phillips- Perron
RESET	Ramsey Regression Equation Specification Error Test
SARB	South African Reserve Bank
SBC	Schwartz Bayesian Criteria
SOEs	State Owned Enterprises
SVAR	Structural Vector Autoregressive
UECM	Unrestricted Error Correction Model
VAR	Vector Auto Regression
VECM	Vector Error Correction Model

REPORT OF PLAGIARISM SHEET

It is certified that this thesis entitled **AN ASSESSMENT OF PUBLIC CAPITAL EXPENDITURE AND PRIVATE INVESTMENT IN NEPAL** submitted by **Mr. SUDIP SHARMA** to the Department of Economics, Faculty of Humanities and Social Sciences, Patan Multiple Campus, Tribhuvan University, in partial fulfillment of the requirements for the Degree of MASTER OF ARTS in ECONOMICS has passed the plagiarism test. Therefore, we accept this thesis as a part of the said degree.

CHAPTER I

INTRODUCTION

1.1 Background of the study

Public expenditure is generally understood to refer to government spending on public entities in accordance with the fiscal policies and framework that influence macroeconomic factors to produce the anticipated macroeconomic objectives and target. There are various forms of public expenditure and common forms are public consumption, public investment, and transfer payments (Bista & Sankhi, 2022). Issues such as growing divide between current and capital expenditure, rising current spending, continuously declining and inefficient capital expenditure are common problems in public expenditure of Nepal for two decades (Paudel, 2023).

Government capital expenditures can be related to construction of school buildings, hospitals, roads, hydropower projects, establishment of industries and so on. Since the 1950s, the Panchayat Regime (1960–1990) concentrated expansionary public spending on the construction of labor consuming public products and services and facilities for creating jobs, achieving rapid growth, and enhance the welfare of the people in Nepal (Bista, 2021).

The concern for impact of state capital expenditure on private investment gained due importance from 1990s in Nepal. According to Bista and Sakhi (2022). efficiency of public expenditure during Panchayat System was poor and it was one of the causes of economic crisis in 1980s. According to World Bank (2021), after Nepal adopted federal system, the government expenditure and debt level both have increased and the spending needs, specially related to infrastructures have remained unmet and this will ultimately affect the private sector.

In the context of different countries, however, the relationship between public and private capital spending is different. Based on the literatures, there can be either crowding-in, crowding-out, or neutral relation between public investment and private investment. According to Sen and Kaya (2014) government capital expenditure attracts business investment in the economy by having a multiplier impact. It is uncommon for an economy to consistently maintain full employment. Hence, due to

underemployment situation, cost of borrowing is less sensitive to fixed capital formation. While examining the effect of government capital expenses on private sector's capital formation in China, Xu and Yan (2014) found that the public capital expenditure in the public good is productive while that in private goods through state-owned business were counterproductive. Public capital expenditure in India drives out private fixed capital formation, according to Dash (2016). On the other side, another study carried by Barik et al. (2019) discovered that public capital expenditure stimulates fixed capital formation by private sector in India. Karun et al. (2020) finds that both infrastructure and non-infrastructure investment in India crowds-in fixed capital formation by private sector.

In early-industrialized nations, the rise of government spending has slowed down since 1980, and in some cases, it has actually decreased. Social spending accounted for the majority of the increase in public spending in early industrialized nations. Despite differences in quantities, all of these nations' public spending as a proportion of GDP has grown now as compared before World War II. At the end of the 19th century, less than 10 percentage of the GDP of European countries was spent on the government. This percentage now approaches 50 percentage in many European nations High-income nations spend more on social security than nations with lower incomes do. In many nations with poor income, a sizable portion of public spending goes for employee salaries (Ospina & Roser, 2016).

While the developed countries continue to account for the bulk of spending in absolute terms, several developing countries, especially in Asia, have seen a quick expansion that is mostly attributable to their strong economic growth. When comparing their shares of overall spending, developing nations have performed better than their industrialized counterparts when it comes to investments in useful industries like infrastructure and agriculture. Both developed and developing nations have seen a significant increase in social protection spending, with richer nations experiencing a considerably more marked increase. The volume and makeup of public spending on social services and social protection varied between regions between 1980 and 2010, although spending on infrastructure and agriculture converged (Yu et al., 2015).

Akinlo and Oyeleke (2018) identified a positive long-term relation between fixed capital formation by the government and private sector but GDP per person have retarding effect upon public capital expenditure. In developed countries like Mexico, Carrillo et al. (2018) discovered that public capital expenditure stimulates private investment. Nguyen et al. (2018) finds that in lower middle-income economy like Vietnam, public investment and private investment resembles inverse U shape and there should be a threshold level of public investment.

Although classical and neoclassical economists argued for limited involvement of government in the economy during the 17th and 18th centuries, Keynes (1936) emphasized on its significant role in generating effective demand through multiplier effect. According to Saeed et al. (2006), policy makers often argue that increase in public investment leaves very few funds to the business community in the market which is more probable to raise the interest rate, thus squeezing private investment. Indirect crowding out can be observed through price and interest rate mechanisms while direct crowding out is connected with the scarcity of physical resources.

National employment policy of 2071 BS has stated private sector as the main driver of growth in the economy and employment generation while public sector has been regarded as facilitator. To achieve the 9.6 percentage average economic growth targeted by 15th periodic plan, 55.6 percentage out of the total investment is required form the private sector alone. Investment from the private sector is anticipated to be used to create jobs, industrialize and modernize the economy, produce energy, and invest in urban areas, tourism, trade, and the transportation and communication sectors. However, the impact of economic decisions made by the government highly affects the economic decision of the private sector.

There are no clear empirical evidences regarding the association between pubic capital expenditure and private sector investment in Nepal. Although ample researches have been carried out in different countries to study how private spending is affected by public spending, they show mixed results. As a result, it has become challenging to make generalizations of the results of the research that has already been done at the macroeconomic level. Furthermore, relying on multi-country cross sectional data to derive a common conclusion for all countries is also based on faulty assumptions since all countries are not homogeneous. It is equally necessary to

understand whether the trend and nature of government expenditure, basically investment expenditure, are on a right track to meet the objectives of output, income and employment.

1.2 Statement of the Problem

Public spending is a crucial component of fiscal policy to accomplish the macroeconomic goals. Distinct types of public spending have distinct impacts on a nation's commercial sector and in many cases the desired results are not achieved due to the difference between actual and expected effect of this discretionary fiscal practice. In case of developing countries like Nepal, the portion of government recurrent expenditure are quite high as compared to capital expenditure. The actual capital expenditure out of the allocated expenditure is also lower.

Giri (2022) found that the growth in GDP in Nepal is what is responsible for growth in private expenditure caused by rise in the public expenditure on health, education, transportation and social service sector. According to Gupta (2018), more investment in the nation's industries and services spurs economic growth through encouraging private sector investment in the nation. In contrast, the study conducted by Anyanwu et al. (2017) to examine the impact of government domestic credit, private sector borrowing, and the crowding out effect in oil-dependent countries, including Nepal, discovered that domestic borrowing by the government significantly negatively affects private credit without raising the price of debt to the private sector. In this situation, capital spending is anticipated to have a favorable, long-term impact on Nepal's private investment.

Even in a market-based economy, the government must exercise some degree of restricted control over output and price in order to meet its equitable goals (Pradhan et al., 1990). However, government has some serious constraints that can be fulfilled by private spending. If the private sector is being victimized because of the increase in government spending, then the actual output will always fall short of the potential or desired output. In the least developed countries like Nepal, private investment is driven by non-economic factors too.

According to Bista and Sankhi (2021), to increase the longer-term multiplier parameter, the state ought to improve the effectiveness of government expenditure as

well as the proportion of fixed capital formation spending to investment from private sector. But there is high political uncertainty in Nepal. Massive political uncertainty has compelled private sectors to postpone their investment until their favorable government is formed (Julio & Yook, 2012). Similarly, as per political business cycle theory, policy instruments are manipulated by incumbent politicians prior to elections to maximize their chance of election again (Nordhaus, 1975).

Numerous studies have been conducted to determine how government spending affects private investment in Nepal. According to a study carried by Nikolov and Bonci (2020), public transfers may cause private transfers to become crowded in in the low-income country like Nepal. However, Paudyal (2013) studied crowding out effect in Nepalese economy using the interest rate mechanism and found that budget deficits in Nepal are interest rate neutral; hence the budget deficits are not crowding out private investments in Nepal. It's interesting to note that Pandit's (2005) analysis on the effect of the budget deficit on a long-term nominal rate of interest in Nepal concluded that the only way to affect the interest rate in Nepal is through monetary policy.

Government spending has been divided into recurrent and capital expenditures in certain studies, while others have looked at how overall government spending affects private investment. However, majority of the studies are focused on examining the effect of government expenditure on economic expansion, indirectly through private investment avenue. However, none of these studies are sufficient. None of them have studied the “Real Crowding Out” effect in Nepalese economy using modern and sophisticated statistical tools over a short sample period.

In this scenario, the research aims to find answer to the queries below:

i. What is the structure and trend of Private Investment Expenditure, Public Capital Expenditure, Public Consumption Expenditure, and Productivity of Private Capital in Nepal?
ii. What is the relationship between public capital expenditure and private investment in Nepal?

1.3 Objectives of the study

The broad objective of the study is to describe the state of Nepal's public and private investment, public consumption, and private capital productivity. The specific objectives are as follows:

i. To determine the structure and trend of Private Investment Expenditure, Public Capital Expenditure, Public Consumption Expenditure, and Productivity of Private Capital in Nepal.
ii. To determine the relationship public capital expenditure and private investment in Nepal.

1.4 Hypotheses

Null Hypothesis:

H_o: There exists no significant relationship between public capital expenditure and private investment in Nepal.

Alternative Hypothesis:

$H_{1:}$ There exists notable relationship between public capital expenditure and private investment in Nepal.

1.5 Significance of the Study

There are very few literatures available that study the nexus between private investment and state capital expenditure in Nepal to observe the "Real Crowding Out Effect" using advanced statistical tools over a large sample period. In such scenario, this study is relevant and significant. This study provides empirical justification to the existing theories on crowding out effect. The study's main issue will be the decrease in the amount of physical resources that the private sector has access to as a result of government investment spending. It will clearly separate government spending into consumption and investment spending for this purpose and focus on analyzing how government capital spending affects the creation of private capital in the economy using a private investment function built on a neo-classical framework.

The line ministries and National Planning Commission can incorporate the findings of this research while setting targets and making policies, both on a micro and a macro scale, in order to promote short-term stability and long-term economic expansion. The output of this research will be an invaluable contribution to Nepal's policymakers and

planners as they seek to adopt a mid-term expenditure framework to increase the effectiveness of public spending. More specifically, this study assists in studying the efficiency of Nepal's fiscal policy factors.

1.6 Scope and Limitations of the Study

The study's conclusions can be applied to analyze Nepal's macroeconomic policies, including its investment policies. It provides platform for conducting further studies on the topic in near future.

However, a number of restrictions place a cap on the study's reach. Despite the fact that the study includes time series data on macroeconomic variables of Nepal from 1975 to 2019 periods, it is still inadequate for drawing better conclusions. Besides this, the study's model is based on a small number of independent factors that accurately represent the impact on private investment. It disregards the effect that changes in real interest rates and inflation have on private investment. This study remains silent on the sources of funds incurred in public spending.

Additionally, it is unable to separately study several components of private investments (e.g., credit to private sector and FDI), and government investment (e.g., investment in infrastructure and other areas or agriculture and non-agriculture investment or investment through state owned enterprises or current and capital expenditure etc.).

1.7 Outline of the study

The study is divided into five chapters in accordance with the requirements. The study's history, a statement of the problem, objectives, a hypothesis, the study's scope and constraints, and its organization are all included in the first chapter, which is titled "Introduction".

A review of the literature is presented in the second chapter. It consists of review of most recent empirical studies related to the topic. It consists of details about title, objectives, variables, method, major findings, major recommendation of the authors, and critical comments. Along with narrative review, systematic type of literature review is also presented in matrix form. The third chapter covers research methodology, which includes the research design, conceptual framework, data

sources, and methods and instruments for data analysis. Data analysis and presentation are discussed in chapter 4 in detail. Finally, chapter five includes summary and conclusion of the report.

CHAPTER II

REVIEW OF LITERATURE

2.1 Introduction

The present section includes an overview of the relevant literatures about the topic under consideration. The empirical review of the literatures consists of review of dissertations, research articles and relevant project works. The review is based on text books and several rated journals. Though there are limited research works regarding the topic in Nepal, affluent articles were available concerning various countries. Among such countries, those having socioeconomic condition similar to that of Nepal are given priority. Furthermore, the articles about neighboring countries, especially India, are also thoroughly studied for discovering new knowledge and finding research gaps. The review of relevant literatures has led to derive foundation for comprehensive conceptual framework.

2.2 Review of Literature

The study consists of critical review of relation between both public and private investments. Both in the context of developed and emerging countries, relevant and current literature regarding such a link has been investigated. It makes an effort to concentrate on important factors affecting private investment.

The investigation of how public investment affects private investment is not a recent area of study in social science. Many empirical studies have been made regarding the topic from the national, regional and international level. Carlson and Spencer (1975) have explained many popular models of crowding out hypothesis through comprehensive survey of the literatures of influential economists.

Classical, Keynesian, Knight, ultra-rational and Friedman case have been presented notably. Other cases—aside from the ultra-rational case—have concentrated on the gradient of the IS and LM curves. The relationship between private and governmental investment and the crowding out theory has been theorized using the IS-LM model. For instance, the vertical or interest inelastic LM curve is advocated by the classicists. Thus, any increase in government expenditure, which is financed either by tax or by

bond is completely crowded out by reduction in private investment. It is both due to real and monetary factors. Similarly, IS curve being horizontal to the output axis as explained in Knights' case. It depicts constant marginal returns to investment. According to Carlson and Spencer (1975), the IS curve is interest inelastic. It implies that when existing capital stock is large, any additional capital stock will not increase productivity of investment.

Any improvement in total factor productivity brought on by research and development investments will be counterbalanced by a decline in investment productivity. Therefore, government fiscal policies cannot change the IS curve. In Knights' example, the multiplier for government spending will have a value of zero. Therefore, any increase in government spending will be equal to the committed private investment which will be contracted. Additionally, the authors have provided an explanation of the David and Scadding (1974) ultra-rational situation. According to the assumption, households see private and public borrowing as alternatives to each other as well as public and private consumption. Therefore, any increase in government borrowing and spending will also result in a decrease in private borrowing and consumption. It is in charge of returning the IS curve to the original position.

The review of literature has been divided into three parts; namely, international context, national context, and research gap respectively, as follows:

2.2.1 International Context

Nguyen (2023) used time series data on public and private investment of a group of 36 developed nations and 98 developing countries from 2002 to 2019 to analyze the link between public expenditure and private investment in developed and developing economies. The relationship was examined using econometric model. According to the study, private investment is suppressed by state spending in rich nations but is stimulated in underdeveloped ones. Similarly, it was found that institutional quality influences private investment differently in industrialized and developing nations. Additionally, freedom of trade boosts investment from the private sector in emerging nations, whereas price hike boosts it in wealthy nations. The study advised governments in affluent nations to reduce pointless public expenditure and turn to the private sector, while governments in underdeveloped nations should continuously

change institutional frameworks. The analysis is strengthened by the wide range of both developed and developing nations that are included in it. However, the study's breadth is constrained since it ignores the political environments of industrialized and developing nations as well as the differences in current public spending between these two groups of nations.

Pamba (2022) conducted a study to investigate the relationship between governmental investment and private sector investment in context of South Africa. Time series data spanning from 1980 to 2020 were used in the study, and an econometric model was used for analyzing the dataset. The study discovered that while government consumer spending was found to have a detrimental influence on private investment, government investment and real GDP had beneficial long-term effects. It was found that FDI and public investment were positively correlated, but FDI and government consumption expenditure had negative association. The study recommended a holistic approach to observing private investment in the economy and emphasized wise consumption spending by the government and increased spending on FDI for the economic well-being of South Africa. The study additionally found that FDI and private sector financing to the private sector is squeezed out by public investment. The study's strength is that it aims to logically split and analyze private investment into lending to the private investment and FDI, which sets it apart from prior studies. However, this study suffers from a serious limitation of non-uniform results based on different model.

Karun et al. (2020) investigated into the relationship between public and private investment in India. An econometric model was applied to evaluate quarterly time series data from 2011 to 2016 for the study. In India, private investment did not decrease over the study period, according to the research. In reality, it was discovered that state investments in both infrastructure and non-infrastructure crowd out private investment. The study also discovered that lowering borrowing costs stimulates private investment in the economy. The study recommends improving ease of doing business in India by removing any obstacles in infrastructure and bureaucracy, as public investment is essential to overcome the limitations of costly and uncertain private investment. The major strength of the study was that it used ME bootstrap method unlike previous studies which rules out the need for tests for unit roots, and

transformation of the original time series. However, the presence of limited time series data and employment of limited models have limited the scope of this study.

Javid (2019) used time series data from 1972 to 2015 and an econometric model to analyze public and private infrastructure investment and economic growth in Pakistan, both at the aggregate and sectoral levels. According to the study, infrastructure investments made by both the public and private sectors benefit Pakistan's economic expansion., with public investments often having a greater impact than private ones in most sectors. The study recommended that for attracting private investment, the state must provide a supportive policy environment that includes the structural peculiarities of the various sectors and policymakers can calculate the impact of policies aimed at the particular sector using the various estimates of elasticity. The study also recommended involving private sector in infrastructural provisions to cope up with the tight budgetary situation. The main strength of the study is that it compares and contrasts the various types of infrastructure investments, including public and private investments as well as infrastructure investments in different sub-sectors including the power, transportation, and telecommunication sectors. This study, however, is more narrowly focused on economic growth and does not examine the direct relationship between public and private infrastructure spending.

Kalaipriya and Uthayakumar (2019) examined the link between private investment and state investment after liberalization of the economy in Srilanka, based on time series dataset spanning from 1977 to 2016. Econometric model was used to analyze such relationship. The study observed that during the study period, private investment in Sri Lanka was crowded out by inflation whereas government investment had the opposite effect. The study recommended that the government should keep interest rate low for encouraging business sector investment while inflation should be kept at a fair level. The strength of the study is that it is concerned on observing crowding out phenomenon after economic liberalization policy was introduced by the government in Srilanka. However, use of ordinary least square analysis for time series variables provides benefit of doubt and thus limit the scope of the study.

Carrillo et al. (2018) used quarterly data from 1993 to 2017 to study the relationship between private and state investment in Mexico. An econometric model was

employed to analyze the relationship between the time series data. Over the study period, there was a positive correlation between public and private investment, demonstrating that public investment had a positive and significant impact on private investment. The authors stressed the significance of government investment for economic growth and suggested coordinating government spending at all levels, strengthening of capacity for public investment, and ensuring regulatory provisions for public investment at the governmental level. They also recommended implementing a robust financial management system to increase effectiveness of public investment. The study used an econometric model, including ARIMA model and regression analysis, and performed various tests, including ADF, PP, KPSS, and ARDL tests to confirm the findings. The variables used in the model had a large explanatory power as indicated by the goodness of fit. Though the study is significant in many aspects, it couldn't properly justify the inverse trend between the state and private sector investment during the 2009-2017 periods. It opens door for future research on this topic.

Akinlo and Oyeleke (2018) examined at how government spending affected private investment in Nigeria. An econometric model was utilized in the study to analyze data from the years 1980 to 2016. The study discovered a long-term relationship between the variables studied, showing that government spending in Nigeria significantly affects private investment. The study also discovered that over the long run, interest rates and inflation had negative but notable effects on private investment. In order to draw private investment, the study suggested that the government boost spending on infrastructure, education, research, and security. The study also suggested that maintaining inflation within a reasonable limit and increasing GDP per capita could positively impact business sector investment in Nigeria. The study provides policy implications for the government of Nigeria which are also relevant in context of Nepal. The variables used in the model have large explanatory power and are equally relevant in context of Nepal. However, the short sample period used for the study possess serious limitation.

Nguyen et al. (2018) studied the impacts of government capital expenditure on private investment expenditure and economic growth in Vietnam by using macroeconomic time series dataset of Vietnam for the period of 1990 to 2016 and assessed the relationship using econometric models. The neoclassical theory was taken as the basis

for evaluating the effect on private sector investment. According to the study, economic expansion and governmental investment both favorably impact private investment. However, in the short term, real interest rates, SOE investment, and state-owned capital have a detrimental impact on private investment. The study is peculiar from other studies mainly in terms of two aspects. First, it has increased the need for a threshold level of public investment in the economy and second, it has supported the "Inverted U" shape influence of public investment on private investment in the economy using short- and long-term effects. However, the study's conclusions are presented in an ambiguous manner, which restricts its use.

Dash (2016), using time series data from 1970 to 2013, examined the effects of state investment on private investment in India. The data analysis employed the Econometric model. The analysis revealed that because the cost of borrowing to the private sector increased over this time, public investment in India displaced private investment. However, it was found that if the public investment is concentrated on infrastructure development, it would promote private investment, provided that the infrastructure of development is sustainable and the public investment doesn't make lending costly to the private sector. FDI was also found to reduce the crowding-out effect. In order to prevent financing for infrastructure projects from having an impact on interest rates and the availability of loans to the private sector, the author advised that government investment should concentrate on non-rival and non-excludable public goods. The control variables used along with the independent variables have increased the credibility and strength of this research. The study's reach is constrained by the use of a single endogenously driven structural break and by the exclusion of multiple breaks.

Sen and Kaya (2014), using annual data from 1975 to 2011, studied the crowding-out or crowding-in impacts of public spending on private investment in Turkey. Econometric model was used for examining such relationship. The findings demonstrated that only government capital spending attracts private investment, while other expenditures like current, transfer, and interest spending by the government drive away private investment. The research suggested for separate analysis of public expenditure components rather than an overall analysis and advised the government to prioritize capital spending above other forms of spending to encourage private investment. The study has made attempt to bring uniformity in terms of providing

policy advice, both theoretically and empirically. The study is peculiar as compared to other studies on the ground that it decomposes government spending into several forms and examines the influence of each form on private investment, instead of studying them in aggregate. However, the study was unable to make any policy implication and it limits the scope of the study.

Xu and Yan (2014) conducted a study in China to look how the government investment affects private investment. The study used annual data from 1980 to 2011 and employed econometric model to examine the association between government and private sector investment. According to the study, government spending on public goods attracts more private investment while spending on private products through SOEs repels private investment. In order to encourage future growth in China, the report suggests that the government increase expenditure on public goods while decreasing spending in industries that directly compete with the private sector. When governments spend in public goods, private investment tends to increase, whereas when governments engage in private products through SOEs, private investment tends to decrease. The study has stressed the need for less government investment in private goods in order to achieve faster economic growth while also defending the significance of public goods investment in the economy. Fixed asset investment of the private sector has been used as proxy of government spending, which is also convincing. However, the study neglects the welfare state role of the government, which limits the scope of the study.

2.2.2 National Context

Paudel (2023) studied the association between capital expenditure and economic growth of Nepal through a sector wise analysis of public expenditure, using time series data from 1981 to 2020. The study used the ARDL approach to co-integration to investigate this association and discovered that current and capital expenditure, taken together, have no positive impact on Nepal's economic growth. Educational spending-either current or capital- was found to make a remarkable contribution to economic expansion. The study recommended the government expenditure on health should be oriented more towards capital expenditure than towards current expenditure. It is the greatest strength of the study that it has attempted to study effects of public expenditure from a new dimension in Nepal to find out threefold

results by using the most recent dataset. Despite making such valuable contribution, the study has remained silent regarding the private investment and its impact on the economic growth of Nepal, which limits the breadth of the study.

Bista and Sankhi (2022) examined the multiplier impact of governmental expenditures on economic growth in Nepal, using time series data on public expenditure and economic growth covering a period from 1974–75 to 2018–19. The investigation used an econometric model to examine the impact of governmental spending and discovered that, both in the short- and long-term, Nepal's economic growth responds favorably to public spending and its constituent parts. Recurrent spending, however, has a more noticeable impact on the multiplier to encourage economic growth in Nepal than capital spending. In order to maximize the influence on multiplier over time, the study advocated increasing the efficiency of government spending and the proportion of capital expenditure to private investment. Though this study segregates public expenditure into current and capital expenditure to observe the multiplier effect, it couldn’t establish its direct effect on the private investment in Nepal.

Giri (2022) examined how governmental expenses and economic expansion rate are related in Nepal. The relation was observed using data on time series of Nepal over the period of 1975 to 2021 and econometric model was employed for analysis of the dataset. The study found that the growth in real GDP is attributed to the growth in private expenditure caused by the rise in public expenditure in health, agriculture, transportation and social service. The study recommended that public spending should be used most effectively for the development of transportation, communication, and social services in order to lessen geographic fragmentation, increase the profitability of private investment, as well as by expanding the size of the market, skill, and efficiency of labor. However, the variables selected to examine the link between the variables of interest have a limit on the study's applicability.

Gupta (2018) examined if government spending impacted Nepal's economic expansion and prompted private sector spending. Annual time series data from 2002/3 to 2015/16 were used in the study, and an econometric model was used to analyze the data. It found that higher investment on industry and service sector of the country boosts the growth of the economy by catalyzing the private sector’s capital formation

in the country. It also found that higher investment in the agriculture sector of the country boosts private investment and growth of economy of Nepal. It is the greatest strength of the study that it has separately studied agriculture and non-agriculture investment, industry and service sector investment. However, the study doesn't state extent to which public capital expenditure determine private sector capital expenditure in Nepal, which limits the scope of the literature. Additionally, use of simple regression model for time series variables used for reaching the conclusion provides evidence of spurious regression in the study.

Anyanwu et al. (2017) looked at the impact of domestic government debt, credit from the private sector, and the crowding out effect on nations depending on oil, including Nepal. The study applied an econometric model for data analysis, employing both fixed effects and generalized method of moments estimators, and examined annual time series data of 28 oil-dependent countries from 1990 to 2012. The study found that domestic borrowing by the government significantly affects private credit negatively, without increasing the cost of credit to the private sector. The study is important because it quantifies both actual and monetary crowding out of private investment. However, it is exceedingly challenging to quantify the financial or indirect crowding out of private investment in Nepal as Nepal Rastra Bank controls to a greater extent, the credit rationing and interest rates. It limits the scope of the study.

Paudyal (2013) studied crowding out effect in Nepalese economy using the interest rate mechanism. The effect was observed using annual time series data on budgetary deficit and both short and long-term nominal interest rates for the 1988 to 2011 periods. It used econometric model for data analysis. The study found that budget deficits in Nepal are interest rate neutral; hence the budget deficits are not crowding out private investments in Nepal. However, the study found that deficit budget in Nepal is causing rise in burden of loans for financing current consumption on the cost of future consumption, thereby causing negative effect on growth of the economy. The study concludes that the interest rates are found to be deficit neutral due to large mobility of capital. However, the study recommends further research on other factors affecting interest rates, which restricts the scope of the study. It is also a constraint of the study that it doesn't observe real crowding out effect and is more focused on financial crowding out effect only.

2.2.3 Research Gap

Based on these representative studies there is literature gap, mainly in three aspects. There have been few studies to evaluate the relationship between public capital spending and private investment in context of Nepal, according to a survey of pertinent literature in the national and worldwide context. Insufficient time series data were employed in the research to observe these correlations. In much of the literature, the direct connection between governmental capital spending and private investment has also not been examined. In a similar vein, many of the findings from the body of literature already in existence have been expressed in imprecise ways. Studies focused on real crowding out effect are almost negligible in case of Nepal.

CHAPTER III

RESEARCH METHODOLOGY

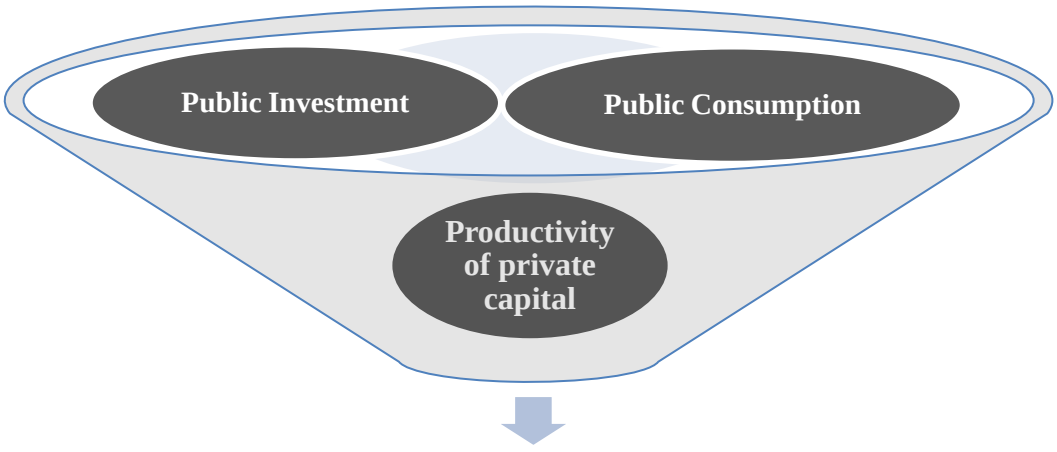
3.1 Introduction

Research methodology is a methodological approach of addressing a particular issue. It includes the procedure by which the study goes about in describing, explaining and predicting phenomena. This chapter provides a description of each step of the research process. It includes the plan for conducting research and solving the research problem. This chapter justifies the rationale for choosing specific research method that the study intends to employ.

3.2 Conceptual Framework

The research has followed the method used by Aschauer (1989) in the form modified by Arigmon et al. (1997) in light of the neo classical framework. The regression equation was used in this study to determine whether or not an increase in government spending distorts private sector investment by lowering the ideal private capital stock. Additionally, the study examined the neoclassical theory that public infrastructure spending encourages private investment by raising private capital's productivity.

Figure 3.1 :Diagram of conceptual framework



Source: Aschauer (1989) and Arigmon et al. (1997)

3.3 Research Design

The research design used in the study is both descriptive and quantitative. It is conducted with the aim of studying in detail about the strength of nexus between private investment and public capital expenditure in Nepal. It has been concerned more on public capital formation than other forms of public spending. It also attempts to describe the reason behind existence of such relationship.

In order to assess the relationship between public capital expenditure and private investment in Nepal, the study has used the blend of total factor productivity approach and investment function approach developed by Aschauer (1989), however, in the form as modified by Arigmon et al. (1997). In order to estimate the regression equation, the study analyzed time series data from 1975 AD to 2019 AD. The regression equation estimated the private sector's capital formation by using governmental capital expenditure, government consumption and private capital productivity as the independent variables.

3.4 Nature and Sources of Data

For this study, annual time series data spanning 45 years, from 1975 A.D. to 2019 A.D., were used. It was based solely on the secondary data extracted from multiple sources because the data related to all the variables are not available in a single source. The information on Gross Domestic Product and the stock of private capital was gathered from the IMF database, while that regarding General Government Final Consumption Expenditure and Gross Fixed Capital Formation by both the public and private sectors was obtained from the World Bank database. The productivity of private capital is the GDP divided by private capital stock.

3.5 Data Collection Method

All of the data and information for this study were gathered by visiting the World Bank and IMF's official websites. Data related to all the variables were obtained from the grand data set of Nepal. While choosing the sample period of study, priority was given to the variable, the data on which was available for the least possible year.

3.6 Econometric Model Specification

The relationship between governmental spending and private investment spending is related to the specification of the econometric model. The following model has been applied in order to achieve the goals of the study.

$$RPI=a + b_1 RPUI + b_2 RPUC + b_3 RPPC + e_i \quad \text{(3.1)}$$

Applying natural logarithm on both sides of above equation, except on variable RPPC, we get:

$$Ln\ RPI=a + b_1 Ln\ RPUI + b_2 Ln\ RPUC + b_3 RPPC + e_i \quad \text{(3.2)}$$

Where, RPVI is the Real Private Investment. RPUI is the Real Public Investment. RPUC is the Real Public Consumption. RPPC is the Real Productivity of Private Capital which and is measured by the ratio of GDP to private capital stock. e_i is the Stochastic Disturbance Term. In order to smoothen the data and ease interpretation of data, we take log transformation of equation 3.1. The elasticity of the dependent variable with respect to the exogenous variable is most effectively captured via log transformation. However, log transformation has not been applied to the ratio variable RPPC in order to achieve purpose of the study and because of the form of the data.

3.7 Econometric Procedure

3.7.1 Unit Root Test

A time series Yt is said to be integrated of order one I(1) if it doesn't have constant mean variance, and auto covariance at the level but only after first derivative. If the series is stationary at level, it is identified by I(0). The time series at the level exclusively consist of non-differentiated time series (Brooks, 2002)

Dash (2016) emphasizes that in order to apply the standard linear regression model, the regressor and regressend must both be stationary. When the variables are non-stationary, the outcome will be spurious regression. In spurious regression, though the variables have large R^2 and significant value of t-statistics, the results don't have any economic meaning. To determine if the data under examination are stationary in their own level, or in the first or second difference, the Augmented Dickey-Fuller test (ADF) has been applied. Though there are number of tests like PP test, KPSS test etc.

for testing stationarity, ADF test has been employed due to being sufficient for the purpose of the study.

The number of initial differences needed for the dependent variable is calculated for the ADF test using the AIC test. Below are the results of the test null hypothesis (H_0) and alternative hypothesis (H_1):

$H_{0:}\mu=0$ i.e., the time series is non-stationary and contains a unit root in its undifferentiated form.
$H_{1:}\ \mu<0$ i.e., the undifferentiated form of the time series is stationary.
ADF test is nothing, but just a regression analysis based on the following equation.

$$\Delta Y_t = \beta_1 + \lambda_t + \phi\ Y_{t-1} + \sum^{p}_{i=1} \alpha_i\ \Delta Y_{t-i} + U_t \quad \text{..... (3.3)}$$

Where,
U_t is an error term.
For time series analysis, it is better if null hypothesis of having unit root (non-stationarity) is refused, it is said to be I(0). If H_0 is rejected, it means either Y_t is stationary with zero mean, or with non-zero mean (Johansen, 1988).

3.7.2 ARDL Bound Test Approach to Co-integration

The co integration test is the next step after determining whether the variables are co integrated of order zero or one. If two or more different time series remain stationary after differentiating, they are said to be cointegrated. When using OLS with I(1) variables, Granger (1981) and Engle and Granger (1987) demonstrated that the estimators are not BLUE and that there may be irrational connection between the variables. If the variables are non-stationary at levels but are difference stationary, the cointegration test helps to test the presence of long run relationship between the variables.

Pesaran and Shin (1999) created the initial version of this strategy, which Pesaran et al. (2001) later expanded. The following equation is frequently used in studies to analyze potential correlations between two or more variables and create specifications in line with those findings.

$$Y=f(X) \quad \text{..... (3.4)}$$

Where,

Y= Dependent variable

X= Vector of independent variables

f= function

The ARDL model tries to detain the relationship in f(X).

The estimation of a UECM is the foundation of the ARDL Bound Test Approach. The following are some benefits of UECM over other traditional cointegration approaches, such as Engle Granger (1987) and Johansen-Juselius (1990):

i. Cointegration analysis of small samples can be performed using it. (Pearson et al., 2001; Narayan & Smith, 2005). It'll be appropriate for this study too.
ii. The ARDL test is applicable regardless of whether the regressors are mutually cointegrated, I(0), or I(1). However, non-stationary time series with the same order of integration I(1) cannot be used with other traditional techniques like Engle Granger (1987) and Johansen-Juselius (1990).
iii. The ARDL approach enables the estimation of both long- and short-term relationships between the model's parameters at the same time. The UECM model does not include short run phenomena in the residual terms, in contrast to the E-G model (Banerjee et al., 1993; Banerjee et al., 1998; Pattichis, 1999). As a result, it is probably better in terms of statistics. Banerjee et al. (1993) claim that by utilizing this method, we may create a dynamic ECM through a straightforward linear transformation, allowing us to integrate short-run dynamics with long-run equilibrium while preserving long-term information. As a result, it permits making long-term inferences, whereas other models do not (Sezgin & Yildirim, 2002).
iv. The ARDL method helps to get rid of the autocorrelation and endogeneity issues by making clear distinction between dependent and independent variables (Rahman & Afzal, 2003).
v. By overcoming the challenges caused by serial autocorrelation and endogeneity issues, it validates t-statistics and gives unbiased estimates of the long run model (Harris & Sollis, 2003; Odhiambo, 2009). It is still true, according to Harris and Sollis (2003), even if some of the regressors are endogenous.
vi. The ARDL model applies to a general-to-specific framework and takes a sufficient number of lags. It estimates (p+1) k number of lags and determines

the ideal lag length for each variable if p is the maximum number of lags that can be utilized and k is the number of variables in the equation. Once the order of the delays is established, the cointegration relationship can be evaluated using the straightforward OLS approach.

Equation 3.4 is frequently used to hypothesize the equation for examining potential relationships between two or more variables. However, according to Pesaran and Shin (1998) and Pesaran et al. (2001), the ARDL (q,p) model of this equation can be described as follows:

$$\Delta Y_t = \beta_{0+} C_0 t + \sum_{i=1}^{q} \tau_i \Delta Y_{t-i} + \sum_{j=1}^{\rho} \omega_i \Delta X_{t-j} + \Upsilon_1 Y_{t-1} + \Upsilon_2 X_{t-1} + \epsilon_t \ldots\ldots\ldots\ldots\ldots (3.5)$$

The coefficient β_0 and C_0 are the drift and trend coefficient respectively. t is the white noise error. The coefficients β_0 and C_0 for all j are equivalent to the short-run relationship while the γ_j ; j = 1, 2 is equivalent to the long-run relationship.

3.7.2.1 Selection of Lag Length

The results of the ARDL test are strongly influenced by the number of lagged differences that comprise the regression equation. In order to prepare a model with a smaller number of lags, we can use the AIC (Stock & Watson, 2006). The AIC model is popular for choosing highest possible lag length unlike the SBC or HQC model models, which produce models by choosing the smallest lag length (Shrestha, 2005). Furthermore, most of the literatures that have been reviewed have also used AIC criterion. Hence the AIC is employed to choose the optimum lag in the aforementioned model.

3.7.2.2 F- bound Test

In order to test the persistent association among the variables, the F-test will be performed. The null hypothesis is rejected if the estimated value of F- statistics exceeds the upper bound critical value. However, if the computed F-value falls below the critical value, it indicates no cointegration and null hypothesis is accepted. However, if the F-statistics falls within the two bounds, no any conclusion can be drawn. Under such situation, Verma (2007) suggests that the ECT can be an appropriate way of conforming cointegration. However, ECT needs to be significant.

Following Pesaran et al. (2001) and following the description above and equation (3.5) equation (3.6) provides the ARDL model that was actually used:

$$\Delta LnRPI = \mu + \sum^{m}_{i=0}\eta_i \Delta LnRPI_{t-i} + \sum^{n}_{i=0}\omega_i \Delta LnRPUI_{t-i} + \sum^{\rho}_{i=0}\varphi_i \Delta LnRPUC_{t-i} + \sum^{q}_{i=0} \pi_i \Delta RPPC_{t-i} + \Theta_1 LnRPI_{t-1} + \Theta_2 LnRPUI_{t-1} + \Theta_3 LnRPUC_{t-1} + \Theta_4 RPPC_{t-1} + \epsilon_t \quad (3.6)$$

Where Δ denotes operator of first derivative, μ is the intercept term, ϵ_t is the white noise and m, n, p, q are the employed lag of first-differenced variables. The other parameters describe short-run and long-run association. The θ_j; j=1, 2,.4 are equivalent to the long-run association whereas the short-run influences are grabbed by the parameters for the first derivative variables i.e., η_i, ω_i, φ_i, π_i.

Equation (3.6) deviates from conventional distributed lag models in that it contains a straight-line mixture of the lagged level of all variables, generally known as an error correction term (Bahamani-Oskooee & Ardalani, 2006). Without sacrificing any details on the long run, the ARDL model provided in equation (3.6) combines short-run fluctuations with the long-term equilibrium.

For estimating long term association, two steps are followed under ARDL approach (Pesaran & Shin, 1999). In the very beginning, we calculate F-Statistics to observe the association among all the parameters involved in the model. If there is no cointegration, there is lack of long-term association.

Mathematically,
H_o: $\Theta_1 = \Theta_2 = \Theta_3 = \Theta_4$ i.e., there is no long-term association.
H_1: $\Theta_1 \neq \Theta_2 \neq \Theta_3 \neq \Theta_4$ i.e., there is a long-term association.

After the first step, the next step is determining the coefficients for the long-term association. We then estimate short-term sensitivity of those variables (Tzougas, 2013).

However, the F-bound test suffers from several limitations. According to Pesaran and Shin (1999), the F bound test is not the final test of cointegration and we should rely more on the second test. Furthermore, it assumes that the sample period is long enough and the model specification is correct. It might not perform well with the small sample size. As a result, it is desirable to complement the F-Bound test with

other tests and approaches that can provide additional data and support the conclusions. For cross-validation of the outcomes from F Bound test and evaluation of the strength of the findings, the Johansen-Juselius cointegration test is also performed as part of the study.

3.7.2.3 Johansen Cointegration test

Associated with Soren Johansen, a Danish Economist, Johansen test is performed in order to determine cointegration in multivariate time series. The test is predicated on the notion that every variable, including the dependent variables, is stationary at the initial difference. It uses two types of statistics, trace statistics and Max Eigenvalue.

The null (H_0) and alternative (H_1) hypothesis for the test are mentioned below:

H_o: $\mu=0$ i.e., there is lack of long run relation.

H_1: $\mu\neq0$ i.e., there is presence of long run relation.

We have to reject H_0 if either of the trace value or Max Eigenvalue exceeds its boundary value and accept that there is cointegration.

Unlike Engle Granger method, which can identify only one cointegrating equation, Johansen Cointegration test can identify more than one cointegrating relationship.

The following fundamental equation (Johansen, 1991, 1995) encapsulates the Johansen's co-integration test:

$$Z_t = AZ_{t-1}+\ldots+ A_nZ_{t-n} + BX_t +\epsilon_t \quad (3.7)$$

In equation 3.7, Zt is the vector for the regressors and regressand that are stationary at first difference, X_t is the vector of the variable of nonrandom nature and ϵ_t is the error correction term.

3.7.2.4 Test for Short- Run Coefficients

If null hypothesis is accepted after conducting F-bound test, it implies that the variables under study have long run equilibrium association. However, those variables may not be in equilibrium in the short-term. It can be justified with the help of following equation:

$$Y_t= a + b_1 X_t + \epsilon_t \quad (3.8)$$

In the above equation, even if Y_t and X_t have long run equilibrium relationship, they might not be in equilibrium in the shor-term. Hence, the error term in the above equation is the equilibrium error term. It is used to connect short-term nature of Y to its value in long-term. Sargan (1984), for the first time, used the ECM and it was later made popular by Engle and Granger.

The error correction term $ECM_{t-1} = Y_{t-1} – \beta_1 – \beta_2 X_{t-1}$, where β's are the estimators generated from equation (3.8), is introduced to reflect the convergence of the model towards equilibrium. The residuals from equation (3.8) are shown as ECM_{t-1}. The difference between the regressors and response variables (ECM_{t-1}) cannot rise; it must instead decrease if the model is heading towards long-run equilibrium. Utilizing the given values of X_t, Y_t, and β_j from the regression in equation (3.8), the calculation of ECMt-1 essentially generates a new data series.

The following stage entails applying equation (3.6) to estimate the short-term fluctuation while substituting the lagged variables X_t and Y_t with the error correction term ECM_{t-1} this time. To substitute a linear combination of the lagged variables, the ARDL technique to co-integration generates the lagged error correction term (ECM_{t-1}) from the long-run coefficients. The model is then updated to reflect the ideal lags chosen using the model selection criterion (Bahamani-Oskooee & Ardalani, 2006). Consequently, the following is the model's short-run error correction specification:

$$\Delta LnRPI = \mu + \sum^{m}_{i=0}\eta_i \Delta LnRPI_{t-i} + \sum^{n}_{i=0}\omega_i \Delta LnRPUI_{t-i} + \sum^{\rho}_{i=0}\varphi_i \Delta LnRPUC_{t-i} + \sum^{q}_{i=0}\pi_i \Delta RPPC_{t-i} + \Upsilon ECM_{t-I} \quad \ldots\ldots (3.9)$$

The error correction mechanism term (ECM) in equation (3.9) is derived as a residual from the estimation of the long-run co-integrating equation (3.6); η_i , ω_i , φ_i , π_i , λ_i and ψ_i are the dynamic short run coefficients of the model’s convergence to equilibrium, and γ controls the rate of transition from short-run towards equilibrium.

While computing ECM, the coefficient must be statistically noteworthy and less than zero. If these two conditions are fulfilled, then only the model converges to equilibrium. The speed of adjustment is directly proportional to the intensity of negative coefficients.

3.7.3 Diagnostic Testing

Upon determination of the estimators from the specified model, they should differ very little with a large sample. If the estimators diverge significantly, the model is more likely to be mis-specified. Hence diagnostic tests must be performed once estimators are determined using the ARDL model. The study will use stability, serial correlation, heteroscedasticity, and normality tests. It helps to further corroborate the results and make sure that they are statistically powerful. Only if the aforementioned biases are absent, the result obtained from the model can be used for analysis.

3.7.3.1 Ramsey RESET test

Ramsey's (1969) RESET test is used to test whether the model can be better represented by non-linear functional form instead of the linear functional form. If the non-linear combination of the values that are fitted can explain the dependent variable, it implies that the model is mis specified. Therefore, this test is conducted to verify the correctness of the specified functional form.

The null hypothesis (H_o) and alternative hypothesis (H_1) for Ramsey RESET test are as follows:

H_o: The model is correctly defined and there is no power in the non-linear combination.

H_1: There non-linear combinations have power and the model is not correctly-defined.

3.7.3.2 Serial Autocorrelation Test

Even though the phrases "autocorrelation" and "serial correlation" are used interchangeably, the former refers to the lag correlation of a single series and the latter to the lag correlation of two series. There is autocorrelation if the variance of the disturbance term during any given time is connected with its own prior value. In such situation, $E(Ui\, U_j) \neq 0$, for $i \neq j$.

The serial autocorrelation is tested using Godfrey's (1978) Breusch-Godfrey test. Presence of serial autocorrelation doesn’t affect the unbiasedness of the estimates, but due to the larger variance, the estimators are not efficient.

The null hypothesis (H_o) and alternative hypothesis (H_1) for serial correlation test are as follows:

H_0: $\rho = 0$ i.e., The model contains no serial correlation.

H_1: $\rho \neq 0$ i.e., The model contains serial correlation.

3.7.3.3 Heteroscedasticity Test

Heteroscedasticity is the state in which all disturbance factors do not have the same variance. The residual terms are presumed to have a constant variance in both the ARDL model and the OLS estimation. If there isn't a constant variance, the estimated coefficients will have the wrong variance and will be ineffective.

The null hypothesis (H_o) and alternative hypothesis (H_1) for heteroscedasticity test are as follows:

H_0: There is fixed residual variance

H_1: There is no fixed residual variance

The null hypothesis is accepted and there is homoscedasticity, or there is heteroscedasticity, if the likelihood of the observed R-square is greater than the probability at the 5% level of significance.

3.7.3.4 Test for Normality in the residuals

It is believed that the residuals will be dispersed normally. Testing your hypotheses is necessary. In the event that the residuals are not normally distributed, the model cannot be generalized because this may cause fit, stability, and reliability issues. The JB test will be applied to test the normality. The null ($H_{o)}$ and alternative hypotheses ($H_{1)}$ are as follows:

H_0: The residuals exhibit normalcy.
H_1: The residuals do not exhibit normalcy.

When doing a normalcy test, the null hypothesis will be rejected if the estimated p value of the JB statistic is below the traditional level of significance.

3.8 Operational Definition of the Variables

Real Private Investment (RPI) is the total financial resources allocated by the private business, including domestic and foreign enterprises for the purpose of capital expenditure, expansion, and the development of productive assets within Nepal. Real Public Investment (RPUI) is the portion of the government spending that is allocated towards the acquisition, construction, or improvement of physical assets and infrastructure, adjusted for change in price level. It represents the actual value of government in public projects, including areas such as transportation infrastructure such as roads, bridges and airports, public buildings, utilities, education facilities, health care facilities, and other public capital projects. Real Public Consumption (RPUC) refers to government current spending on purchases of goods and services (including employee remuneration), as well as compensation for employees. However, it does not include government military spending that is a component of fixed investment. It also comprises the majority of national defense and security expenditures. Real Productivity of Private Capital (RPPC) measures efficiency and effectiveness of private sector investment in physical assets such as machinery, equipment, infrastructure, and buildings, adjusted for inflation. It is a ratio variable and is measured by the ratio of the value of Real Gross Domestic Product (RGDP) to the stock of private capital.

All the variables have been measured in billions of Nepalese Rupees.

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This section includes empirical examination of the variables being studied to achieve the objectives of the research. In this study, the impact of state spending, particularly capital spending, on the private sector investment in Nepal is examined. The focus has been on assessing the immediate and long-term relationships amongst the variables. Additionally, this chapter also analyses how other variables, public consumption and productivity of private capital are associated with private sector investment in Nepal.

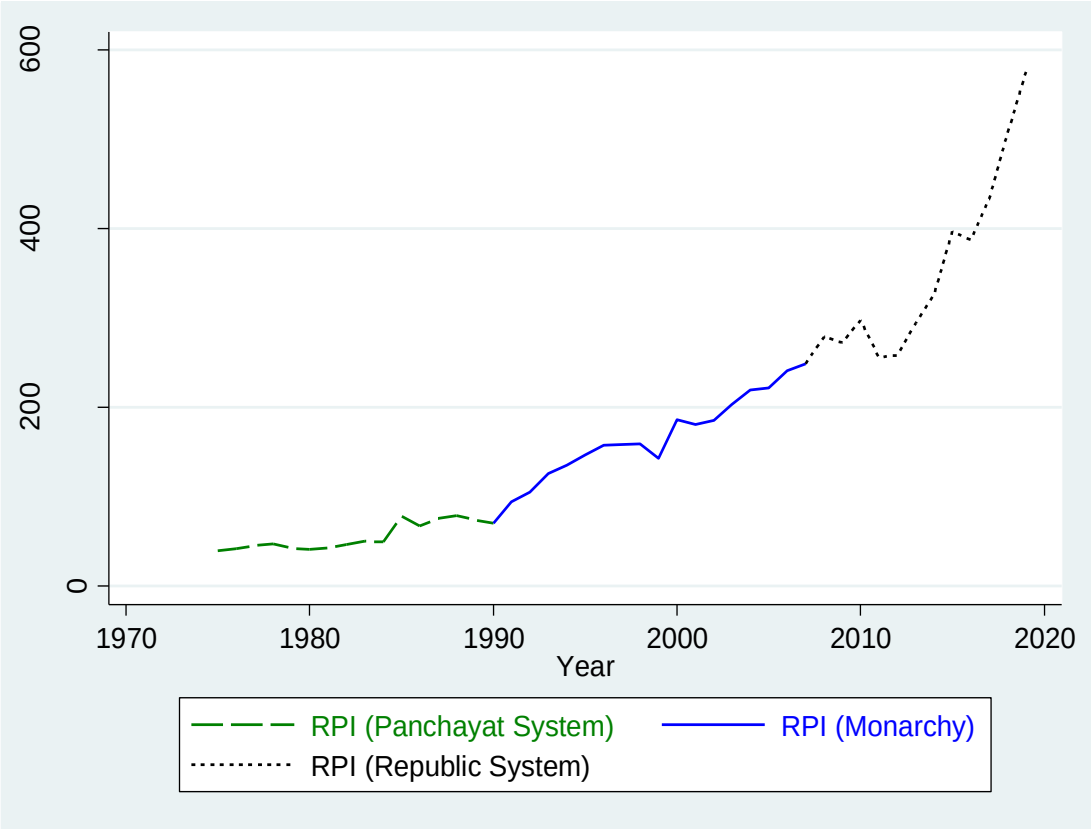
4.2 Overview of Trend of Public Expenditure and Private Investment in Nepal

This section consists of analysis of trend of the public and private investment variables over the time. The trend analysis is made by drawing trend line with the time on the horizontal axis and respective variable/s on the vertical axis. For observing the trend based on political regime in Nepal, three political systems are considered, namely; Partyless Panchayat System (before 1990), which is represented by long-dash line, Monarchy (1990-2007), which is represented by continuous line, and Republic System (2007 onwards), which is represented by continuous dotted line.

4.2.1 Private Investment Expenditure Over Different Political Systems

The pattern of Real Private Investment in Nepal over the forty-five years' time frame spanning from 1975 to 2019 has been shown below:

Figure 4.1: Trend of Real Private Investment of Nepal Over Different Political Systems



Source: World Bank and IMF's Data (1975-2019), Annex I

Figure 4.1 depicts that the private capital formation of Nepal has been continuously in an increasing trend since the mid-1970s in Nepal. However, it didn't increase much till 1990 AD. This might be because of the macroeconomic disturbances, mainly rising fiscal deficits and falling foreign exchange reserve, during the 1980s. The financial system was also largely state led till 1984 AD that might have made private sector reluctant to invest.

The private sector investment didn't rise significantly until Partyless Panchayat system was replaced by multiparty democratic system in 1990 AD. Adoption of economic liberalization policy, privatization of state-owned enterprises, and opening up market to the private sector were some of the reforms of the new government led by Nepali Congress that turned out to be a tonic for boosting private sector investment. The legislative reforms were also initiated by forming and implementing Industrial Enterprise Act-1992, Foreign Investment and Technology Transfer Act-1992 etc. As a result, the private investment surged by more than half in 2000 as

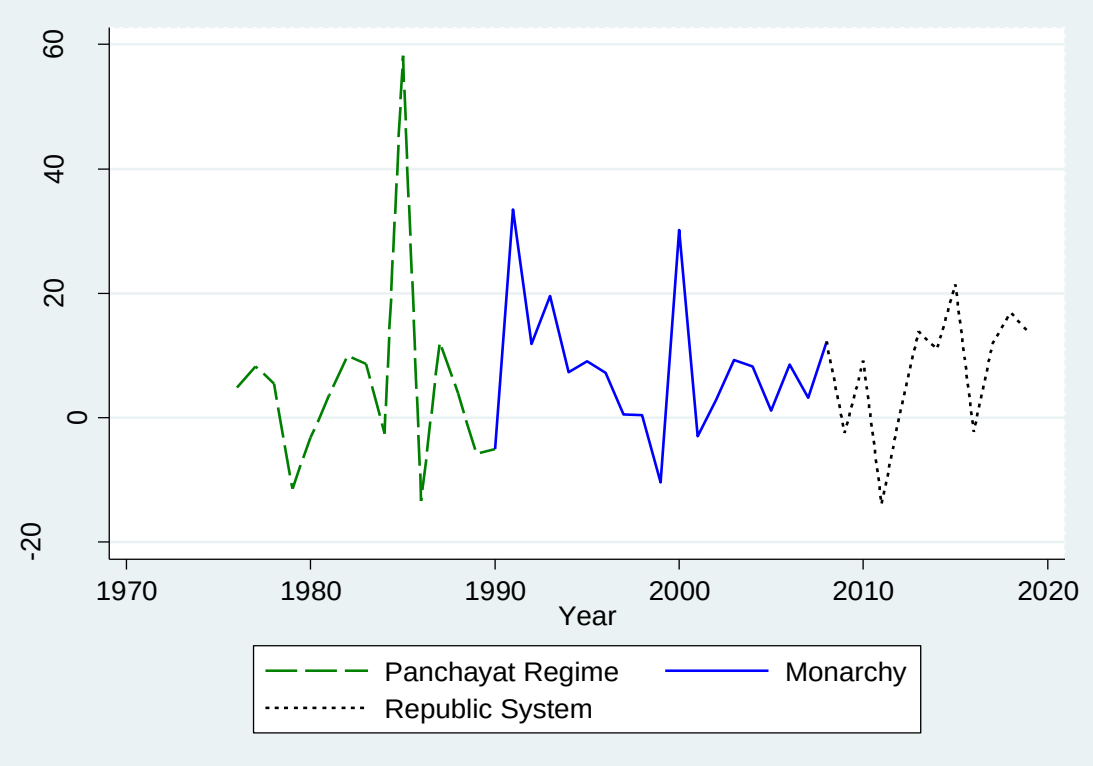
compared to 1990. It paved a pathway for both national as well as international investors to make private investment in Nepal.

The private investment further increased after the political insurgency ended with the comprehensive peace accord in 2006 and constituent assembly election in 2008. After the devastating earthquake hit Nepal in the year 2015, the involvement of private sector further increased and the investment continued to rise rapidly.

If we observe the trend of private investment according to the three political systems, it can be clearly observed that the gradient of the trend path during Republic System is higher than the other two regimes, followed by Monarchy and Partyless Panchayat System.

After calculating the growth rate of public investment during three different regimes and plotting them in graph, we can get the following results:

Figure 4.2: Growth Rate of Real Private Investment in Nepal Over Different Political Systems



Source: World Bank and IMF's Data (1975-2019), Annex I

Figure 4.2 represents the periodic rate of growth of private investment in Nepal during the period of forty-five years from 1975 AD to 2019 AD. It shows that Nepal

witnessed highest growth rate of private investment during Panchayat period followed by Monarchy. Though the growth rates are all time high during these two regimes, the variation in growth rates is also equally volatile. As represented by continuous dotted line, growth rate of private investment after adopting Republic system has been less volatile in Nepal. It might be because of growing confidence in the private sector due to the end of Maoist insurgency and civil war. It indicates that the expansion of private capital formation in Nepal has been less volatile during the current political system.

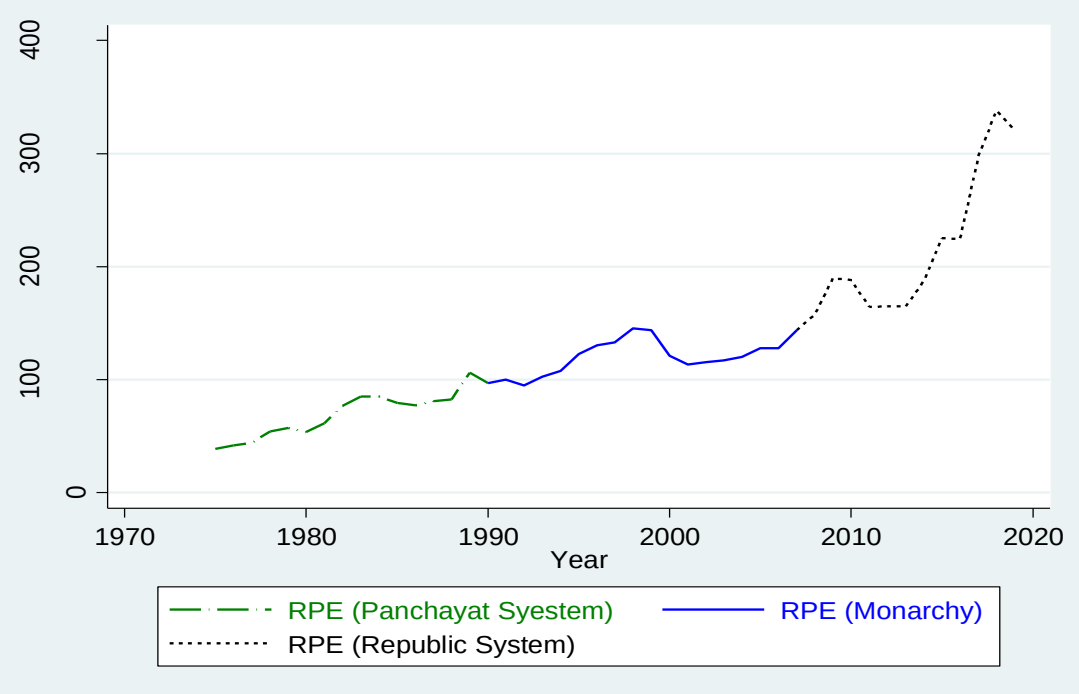
4.2.2 Trend of Public Expenditure over Different Political Systems

The trend of overall governmental expenditure, government capital spending and public consumption spending are observed under different headings below:

4.2.2.1 Real Public Expenditure

Real public expenditure is composed of investment made by the government and its final consumption spending. The trend of Public Expenditure in Nepal for the forty-five years period, spanning from 1975 to 2019, has been shown below:

Figure 4.3: Trend of Real Public Expenditure of Nepal Over Different Political Systems



Source: World Bank and IMF's Data (1975-2019), Annex I

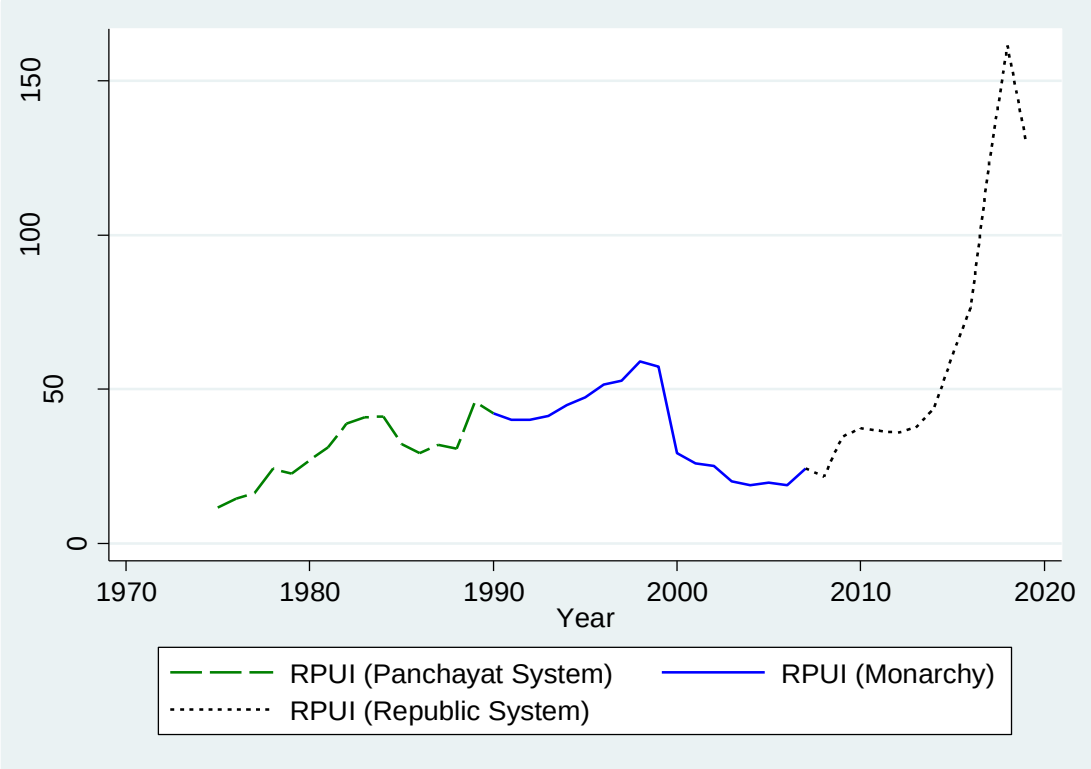
Figure 4.3 reveals that the public expenditure in Nepal has been gradually increasing over these periods, despite decreasing in some years. During pre-1990s, the public expenditure increased steadily, with some fluctuations. During Monarchy, the real public expenditure continued to rise, but somehow at a slower pace than during Panchayat System in Nepal. However, there was also notable drop in public expenditure during late 1990s and early 2000s. The government spending might have been affected due to civil war during this period.

Compared to other two political systems, Republic system shows a remarkable increase in public expenditure in Nepal. It is required to study the rise in government expenditure in a disaggregated manner for better understanding.

4.2.2.2 Real Public Investment Expenditure

The trend of Real Public Investment in Nepal for the forty-five years period, spanning from 1975 to 2019, has been shown below:

Figure 4.4: Trend of Real Public Investment of Nepal Over Different Political Systems



Source: World Bank and IMF's Data (1975-2019), Annex I

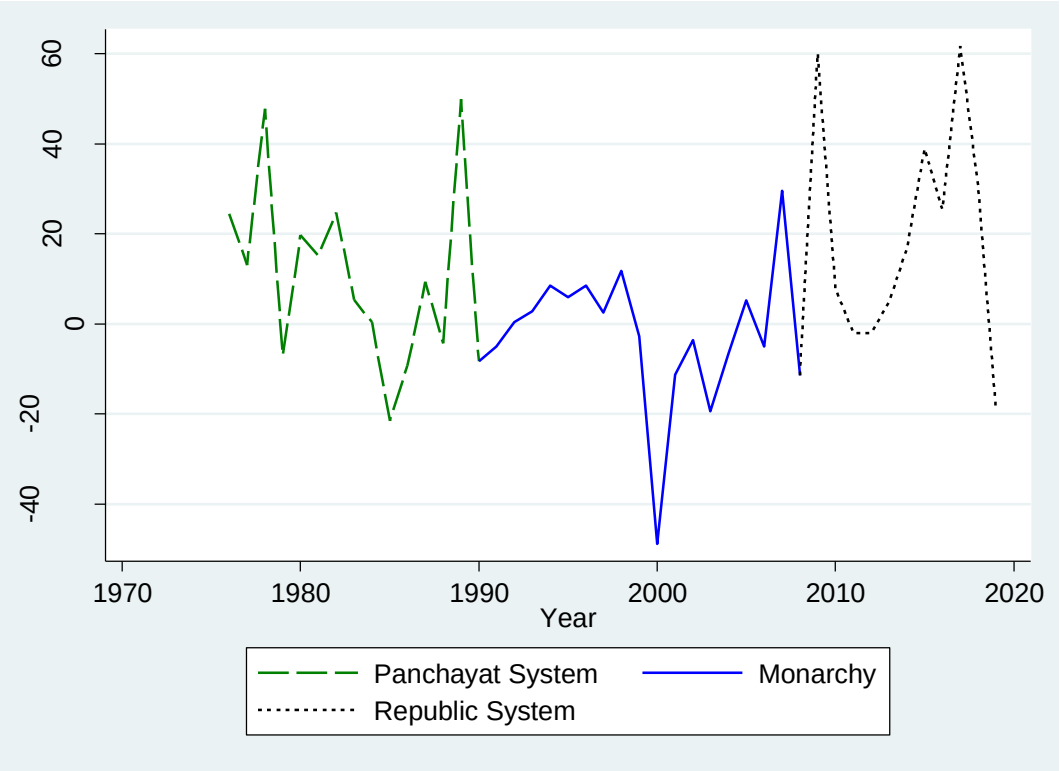
Figure 4.4 reveals that the public investment in Nepal has been highly uneven during these periods. As compared to 1975, the increase in public investment at 2019 is significant. However, this increase is not exciting because the time series for public investment are more likely to consist of structural trends. The trend line shows that the investment by the public sector gradually increased during 1975 to mid-1980s and thereafter dropped by a few amounts and then remained nearly stagnant till 1990.It increased at a decreasing rate thereafter while falling sharply during the first decade of 21st century. The decline was so massive that it was equivalent to the investment during the late 1970s. It was partly because of the escalating Maoist insurgency and political bickering among mainstream political parties and partly due to the financial crises during the period.

The rapid upsurge in government investment after 2010, mainly driven by the election of Constituent Assembly and development of financial system decreased slightly during second half of 2010s. Significant rise in government investment expenditure during the period was due to the post-earthquake reconstruction and rehabilitation programs.

If we observe the trend of public investment according to the three political systems, it can be clearly seen that the gradient of the trend path during Republic System is higher than the other two regimes, followed by Partyless Panchayat System and Monarchy.

After calculating the growth rate of public investment during three different regimes and plotting them in graph, we can get the following results:

Figure 4.5: Growth rate of Real Public Investment in Nepal Over Different Political Systems



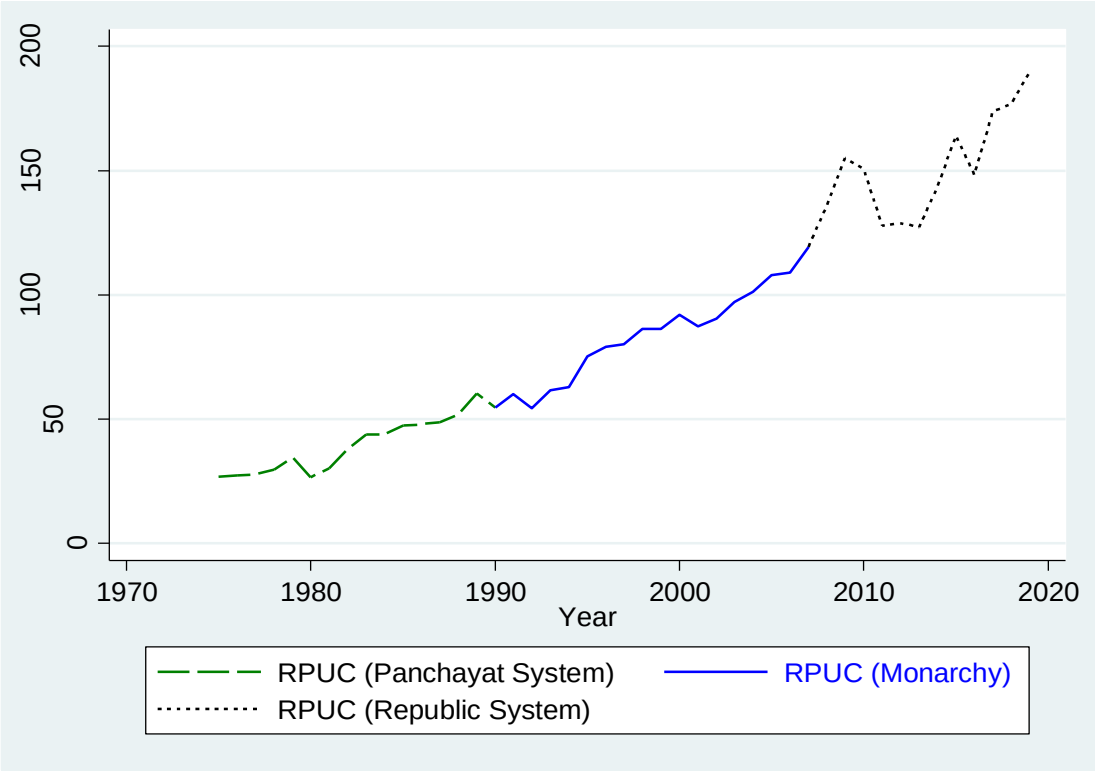
Source: World Bank and IMF's Data (1975-2019), Annex I

Figure 4.5 shows that Nepal witnessed highest average growth rate of public investment during Republic system followed by Panchayat system. Though the growth rates are all time high during these two regimes, the variation in growth rates is more volatile during Panchayat System. As represented by the short-dotted line, growth rate of public investment after adopting Republic system has been less volatile in Nepal. It might be because of rapid increase in government expenditure driven by post-conflict reconstruction, economic growth, post-earthquake reconstruction, etc. It indicates that the rate of expansion of capital formation by the government in Nepal has been less volatile during the current political system.

4.2.2.3 Public Consumption Expenditure

The trend of Real Public Consumption in Nepal for the forty-five years, spanning from 1975 to 2019, has been shown below:

Figure 4.6: Trend of Real Public Consumption of Nepal Over Different Political Systems



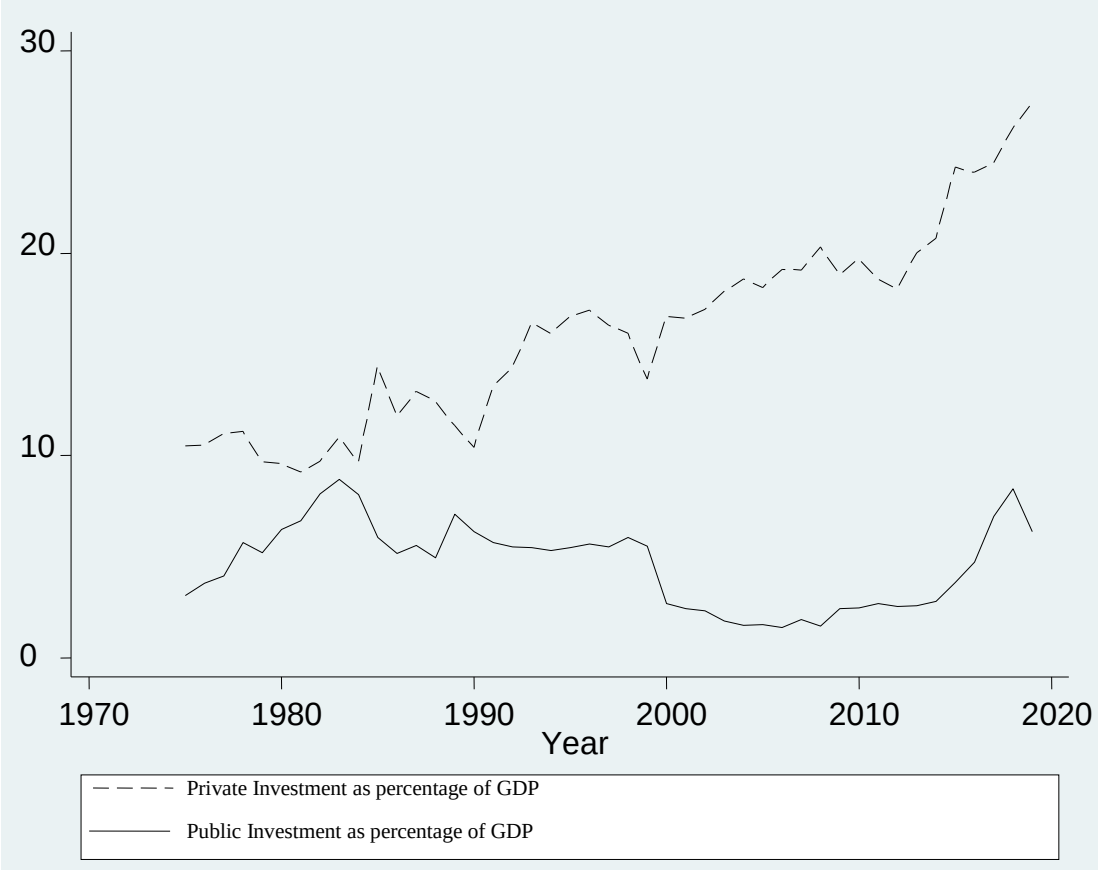
Source: World Bank and IMF's Data (1975-2019), Annex I

Figure 4.6 shows that the government consumption expenditure follows an upward trend and it has been increasing steadily over the years, with particularly significant growth in 2000s and 2010s. Except for few years, the public consumption expenditure has been increasing in Nepal for all other years, regardless of the political system adopted by the country. However, the public consumption expenditure after the Republic System in Nepal is found to be more volatile as compared to the Panchayat System and Monarchy.

4.2.3 Public Investment and Private Investment as a Percentage of GDP

The result of trend line of real public investment and real private investment of Nepal, expressed as a percentage of GDP, during the forty-five years period of 1975 to 2019 AD is represented below:

Figure 4.7: Trend of Public and Private Investment of Nepal as a Percentage of GDP



Source: World Bank and IMF's Data (1975-2019), Annex I

Figure 4.7 depicts a two-way trend line for Nepal's time series data on governmental and private investment expressed as a proportion of GDP. It measures time along the X-axis and the percentage of public investment and private investment in real GDP along the Y-axis. It demonstrates that while private investment has been steadily rising, public investment as a share of GDP in the Nepalese economy has been extremely variable.

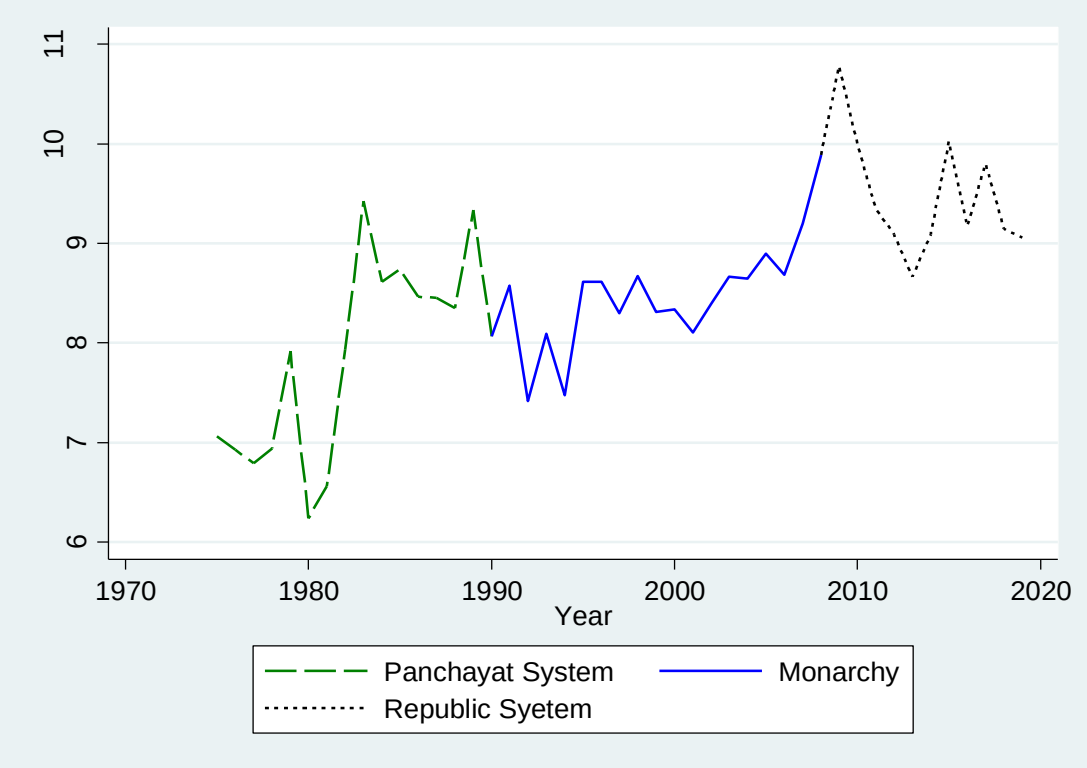
The diagram clearly shows that governmental investment crowds out private capital for the majority of the years, while it crowds in private capital for few years. During the period of forty-five years, there have been several fluctuations in public investment to GDP ratio. The external shocks cause adverse impact on the government's current account which then negatively affects the private investment. The public investment was highest of all during year 1983. The amount of private investment relative to GDP rose concurrently. This supports crowding in effect.

The year 2006 AD saw the lowest ratio of governmental investment to real GDP. During the same year, private investment had increased in proportion to the GDP. There have been speculation that political and societal issues play a significant role in determining private investment. It might also be due to the social welfare responsibilities to be undertaken by the government. In light of this situation, it is incredibly fascinating to determine the overall impact of government spending on private investment.

4.2.4 Public Consumption as a Percentage of GDP

The following chart displays the actual public consumption trend line for Nepal over the forty-five-year period of 1975 to 2019 AD, expressed as a percentage of GDP:

Figure 4.8: Trend line of Public Consumption of Nepal as a Percentage of GDP



Source: World Bank and IMF's Data (1975-2019), Annex I

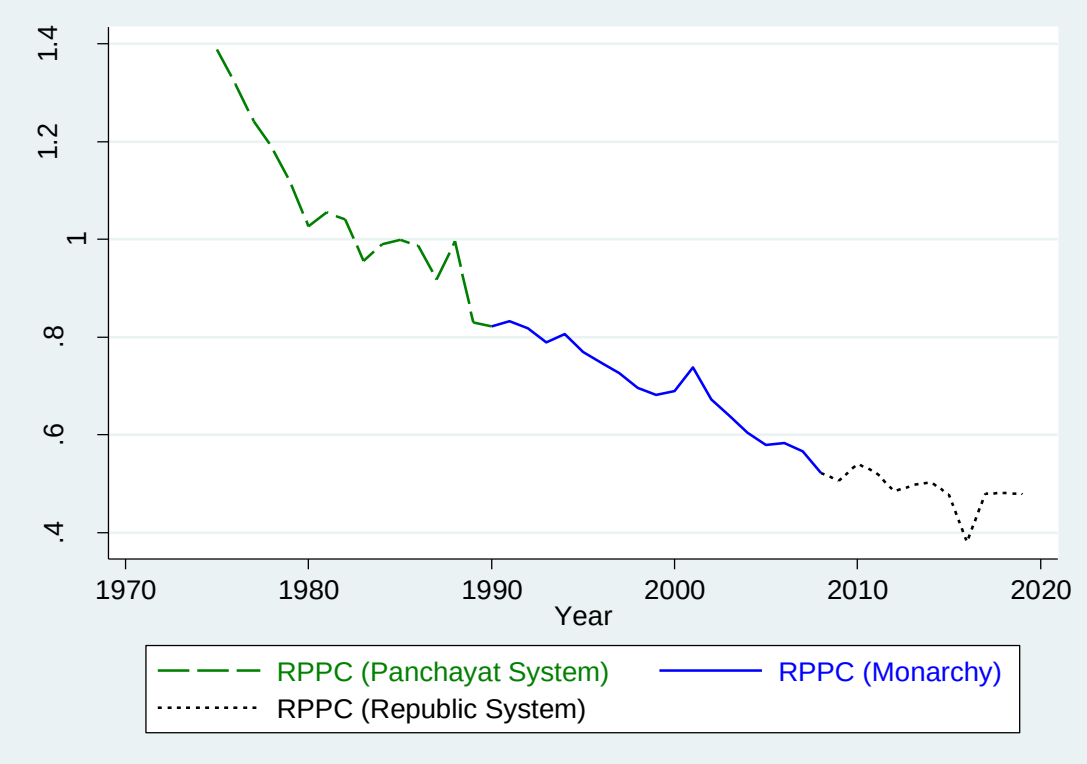
Figure 4.8 measures Year (AD) and Public Consumption (in billion rupees) along the horizontal and vertical axix respectively. It represents the trend line of public consumption expenditure of Nepal, as a share of GDP, for forty-five years span, starting from 1975 AD.

The diagram reveals that the portion of public consumption in the GDP of Nepal is between five to eleven percentages throughout the study period. It had reached to the highest point during the year 2009, soon after Nepal adopted Republic System, while it had remained lowest during 1980 AD, during Panchayat System. The trend line shows that public consumption as a share of Gross Domestic Product is less volatile during the study period. It indicates a consistent commitment of the government towards public service and welfare programs. However, we can't ignore that the share of public consumption in GDP during Monarchy, as compared to other regimes in Nepal, has been highly stable.

4.2.5 Trend Analysis of Productivity of Private Capital of Nepalese Economy

The trend analysis of private capital productivity demonstrates the impact on output per unit of capital in the economy. The graph showing the productivity of private capital based on the political system of Nepal has been shown below:

Figure 4.9: Trend of Real Productivity of Private Capital in Nepal



Source: World Bank and IMF's Data (1975-2019), Annex I

Figure 4.9 measures Year (AD) and Real Productivity of Private Capital along X-axis and Y-axis respectively. It shows the trend of productivity of private capital in Nepal for the forty-five years period ranging from 1975 to 2019. The trend line reveals that the private capital's productivity in Nepal has been continuously decreasing during the forty-five years period, excluding few years. The neoclassical theory of diminishing factor input productivity with rising stock of that particular element of production provides justification for the average productivity of private capital's decline with the rise in capital stock. The sharp fall in productivity during the period of 2015 to 2016 is due to the devastating earthquake. The productivity was all time lowest during the year 2016.

4.3. Descriptive Statistics

The average, median, standard deviation with highest and lowest values, as well as skewness and kurtosis of the data, make up the descriptive statistics.

The summary of the descriptive statistics of the regressors and regressand variables is shown below:

Table 4.1: Summary of Descriptive Statistics

	LNRPI	LNRPUI	LNRPUC	RPPC
Mean	4.905	3.581	4.306	0.771
Median	5.061	3.600	4.383	0.738
Maximum	6.355	5.083	5.246	1.388
Minimum	3.685	2.460	3.282	0.381
Std. Dev.	0.795	0.539	0.590	0.254
Skewness	-0.098	0.639	-0.218	0.584
Kurtosis	1.802	3.875	1.911	2.493
Jarque-Bera	2.762	4.500	2.579	3.045
Probability	0.251	0.105	0.275	0.218
Sum	220.763	161.180	193.779	34.697
Sum Sq. Dev.	27.821	12.813	15.351	2.839
Observations	45	45	45	45

Source: World Bank and IMF's Data (1975-2019), Annex I

Table 4.1 shows that all the time series variables have forty-five observations. The standard deviation for all the variables in their natural logarithm form is smaller than the mean.

If we consider the value of natural log on the real private investment, it indicates that the average value is 4.91 and it deviates 0.80 from the mean value. The highest value in the series is 6.36 and the lowest value is 3.69. The skewness measures the degree of asymmetry of particular series and for a normal skewness, the value is zero. Therefore, LnRPI mirrors a negative skewness. The kurtosis is 1.80 which is smaller than 3. Hence, the distribution is platykurtic.

The value of natural log on the real public investment indicates that the average value is 3.58 and it deviates 0.54 from the mean value. The highest value in the series is 5.08 and the lowest value is 2.46. The skewness measures the degree of asymmetry of particular series and for a normal skewness, the value is zero. Therefore, LnRPUI mirrors a positive skewness. The kurtosis value is 3.88 which is larger than 3. Hence, Hence, the distribution is leptokurtic.

The value of natural log on the real public consumption indicates that the average value is 4.31 and it deviates 0.59from the mean value. The highest value in the series is 5.25 and the lowest value is 3.28. The skewness measures the degree of asymmetry of particular series and for a normal skewness, the value is zero. Therefore, LnRPUC mirrors a negative skewness because the skewness is -0.22. The kurtosis is 1.91, which is smaller than 3. Hence, the distribution is platykurtic.

Similarly, the value of natural log on the private capital's productivity indicates that the average value is 0.77 and it deviates 0.25 from the mean value. The highest value in the series is 1.39 and the lowest value is 0.38. The skewness measures the degree of asymmetry of particular series and for a normal skewness, the value is zero. Therefore, RPPC mirrors a positive skewness because the skewness is 0.58. The kurtosis is 2.49, which is smaller than 3. Hence, the distribution is platykurtic.

4.4 Econometric Tests

The link between public and private expenditure in Nepal has been examined using econometric tests, and the findings are presented below:

4.4.1 ADF Unit Root Test

One of the formal tests to determine whether the variable under consideration is stationary or not is the unit root test. The result of dickey fuller test is shown in the table below:

Table 4.2: Results of Dickey Fuller Unit Root Test

Variables	ADF Test statistics	p-value	Critical Values			Remarks
			1%	5%	10%	
LnRPI	-3.062	0.127	-4.180	-3.515	-3.188	
D1.LnRPI	-8.344	0.000	-3.592	-2.931	-2.603	I(1)
LnRPUI	-1.272	0.881	-4.180	-3.515	-3.188	
D1.LnRPUI	-5.299	0.000	-3.592	-2.931	-2.603	I(1)
LnRPUC	-3.184	0.101	-4.192	-3.520	-3.191	
D1.LnRPUC	-4.412	0.001	-3.605	-2.936	-2.606	I(1)
RPPC	-2.725	0.079	-3.626	-2.945	-2.611	
D1.RPPC	-5.839	0.000	-3.601	-2.935	-2.605	I(1)

Source: World Bank and IMF's Data (1975-2019), Annex II

The outcome of the dickey fuller test, which was used to check the stationarity of the variables under investigation, is shown in Table 4.2. There are two results for each variable, one in level and the other in the form of the variable's first derivative, both stated in logarithmic form. It is evident that if p-value for a variable is smaller than 0.05, then it is stationary. The p-value for each variable, however, is greater than 0.05 at each level, showing that the variance and mean of the variables are not constant. It provides evidence in favor of the hypothesis that the majority of the trended variables are non-stationary at their level.

In order to resolve the problem, the variables are differentiated in their first difference, as shown in the second, fourth, sixth and eighth rows. As a result, the p-value for each variable was less than 0.05, indicating that all of the series are non-stationary and have a unit root. Because of this, all non-stationary variables become stationary at their first difference. Therefore, all other variables are integrated of the first order, i.e., I(1). Therefore, we can't use the OLS in this case and we have to use either co-integration or VAR models.

4.4.2 ARDL Test

The ARDL test is carried out once the variables' integration order has been established. The co-integration method enables study to check for the existence of long-term and short-term equilibrium linkages among the variables when they are not stationary at levels but difference stationary or stationary at the levels or the combination of both. The results are discussed under the following headings.

4.4.2.1 Optimal Lag Length Selection

As specified in the methodology part, a VAR Estimation was run to select the optimal lag length. Because a time series has a tendency for its values to be linked with earlier iterations of itself, a phenomenon known as autocorrelation, lags are highly helpful in time series analysis. The variables are estimated in differences and the outcomes are shown in the table below:

Table 4.3: VAR Lag Length Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	31.740	NA	3.14e-06	-1.320	-1.155	-1.260
1	174.883	252.210*	7.39e-09*	-7.375*	-6.548*	-7.072*
2	189.2554	22.580	8.17e-09	-7.297	-5.808	-6.751
3	202.148	17.804	1.00e-08	-7.149	-4.998	-6.361

Source: World Bank and IMF's Data (1975-2019), Annex II

Note: * indicates lag order selection by the criterion

Table 4.3 shows different criteria to choose the lag order. If we choose any criteria from LR, FPE, AIC, HQIC, and SBIC show the optimal lag to be one. Since most of the literatures reviewed in chapter 2 used AIC and HQIC criteria, the optimal lag for this research has been chosen to be 1.

4.4.2.2 ARDL Model

The ideal number of lags for each of the variables is represented as ARDL (1 1 1 0) with an optimal lag length of 1. Table 4.4 below presents the outcome of the chosen ARDL model.

Table 4.4: Result of ARDL (1 1 1 0) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPI(-1)	0.615	0.129	4.755	0.0000
LNRPUI	-0.148	0.075	-1.950	0.0583
LNRPUI(-1)	0.170	0.077	2.203	0.0340
LNRPUC	0.436	0.185	2.352	0.0242
LNRPUC(-1)	-0.332	0.202	-1.643	0.1091
RPPC	0.405	0.299	1.353	0.1843
C	0.504	0.847	0.595	0.5550
@TREND	0.025	0.009	2.737	0.0096
R-squared	0.9873	F-statistic		400.378
Adjusted R-squared	0.984	Prob(F-statistic)		0.000
S.E of Regression	0.096	Durbin-Watson statistics		2.253

Source: World Bank and IMF's Data (1975-2019), Annex II

Table 4.4 provides the outcomes of ARDL model with the dependent variable LnRPI. After adjustments, there are 44 data points in the sample and the AIC was used to choose the best model with optimal lag of one. There are three dynamic regressor with one lag each, namely; LNRPUI, LNRPUC, and RPPC. The model uses two fixed regressor, constant and the time trend. Total 8 different models were evaluated during model selection. The final ARDL model is ARDL (1 1 1 0), indicating one lag for each for LNRPI, LNRPUI, LNRPUC, and no lags for RPPC.

The lagged value of LNRPI has a coefficient of 0.62, which is statistically significant at 5 percentage. It indicates a positive relationship between the previous period's LNRPI and the current periods LNRPI.

LNRPUI has a coefficient of -0.15, which is marginally statistically significant since p value is 0.058. The negative coefficient suggests that a one percent rise in public investment of current period leads to 0.15 percentage fall in investment of the private sector. The lagged value of LNRPUI has a coefficient of 0.17, which is statistically significant. It indicates that a percentage increase in previous periods public capital expenditure leads to 0.17 percentage rise in current periods private investment.

LNRPUC has a coefficient of 0.44, and it is also statistically significant. It suggests that an increase in LNRPUC leads to increase in LNRPI. Additionally, the time trend variable has a positive and significant coefficient which indicates a positive trend in LNRPI over time.

When it comes to how well the model fits the data, the values of R-squared and modified R-squared are extremely high. Lower value of AIC indicated better fit of the model. Additionally significant is the value of the F statistics, which demonstrates the model's overall relevance. The Durbin-Watson value is close to 2 which suggests no significant autocorrelation.

The ARDL equation based on the selected ARDL model is:

$LNRPI_t$= 0.615786* $LNRPI_{t-1}$- 0.148505* $LNRPUI_t$+ 0.170537* $LNRPUI_{t-1}$+ 0.436609* $LNRPUC_t$- 0.332443* $LNRPUC_{t-1}$+ 0.405882*$RPPC_t$+ 0.504816*C + 0.025999*TREND +e_t …….……. (3.9)

4.4.2.3 Bound Test Results

Table 4.5 displays the outcome of the ARDL bound test strategy to cointegration. According to the Akaike Information Criterion, the ARDL model's ideal lag order is one (1).

Table 4.5: F- Bound Test Table of ARDL (1 1 1 0) Model

F-Bounds Test		Null Hypothesis (H_o): no levels relationship		
Test Statistic	Value	Significance	I(0) bound	I(1) bound
F-statistic	2.991051	10%	3.74	4.78
K	3	5%	4.45	5.56
		1%	6.053	7.458

Source: World Bank and IMF's Data (1975-2019), Annex II

Since the value of F-statistic (2.99) from the F-Bounds test is below all the critical F-values, we do not reject the null hypothesis. The coefficients of the level equation are thus, not jointly significant. Hence, we do not find sufficient evidence to conclude a long-term association among the variables in the ARDL (1 1 1 0) model.

However, as suggested by Pesaran and Shin (1999), we cannot fully rely on the results from F bound test. if the coefficient of the lagged value of error correction term is

significant and negative, it helps to conform the long run relationship. As per the estimation procedure, Johansen test is also carried for confirming the findings of the F Bound test results. For this purpose, Johansen System Cointegration test has been conducted. The assumption of the deterministic trend of the set has been based on Akaike Information Criteria by rank as well as trend. The results obtained after allowing for linear deterministic trend in level data with only intercept in Cointegrating Equation (CE) and test VAR are shown below:

Table 4.6: Johansen Cointegration Test Results for Cross Validation

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	0.05 critical value	Prob.**
None *	0.490	50.458	47.856	0.027
At most 1	0.300	22.106	29.797	0.292
At most 2	0.131	7.0753	15.494	0.568
At most 3	0.027	1.1569	3.8414	0.282
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.490	28.351	27.584	0.039
At most 1	0.300	22.106	29.797	0.292
At most 2	0.131	7.075	15.494	0.568
At most 3	0.027	1.156	3.8414	0.282

Source: World Bank and IMF's Data (1975-2019), Annex II

The Johansen Cointegration test results are shown in Table 4.6. The table represents Trace statistics and Maximum Eigen statistics in the third row. Here the asterisk sign in the hypothesized no. of CEs column is in "none", which indicates that there is only one cointegrating equation with dependent variable LnRPI. The Trace value (50.46) is larger than its critical value (47.86) and it is significant at the traditional 0.05 level of significance level. Similarly, the maximum Eigen statistics (28.35) is more than critical value (27.584) and it is also statistically significant at 0.05. It suggests that the variables have a reliable, long-term relationship.

In our case, though F bound test doesn't support the existence of cointegrating relationship, which is quite unexpected; The results of the Johansen Test demonstrate that there is at least one cointegrating link between private investment and the independent variables, including public investment. Since the series have co integrating relationship, it implies that they exhibit a long-term relationship. Thus, we must estimate both the short and long run model.

4.4.2.4 Long Run Coefficient Test Results

The series exhibit long-term relationships if they are co integrated. It suggests that they are connected and that they can be put together in a straight line. In other words, even if there are short-term shocks, they would eventually converge over time. The table below displays the estimated long-term coefficients

Table 4.7: Long-Run Coefficients of ARDL (1 1 1 0) model

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LNRPUI	0.104	0.053	1.963	0.061
LNRPUC	-0.338	0.370	-0.912	0.370
RPPC	-1.594	0.778	-2.047	0.051

Source: World Bank and IMF's Data (1975-2019), Annex II

Table 4.7 shows the long run results of the ARDL model. According to the above table, public investment has a positive impact whereas public consumption and the productivity of private capital have long-term negative effects on private investment. The coefficient of LnRPUI is 0.10, which indicates that other things being constant, a percentage rise in the public investment expenditure causes the private investment expenditure to rise by 0.10 percentage. However, the coefficient is marginally significant.

The public consumption has very little elasticity. It shows that over time, public investment expenditure has a greater impact than public consumption expenditure. However, the elasticity of productivity of private capital in real terms is -1.59 and it is just significant.

The evidence of crowding in of private investment due to public investment in the long run is in line with the findings of Arigmon et al. (1997), Sen and Kaya (2014), Akinlo & Oyeleke (2018), Carrillo et al. (2018), Gupta (2018), Kalapriya &

Uthayakumar (2019), Pamba (2022), Karun et al. (2020), Giri (2022), Pamba (2022), and Nguyen (2023).

4.4.2.5 ECM Results

The short-term dynamics and long run impact of the variables are projected by the ECM. By estimating the ECM, we can study the short-term trends and linkages between the variables even if the bound test does not show evidence of a long run relationship. We may examine short-term dynamics and how variables respond to changes from the long-term equilibrium using the ECM. It will provide insights into how the variables react to short-term changes and how they converge back to their long-run relationship, even if it doesn't exist. The following table displays the short-term results of the error correction model.

Table 4.8: ECM Representation for the Selected ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.504	0.135	3.731	0.0007
@TREND	0.025	0.007	3.686	0.0007
D(LNRPUI)	-0.148	0.069	-2.144	0.0389
D(LNRPUC)	0.436	0.152	2.862	0.0070
CointEq(-1)*	-0.384	0.106	-3.600	0.0010

Source: World Bank and IMF's Data (1975-2019), Annex II

Table 4.8 represents the results of ECM regression. The short run impact on first difference if log of real private investment that is not explained by other variables is represented by the coefficient of the constant term 0.50 and it is statistically significant with p value of 0.0007. Similarly, the coefficient for the time trend variable is 0.026 and is also statistically significant. This suggests that there is a positive trend in the short run dynamics of first difference of LnRPI over time.

D(LnRPUI) shows the change in LnRPI, that is associated with a 1 percentage change in LnRPUI. The coefficient for the change in LnRPUI is -0.15 and it is significant at 5 percentage. It indicates in the short run, when real public investment increases by 1percentage, then change in real private investment is expected to decrease by 0.15 percentage, other things held constant. This outcome agrees with Dash's (2016) and Pamba's (2022) findings. The coefficient for the change in LnRPUC (D(LNRPUC)) is

0.44 with p-value of 0.0070. This shows that, in the near run, when real public consumption rises by one percentage, real private investment rises by 0.44 percentage, with all other factors remaining the same.

The coefficient of the ECM is -0.38 and it is significant with a p-value of 0.0010. This demonstrates that the system's short-run disequilibrium converges to equilibrium at a rate of 38.42 percentage points annually. In a more simplified way, the relationship which might be deviated in the short run returns to equilibrium nearly after two and half years.

4.5 Diagnostic Test Results

To further investigate the dependability of the estimated ARDL model, diagnostic tests such the Regression Specification Error Test, Serial Correlation Test, Heteroscedasticity Test, Normality Test, and Stability Test are utilized. In this part, the outcomes of such test are displayed.

4.5.1 Regression Specification Error Test

In order to verify that the model's given functional form is accurate, Ramsey RESET test has been employed. It tests the model for the omitted variables and hence it is also known as "Omitted Variables Test". It allows us to examine whether or not a particular class of independent variables would add additional explanatory power to the model. The null hypothesis that the model has no missing variables is tested using the Ramsey test. For this purpose, the variables are tested after converting to first difference.

Table 4.9: Results of Ramsey RESET Test

Ho: model has no omitted variables
F (3, 37) = 1.053058
Prob > F = 0.3115

Source: World Bank and IMF's Data (1975-2019), Annex II

Table 4.9 shows that the probability value of the F-statistics is 0.31, exceeding the conventional significance criterion of 5 percentage points. As a result, we accept the null hypothesis that there are no missing variables in the model. In other words, second, third or fourth power of the independent variables does not jointly add all that

much additional explanatory power to the model. So, it is not worth considering adding them to the model.

4.5.2 Breusch- Godfrey (BG) LM test for autocorrelation

The serial correlation of the residuals is measured via autocorrelation. Upon performing autocorrelation test, following outcomes were derived:

Table 4.10: Results of BG LM test for autocorrelation

F-statistic	1.632457	Prob. F (2,34)	0.2104
Obs*R-squared	3.855000	Prob. Chi-Square (2)	0.1455
H_o: no serial correlation			

Source: World Bank and IMF's Data (1975-2019), Annex II

The results of the BG LM test for autocorrelation are displayed in Table 4.10. There is autocorrelation if the probability of F-Statistics is less than 0.05. As can be seen from the table, the likelihood value is higher than 5%. As a result, it is agreed that the null hypothesis is true and that the model is not serially correlated.

4.5.3 Heteroscedasticity Test Result

Generally, the error variance is constant in time series data. Upon performing heteroscedasticity test, following result was observed:

Table 4.11: Breusch-Pagan - Godfrey Test for Heteroscedasticity

F-statistic	2.188569	Prob. F (7,36)	0.0586
Obs*R-squared	13.13483	Prob. Chi-Square (7)	0.0689
Scaled explained SS	9.680819	Prob. Chi-Square (7)	0.2074

Source: World Bank and IMF's Data (1975-2019), Annex II

The likelihood of estimated F statistics is more than 0.05, according to table 4.11. As a result, the null hypothesis is accepted and there is no heteroscedasticity in the model.

4.5.4 Result of Normality Test

OLS regression and time series data make the assumption that the error terms are normally distributed as one of their key presumptions. The Jarque-Bera test was

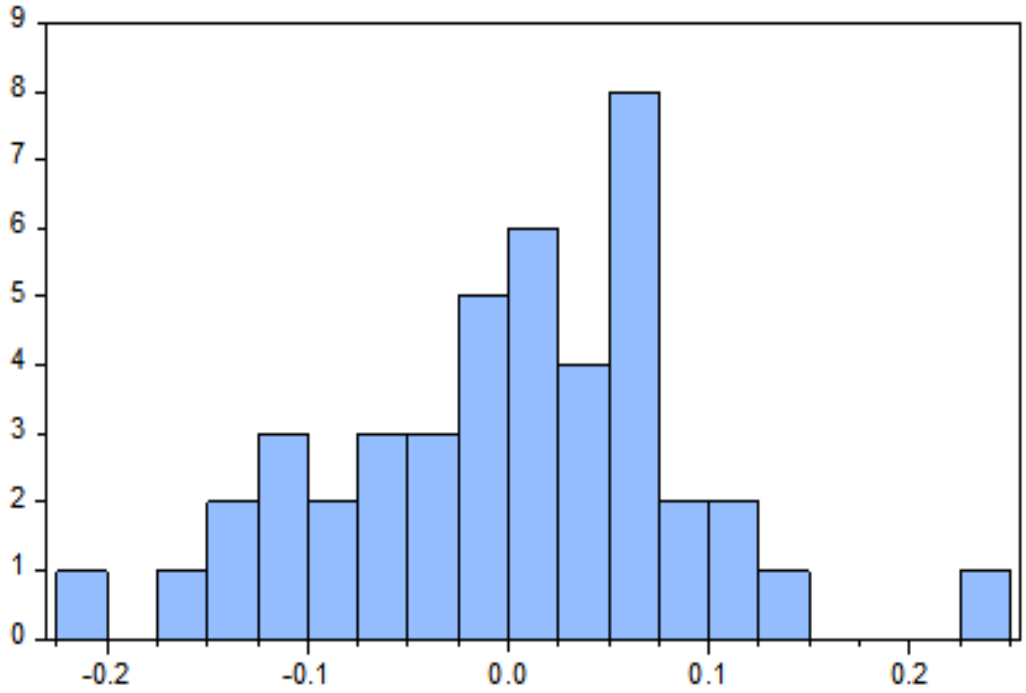
carried out to undertake a normality test. In the figure below, the results of the JB test for normality are shown.

Table 4.12: Statistics of Normality Test Results

Statistical Tools	Statistical Value
Mean	2.27e- 16
Median	0.006447
Maximum	0.242297
Minimum	-0.200365
Std. Dev	0.088068
Skewness	-0.039501
Kurtosis	3.202004
Jarque-Bera	0.086252
Probability	0.957790

Source: World Bank and IMF's Data (1975-2019), Annex II

Figure 4.10: Histogram Normality Test Results



Source: World Bank and IMF's Data (1975-2019), Annex II

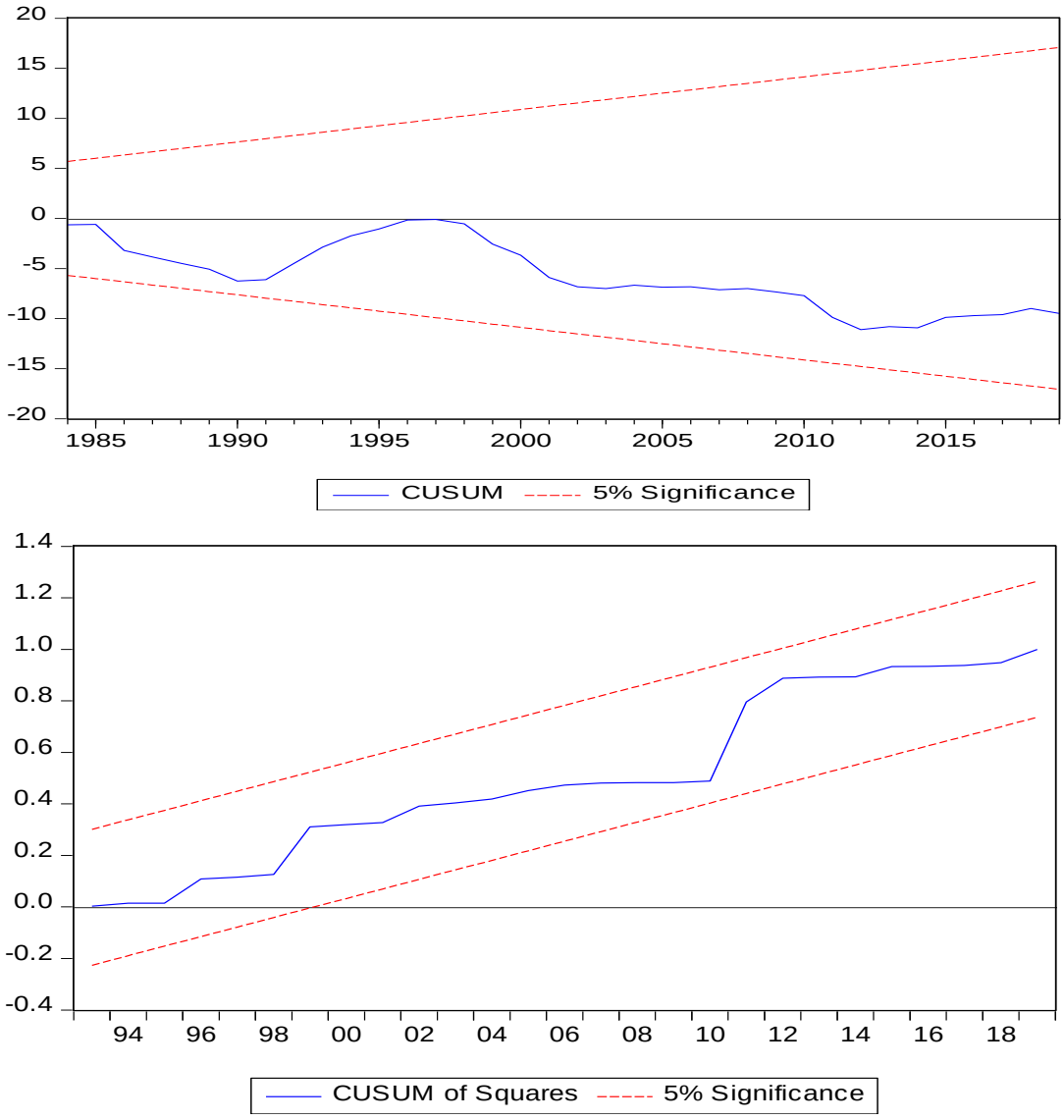
Table 4.12 shows that the Jarque Bera statistic's value is 0.09, with a probability value of 0.96, which is higher than the standard significance level of 5%. As a result,

the null hypothesis cannot be refuted. The JB test for normalcy has found that residuals have a normal distribution.

4.5.5 Result of Stability Test

It is assumed that the coefficients in a time series regression would remain constant across time. It has been tested whether the parameters are stable over time using the cumulative sum test. Since ARDL is sensitive to recursive residuals because of structural breaks, CUSUM and CUSUMQ test have been performed. The graph below illustrates the stability of the calculated long-run ECM coefficients as well as the CUSUM and CUSUMQ statistics:

Figure 4.11: Plot of Cumulative Sum of Recursive and Square Recursive Residuals



Source: World Bank and IMF's Data (1975-2019), Annex II

Figure 4.11 reveals that the graph of CUSUM, and CUSUM of Squares, as indicated by the middle line, don't cross either of the boundary lines. This indicates that there is no issue of recursive residuals in terms of mean and variance. Hence, it is confirmed that the model is stable.

4.6 Discussions

In order to achieve the first objective of the study, graphs showing the trend of the variables for forty-five years period were prepared using STATA. The trend of the variables was studied by segregating the sample period of study into three political regimes, namely; Partyless Panchayat System (1975-1990), Monarchy (1990-2007), and Republic System (2007-2019).

It was observed that all the variables were trended variables, with some periodic fluctuations driven by political changes, policy changes, external and internal economic shocks, armed conflict, natural disasters, etc. Private Investment and Public Investment both revealed clear crowding-in effect during the current political system. The trend line of private capital's productivity revealed that it has been continuously decreasing over the forty-five years period, excluding few years which verifies the neoclassical theory of diminishing factor input productivity with rising stock of that particular element of production.

On the other side, to examine the relationship between private sector investment and government capital expenditure in Nepal, several quantitative and econometric tests were formed. The ARDL (1,1,1,0) model showed that the private capital formation in Nepal depends not only on the current value of public investment, public consumption, and real productivity of private capital, but also on the private investment, public investment and public consumption of the previous periods. One percent rise in the private investment of the previous period causes 0.62 percentage rise in the private investment of current period, other things remaining constant, and it was highly significant.

Similarly, the public investment of current period has a coefficient of -0.15, which was marginally significant. The negative coefficient suggests that a one percent rise in public investment of current period is associated with 0.15 percentage decrease in private investment, other things remaining constant. The lagged value of log of public

investment has a coefficient of 0.17, which is statistically significant. It indicates that one percent increase in previous period's governmental capital expenditure is associated with 0.17 percentage increase in current period's private capital expenditure, other things remaining constant. Coefficient 0.44 of log of public consumption, which is significant at 5 percentage level, indicates that a one percent rise in public consumption of current period is associated with 0.44 percentage increase in private investment of current period, other things remaining constant.

Though the lagged value of public consumption has negative effect on the private investment of current period, as indicated by the negative coefficient, the relationship is not significant. Similarly, the coefficients of RPPC and constant are also positive but not significant at 5 percentage significance level. However, the time trend variable has a positive coefficient which is significant at traditional significance level. This indicates a positive trend in real private investment over time.

A stable long-term link between public and private investment in Nepal was discovered during cointegration testing. Long-term public investment spending has a favorable impact on Nepal's private investment. Other things remaining same, if the public capital expenditure increases by one percentage, the private capital formation of Nepal increases by 0.10 percentage. It is marginally significant. Public consumption has retarding effect on private sector’s investment in the long run as indicated by the negative sign of the coefficient. However, it is insignificant even at 10 percentage level of significance.

The proof of crowding in of private investment due to public investment in the long - term is in line with the findings of Arigmon et al. (1997) in context of OECD countries, Sen and Kaya (2014) in context of Turkey, Akinlo and Oyeleke (2018) in Nigeria, Carrillo et al. (2018) in case of Mexico, Kalapriya and Uthayakumar (2019) in case of Srilanka, Karun et al. (2020) in India and Pamba (2022) in South Africa. The findings are also in line with the findings of Gupta (2018), and Giri (2022) in case of Nepal.

Real private investment is anticipated to rise by roughly 2.60 percentage points for each unit of time (year) based on the short run outcomes of the error correction model. Private investment is eventually encouraged by state investment. When real public investment increases by 1 percentage, real private investment is expected to decrease

by 0.15 percentage, other things held constant. This result of crowding-out is in line with the findings made by Dash (2016) and Pamba (2022). In the short run, public consumption promotes private investment in Nepalese economy. When real public consumption increases by 1 percentage, real private investment increases by 0.44 percentage, other things remaining the same. The short run disequilibrium on the system converges to equilibrium at a rate of 38.42 percentage points per year, as indicated by the ECT coefficient -0.3842, with a negative adjustment in the previous period. The relationship which might be deviated in the short run returns to equilibrium nearly after two and half years.

It is not surprising that public investment pushes out private investment in the short term but attracts it in the long term. This is due to the fact that public investment acts as a positive catalyst to boost private investment by reducing risk and uncertainties to the private sector over time, rather than reflecting the effect of government investment in infrastructure immediately in the short term. Moreover, as suggested by Bista (2021), both recurrent and capital expenditure have notable effect on multiplier to induce growth of Nepalese economy, but the outcome of recurrent expenses is more notable. This might be the topic of further research in future.

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Introduction

It is untenable that the economic activities of the government can cause positive as well as negative impact on the private sector economic activities. Different economists from various schools of thought have presented examples of private economic activity crowding in or crowding out due to government economic activity. Depending upon the country of study and time period, mixed results have been obtained. Surprisingly, mixed results have been obtained by different studies even within a same country, for different time period of study.

The goal of the study was to establish trends in public and private capital formation, public consumption spending, and private capital productivity in Nepal. It also sought to establish the relationship between public and private investment in Nepal. Examining the degree to which state spending affects private sector investment in Nepal has been the main purpose of this study. In order to study this, a private investment function has been derived with public investment expenditure, public consumption expenditure, and productivity of private capital as independent variables.

5.2 Summary

The first aim of the study was to study the structure and trend capital expenditures of public and private sectors, consumption of public sector and productivity of private capital in Nepal for forty-five years period from 1975 to 2019. The second goal was to investigate the relationship between public and private investment throughout the same time period in Nepal.

The study was undertaken with the intention of examining in depth the strength of the relationship between private and state investment in Nepal using a descriptive and quantitative research design. It was concerned on public capital formation than other forms of public spending. For this, the study had used the blend of total factor productivity approach and investment function approach developed by Aschauer (1989), in the form as modified by Arigmon et al. (1997). The regression equation

was estimated for private investment, using public investment, public consumption and productivity of private capital as the independent variables. All the variables, except real productivity of private capital, were logged to measure the elasticity.

The World Bank and IMF databases were used to gather time series data on public and private investment, public consumption, GDP, GDP deflator, and stock of private capital in order to achieve the study's objectives. The data in nominal forms were converted into real form, by adjusting for inflation, measured by GDP deflator. Real Productivity of Private Capital was calculated as the ratio of total output to the stock of private capital.

The following list summarizes the study's key findings:

i. Government capital expenditure, private capital expenditure, public consumption, and real productivity of private capital all are trended variables with some periodic fluctuations driven by political changes, policy changes, external and internal economic shocks, armed conflict, and natural disasters.
ii. Nepal witnessed highest periodic growth rate of public investment during Republic System, followed by Panchayat System. Though the growth rates were all time high during these two regimes, the variation in growth rates was more volatile during Panchayat System.
iii. There was highest periodic growth rate of private investment during Panchayat System, followed by Monarchy. Though the growth rates are all time high during these two regimes, the variation in growth rates is also equally volatile. Periodic growth rate of private investment after adopting Republic System has been less volatile in Nepal.
iv. In Nepal, private capital creation is influenced by past private, public, and public consumption as well as the current value of public investment, public consumption, and real private capital productivity.
v. Public investment spending eventually has a favorable impact on Nepal's private investment. Other things remaining same, if the government capital expenditure increases by a percent, the private investment of Nepal increases by 0.10 percentage.

vi. The long-term negative sign of the coefficient suggests that public consumption has a deterrent effect on private investment. However, it has no significance.

vii. Government capital expenditure has notable effect to induce private investment than government consumption in the long term.

viii. For each unit of time, real private investment of Nepal is expected to increase by approximately 2.60 percentage.

ix. Government capital expenditure has negative influence on the private investment of Nepal in the short run. When governmental capital expenditure increases by 1 percentage, then private investment is expected to decrease by 0.15 percentage, other things held constant.

x. Public consumption promotes private capital formation in Nepalese economy in the short run. When real public consumption increases by a percent, private capital expenditure increases by 0.44 percentage, other things remaining the same.

xi. Public consumption expenditure has notable effect than public investment expenditure to induce private investment in Nepal in the short term.

xii. With a negative adjustment in the prior period, the system's short-term disequilibrium converges to equilibrium at a rate of 38.42 percentage points annually. The private investment which might be deviated in the short run returns to equilibrium nearly after two and half years.

5.3 Conclusion

This study based on the ARDL and ECM showed that there exists a significant relationship between public capital expenditure and private investment in Nepal. Public capital spending is shown to have a positive long-term impact on private investment, contradicting the crowding out argument. However, in the short term, public capital expenditure had a significant influence on retarding the private investment of Nepal, supporting crowding-out hypothesis. Contrarily public consumption had a affirmative effect on escalating investment of the private sector in Nepal in the short run. Public consumption is a major determinant of private investment in Nepal in the short run.

The real private investment has a tendency to adapt downward toward its long-term equilibrium relationship with the real public investment and the real public consumption expenditure, according to the negative and substantial coefficient of the ECM term. The ARDL model also showed that the present value of private investment is highly tied to private investment from the previous period, public investment from the current and previous periods, and public consumption from the current and previous periods. Therefore, the null hypothesis that there is no meaningful relationship between government capital expenditure and private investment in Nepal can be rejected.

Some of the possible reasons for crowding out phenomenon in the short run in Nepal, as shown by ECM, can be due to the reduced availability of loan to private sector as a result of government borrowing, expectations and uncertainty of private sector regarding the overall business climate, highly skewed public investment towards a particular region or sector, frequent changes in the government and tight monetary policies adopted by the central banks. It might also be due to the time lag in observing the immediate effect of government expenditure.

Similarly, some of the possible reasons for the positive association between public capital expenditure and private investment in Nepal in long run can be due to the public investment in basic infrastructures, mainly energy facilities and road connectivity, crowding-in effect, increase in demand for goods and services produced by private sector, risk mitigation to private sectors as a result of government investment, multiplier effect, policy coordination, political transition of Nepal and many other factors.

There are several policy implications that should be thought about in light of the results. Policymakers should work to create a balance between public and private investment in order to reduce the short-term crowding-out of private investment owing to public spending. The government investment should be concentrated in building quality infrastructure to encourage investment climate and attract private investment. Creating a stable and predictable policy environment through consistent policies through reduced red-tapism and rent-seeking behavior is must. Government policies should be strictly oriented to minimize the effect on the private sectors due to high inflation, rate instable exchange rate, and fiscal deficits.

Whereas, the government consumption expenditure positively affects private capital formation in the short run, it implies that the rise in consumption demand of the government seems to have induced private sectors to produce more goods. However, government should be cautious in making wise consumption spending, as the ultimate burden of such expenditure will ultimately fall upon the taxpayers. Policymakers should consider these short-term effects while designing and developing investment and fiscal policies of Nepal. Even when private investment is crowded in eventually by governmental capital expenditure, the link is just significant at a conventional threshold of significance. To establish the optimum balance, an acceptable threshold of public investment should exist. To maximize their influence on the growth of the private sector, public investment initiatives should be focused on increasing their efficacy and efficiency.

Future studies can be oriented towards using more relevant models that capture the impact of public capital expenditure on private investment in context of Nepal. Based on the multiplier effect of public expenditure, it is also possible to see the crowding-in and crowding-out effect. On the other side public and private expenditures can be studied in a disaggregated manner for robust analysis of crowding out effect in Nepal. For example, the studies can include agriculture and non-agriculture investment, manufacturing and non-manufacturing investment, investment made through the state-owned enterprises, human capital expenditure etc. Including time series data of additional years and conducting studies on similar topic can also be the area of future enquiry. The financial crowding out effect might also be observed by taking interest rate and money supply variables under consideration.

REFERENCES

Akinlo, T., & Oyeleke, O.J. (2018). Effects of government expenditure on private investment in Nigerian Economy. *Sage. 4*(2), 147-156. https://doi.org/10.1177percentage2F2394901518795067

Anyanwu, A., Gan, C., & Hu, B. (2017). Government domestic debt, private sector credit, and crowding out effect in oil-dependent countries. *Journal of Economic Research, 22*, 127-151.

Argimon, I., Gonzalez-Paramo, J.M., & Roldan, J. M. (1997). Evidence of public spending crowding-out from a panel of OECD countries. *Applied Economics, 29*(8), 1001-1010.

Aschauer, D.A. (1989). Does public capital crowd out private capital? *Journal of Monetary Economics, 24*(2), 171-188.

Banerjee, A., Dolado, J.J., Galbraith, J.W., & Hendry, D. (1993). Cointegration, error correction and the econometric analysis of non-stationary data. *Journal of Applied Econometrics, 9*(1), 101-103.

Banerjee, A., Dolado, J.J., & Mestre, R. (1998). Error correction mechanism tests for cointegration in a single equation framework. *Journal of Time Series Analysis, 19*(3), 267-283.

Barik, A., & Mohanty, A.R. (2019). New evidence on the relationship between public and private investment in India. *Economics Bulletin*, *39*(3), 1989-2001. http://www.accessecon.com/Pubs/EB/2019/Volume39/EB-19-V39-I3-P187.pdf

Bista, R.B. (2021). *Economics of Nepal (4th ed.)*. Kathmnadu: New Hirabooks.

Bista, R.B. & Sankhi, K.P (2022). Assessing multiplier effects of public expenditures on economic growth in Nepal: SVAR model analysis. *Journal of Economic Impact, 4*(1), 50-58.

Brooks, C. (2002). *Introductory Econometrics for Finance (3rd ed.).* New York: Cambridge University Press.

Buiter, W.H. (1977). Crowding out and its critics. *Federal Reserve Bank of St. Louis Review, 57*(12), 2-17.

Bukhari, S.K.H., Saeed, N., & Ali, A. (2006). The impact of public investment on private investment: A disaggregated analysis. *The Pakistan Development Review, 45*(4), 639-663.

Carlson, K.M., & Spencer, R.W. (1975). Crowding out and its critics. *Federal Reserve Bank of St. Louis Review, 57*(12), 2-17.

Carrillo, A. L. B., Pino, V. M. V., & Heredia, L. C. A. (2018). Analysis of the relationship between private investment and public investment in Mexico. *International Journal of Economic, Finance and Management Sciences*, *6*(4), 174- 184. https://doi: 10.11648/j.ijefm.20180604.15

Dash, P. (2016). The impact of public investment on private investment: Evidence from India. *Vikalpa: The Journal for Decision Makers, 41*(4), 288-307. https://doi.org/10.1177/0256090916676439

David, P.A., & Scadding, J.L. (1974). Private savings: Ultra rationality, aggregation and Denison's Law. *Journal of Political Economy, 82*(2), 225-249.

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation and testing. *Econometrica*, *55*(2), 251-267. https://www.jstor.org/stable/1913236.

Ospina, E.O., & Roser, M. (2016). Government spending. *Our World in Data.* https://ourworldindata.org/government-spending

Fan, S., & Rao, N. (2003). Public spending in developing countries: Trends, determination, and impact. *International Food Policy Research Institute*, 99, 1-54.

Giri, S. (2022). Public expenditure and economic growth of Nepal. *The Lumbini Journal of Business and Economics, 10*(1), 203–215. https://doi.org/10.3126/ljbe.v10i1- 2.54216

Godfrey, L.G. (1978). Testing against general autoregressive and moving average error models when the regressors include lagged dependent variables. *Econometrica: Journal of the Econometrica Society, 46*(6), 1293-1301. https://www.jstor.org/stable/1913829.

Granger, C. (1981). Some properties of time series data and their use in econometric model specification. *Journal of Econometrics, 16*(1), 121-130. https://doi.org/10.1016/0304-4076 (81)90079-8

Gupta, R (2018). The impact of government expenditure on economic growth in Nepal. *Social Science Research Network,* 1-6. http://dx.doi.org/10.2139/ssrn.3099218

Harris, R., & Sollis, R. (2003). *Applied Time Series Modeling and Forecasting.* West Sussex: Wiley.

Javid, M. (2019). Public and private infrastructure investment and economic growth in Pakistan: An aggregate and disaggregate analysis. S*ustainability, 11*(12), 33-59.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration-With the application to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*, 169-210.

Johansen, S. (1988). Statistical analysis of co-integration vectors. *Journal of Economic Dynamics and Control, 12*, 231-254.

Julio, B., & Yook, Y. (2012). Political uncertainty and corporate investment cycles. *The Journal of Finance, 67*(1), 45-83.

Kalapriya, J. & Uthayakumar, S. (2019). The relationship between private investment and government investment after economic liberalization. *Journal of Business Economics, 1*(1), 46-55.

Kang, S.J. (2004). Are public transfers crowded out by public transfers? The case of Nepal. *The Developing Economies, 42*(4), 510-528.

Karun, H., Vinod, H., & Chakraborty, L.S. (2020). Did public investment crowd out private investment in India? *National Institute of Public Finance and Policy*, 312, 1-12.

Keynes, J.M. (1936). *The general theory of employment, interest and money*. Harcourt, Brace and Co., New York.

Mauro, P., Romeu, R., Binder, A. & Zaman, A. (2015). A modern history of fiscal prudence and profligacy. *Journal of Monetary Economics, 76*, 55-70.

Narayan, P.K., & Smyth, R. (2005). Electricity consumption, employment and real income in Australia: Evidence from multivariate granger causality tests. *Energy Policy, 33*(9), 1109-1116.

Nguyen, C.N., & Trinh, L.T. (2018). The impacts of public investment on private investment and economic growth: Evidence from Vietnam. *Journal of Asian Business and Economic Studies, 25*(1), 15-32.

Nguyen, V.B. (2023). The relationship between public expenditure and private investment in developed and developing economies: Policy implications based on the difference. *Review of Public Economics, 25*(1), 37-55.

Nikolov, P., & Bonci, M. (2020). Do public program benefits crowd out private transfers in developing countries? A critical review of recent evidence. *World Development, 134*, 104-967. https://doi.org/10.1016/j.worlddev.2020.104967

Nordhaus, W. (1975). The political business cycle. *Review of Economic Studies, 42*(2) 169-190.

Odhiambo, N.M. (2009). Energy consumption and economic growth in Tanzania: An ARDL bounds testing approach. *Energy Policy, 37*(2), 617-622.

Pamba, D. (2022). Crowding in or crowding out? Public investment and private investment in South Africa: An ECM approach. *Preprints, 1,* 1-18 https://doi.org/10.20944/preprints202201.0450.v1

Pandit, R. (2005). The impact of fiscal deficit on long-term nominal interest rate in Nepal. *Economic Review of Nepal Rastra Bank, 17*(6), 113-133.

Pattichis, C. A. (1999). Price and income elasticities of disaggregated import demands: Results from UECMS and an application. *Applied Economics, 31*, 1061-1071. https://doi.org/10.1080/000368499323544

Paudel, R.C. (2023). Capital expenditure and economic growth: A disaggregated analysis for Nepal. *Cogent Economics and Finance, 11* (1), 1-21.

Paudyal, S.B. (2013). Do budget deficits raise interest rates in Nepal? *Economic Review of Nepal Rastra Bank, 25*(1), 52-66.

Pesaran, M. H., Shin, Y., & Smith, R.J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326.

Pradhan, B.K., Ratha, D.K., & Sharma, A. (1990). Complementarity between public and private investment in India. *Journal of Development Economics, 33*(1), 101-116. http://dilipratha.com/index_files/RathaPradhanSarmaJDE.pdf

Rahman, H. U., & Afzal, M. (2003). The J curve phenomenon: An evidence from Pakistan. *Pakistan Economic and Social Review, 41*(1), 45-58.

Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society. 31*(2), 350-371. http://www.jstor.org/stable/2984219

Saeed, N., Hyder, K., & Ali, A. (2006). The impact of public investment on private investment: A disaggregated analysis. *The Pakistan Development Review, 45*(4), 639-663. http://dx.doi.org/10.30541/v45i4IIpp.639-663

Sen, H., & Kaya, A. (2014). Crowding-out or crowding-in? Analyzing the effects of government spending on private investment in Turkey. *Anoeconomicus, 61*(6), 631-651. https://doi.org/10.2298/pan1406631s

Sezgin, S., & Yildirim, T. (2002). The demand for Turkish defense expenditure. *Defense and Peace Economics, 13*(2), 121-128. https://doi.org/10.1080/10242690210973.

Shapiro, E. (1966). *Macroeconomic Analysis* (4th ed.). Harcourt Brace Jovanovich.

Shrestha, M. (2005). *Financial liberalization in Nepal*. School of Economics and Information, University of Wollongong, Australia.

Shrestha, P, K. (2009). The composition of public expenditure, physical infrastructure and economic growth of Nepal. *Economic Review of Nepal Rastra Bank, 21*, 79-94.

Stock, J. H., & Watson, M. W. (2006). *Introduction to Econometrics* (2nd ed.). Boston: Pearson Addison Wesley.

Tzougas J. (2013). Immigration, economic growth and unemployment in Greece: An application of the ARDL bounds testing approach to cointegration. *Social Science Research Network.* https://papers.ssrn.com/so13/papers.cfm?abstract_id= 2297466

World Bank (2021). *Nepal Public Expenditure Review - Fiscal Policy for Sustainable Development*. Washington, DC: World Bank.

Yu, B., Fan, S., & Magalhaes, E. (2015). Trends and composition of public expenditures: A global and regional perspective. *European Journal of Development Research, 27*, 353–370.

Xu, X., & Yan, Y. (2014). Does government investment crowd out private investment in China? *Journal of Economic Policy Reform, 17*(1), 1-12.

ANNEX

Annex I: Data

Year	LnRPI	LnRPUI	LnRPUC	RPPC
1975	3.68521	2.460852	3.29017	1.38899
1976	3.732502	2.679757	3.313755	1.318154
1977	3.812169	2.80202	3.323427	1.241933
1978	3.865128	3.192404	3.38868	1.187289
1979	3.744003	3.119503	3.543672	1.117689
1980	3.712144	3.299429	3.282171	1.026694
1981	3.747156	3.440995	3.411271	1.05541
1982	3.842403	3.662229	3.638566	1.040839
1983	3.925857	3.713998	3.781112	0.955794
1984	3.899965	3.717324	3.783895	0.989548
1985	4.358365	3.475447	3.857652	0.999168
1986	4.214894	3.378336	3.870549	0.987066
1987	4.329075	3.467494	3.886004	0.918156
1988	4.367171	3.423479	3.947782	0.996374
1989	4.307765	3.828447	4.101619	0.83053
1990	4.255784	3.741363	4.001162	0.82176
1991	4.544436	3.689457	4.095916	0.832411
1992	4.656789	3.693588	3.997883	0.817729
1993	4.835468	3.721578	4.119704	0.789664
1994	4.905732	3.802834	4.143082	0.806593
1995	4.992114	3.860676	4.319197	0.769907
1996	5.061907	3.94191	4.371159	0.747665
1997	5.067426	3.967245	4.382974	0.726504
1998	5.071987	4.078882	4.457101	0.696041
1999	4.962757	4.050363	4.457898	0.681713

2000	5.226665	3.37859	4.520769	0.689348
2001	5.196155	3.258054	4.468482	0.738124
2002	5.224307	3.221808	4.505248	0.672219
2003	5.312865	3.006448	4.575192	0.639673
2004	5.391916	2.937089	4.618533	0.604187
2005	5.403059	2.98827	4.681821	0.579933
2006	5.484783	2.936532	4.690316	0.584175
2007	5.516557	3.195952	4.781536	0.566746
2008	5.632565	3.07517	4.913208	0.52249
2009	5.607646	3.545285	5.043697	0.506845
2010	5.69523	3.620765	5.01497	0.540521
2011	5.545568	3.600864	4.850574	0.524053
2012	5.555015	3.57975	4.858821	0.484745
2013	5.684767	3.626895	4.846531	0.496816
2014	5.789405	3.780811	4.965022	0.504005
2015	5.983757	4.109397	5.100543	0.478112
2016	5.960438	4.336219	4.998901	0.381283
2017	6.071493	4.816709	5.156964	0.480187
2018	6.227461	5.08311	5.175282	0.481108
2019	6.355362	4.87332	5.246598	0.47929

Source: World Bank and IMF Database

Annex II: Estimation Results

Summary of descriptive statistics

Date: 07/28/23
Time: 15:28
Sample: 1975 2019

	LNRPI	LNRPUI	LNRPUC	RPPC
Mean	4.905849	3.581792	4.306209	0.771055
Median	5.061907	3.600864	4.382974	0.738124
Maximum	6.355362	5.083110	5.246598	1.388990
Minimum	3.685210	2.460852	3.282171	0.381283
Std. Dev.	0.795174	0.539648	0.590667	0.254043
Skewness	-0.097716	0.639157	-0.218376	0.584678
Kurtosis	1.802052	3.875285	1.911418	2.493148
Jarque-Bera	2.762388	4.500391	2.579558	3.045548
Probability	0.251278	0.105379	0.275332	0.218106
Sum	220.7632	161.1806	193.7794	34.69748
Sum Sq. Dev.	27.82127	12.81366	15.35104	2.839669
Observations	45	45	45	45

VAR Result

VAR Lag Order Selection Criteria
Endogenous variables: LNRPI LNRPUI LNRPUC RPPC
Exogenous variables: C
Date: 07/28/23 Time: 15:30
Sample: 1975 2019
Included observations: 42

Lag	LogL	LR	FPE	AIC	SC	HQ
0	31.74000	NA	3.14e-06	-1.320952	-1.155460	-1.260293
1	174.8863	252.2102*	7.39e-09*	-7.375539*	-6.548078*	-7.072242*
2	189.2554	22.58002	8.17e-09	-7.297877	-5.808446	-6.751942
3	202.1483	17.80448	1.00e-08	-7.149920	-4.998520	-6.361347

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Unit Root Test Result

Null Hypothesis: LNRPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.062173	0.1279
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRPI)
Method: Least Squares
Date: 07/18/23 Time: 18:48
Sample (adjusted): 1976 2019
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRPI(-1)	-0.379446	0.123914	-3.062173	0.0039
C	1.386889	0.439583	3.155008	0.0030
@TREND("1975")	0.023236	0.007454	3.117281	0.0033

R-squared	0.191684	Mean dependent var	0.060685
Adjusted R-squared	0.152254	S.D. dependent var	0.112906
S.E. of regression	0.103956	Akaike info criterion	-1.623947
Sum squared resid	0.443083	Schwarz criterion	-1.502298
Log likelihood	38.72684	Hannan-Quinn criter.	-1.578834
F-statistic	4.861382	Durbin-Watson stat	2.109457
Prob(F-statistic)	0.012747		

Null Hypothesis: D(LNRPI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.344635	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRPI,2)
Method: Least Squares
Date: 07/18/23 Time: 18:50
Sample (adjusted): 1977 2019
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRPI(-1))	-1.262881	0.151340	-8.344635	0.0000
C	0.076539	0.019224	3.981370	0.0003

R-squared	0.629405	Mean dependent var	0.001875

Adjusted R-squared	0.620366	S.D. dependent var	0.181086
S.E. of regression	0.111575	Akaike info criterion	-1.502839
Sum squared resid	0.510411	Schwarz criterion	-1.420923
Log likelihood	34.31105	Hannan-Quinn criter.	-1.472631
F-statistic	69.63294	Durbin-Watson stat	1.964595
Prob(F-statistic)	0.000000		

Null Hypothesis: LNRPUI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.272755	0.8817
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRPUI)
Method: Least Squares
Date: 07/18/23 Time: 18:52
Sample (adjusted): 1976 2019
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRPUI(-1)	-0.089549	0.070358	-1.272755	0.2103
C	0.323742	0.229849	1.408497	0.1665
@TREND("1975")	0.002187	0.002784	0.785514	0.4367

R-squared	0.039094	Mean dependent var	0.054829
Adjusted R-squared	-0.007780	S.D. dependent var	0.206856
S.E. of regression	0.207659	Akaike info criterion	-0.240090
Sum squared resid	1.768017	Schwarz criterion	-0.118441
Log likelihood	8.281987	Hannan-Quinn criter.	-0.194977
F-statistic	0.834028	Durbin-Watson stat	1.537262
Prob(F-statistic)	0.441530		

Null Hypothesis: D(LNRPUI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.299833	0.0001
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRPUI,2)
Method: Least Squares
Date: 07/18/23 Time: 18:53
Sample (adjusted): 1977 2019
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRPUI(-1))	-0.825397	0.155740	-5.299833	0.0000
C	0.040365	0.032979	1.223954	0.2280

R-squared	0.406556	Mean dependent var	-0.009970
Adjusted R-squared	0.392082	S.D. dependent var	0.265617
S.E. of regression	0.207099	Akaike info criterion	-0.265843
Sum squared resid	1.758492	Schwarz criterion	-0.183927
Log likelihood	7.715627	Hannan-Quinn criter.	-0.235635
F-statistic	28.08823	Durbin-Watson stat	2.010661
Prob(F-statistic)	0.000004		

Null Hypothesis: LNRPUC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.184726	0.1013
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRPUC)
Method: Least Squares
Date: 07/18/23 Time: 18:55
Sample (adjusted): 1978 2019
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRPUC(-1)	-0.566786	0.177970	-3.184726	0.0029
D(LNRPUC(-1))	0.088081	0.178270	0.494090	0.6242
D(LNRPUC(-2))	0.110951	0.161810	0.685683	0.4972
C	1.913400	0.577590	3.312731	0.0021
@TREND("1975")	0.024624	0.008002	3.077259	0.0039

R-squared	0.267098	Mean dependent var	0.045790
Adjusted R-squared	0.187866	S.D. dependent var	0.095865
S.E. of regression	0.086392	Akaike info criterion	-1.948507
Sum squared resid	0.276150	Schwarz criterion	-1.741641
Log likelihood	45.91865	Hannan-Quinn criter.	-1.872683
F-statistic	3.371067	Durbin-Watson stat	2.005894
Prob(F-statistic)	0.018933		

Null Hypothesis: D(LNRPUC) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.412879	0.0011
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNRPUC,2)
Method: Least Squares
Date: 07/18/23 Time: 18:56
Sample (adjusted): 1980 2019
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRPUC(-1))	-1.917246	0.434466	-4.412879	0.0001
D(LNRPUC(-1),2)	0.609824	0.350703	1.738859	0.0908
D(LNRPUC(-2),2)	0.417173	0.264727	1.575858	0.1241
D(LNRPUC(-3),2)	0.133704	0.171108	0.781402	0.4398
C	0.083129	0.024457	3.398974	0.0017

R-squared	0.653025	Mean dependent var	-0.002092
Adjusted R-squared	0.613370	S.D. dependent var	0.152358
S.E. of regression	0.094736	Akaike info criterion	-1.758982
Sum squared resid	0.314120	Schwarz criterion	-1.547872
Log likelihood	40.17963	Hannan-Quinn criter.	-1.682651
F-statistic	16.46793	Durbin-Watson stat	1.597155
Prob(F-statistic)	0.000000		

Null Hypothesis: RPPC has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.725672	0.0796
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RPPC)
Method: Least Squares
Date: 08/17/23 Time: 09:09
Sample (adjusted): 1984 2019
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RPPC(-1)	-0.123488	0.045306	-2.725672	0.0113
D(RPPC(-1))	-0.578641	0.167260	-3.459523	0.0019
D(RPPC(-2))	-0.532806	0.203916	-2.612873	0.0147
D(RPPC(-3))	-0.598716	0.234403	-2.554223	0.0168
D(RPPC(-4))	-0.322947	0.210520	-1.534044	0.1371
D(RPPC(-5))	-0.536996	0.190439	-2.819786	0.0091
D(RPPC(-6))	-0.322948	0.187341	-1.723854	0.0966
D(RPPC(-7))	-0.168451	0.180133	-0.935147	0.3583
D(RPPC(-8))	-0.285788	0.166034	-1.721268	0.0971
C	0.010351	0.026536	0.390063	0.6997

R-squared	0.514443	Mean dependent var	-0.013236
Adjusted R-squared	0.346365	S.D. dependent var	0.045837
S.E. of regression	0.037058	Akaike info criterion	-3.522515
Sum squared resid	0.035706	Schwarz criterion	-3.082648
Log likelihood	73.40527	Hannan-Quinn criter.	-3.368990
F-statistic	3.060744	Durbin-Watson stat	2.079929
Prob(F-statistic)	0.012290		

Null Hypothesis: D(RPPC) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on AIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.839569	0.0000
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RPPC,2)
Method: Least Squares
Date: 08/17/23 Time: 09:13
Sample (adjusted): 1978 2019
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RPPC(-1))	-1.419159	0.243025	-5.839569	0.0000
D(RPPC(-1),2)	0.117268	0.153259	0.765161	0.4488
C	-0.026712	0.008700	-3.070283	0.0039

R-squared	0.649820	Mean dependent var	0.001772
Adjusted R-squared	0.631862	S.D. dependent var	0.075658
S.E. of regression	0.045905	Akaike info criterion	-3.255727
Sum squared resid	0.082184	Schwarz criterion	-3.131608
Log likelihood	71.37026	Hannan-Quinn criter.	-3.210232
F-statistic	36.18563	Durbin-Watson stat	2.025087
Prob(F-statistic)	0.000000		

ARDL (1110) MODEL

Dependent Variable: LNRPI
Method: ARDL
Date: 07/28/23 Time: 15:44
Sample (adjusted): 1976 2019
Included observations: 44 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): LNRPUILNRPUCRPPC
Fixed regressors: C @TREND
Number of models evalulated: 8
Selected Model: ARDL(1, 1, 1, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPI(-1)	0.615786	0.129480	4.755822	0.0000
LNRPUI	-0.148505	0.075920	-1.956066	0.0583
LNRPUI(-1)	0.170537	0.077379	2.203928	0.0340
LNRPUC	0.436609	0.185613	2.352255	0.0242
LNRPUC(-1)	-0.332443	0.202326	-1.643110	0.1091
RPPC	0.405882	0.299874	1.353509	0.1843
C	0.504816	0.847227	0.595845	0.5550
@TREND	0.025999	0.009498	2.737420	0.0096

R-squared	0.987318	Mean dependent var	4.933591
Adjusted R-squared	0.984852	S.D. dependent var	0.782028
S.E. of regression	0.096250	Akaike info criterion	-1.680768
Sum squared resid	0.333507	Schwarz criterion	-1.356370
Log likelihood	44.97690	Hannan-Quinn criter.	-1.560466
F-statistic	400.3781	Durbin-Watson stat	2.253758
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Long Run Form and Bounds Test

Dependent Variable: D(LNRPI)
Selected Model: ARDL(1, 1, 1, 0)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 07/28/23 Time: 15:51
Sample: 1975 2019
Included observations: 44

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.504816	0.847227	0.595845	0.5550
@TREND	0.025999	0.009498	2.737420	0.0096
LNRPI(-1)*	-0.384214	0.129480	-2.967357	0.0053
LNRPUI(-1)	0.022032	0.033515	0.657369	0.5151
LNRPUC(-1)	0.104166	0.219663	0.474206	0.6382
RPPC**	0.405882	0.299874	1.353509	0.1843
D(LNRPUI)	-0.148505	0.075920	-1.956066	0.0583
D(LNRPUC)	0.436609	0.185613	2.352255	0.0242

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRPUI	0.104825	0.053397	1.963132	0.0613
LNRPUC	-0.338435	0.370731	-0.912884	0.3704
RPPC	-1.594566	0.778761	-2.047567	0.0517

EC = LNRPI - (0.1048*LNRPUI -0.3384*LNRPUC -1.5946*RPPC)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	2.991051	10%	3.47	4.45
k	3	5%	4.01	5.07
		2.5%	4.52	5.62
		1%	5.17	6.36
			Finite Sample: n=45	
Actual Sample Size	44			
		10%	3.74	4.78
		5%	4.45	5.56
		2.5%	6.053	7.458
			Finite Sample: n=40	
		10%	3.76	4.795
		5%	4.51	5.643
		2.5%	6.238	7.74

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-2.967357	10%	-3.13	-3.84
		5%	-3.41	-4.16
		2.5%	-3.65	-4.42
		1%	-3.96	-4.73

ARDL Error Correction Regression

Dependent Variable: D(LNRPI)
Selected Model: ARDL(1, 1, 1, 0)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 07/28/23 Time: 15:57
Sample: 1975 2019
Included observations: 44

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	0.504816	0.135278	3.731696	0.0007
@TREND	0.025999	0.007053	3.686262	0.0007
D(LNRPUI)	-0.148505	0.069265	-2.144021	0.0389
D(LNRPUC)	0.436609	0.152528	2.862480	0.0070
CointEq(-1)*	-0.384214	0.106721	-3.600170	0.0010

R-squared	0.391584	Mean dependent var	0.060685
Adjusted R-squared	0.329182	S.D. dependent var	0.112906
S.E. of regression	0.092474	Akaike info criterion	-1.817132
Sum squared resid	0.333507	Schwarz criterion	-1.614383
Log likelihood	44.97690	Hannan-Quinn criter.	-1.741943
F-statistic	6.275220	Durbin-Watson stat	2.253758
Prob(F-statistic)	0.000535		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	2.991051	10%	3.47	4.45
k	3	5%	4.01	5.07
		2.5%	4.52	5.62
		1%	5.17	6.36

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.600170	10%	-3.13	-3.84
		5%	-3.41	-4.16
		2.5%	-3.65	-4.42
		1%	-3.96	-4.73

Johansen Cointegration Test

Date: 08/21/23 Time: 14:46
Sample (adjusted): 1978 2019
Included observations: 42 after adjustments
Trend assumption: Linear deterministic trend
Series: LNRPILNRPUILNRPUCRPPC
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.490861	50.45826	47.85613	0.0279
At most 1	0.300852	22.10684	29.79707	0.2926
At most 2	0.131436	7.075362	15.49471	0.5689
At most 3	0.027171	1.156969	3.841466	0.2821

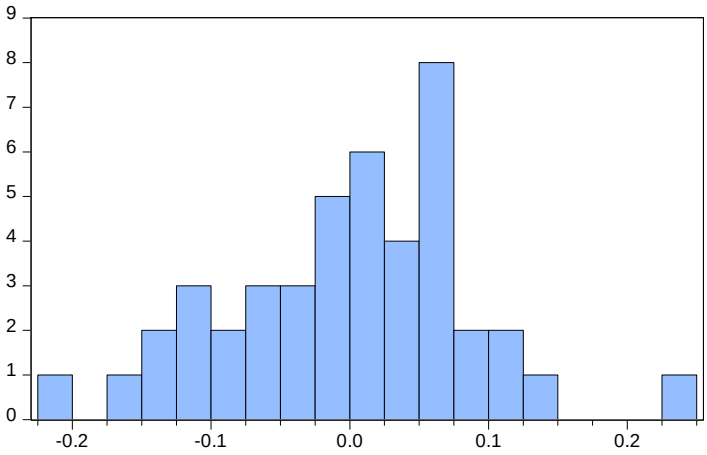
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.490861	28.35142	27.58434	0.0398
At most 1	0.300852	15.03148	21.13162	0.2867
At most 2	0.131436	5.918393	14.26460	0.6237
At most 3	0.027171	1.156969	3.841466	0.2821

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Normality Test



Series: Residuals
Sample 1976 2019
Observations 44

Mean	2.27e-16
Median	0.006447
Maximum	0.242297
Minimum	-0.200365
Std. Dev.	0.088068
Skewness	-0.039501
Kurtosis	3.202004
Jarque-Bera	0.086252
Probability	0.957790

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.632457	Prob. F(2,34)	0.2104
Obs*R-squared	3.855000	Prob. Chi-Square(2)	0.1455

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 07/28/23 Time: 16:06
Sample: 1976 2019
Included observations: 44
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRPI(-1)	-0.121243	0.291048	-0.416574	0.6796
LNRPUI	-0.034149	0.079062	-0.431932	0.6685
LNRPUI(-1)	0.026688	0.077811	0.342982	0.7337
LNRPUC	-0.050947	0.188379	-0.270449	0.7884
LNRPUC(-1)	0.055935	0.238189	0.234832	0.8157
RPPC	0.143948	0.312419	0.460752	0.6479
C	0.272210	1.014788	0.268244	0.7901

@TREND	0.009736	0.016413	0.593181	0.5570
RESID(-1)	0.039573	0.364087	0.108692	0.9141
RESID(-2)	0.368682	0.276933	1.331302	0.1919

R-squared	0.087614	Mean dependent var	2.27E-16
Adjusted R-squared	-0.153900	S.D. dependent var	0.088068
S.E. of regression	0.094602	Akaike info criterion	-1.681551
Sum squared resid	0.304287	Schwarz criterion	-1.276053
Log likelihood	46.99412	Hannan-Quinn criter.	-1.531173
F-statistic	0.362768	Durbin-Watson stat	2.031791
Prob(F-statistic)	0.944883		

Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.188569	Prob. F(7,36)	0.0586
Obs*R-squared	13.13483	Prob. Chi-Square(7)	0.0689
Scaled explained SS	9.680819	Prob. Chi-Square(7)	0.2074

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 07/28/23 Time: 16:10
Sample: 1976 2019
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.042877	0.091673	-0.467711	0.6428
LNRPI(-1)	-0.022484	0.014010	-1.604850	0.1173
LNRPUI	-0.011274	0.008215	-1.372327	0.1785
LNRPUI(-1)	0.015633	0.008373	1.867183	0.0700
LNRPUC	0.012185	0.020084	0.606719	0.5478
LNRPUC(-1)	0.017399	0.021892	0.794767	0.4320
RPPC	0.022390	0.032448	0.690051	0.4946
@TREND	3.97E-05	0.001028	0.038638	0.9694

R-squared	0.298519	Mean dependent var	0.007580
Adjusted R-squared	0.162120	S.D. dependent var	0.011378
S.E. of regression	0.010415	Akaike info criterion	-6.128243
Sum squared resid	0.003905	Schwarz criterion	-5.803845
Log likelihood	142.8214	Hannan-Quinn criter.	-6.007941
F-statistic	2.188569	Durbin-Watson stat	1.712670
Prob(F-statistic)	0.058626		

Ramsey RESET Test

Equation: UNTITLED
Specification: LNRPILNRPI(-1) LNRPUILNRPUI(-1) LNRPUC
RPPCPER C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.026186	37	0.3115
F-statistic	1.053058	(1, 37)	0.3115

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.011463	1	0.011463
Restricted SSR	0.414237	38	0.010901
Unrestricted SSR	0.402773	37	0.010886

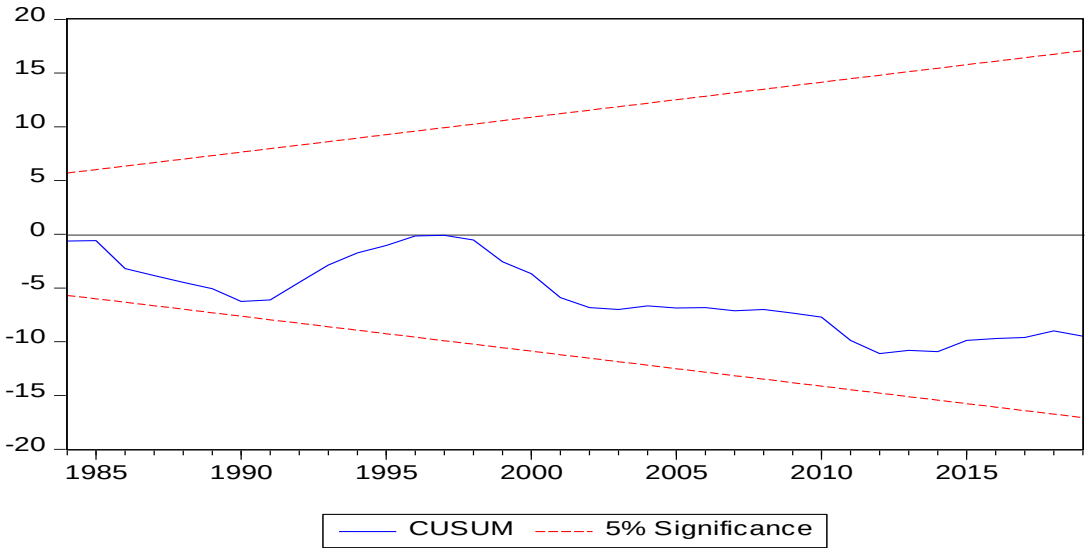
Unrestricted Test Equation:
Dependent Variable: LNRPI
Method: ARDL
Date: 07/22/23 Time: 15:56
Sample: 1976 2019
Included observations: 44
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPI(-1)	0.447075	0.291887	1.531669	0.1341
LNRPUI	-0.095518	0.078834	-1.211641	0.2333
LNRPUI(-1)	0.104162	0.083078	1.253788	0.2178
LNRPUC	0.305677	0.242816	1.258883	0.2160
RPPCPER	0.000802	0.003443	0.232929	0.8171
C	0.445200	1.568724	0.283797	0.7781
FITTED^2	0.036115	0.035193	1.026186	0.3115

R-squared	0.984684	Mean dependent var	4.933591
Adjusted R-squared	0.982200	S.D. dependent var	0.782028
S.E. of regression	0.104335	Akaike info criterion	-1.537512
Sum squared resid	0.402773	Schwarz criterion	-1.253663
Log likelihood	40.82526	Hannan-Quinn criter.	-1.432247
F-statistic	396.4606	Durbin-Watson stat	2.112809
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

CUSUM Test



CUSUM of SQUARES Test