Do International Crude Oil Price and Public Investment Affect Private Investment? An Empirical Analysis for a Large Emerging Economy

Manoranjan Sahoo[1], Mantu Kumar Mahalik[2] and Hrushikesh Mallick[3]

December 8, 2017

Abstract: Using the annual data, this study attempts to examine the impact of the international price of crude oil on private investment in India during the period 1980-2014, by endogenizing public sector investment, real interest rate, financial sector development, economic growth and economic globalization as other additional key determinants in a private investment model. This framework also serves as another additional objective of verifying whether public investment crowds out private investment or crowds in private investment of India. From our empirical estimation, we observed that crude oil price, public investment, and interest rate have detrimental effects on the growth of domestic private investment, whereas financial development, economic growth, and globalization help to boost up private investment. From a policy perspective, the study suggests that India should intensively shift its focus towards both production and consumption of renewable energy and tap other alternative potential sources of energy in order to offset the risks arising on account of India's heavy reliance on the imports of crude oil from other oil exporting countries. This study further urges that the role of international crude oil price, public investment, and real interest rate can't be under-emphasized while designing for a comprehensive growth and energy policy strategies for India in order to achieve a sustainable economic development of the economy.

Key Words: Oil Price, Private Investment, Public Investment, interest rate, Bayer-Hanck Cointegration & DOLS

JEL Codes: E22, F4, O10, Q31, Q32 & Q430

[1] Research Scholar, Department of Humanities and Social Sciences, Indian Institute of Technology Madras, India. (Corresponding Author: msahoo100@gmail.com)

[2] Assistant Professor, Department of Humanities and Social Sciences, National Institute of Technology (NIT), Rourkela, India.

[3] Associate Professor, Centre for Development Studies (CDS) Trivandrum-11, Kerala, India.

Note: *The paper is presented in the 10th International Research Conference organised by the Central Bank of Sri Lanka, Colombo held on December 8, 2017.*

1. Introduction

Economic theory points out that in the face of increasing international crude oil price, the countries with a high dependency on oil imports and low import elasticity of demand end up with higher current account imbalances.[4] The critical sectors in such economies which are sensitive to high international crude prices, would tend to reduce their investments and output, and hence contributing to lower savings to fund for increasing investment, required in other sectors of the economy and thereby resulting in increasing current account deficits (Kaminsky &Reinhart,1999; Kilian, Rebucci & Spatafora,2009). In this context, the study focuses on India, which is considered as the fourth largest oil importer in the world after the USA, China and Japan (U.S. Energy Information Administration, 2014). This shows India's high dependence on oil, as oil is used as a source of energy to augment production, consumption and investment activities in the economy. Therefore, any larger fluctuation in the oil price can significantly affect the overall economic activities of India.

Among the economic activities, the present study focuses on understanding the linkage between the movement of international crude oil prices and real domestic private investment for an emerging economy, India, which has been transitioning to a market economy since the period of 1990-91 by undertaking a number of reforms in respect of liberalization and globalization measures. Along with increasing population pressure on energy consumption, on the one hand, industrialization and urbanization resulting from India's gradual integration with the rest of the world on the other, are simultaneously putting increasing demand pressures on the use of crude oil energy in India. Thus, the expansion of macroeconomic activities are not only the causes of more demand for crude oil energy but also can greatly be responsible for the changes in the pattern of crude oil energy usages along with a change in the overall composition of energy demand from various sources of energies. Therefore, the countries with their economic progress and prosperity have gone in for production and consumption of more cleaner forms of energy (such as electricity, natural gas and solar power etc.) and, in some cases they have also gone in for substituting the import of most cleaner forms of energy in place of crude oil and other traditional forms of energies. There are also natural and financial resource constraints which limit the production and usage of these cleaner forms of energy sources for the individual countries more especially in the context of developing world. Nevertheless, even in the most advanced countries around the globe, one would also observe that along with a rise in the use of cleaner forms of energies, there is still

[4]See Table A1 in Appendix.

an increasing use of these crude forms of oil energies. Therefore, the advanced countries such as the USA and Europe are still heavily using crude oil energy along with the other cleaner forms of energies in their economic activities. As a consequence, these advanced countries have majorly been responsible for accumulated carbon emissions in the atmosphere than the less developed economies, and this has got more externality or spill over effects in terms of climate change and thereby causing natural disastrous in various regions of the planet to which the developing countries are party to it.[5] The basic point is that the countries might be economically progressive but the gain in economic progress sometimes may trade off with the cost to the environment, the consequences of which the countries and international organizations are quite well aware of and are working to mitigate such avoidable environmental risks imposed on the future. However, the concern of the present paper is not to address the environmental quality as a result of carbon emissions or air pollution. Rather, it tries to establish the interaction of energy prices which goes as an input cost into private investment or production, whether it has any effect on private investment in emerging economies like India.

The rate of investment is known to be a basic determinant of growth and prosperity of an economy. Therefore, at any point in time, investment should not be curbed from its expansion. Rather, economies need to augment their private investment to its desired levels for achieving a higher level of growth and welfare. There are also evidences for developing countries context, which suggest that private sector investment than public sector investment is the key to attaining higher growth (Khan and Reinhart, 1990). The inefficiencies are observed to be largely associated with public sector investment especially during the controlled regime where there was dominancy of the public sector. This has stimulated further research in investigating the determinants of private investment especially for the developing countries' context (Chhibber et al. 1992.; Serven and Solimano, 1993). However,

[5]Now the international statistics point out that the developing countries like China and India are not less emitters of carbon dioxide although the advanced countries are the major contributors in terms of accumulated emissions and climate change. For instance, China after registering as world's highest CO_2 emitter since 2008, its share of carbon emissions has reached to 25% of the global greenhouse gas emissions in 2012, and had further risen to 29% of the total greenhouse gas emissions in 2015. Air pollution has become one of the most crucial environmental issues in China as well as in India. China's environmental deterioration and vulnerability has seriously threatened the physical and psychological health of the Chinese citizens and has dented China's international image (Zhang and Hao, 2016). China, USA, India, Russian Federation, Japan, Germany, Korea and Canada, Iran and Saudi Arabia are the top ten emitter countries in the world which almost accounted 2/3rd of CO_2 emissions in the world by the year 2013, with the shares of China (28%) and the United States (16%). Combined, these two countries, alone produced 14.1 GtCO2 out of global total of 32.2 $GtCO_2$ in 2013. Further, in 2015, the five largest emitting countries and the European Union, together accounted for two thirds of total global emissions. Those are China (with a 29% share in the global total), the United States (14%), the European Union (EU-28) (10%), India (7%), the Russian Federation (5%) and Japan (3.5%).

several uncertainties can be associated with the private sector investment besides the international oil price fluctuations and price of various other inputs, demand and exchange rate fluctuations. The econometric evidence indicates that rate of private investment is positively related to real GDP growth, per capita GDP, and the rate of public sector investment, and negatively related to real interest rates, domestic inflation reflecting the prices of raw materials used in manufacturing and investment activities among other things (Greene and Villanueva, 1991).

In the Indian context although international crude oil (and gas) prices are domestically regulated, and hence likely to bear weak relationships with the movement of the domestic price of crude oil (and gas), however, the international prices of crude oil are still likely to have significant influences on the private investment[6]. Therefore, examining the relationship between private fixed investment and crude oil energy prices has crucial implication towards the macro policy stability, besides endogenizing all other determinants of private investment in a model of private investment. The investment model developed here is based on the framework of neo-classical literature. Although it is realized that there is a greater likelihood of international oil prices directly and immediately affecting the domestic crude oil prices and thereby the private investment only in recent years, however, we could not divide the data into two sub-periods on the basis of these two regimes – administered/controlled regime and liberalized regime. This is on account of the fact that the changed regime spans only for few years to explore any clear statistical relationships between the oil price and the private investment. Rather, we tried to account this changed economic environment in our statistical modeling by putting a dummy variable in the model while using the annual observation.

Looking at the sectoral use of crude oil in India, it shows that there is also a dramatic change in the pattern of crude oil consumption, as there is a shift in the consumption share of oil from agriculture and industry and transport and power generation sectors to the miscellaneous service sector. This implies that the traditional sectors which had been increasingly relying on crude oil energy sources, their reliance have drastically gone down. Instead, the emerging sectors under the miscellaneous categories are consuming significant shares of the total crude

[6]During the regulated regime, the domestic prices of crude oil and gas in India were often revised after a time gap from the date of revision taking place in the international markets. While petrol price was freed from government control in June 2010, diesel prices were deregulated in October 2014. From May 2017, the prices of petrol and diesel are revised on daily basis in accordance with the changes in international rates, much like what happens in most of the advanced markets. Thus, the oil companies now have the freedom to revise rates, which earlier often have been guided by political considerations.

oil consumption in India.[7]Nevertheless, one does not know the reasons for such decrease in the share of consumption of these traditional sectors in the total crude oil consumption. This phenomenon has given rise to a range of questions such as, whether it is the rise in international crude oil prices which can be one of the major factors explaining this decrease in the share of crude oil consumption in India? Or, it is the pattern of the growth of those sectors itself has been responsible for such pattern in the share of crude oil consumption? Or, there is any qualitative shift in the energy consumption of crude oil to using the cleaner forms of energy sources for those latter sectors, which are quite crucial issues for the policy. If international oil prices are affecting the industrial use, then it has a significant bearing on the energy and industrial policies of the economy. In view of this, the study has aimed at examining the implication of crude oil price on private investment to understand whether crude oil price is affecting the private investment in an emerging economy like India.[8]The relationship of linking international crude oil and investment along with other factors affecting private investment demand is quite crucial for a country like India where the population is growing at a rate of 1.2 percentage (2016) and where investment rate (gross fixed investment to GDP i.e. the great ratio) has been sliding over the years. For instance, the gross fixed investment as a percentage of GDP which was 35.57% in 2005 has slid down to 29% in 2015 (As per NAS, 2017).[9]

It is known that the emerging non-oil economies have limited capacity and financial resource constraints to invest and produce more subtle forms of cleaner energy and also use those energy sources more intensively in different sectors. Therefore, their demand for these traditional energies is still increasing along with a slow and gradual discovery of other modern sources of energies. Since many of the large emerging economies like India and China have very limited oil mineral deposits, they continue to import a significant portion of crude oil energy from the Gulf and other major oil producing countries of the world. As a result, when the international crude oil price shoots up due to any exogenous factors (like excess demand for crude oil or speculative forces in the international market), the oil

[7]See the Table A2 and Table A3 in Appendix.

[8]Although most of the manufacturing firms or investment companies do not directly consume the crude oil, they do consume petroleum products such as gasoline, heating oil and jet fuel which are all processed from crude oil. And, the prices of these petroleum products also closely move in line with the price of crude oil. Since the rise in oil prices represent an increased cost of doing business and without a corresponding rise in revenues, it can lead to a reduction in profits and discourage the investment.

[9]The population growth rate although consistently declining over the years but India is still one of the highest populated economies in the world. The highest growth was attained in 1970s (2.45% in 1973 and 1974) and slide down to 2.09% in 1990 and since then it is declining to attain at 1.2% in 2015.

importing countries are likely to experience retrenchment of economic activities as well as often severe imbalances in their balance of payments (BOPs), which immediately gets reflected in the deterioration of their trade balance and current account deficits in their respective BOPs.

Since India imports huge amounts of oil from the Gulf and other oil exporting countries, it is important for policy makers, economists and environmental scientists to understand the role of international crude oil prices on the dynamic evolution of real domestic private investment activity in India along with capturing the effects of public investment, real interest rate, financial development, economic growth and globalization as other key determinants of the private investment function. To our best knowledge, there is no published research works so far which has examined this issue for India. In an attempt to empirically address this unaddressed research issue, this study would contribute to the empirical and energy economics literature on many counts. Firstly, Zivot-Andrew (1992) test is used in order to accommodate the single structural break arising in the series. Secondly, the Pesaran's et al. (2001) Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration is used to confirm the presence of long-run relationships between international crude oil prices, private investment, public investment, financial development, economic growth and economic globalization in India. Thirdly, the combined cointegration test recently proposed by Bayer-Hanck (2013) is also utilized to check the robustness of cointegrating results with ARDL model. Fourthly, the dynamic ordinary least squares (DOLS) and fully modified OLS (FMOLS) techniques are also employed to justify the long-run empirical estimates obtained from ARDL model estimation. Finally, in the same framework, our study also tries to empirically examine whether the public investment ''crowds out'' or ''crowds in'' private domestic investment in India. It is also the fact that hardly authors have explicitly allowed bringing the role of structural change as a result of financial liberalization and other policy reforms influencing the private sector investment in India in their models of private investment. This is because the financial liberalization measures are likely to alter the estimated parameters in investment model as a result of relaxation of credit constraints and the increased influence of borrowing costs on investment decisions in periods of financial sector development. By considering all these factors, the study tries to deviate from the existing studies in the Indian context.

The remainder of this study is organized as follows. Section 2 highlights historical challenges facing India in achieving a higher rate of investment and economic development. Section 3 reviews related studies on determinants of private investment. Section 4 demonstrates the

theoretical construction and data sources along with empirical methodology used in the analysis. Section 5 discusses the empirical results. Section 6 concludes with key findings and its policy implications.

2. Historical challenges facing India in achieving high rate of investment and rapid economic development

Soon after India's independence in 1947, the stagnation of industry was quite abysmal over a half of the century. In the first five year plan (1951-56), the emphasis was on the growth of industrialization acting as a key factor to alleviate poverty in the country. Eventually, in the second five-year plan (1956-61), a strong planning system in India had emphasized the growth of the public sector and also driven the industrialization rapidly. Contrasting with the East Asian experience, which went for a strong and vibrant private sector industrialization initiative, India opted for state control over key industries. Believing that the potential contributions from agriculture and exports are limited, the Indian governments taxed agriculture by skewing the terms of trade against it and rather placed emphasis on import substitution. For industrialization, it was felt that there was a need for technical education.
Therefore, the government went up for investing in general education.
Given the large fiscal deficits (8.4 % of GDP in 1985) which contributed to rising current account deficits and thereby leading to the surfacing of twin deficit hypothesis, the Indian government during the sixth plan period (1980-85) had promoted the growth of privatization by-passing the role of public sector investment. Despite such efforts, the India's economy growth in the later period of seventh plan (1985-90) and in the beginning of annual plan periods (1990-91 & 1992-1992), was in a critical zone as foreign exchange reserves were dwindled to a very meagre amount by mid-1991 which could only support two weeks of India's total imports. Moreover, the deficits and debt also reached to very high levels and gave rise to rising interest payments burden on India's foreign debt. Neither the central government nor the state governments could continue to finance both the subsidies and heavy public investment. In such circumstance, the Indian government at the beginning of eight plan period (1992-97) initiated liberalization reform measures and incentivized the private and foreign investments into the economy through various incentive schemes. Thus, the impending bankruptcy drove the reform process and changed the state's role from that of the principal investor to that of facilitator of entrepreneurship and setting up a level-playing field. This shift was expected to free up government finances for more social spending, but in practice, the fiscal crunch prevented a significant increase in government spending on critical

infrastructures, industrialization, and urbanization. The government abolished most industrial and import licensing, devalued the rupee twice in a single month, drastically reduced the import tariffs, liberalized the financial sector and foreign investment, and allowed private investment in areas previously reserved for the government.

During 9th (1997-2002) and 10th (2002-2007) plan periods, the Indian government also took very positive and pragmatic initiatives in direction of a gradual shift in policy towards raising the rate of investment along with attracting the foreign investment into the economy. However, it resulted in the withdrawal of labor forces from the public sector industries through voluntary retirement scheme and also resulted in public sector disinvestment and divestment to the private sector and foreign private entities. Nevertheless, the formidable challenges remained as the rate of industrial growth did not pick up as fast as desired. Rather stayed stagnant as reflected from the gross capital formation which was almost less than 10% of the GDP over a longer period. On the other hand, the Asian tigers continued to grow on a solid growth path with a higher rate of investment as a ratio to their GDPs in the after math of the crisis faced during 1997-98. India required massive infrastructural investments, urbanization first and then industrialization in order to encourage private domestic private and foreign investments.[10]This is also essential for the Indian economy to go for the massive attraction of domestic private and foreign investments, especially in the presence of growing globalization, higher poverty, wide income inequality and regional imbalance economic development.

During eleventh plan period (2007-11), a greater emphasis was given on inclusive development and the government introduced many popular schemes like 100 days rural employment under national rural employment guarantee scheme (2006) and housing to the rural poor so as to remove rural poverty and achieve faster progress in the economy by undertaking a number of welfare promoting measures having significant spillover impact on the society, in terms of by setting up a number of IITs and Central Universities as a catalyst to

[10]By analysing the key economic indicators of both the emerging developing economies (China and India) during 1980-2014, it would give some hindsight about the success story of Chinese economy why it is able to attract higher rate of private and foreign investments and achieve greater inclusive economic development than the Indian economy. Part of the reason could be China had been incisively emphasising on building up mass necessary infrastructures to connect various regions within the country, and designing investor-friendly institutional policies in order to achieve higher rate of industrial growth. This also led to urbanisation and that in turn leading to further investment boosted the growth process. In contrast, the Indian economy although initially emphasised on industrialization but failed in expanding the growth of necessary infrastructures, and designing policies for providing investment-friendly environment to the investors. There is a greater divide between urban and rural places in terms of economic development as policies followed did not boost industrialisation and urbanisation. Without inclusion of the rural economy in the process of economic development, it has resulted in lopsided development as development got concentrated only in few places. This can be referred to as centralised or secluded development.

build up human capital resource base to achieve faster economic growth.[11] But the economic policies did not yield a desired successful result to the desired extent due to redetapism and inefficiencies in implementation and corruption in public offices and beyond.

The present government under the twelfth plan period (2012-17) has also taken a number of concrete measures for removing rural poverty along with placing greater emphasis in attracting foreign investors with "Make in India" campaign and started up rural sanitation programs under the umbrella of Swachh Bharat Mission''. It has also tried to make the Indian cities more attractive places to live and invest by making them model cities in the 21st century along with the launching of Swachha Bharat Abhiyan policies. [12] However, the challenge still remains ahead as India has not been a successful country in leveling up its per capita income and manufacturing growth rate and attracting foreign investors comparing other successful emerging economies like China and South Korea within Asian region and the advanced economies of the West. China which was falling behind India's economic progress a way back, now it is rising at a faster rate and found much progressive well ahead of India in many economic parameters of urbanization, industrialization, and infrastructure development. It seems the Indian government unless taking concerted move in areas of infrastructure, industrialization, urbanization, scientific innovations and industrial research, industrial and other institutional reforms and making the economy a business friendly, it would be difficult to aspire the economy to achieve any greater strides in industrial and overall progress and attain the level of development that of a developed country like USA and UK.

The following graphs plotted in Figures 1 and 2 also reflects why India is dragging behind in terms of economic growth and per capita incomes comparing two other recently well performing or successful emerging Asian economies. The figures reflect that India is historically lagging in terms of gross fixed investment as its trend is below the trends of Korea and China. In recent years, there is a convergence of investment rate of India and Korea on account of falling investment rate in Korea, while there is a greater divergence of investment rate between India and China on account of the faster growth of investment in

[11]The Mahatma Gandhi National Rural Employment Guarantee Act (NREGA) of 2006 provides a legal guarantee of at least 100 days of paid work every year to adult members as long as they are willing to perform unskilled manual work for the government. The government also enacted the Right of Children to Free and Compulsory Education Act of 2010 which declared the education a fundamental right of every child between the ages of 6 and 14, along with introducing the Right to Food bill. The bill puts the legal onus of providing food to two-thirds of the entire Indian population on the government. The program stipulated that 75% of the rural population and 50% of urban population will receive five kilograms of rice/wheat/coarse grain such as *bajra* at 3, 2 and 1 rupees respectively per kilogram.

[12] Make in India' campaign has recognized ease of doing business' as the single most important factor to promote entrepreneurship. A number of initiatives have already been undertaken in this respect.

China. However, when we compare the private investment rate as a percentage of GDP between India and China (as the same statistics is not available for Korea), it shows that China is falling behind India only in recent years. This could be an increase in Chinese investment rate by the private sector outside their economy and increase investment rate by the Chinese government within its domestic economy comparing India's case.

Many authors argue that India has transformed into a service sector led economy by passing over the stage of industrialization. This could be due to the low rate of investment by the public sector along with persistence of unconducive economic climate which was unattractive features for greater domestic private investment. Since the recent government policies are targeting towards making the economy more business friendly along with an emphasis on improving the critical infrastructures of the economy, the measures may provide greater leverage to the economy for faster economic development and achieve many desirable results. However, all it depends on the effectiveness of those policies, with what level of efficiencies they are being executed.

Figure 1: Gross fixed capital formation (as a percentage of GDP) of India comparing China and Korea (1960-2015).

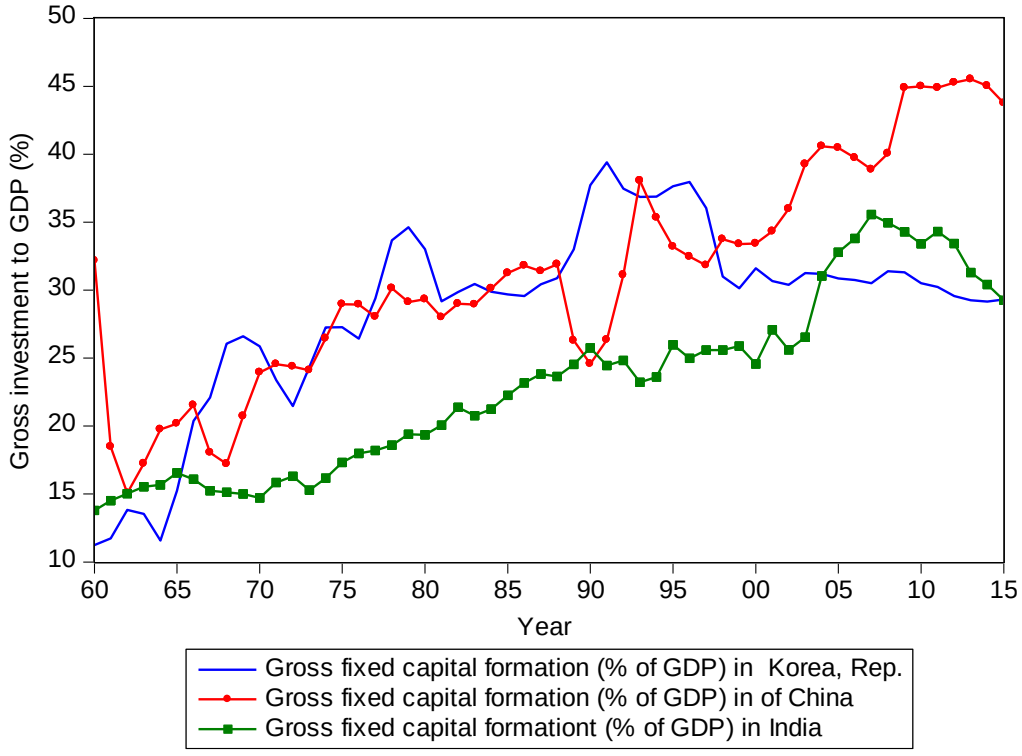
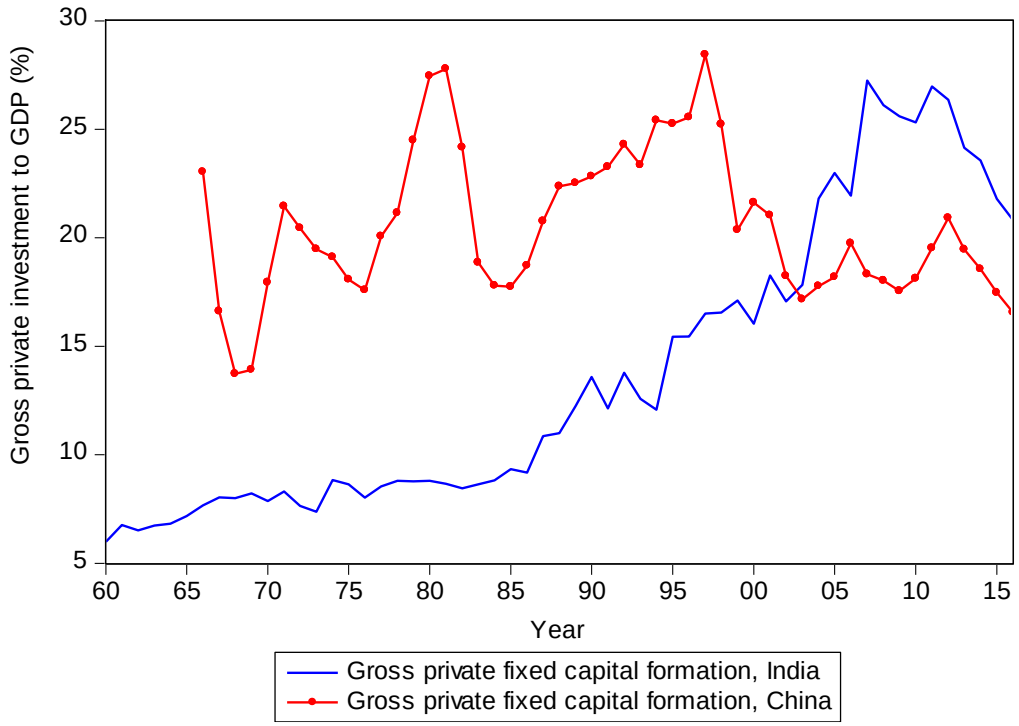


Figure 2: Gross private fixed capital formation (as a percentage of GDP) of India comparing China, 1960-2016



3. Related studies on the determinants of private investment

3.1. Energy price-investment nexus

After doing a careful survey of the literature, to our knowledge, the contemporary research lacks consensus on nature and extent to which rising oil prices have impacted on private investment in oil importing countries like India at the macro level. However, there are significant amounts of literature which tried to analyze the issue at the firm level for other countries' context. For instance, Uri (1980) evidenced the significant effect of energy price on investment of high intensive energy industries in the USA. Lee and Ni (2002) also studied the effect of oil price shocks on demand and supply of fourteen industries in the US and found the adverse effect of rising oil prices on energy producing and consuming industries. Jimenez-Rodriguez (2008) used structural VAR model to explore the effects of oil price shocks on the output of the key manufacturing industries in six advanced countries. Their results evidenced the heterogeneous effects of rising oil price shocks on manufacturing output in most of the industries. Henriques and Sadorsky (2011) in their panel study confirmed the evidence of a U-shaped relationship between oil prices and investments in the USA, indicating that investment initially declines with increasing oil price volatility and then increases after reaching a threshold level of rising oil price volatility.

By using panel data for 25 industries, Ratti et al. (2011) examined the effect of energy price on investment and found the significant and adverse effect of energy price on firm investment in 14 out of 15 countries. In a similar vein, Sadath and Acharya (2015) studied the effects of rising energy price on the investment of Indian manufacturing firms. The results estimated from the generalized method of moments (GMM) evidenced the negative and significant effect of energy price on investment of Indian manufacturing firms. This implies that a rise in energy price is detrimental to the investment of Indian manufacturing firms.

Nazlioglou et al. (2016) explored the role of spot oil price shocks on six asset types of real estate investment trusts (REITs) categories, such as residential, industrial, retail, healthcare, hotels, and mortgages and found the unidirectional causality running from oil prices to all REITs except the mortgage. The reverse causality is observed for the mortgage REITs. Wang et al. (2017) explored the impact of international oil price uncertainty on corporate investment in the Chinese economy and found a negative impact of oil price uncertainty on corporate investment. Moreover, the negative impact of oil price uncertainty on corporate investment is more pronounced for non-state-owned listed companies compared to the state-owned listed ones.

3.2. Globalization-investment linkage

Driffield and Hughes (2003) found the positive impact of inward foreign direct investment (FDI) on domestic investment (DI) for the UK. They further observed the crowding out the effect of inward FDI on DI in some regions of UK. Adams (2009) explored the impact of FDI on DI in a panel of 42 Sub-Saharan African countries and confirmed the presence of a U-shaped relationship between the series, indicating that FDI initially reduces DI and then it adds up to DI in the later period. Eslamloueyan and Jafari (2010) evidenced that greater trade openness is positively associated with higher capital mobility in case of 21 Asian countries. Bahmani-Oskooee and Chakrabarti (2005) observed that capital mobility becomes stronger for open economies due to greater trade openness in case of 126 countries. Payne and Kumazawa (2005) observed that trade openness has appositive and significant impact on capital mobility in case of 29 Sub-Saharan African countries.

Amirkhalkhali and Dar (2007) also found the increasing effect of trade openness on capital mobility in case of 23 OECD countries. Fouquau et al. (2008) indicated that saving-investment relationship is mostly influenced by the degree of openness in case of 24 OECD countries. They further found that capital mobility is higher in countries with the larger degree of openness. By using panel data for 85 countries, Kim and Suen (2013) found that trade openness is not beneficial for human capital investment in less-financial developed countries but beneficial for countries with opposite attributes. In contrast, they also observed that FDI promotes the human capital effect of domestic

investments in less-financial developed countries but hinders it in countries with having opposite attributes. Wang (2010) indicated that the effect of inward FDI on domestic investment varies across a sample of 50 developed and developing countries.

3.3. Financial development-private investment linkage

Huang (2011) observed the existence of bi-directional causality between private investment and financial development in case of 43 developing countries. The result further indicated that financial development adds in private investment. Misati and Nyamongo (2011) also found that financial development promotes private investment in case of 18 Sub-Saharan African countries. Ndikumana (2000) indicated that financial development stimulates private investment in the case of 30 Sub-Saharan African countries. In contrast, Erden and Holcombe (2005) reported that financial development retards private investment for developing economies. Luca and Spatafora (2012) indicated the positive and significant effects of capital inflows and financial development on domestic investment for developing countries. They further revealed that capital inflows matter more than financial development in explaining domestic investment.

3.4. Public investment-private investment nexus

Ramirez (1994) observed that public investment significantly complements private investment for Mexico. Erden and Holcombe (2005) found that public investment complements private investment for developing economies, whereas it crowds out private investment for developed countries. Afonso and Aubyn (2008) found that the crowding-in effect of public investment on private investment varies across 14 European Union countries. Cavallo and Daude (2011) reported the crowding in effect of public investment on private investment for a panel of 116 developing countries. Li and Wei (2009) found that government expenditure crowds in private investment in China. Xu and Yen (2014) reported the varying crowding out effects of public investment on private investment in China. This implies that government investment on public goods in China crowds-in private investment, whereas government investment in private goods crowds-out private investment significantly. Dreger and Reimers (2016) also evidenced that lack of public investment may restrict private investment in the Euro area.

In the context of India, the finding of Mitra (2006) is consistent with the results of Pradhan et al. (1990) and Sahu and Panda (2012) who reported that government investment crowds out private investment in the short-run. Rath and Bal (2014) found that public investment neither crowds out nor crowds-in private investment in India. In case of the Indian economy, Bahal et

al. (2015) found that public investment crowds out private investment with annual data analysis is and vice-versa followed by the quarterly data.

3.5. Interest rate-investment nexus

Green and Villanueva (1991) reported the adverse effect of interest rate on private investment in case of developing countries. Similarly, Misati and Nyamongo (2011) reported the adverse and significant effect of interest rate on private investment for 18 Sub-Saharan African economies. These findings are consistent with the study of Dreger and Reimers (2016) conducted for the Euro Area.

After doing this comprehensive literature survey, we observed that there is a literature gap in understanding the impact of oil price on private investment for a large developing economy like India which mainly relies on major oil-exporting countries in the Gulf for importing its oil energy. Therefore, this motivates us to contribute to existing literature by empirically examining the impact of crude oil price on private investment in India when India is facing energy scarcity with its rising economic activities along with current account balance problem.

4. Theoretical Framework, Data Description, and Estimation Strategy

4.1. Theoretical Framework

The theoretical model specified here is based on the flexible accelerator model originated by Chenery (1952). Following Blejer and Khan (1984) long run accelerator model, the desired stock of capital can be assumed to be proportional to the expected output:

$$KP_t^* = \alpha YR_t^e \tag{1}$$

where KP^* is the capital stock that the private sector wishes to have in place in futures, and YR^e is the corresponding expected level of output. It is assumed that the underlying production function has (technologically) fixed proportions among factor inputs, so that factor prices do not enter into the specification. Whereas the parameter α is assumed to remain constant and KP_t^* is assumed to be influenced due to changing economic conditions so that the model does fit into the flexible accelerator model. Lags in the adjustment of actual investment that arise because of time it takes to plan, build, and install new capital. There is a partial adjustment to the capital stock, whereby the actual stock of capital is assumed to adjust to the difference between the desired stock in period t and the actual stock in the previous period:

$$\Delta KP_t = \beta(KP_t^* - KP_{t-1}) \tag{2}$$

Or,

$$KP_t = \beta KP_t^* + (1-\beta)KP_{t-1} \tag{2a}$$

where KP is the actual private capital stock, so that ΔKP is the net private investment, and β is the coefficient of adjustment, $0 \le \beta \le 1$.

The formulation given in equation (2), or (2a), is in terms of net private investment, whereas the data on investment are available only in gross terms, including depreciation. Equation (2) is therefore transformed into gross investment terms in order to derive an empirically estimable equation. Thus, the gross private investment, IP_t, is defined as equal to net investment plus depreciation of the previous period's capital stock:

$$IP_t = \Delta KP_t + \delta KP_{t-1} \tag{3}$$

where δ is the rate of depreciation. In standard lag-operator notation, equation (3) can be written as:

$$IP_t = [1-(1-\delta)L]KP_t \tag{4}$$

where L is a lag operator, $LKP_t = KP_{t-1}$. By simply inverting equation (4), we can relate the private stock of capital to gross private investment:

$$KP_t = \frac{IP_t}{[1-(1-\delta)L]} \tag{5}$$

Now by substituting for KP_t and KP_{t-1} from equation (5) in equation (2a), one will obtain the following:

$$\frac{IP_t}{[1-(1-\delta)L]} = \beta K_t^* + (1-\beta)\frac{IP_{t-1}}{[1-(1-\delta)L]} \tag{6}$$

This can be solved in terms of the following equation (7):

$$IP_t = [1-(1-\delta)L]\beta K_t^* + (1-\beta)IP_{t-1} \tag{7}$$

Similarly, by substituting K_t^* from equation (1) into (7), one can easily derive a basic dynamic accelerator model for gross private investment:

$$IP_t = \beta\alpha[1-(1-\delta)L]YR_t^t + (1-\beta)IP_{t-1} \quad (8)$$

The above equation (8) has an important merit. Although it is fully consistent with the original capital stock model represented by equation (1) and (2), however, it does not require information on net investment or the stock of capital. It can be readily applied to available gross investment data for developing countries' context where the statistics on net private investment is very hard to obtain.[13]

To allow private investment to vary with underlying economic conditions, and thus to make the model consistent with the flexible accelerator framework, we follow the approach suggested by Coen (1971). In essence, the response of private investment to the gap between desire and actual investment, as measured by the coefficient β, is assumed to vary systematically with economic factors that influence the ability of private investors to achieve the desired level of investment. We hypothesize that the response of private investors depends on three main factors: (1) the stage of the cycle, (2) the availability of financing, and (3) the level of public sector investment.

In our model, instead of adjusted output, we have directly considered the growth rate of net output affecting the private investment which can be measured by the growth rate of Net National Product at factor cost (NNP).

[13]An alternative way of deriving equation (7), and equation (8), would involve directly specifying a partial adjustment function for gross investment, as follows:

$$\Delta IP_t = \beta(IP_t^* - IP_{t-1}) \quad (9)$$

Whereas IP^* is the desired level of investment. In the steady state, desired private investment can be given as

$$IP_t^* = [1-(1-\delta)L]KP_t^* \quad (10)$$

Combining equations (9) and (10) and solving for IP_t would yield an equation which would be exactly same as equation (7).

During the expansionary phase of the cycle, when demand conditions are buoyant, private investors can be expected to respond more rapidly to changes in desired investment. If the trend or potential output is taken as an indicator of full capacity, then the reaction of investment to the discrepancy between the desired and actual rates of investment would be smaller when actual output is above the capacity and more strain is put on available resources, leading to an increase in input prices. Alternatively, the investment could respond more rapidly in situations of excess capacity. It is, therefore, not entirely clear what effect, on average, cyclical factors can be expected to have on the change in private investment.

The effect of the availability of financing on the coefficient of adjustment is less ambiguous. A clear consensus has emerged in recent a year that, in contrast to developed countries, one of the principal constraints on investment in developing countries is the quantity rather than the cost, of financial resources (Furstenberg, 1980). The rates of return on investment in these countries typically tend to be quite high, whereas real interest rates on loanable funds are kept low by governments for a variety of reasons. In such circumstances, the investor cannot be expected to equate the current marginal product of capital to its service cost. The fact that the total amount of financing is limited and the price mechanism is not allowed to operate smoothly as there is a lot of imperfection in the financial market. Therefore, it would seem legitimate to hypothesize that the private investor in a developing country is restricted by the level of available credit from the banking system. Any effect exerted by the rate of interest on private investment is not direct within this rationing framework but, rather, occurs via the channel of financial savings.

An increase in real credit to the private sector, in general, is supposed to encourage real private investment, and rolling over the bank loans can sufficiently lengthen the maturity of the debt. There is a role of foreign capital flows into the domestic economy as it flows into the system either in the form of direct investment or portfolio investment (Weisskopf, 1972; Stillson, 1976; Tun Wai and Wong, 1982). The effects of foreign financing are broadly similar to the effects of variations in bank credit as both tend to increase investment because they expand the pool of financial savings.[14] As control of total bank credit usually is the principal instrument of monetary policy in developing countries where there is less independence of the central banks in exercising their monetary policy obligations (Furstenberg and Malkiel, 1977). The less independent central banks exercise monetary policies only by varying the composition of credit between the public and private sectors, and

[14]A theoretical discussion of how an increase in foreign capital flows can increase total financial savings is contained in Khan and Knight (1982).

the government through its controlled or restrictive policies affects the speed and ability of private investors to respond to achieve the desired levels of investment. Monetary policy can thus have an indirect and potent influence on the rate of private investment. In a similar vein, private investment can be influenced by interest rate and exchange rate policies that can cause changes in private capital flows, which augment or reduce financial resources available to the private sector. This is likely to be captured through the incorporation of globalization indicator in our model.

It is well accepted proposition that in developing countries private and public investment are related (Galbis, 1979; Heller, 1975; Tun Wai and Wong, 1982; Sundararajan and Thakur, 1980), although there is considerable uncertainty about whether, on balance, public sector investment raises or lowers private investment (Furstenberg and Malkiel, 197). In broad terms, public sector investment can cause crowding out if it greatly utilizes scarce physical and financial resources that would otherwise be available to the private sector, or if it produces marketable output that competes with the private sector output. Furthermore, the financing of public sector investment - whether through taxes, issuance of debt, or inflation- would lower the resources available to the private sector and thereby depress the private investment activity. Yet public investment that is related to infrastructure and provision of public goods can also clearly be complementary to private investment. Public investment of this type can enhance the possibilities for private investment and raise the productivity of capital, increase the demand for private output through increased demand for inputs and ancillary services, and augment overall resource availability by expanding aggregate output and savings.

The overall effect of public investment on private investment will, therefore, depend on the relative strength of these various effects, and there is no a priori reason to believe that they are necessarily substitutes or complements. Assuming that the possibility of financial crowding out is taken into account by incorporating the availability of commercial bank credit to the private sector and private capital flows, our specific concern here is with real aspects of public sector investment. If on average public and private investment are substitutes, we would expect the coefficient of adjustment of private investment would be smaller as the rate of public investment increases; and conversely, the complementarity would imply a faster response of private investment.

Finally, many of the recent studies have emphasized on the role of oil price on the private investment behavior (Henriques and Sadorsky, 2011; Wang et al., 2017). The studies argue that oil price rise has an adverse impact on the private investment as a result of either adverse

effect on the demand for output or increase in the cost of production (Sadath and Acharya, 2015).

Given this theoretical background, our augmented investment function for private investment demand can be expressed as follows.

$$PRI_t = f(OP_t, IR_t, PUI_t, FD_t, GR_t, GLOBAL_t) \quad (11)$$

whereas, PRI_t refers to private investment (as % of GDP), OP_t denotes international oil price, IR_t is the real interest rate, PUI_t is public investment (as % of GDP), FD_t is the financial development, GR_t is the real GDP growth and $GLOBAL_t$ denotes a measure of economic globalization.

For the purpose of our empirical estimation, the above investment demand function in Eq. (11) can be expressed as follows:

$$PRI_t = \beta_1 + \beta_2 OP_t + \beta_3 IR_t + \beta_4 PUI_t + \beta_5 FD_t + \beta_6 GR_t + \beta_7 GLOBAL_t + \varepsilon_t \quad (12)$$

4.2. Data source and variable descriptions

The study uses the annual data for the period of 1980 to 2014 sourced from the World Development Indicators (WDI) of World Bank. The time period is selected based on the availability of data set as the study intended to cover the historical data to uncover the long-run relationships among the variables in the estimated model. It has been seen that significant economic changes have been initiated by major individual economies across the globe through the liberalization and globalization measures (financial globalization) since the period of 1980. Considering this as the pickup period of globalization, our study especially focuses on the post globalization period for the empirical analysis. The major variables used in this study are private investment as a percentage of GDP, international real crude oil price, real interest rate, public investment as percentage of GDP, domestic credit to the private sector as percentage of GDP (financial development)[15], real GDP growth and economic globalization index. The crude oil price is taken as the real Brent crude oil price in terms of US dollar per barrel. For capturing the measures of globalization, we have considered

[15]We chose domestic credit to the private sector as a measure of financial development because of this existing literature (Shahbaz et al. 2016, Shahbaz et al. 2017, and Mahalik et al. 2017).

Dreher's (2006) economic globalization index.[16] Table 1 presents the description of variables along with their data sources used for our empirical analysis.

Table 1: Variable description and their sources

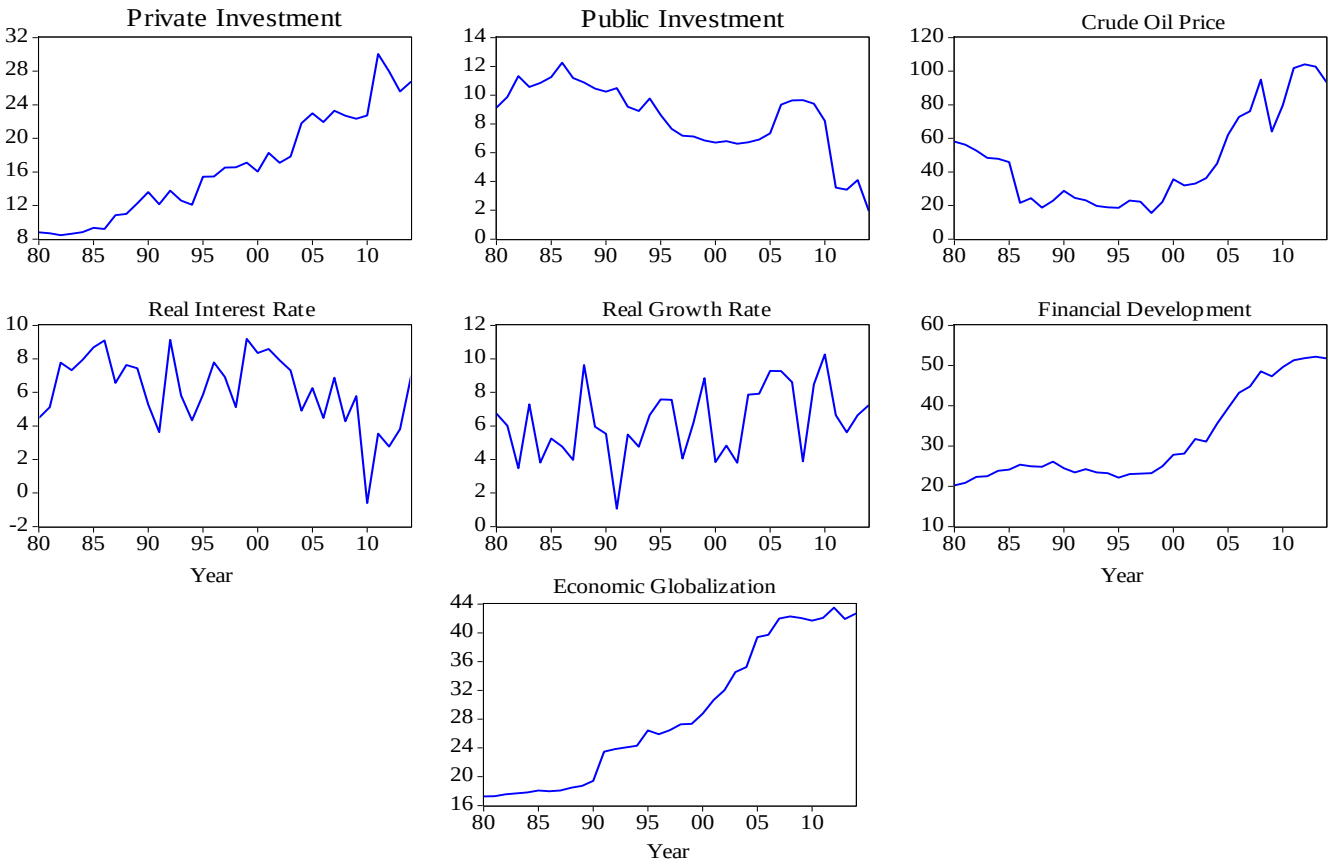
Variables	Definition	Data Source
Private investment (PRI)	Gross private fixed capital formation(% of GDP)	WDI
Real oil price (OP)	Crude oil, Brent, $/bbl, real 2010 US $	WDI
Real interest rate (IR)	Real interest rate (%)	WDI
Public investment (PUI)	Public fixed capital formation (% of GDP)	WDI
Financial development (FD)	Domestic credit to private sector (% of GDP)	WDI
Growth rate (GR)	Real GDP growth (annual %)	WDI
Globalization (GLOBAL)	Economic globalization index	Dreher (2006)

Furthermore, Figure 3 represents the trends of key variables used in our analysis. This shows that while private investment as a percentage of GDP, crude oil price, financial development and globalization show an increasing trend, the public investment as a percentage of GDP has been registering a decreasing trend. The interest rate, with some fluctuations before 2000 where it had a declining tendency, is showing increasing trend after 2010. On the other hand, the trend of economic growth rate indicates that the growth rate of India is almost moving around its mean and there has been some upward movement in the recent past. The Figure3 although presents useful information regarding the movements of different macroeconomic indicators but at the same time it raises several important questions. *First,* India is considered as the fourth largest oil importer in the world after the US, China, and Japan. Thus a high rise in the oil price can adversely affect its domestic investment as oil is considered as one of the most important energy input sources. Heavy oil imports can also destabilize the current account balance in the BOP and hence can be a risk to the domestic economy. *Second*, as India has been experiencing significant financial development and economic globalization over the years similar to other economies, it's important for us to empirically examine the impacts of oil price, financial development, economic globalization, economic growth rate,

[16]The economic globalization is defined as actual flows (trade, FDI, portfolio investment) and restrictions (import barriers, trade tariffs, capital account restrictions).

public investment and real interest rate on the behaviour of private investment in India, which is very vital in the changing context of macroeconomic policies pursued by the government which is trying to attract more private investment. In order to understand the relationships among these crucial variables, this study attempts to utilize an appropriate econometric technique which is described in the following section.

Figure 3. Trends in variables, 1980-2014



4.3. Bayer-Hanck (2013) Combined Cointegration Approach

This study utilizes the combined cointegration test developed by Bayer and Hanck (2013) in order to verify the presence of a long-run relationship between the variables. Though Engle and Granger (1987) developed the residual based cointegration test, it has limitations in providing unbiased estimates. The main problem of Engle and Granger (1987) cointegration test is that long-run regression results may be inefficient if the residuals are not normally distributed. Under such circumstance, it becomes difficult for any researchers to derive any sensible decision regarding cointegration between the variables in the long run. To overcome these issues, we have gone in for estimating the Engle and Yoo (1991) cointegration test

which provides more efficient empirical results due to its power and size. This test can be applied if the distribution of estimators from the cointegrating vector is non-normal. Subsequently, the cointegration test proposed by Philips and Hansen (1990) was also employed to eliminate the biasness of ordinary least squares (OLS) estimates. Inder (1993), however, criticized the Philips and Hansen (1990) test and applied FMOLS for long run estimates compared to estimates of an unrestricted error correction model (UECM). Finally, Stock and Watson (1993) developed dynamic OLS (DOLS) to test for the cointegration. DOLS is a parametric approach which uses leads and lags of variables in an OLS regression, while FMOLS is a non-parametric approach.

Moreover, the Johansen and Juselius (1990) maximum likelihood cointegration approach is used to examine cointegration between the variables under the unique order of condition in the system equation. Although this is a cointegration technique based on the system of equation, its estimation becomes invalid if any of the variables is integrated of I(0) in the system or happens to belong to a mixed order of integration. The Johansen and Juselius (1990) maximum likelihood cointegration results are also sensitive to incorporating the exogenous and endogenous variables in the model. This test indicates only the presence of cointegration between the variables for the long run but provides no information about short run dynamics. However, Pesaran et al. (2001) also suggested the ARDL bounds testing approach to cointegration in order to scrutinize the long run cointegrating relationships, along with accommodating the structural break(s) arising in the series. This cointegration approach is applicable irrespective of the series whether integrated at I(1) or I(0). The ARDL bounds testing approach also simultaneously provides empirical long run and short run relationships among the variables. However, the ARDL bounds testing approach also suffers from some limitations or It is not free of some inherent limitations. In a sense, although it provides efficient and reliable estimates, the consistency of the result is subject to the condition that there must be cointegration relation between the variables in the corresponding single cointegration equation under consideration. Otherwise, the results derived from it will be misleading. If this feeds into policy, that may misguide policy from a constructive path. Finally, this approach will also not produce any conclusive results if some of the variables are found to be integrated of order I(2).

Although there are several cointegration testing approaches available in the time series econometric literature, but in reality, one would come up with different inconclusive results when estimated with all approaches at a time. In light of this, most often it becomes difficult for one to get uniform results because of the fact that one cointegration test may reject the

null hypothesis while the other cointegration tests may not be able to reject the null hypothesis. In applied economics literature, a variety of cointegration tests have been available and employed to see the presence of cointegration between the variables (e.g. Engle-Granger's (1987) residual-based test, Johansen's (1991) system based test, Boswijk (1994) and Banerjee et al. (1998) lagged error correction based approaches to cointegration). It is again suggested by Pesavento (2004) that the power of cointegration tests may be sensitive to the presence of nuisance parameters. To resolve these issues, Bayer and Hanck (2013) recently proposed a new dynamic cointegration technique by combining all the approaches of cointegrating tests to provide uniform and efficient cointegration test results. Thus, the efficient cointegration results are possible by ignoring the nature of multiple testing procedures. This implies that the application of combined cointegration tests not only provides efficient results but also helps to infer robust inferences in comparison to individual t-test or system based test used in the field of applied economics. An insight emerging by applying the Bayer and Hanck (2013) combined cointegration test is that it eliminates the common problem of inconsistent findings which are associated with the other traditional cointegration techniques used in applied economics. In doing this, it is evident that both the efficient and conclusive results are guaranteed from employing the Bayer and Hanck (2013) combined cointegration technique which was not found from using other traditional cointegration models in econometrics.

Therefore, both the efficient and conclusive results emerging from using the Bayer and Hanck (2013) is supposed to add new potential insights for policy making for prescribing sound economic policies, even when it relates to the continuous supply of energy and the growth of domestic private investment in an emerging economy. Moreover, the Bayer and Hanck (2013) cointegration test follows the critical tabulated values of Fisher's (1932) in order to combine the statistical significance level (i.e. p-values of single cointegration test and formula) which is presented as follows:

$$EG-JOH=-2[\ln(P_{EG})+\ln(P_{JOH})] \tag{13}$$

$$EG-JOH-BO-BDM=-2[\ln(P_{EG})+\ln(P_{JOH})+\ln(P_{BO})+\ln(P_{BDM})] \tag{14}$$

The probability values of different individual cointegration tests including Engle-Granger (1987); Johansen (1991); Boswijk (1994) and Banerjee et al. (1998) are reported by

P_{EG}, P_{JOH}, P_{BO} and P_{BDM}, respectively. We also follow Fisher (1932) critical statistical values in order to confirm the presence of cointegration between the variables in our model. We can confirm the presence of cointegration by rejecting the null hypothesis of no cointegration when the critical values of Bayer and Hanck (2013) are found to be less than the calculated statistical values of Fisher (1932), and otherwise, the reverse would hold true.

4.4. ARDL Bounds Testing Approach to Cointegration

The study employs the ARDL bounds testing approach as proposed by Pesaran et al. (2001) in order to establish both the long-run and short-run relationships among the variables in the model. The ARDL bounds testing approach to cointegration is used in this study because of its several advantages over the traditional co-integration procedures. First, the ARDL Bounds testing approach overcomes the problem of endogeneity among the variables in the estimated model which is normally associated with Engle-Granger cointegration (Pesaran and Shin, 1996; Pesaran et al., 1996; Pesaran et al., 2001; AI-Mulai et al., 2015). Second, this method does not require any pre-testing in the order of the integration of variables used in the ARDL model (Pesaran and Pesaran, 1997; Pesaran et al., 2001) because it can be applied irrespective of the mixed order of integration of regressors (e.g. I(1)/I(0)). Third, it enables us to understand simultaneous analysis of both the short-run and long-run effects of the independent variables on the dependent variable. Finally, it also produces superior results even with small sample size in the time series. Given these advantages, ARDL bounds testing approach has gained wide popularity among the researchers and economists in the field of applied economics and therefore our study also utilizes this method for our empirical estimation.

Hence the ARDL bounds testing approach takes the following form as represented in Eq. (5) in order to examine the long-run relationship between the variables:

$$\begin{aligned}\Delta PRI_t = \alpha_0 &+ \sum_{i=1}^{m} \alpha_{1i} \Delta PRI_{t-i} + \sum_{i=0}^{m} \alpha_{2i} \Delta OP_{t-i} + \sum_{i=0}^{m} \alpha_{3i} \Delta IR_{t-i} + \sum_{i=0}^{m} \alpha_{4i} \Delta PUI_{t-i} \\ &+ \sum_{i=0}^{m} \alpha_{5i} \Delta FD_{t-i} + \sum_{i=0}^{m} \alpha_{6i} \Delta GR_{t-i} + \sum_{i=0}^{m} \alpha_{7i} \Delta GLOBAL_{t-i} + \alpha_8 PRI_{t-1} + \alpha_9 OP_{t-1} \\ &+ \alpha_{10} IR_{t-1} + \alpha_{11} PUI_{t-1} + \alpha_{12} FD_{t-1} + \alpha_{13} GR_{t-1} + \alpha_{14} GLOBAL_{t-1} + \mu_t \end{aligned} \quad (15)$$

where m denotes the optimal lag length of variables and Δ is first difference of the concerned variables. α_0 is intercept. Moreover, μ_t is the error term. First and second parts of the above

equation denote error correction dynamics and the long-run relationship among the series, respectively. To test the existence of the long-run relationship, F-test is conducted on the joint coefficients of all lagged level variables on the ARDL structure. The null-hypothesis of the bounds test involves no cointegration among variables and that can be represented as $H_0 : \alpha_8 = \alpha_9 = \alpha_{10} = \alpha_{11} = \alpha_{12} = \alpha_{13} = \alpha_{14} = 0$. It's alternative hypothesis can be written as $H_1 : \alpha_8 \neq \alpha_9 \neq \alpha_{10} \neq \alpha_{11} \neq \alpha_{12} \neq \alpha_{13} \neq \alpha_{14} \neq 0$. Finally, the computed *F-statistics* are compared with the critical values provided by Narayan (2005). This is because its lower and upper bounds critical values of Narayan (2005) are more appropriate than that of Pesaran et al. (2001) in the case of small sample sizes. A decision can be inferred about the confirmation of co-integration relationship if the computed F-statistic falls outside the upper and lower critical bounds values as suggested by Narayan (2005). More specifically, the null hypothesis of no cointegration can be rejected, if the calculated F-statistic is higher than the upper bound critical value I(1) for a given number of explanatory variables. Furthermore, the null hypothesis of no cointegration cannot be rejected (Narayan and Narayan, 2004), if the computed *F-statistic* is lower than the lower bound critical value I(0). Finally, no exact decision relating to cointegration can be made, if the calculated F-statistic lies in between the lower and upper critical values (Ertugrul and Mangir, 2015; Seker et al., 2015). The optimal lag order for the above model is selected on the basis of Akaike Information Criterion (AIC). The optimal lag length of the model can be decided based on the minimum AIC values.

5. Results and Discussions

Before we empirically estimate our above model, as a prelude to our empirical analysis, this study presents the summary statistics and pairwise correlation results which are shown in Table 2 and Table 3, respectively. The summary statistics results show that the standard deviation of the oil price (OP) is relatively higher among all the variables. This implies that OP is the most fluctuating variable in our model. Further, from the pairwise correlation results, we noted that the real interest rate (IR) and public investment (PUI) are negatively correlated with the private investment. On the other hand, the other variables like oil price, financial development, growth rate and economic globalization are positively correlated with private investment. Since the correlation analysis does not establish any causality among the variables, therefore, this study subsequently attempts estimating the relationship with the use of the suitable econometric technique.

Table 2: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
PRI_t	35	16.531	6.252	8.456	30.063
OP_t	35	47.026	28.149	15.476	104.062
IR_t	35	6.181	2.149	-0.597	9.191
PUI_t	35	8.408	2.472	1.945	12.262
FD_t	35	31.567	11.175	20.189	52.203
GR_t	35	6.250	2.113	1.057	10.260
$GLOBAL_t$	35	28.743	9.660	17.280	43.480

Table 3: Pair-wise Correlation Statistics

Variable	PRI_t	OP_t	IR_t	PUI_t	FD_t	GR_t	$GLOBAL_t$
PRI_t	1.000						
OP_t	0.704	1.000					
IR_t	-0.443	-0.520	1.000				
PUI_t	-0.781	-0.488	0.239	1.000			
FD_t	0.908	0.868	-0.507	-0.589	1.000		
GR_t	0.378	0.224	-0.200	-0.192	0.352	1.000	
$GLOBAL_t$	0.964	0.714	-0.458	-0.687	0.921	0.390	1.000

Our aim is to test cointegrating (long-run) relationships among the variables. Since the ARDL approach does not require pretesting of variables in order to know their order of integration as mentioned in the preceding section, we have, therefore, used a battery of traditional unit root tests, such as Augmented Dickey-Fuller (ADF, 1979), Phillips-Perron (PP, 1988) and Ng and Perron (2001)test. The unit root tests results are shown in Table 4 and Table 5. All these conventional unit root tests results reveal that all the variables, except the real interest rate, are found to be first difference stationary and the real interest rate is stationary at its level.

It is well known that in the presence of structural break(s), the above conventional unit root tests are likely to yield biased results as they do not accommodate the information about the unknown structural break(s) in the model. To overcome such issue, Zivot and Andrews

(1992) unit root test is employed in our analysis which accommodates the information about a single structural break in the series.[17] The results of Zivot and Andrews (1992) structural break unit root test is presented in Table 6. The results show that all the variables, except PRI and IR, are non-stationary at their levels and stationary at their first differences. This implies that while PRI and IR are integrated of order zero i.e. *I*(0), whereas all other variables are integrated of order one or *I*(1). Therefore, we concluded that the variables are integrated of mixed order (either *I*(0) or *I*(1)) even in the presence of a single structural break and, no variable is integrated of order two or of any higher order.

Table 4: Unit root test results

Variables	ADF		PP	
	Level	1st Difference	Level	1st Difference
PRI_t	1.735723	-6.391045*	0.159824	-12.96541*
OP_t	-0.464919	-5.925972*	-0.403006	-5.926502*
IR_t	-3.807285*	-	-3.889474*	-
PUI_t	0.014429	-4.640262*	-0.257682	-4.568376*
FD_t	1.003820	-4.780301*	0.468790	-5.161775*
GR_t	2.682388	-4.388418*	3.814951	-4.388418*
$GLOBAL_t$	0.138300	-5.792221*	0.054724	-5.822460*

Note: *, ** represent significance at 1% and 5% levels respectively.

Table 5: Ng and Perron (2001) unit root test results

Variables	MZa	MZt	MSb	MPt
PRI_t	0.365(0)	0.207	0.567	24.133
OP_t	-1.308(0)	-0.611	0.467	13.618
IR_t	-13.813*(0)	-2.610	0.189	1.841
PUI_t	-0.423(0)	-0.143	0.339	11.765
FD_t	-3.603(2)	-1.055	0.293	6.800

[17]The potential advantage of controlling the structural break is that the structural break is highly associated with the co-integration process between the level series. So it is important to efficiently capture the structural break stemming in the time series data in order to capture the true nature of stationary behaviour in the level series.

GR_t	1.112(1)	0.671	0.604	30.158
$GLOBAL_t$	-0.565(2)	-0.277	0.490	16.708
ΔPRI_t	-35.264*(1)	-4.193	0.119	0.712
ΔOP_t	-16.464*(0)	-2.841	0.173	1.592
ΔIR_t	-	-	-	-
ΔPUI_t	-15.790*(0)	-2.651	0.168	2.126
ΔFD_t	-8.477**(0)	-2.047	0.242	2.933
ΔGR_t	-15.646*(0)	-2.777	0.177	1.642
$\Delta GLOBAL_t$	-16.413*(0)	-2.862	0.174	1.501

Note: The lag length is shown in parentheses. For details of these notations including MZa, MZt, MSB and MPT, please see the study by Ng and Perron (2001).* and** represent significance at 1% and 5% levels, respectively.

The structural breaks i.e. 2004, 1996, 2002, 2009, 1996, 2001 and 1987 are respectively traced in the series of private investment, oil price, interest rate, public investment, financial development, growth rate and economic globalization. We find that the structural breaks occur in the variables such as private investment, interest rate, and financial development during early 2000. During 2000-01, the combined fiscal deficit of both Central and State governments sharply increased to 9.6 percent of GDP from a low level of 6.4 per cent of GDP 1996-97 (Ahluwalia, 2002). At the same time, India's public debt reached the highest point of around 80 per cent of GDP. There are also other breaks that we found during the second half of the 1980s and 1990s. These periods are associated with the periods of globalization and liberalization reforms in India. While the 1980s is considered to be the initial period of globalization during early 1990s just after India's balance of payment crisis of 1991, the Indian government adopted several liberalization measures for the free flow of trade and investment into the economy with the rest of the world.

From the above unit root tests, we find that our variables are integrated of mixed order i.e. I(0) or I(1). In light of this, the ARDL bounds testing approach to cointegration proposed by Pesaran et al. (2001) seems to be more appropriate to test the short and long-run relationships among the variables. In addition, the ARDL model as an empirical estimation strategy has the

greatest relevance with the incorporation of the appropriate lag structure of the variables in the model. This would also help us to overcome any of the endogeneity issues in the model.[18] Since the ARDL bounds testing cointegration model is known to be very much sensitive to the choice of lag length, so the AIC is used to select the optimal lag length of the estimated model. Lütkepohl (2006) emphasized the importance of appropriate lag length for understanding the causal link between the series. The optimal lags given by the AIC are given in Column 2 of Table 7 along with providing the overall cointegration test results. Here we have estimated two models. The first model consists of all the variables, such as PRI, OP, FD, GR, IR, and GLOBAL. In the second model, we drop the IR as explanatory variable given the fact that it is found to be an insignificant factor in explaining the private investment in the first model.

Table 6: Zivot-Andrew's unit root test

Variables	Level		1st Difference		
	T-Stat.	Break	T-Stat.	Break	Decision
PRI_t	-5.549*(0)	2004	-	-	I(0)
OP_t	-3.792(0)	1996	-6.935*(0)	2007	I(1)
IR_t	-4.859**(0)	2002	-	-	I(0)
PUI_t	-2.677(0)	2009	-5.301*(0)	2007	I(1)
FD_t	-3.069(2)	1996	-13.248*(0)	2005	I(1)
GR_t	-3.116(0)	2001	-5.609*(0)	2008	I(1)
$GLOBAL_t$	-2.326(2)	1987	-7.550*(0)	2006	I(1)

Note: Lag order is shown in parenthesis.*,** Represent significance at 1% and 5% levels, respectively. The values -5.34, -4.93 and -4.58 are the tabulated t-statistic values at 1%, 5% and 10% for ZA test, respectively.

Thus, the cointegration test results show that the calculated F-statistic is found to be greater than the upper bound critical value of Narayan (2005) for both the models. The ARDL approach to testing cointegration confirms the existence of a long-run relationship between the variables. The stability of the ARDL private investment model is examined by employing the cumulative sum of recursive residuals (CUSUM) and the CUSUM of squares (CUSUMSQ) suggested by Brown et al. (1975). This is because the model misspecification

[18]Narayan (2005) has provided upper and lower bound critical values for the small sample sizes ranging from 30-80 observations. In our case the sample size also falls within this range, so we use the critical bounds value provided by Narayan (2005) for our purpose of cointegration testing.

may also result in biased coefficient estimates that might influence the explanatory power of the results. Hence Brown et al. (1975) suggested that both CUSUM and CUSUMSQ tests can justify the stability of our ARDL model by checking the constancy of parameters which can be useful for policy makers in emerging economies like India. The plots of both CUSUM and CUSUMSQ are shown in Figures 4-7 at 5% level of significance report that both the tests are falling within critical bounds of 5% level of significance. Hence this suggests us that our estimated ARDL private investment models are stable.

However after ensuring the existence of long-run equilibrium relationship among the variables, we at first estimate the long-run and short-run impacts of oil price, public investment, real interest rate, financial development, growth rate and economic globalization on the dynamic behavior of private investment in India. Our second aim is to test "whether public investment crowds out the private investment" in India. The long run results reported in Table 8 shows that there is a negative and significant relationship between private investment and oil price in all the models. It is further noted that a 1% rise in oil price leads to a 0.070-0.072% fall in the private investment in India, keeping other things constant. This implies that the private investment in India has been falling and rising due to an increase or decrease in the international oil price, respectively. For instance, the rising oil price can discourage the investment expenditure through its adverse effect on demand for the output or increase in the cost of production (Sadath and Acharya, 2015). This result is also consistent with the findings of earlier studies (Ratti et al. 2011, Sadath and Acharya, 2015).

On examining the impact of public investment on the private investment in India, the results of our study reveal that public investment reduces private investment significantly. All other things remaining the same, a one percent increase in public investment reduces private investment by 0.710-0.712 percent. This highlights the crowding out impact of public investment on private investment in India. This result supports the findings of Bouthevillain and Dufrenot (2011) for France, Afonso and Sousa (2011) for Portugal, Bahal et al. (2015) and Pradhan et al. (1990) for India.

In examining the impact of financial development on the private investment, it is found that a rise in financial development is significantly and positively linked to private investment in India. A 1% increase in financial development on an average leads to a 0.241-0.258% increase in the private investment in India. This result to a significant extent supports the findings of Huang (2011) for 43 developing countries, Misati and Nyamongo (2011) for 18 Sub-Saharan African countries and Blejer and Khan (1984) for 24 developing countries who reported that financial development significantly promotes private investment. This indicates

that there is a role for financial development in influencing the private investment as financial development can increase financial savings and thereby lowers the interest rates in the economy (Blejer and Khan, 1984). Based on financial liberalization hypothesis of Mackinnon and Shaw, this relationship could be possible through encouraging efficient investment projects even when interest rate rises during the period of financial liberalization.

The impact of real GDP growth rate on private investment is found to be positive and significant. This result is consistent with the findings of Greene and Villanueva (1991) for 23 developing countries and Oshikoya (1994) for 8 African countries, where the authors have reported that the real GDP growth significantly increases the private investment for economies. This result confirms the validity of accelerator theory for the Indian economy implying that rising GDP accelerates private investment.

Our study also shows that although real interest rate has a negative and insignificant impact on private investment, other factors, such as crude oil price, public investment, financial development and real GDP growth play a vital role in explaining the private investment in India. This result contradicts the findings of existing studies, such as Dreger and Reimers (2016) for Euro area and Misati and Nyamongo (2011) for Sub-Saharan Africa which shows that real interest rate significantly deteriorates the private investment. At the same time, the result of our study supports the findings of Erden and Holcombe (2005)who reported that interest rate does not statistically affect private investment in case of developing economies. This may be due to the fact that the credit controls and lack of credit availability may hinder the growth of private investment.

Finally, we have also tested the impact of economic globalization on private investment in India. Our result shows that economic globalization positively and significantly affects private investment. In existing studies, although different dimensions of globalization are considered, however, in this study we have considered the economic globalization only. This is because of the fact that the standard measure of economic globalization for a host country puts lots of emphasis on the expansion of trade and investment activities between the host country and the rest of the world. However, the economic measure of globalization should also consider accommodating the measure of financial openness along with trade openness (Shahbaz et al., 2016). Therefore, as a result of rising trade and investment activities on account of economic globalization, the private investment in an economy is likely to increase significantly.

Although the study emphasizes the importance of long-run estimates for the policy implications, nevertheless, the short run results reported in the lower segment of Table 8

show that oil price is significantly and negatively related to the private investment demand in India. Public investment lowers the private investment in the short-run, while the impact of growth rate is found to be statistically insignificant in the short run. The impacts of financial development and globalization are found to be positive and significant, while the impact of interest rate is found to be although positive but insignificant. The coefficient of error correction term is negative and significant and it shows that the short-run deviation from the long-run equilibrium gets corrected by 70 to 78 percentages each year. We had also used a dummy variable in order to capture the structural break in private investment series as observed for the year 2004. The impact of the dummy variable is also found to be significant in both long run and short run. This might be capturing the impact of sound fiscal policies being practiced in India from the period 2004 onwards.

Table 7: Results of Cointegration test

Bounds testing approach to cointegration			
Estimated models	Optimal lag	Time Break	F-statistics
Model1: $PRI_t = f(OP_t, PUI_t, FD_t, GR_t, IR_t, GLOBAL_t)$	$(1,2,1,0,2,1,0)$	2004	16.789^{*}
Model2: $PRI_t = f(OP_t, PUI_t, FD_t, GR_t, GLOBAL_t)$	$(2,3,0,3,3,1)$	2004	7.187^{*}
Bayer-Hanck (2013) cointegration approach			
Estimated model	Optimal Lag	EG – JOH	EG – JOH – BD – BDM
$PRI_t = f(OP_t, PUI_t, FD_t, GR_t, GLOBAL)$	4	56.624^{**}	167.148^{**}
Diagnostic tests for ARDL models			
Test statistic		Model 1	Model 2
χ^2_{NORMAL}		3.109	0.612
		(0.211)	(0.736)
χ^2_{ARCH}		2.684	0.219
		(0.112)	(0.643)
χ^2_{RESET}		0.086	0.742
		(0.773)	(0.467)
χ^2_{SERIAL}		0.036	1.556
		(0.858)	(0.254)

Note: Critical lower and upper bounds values are collected from Narayan (2005) including unrestricted intercept and unrestricted time trend. The upper and lower critical values are 6.537, 4.704 (4.790, 3.426) and 4.114, 2.879 at 1% (5%) and 10% levels, respectively. The optimal lag length is determined by AIC. * denotes significance at 1% level and the probability values are given in the parenthesis in the diagnostic test section.

Figure 4. Plot of cumulative sum of recursive residuals [**Model 1 with real interest rate (IR)]**

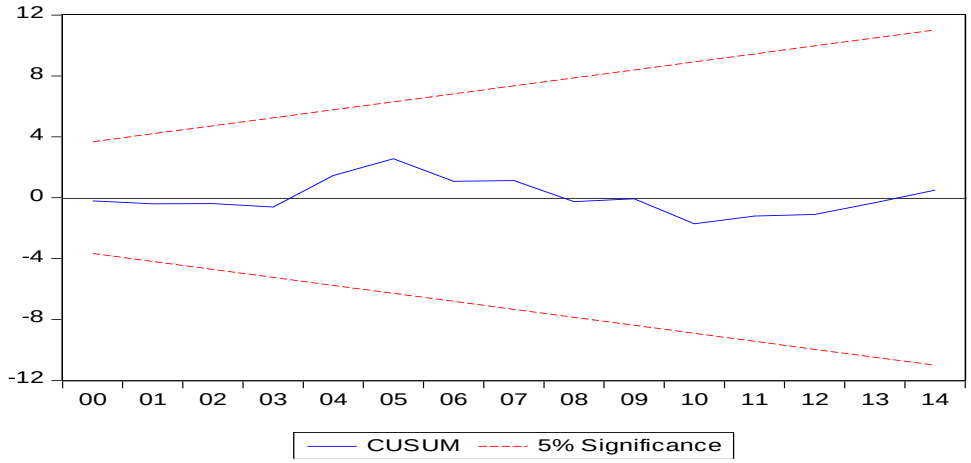


Figure 5. Plot of cumulative sum of squares of recursive residuals

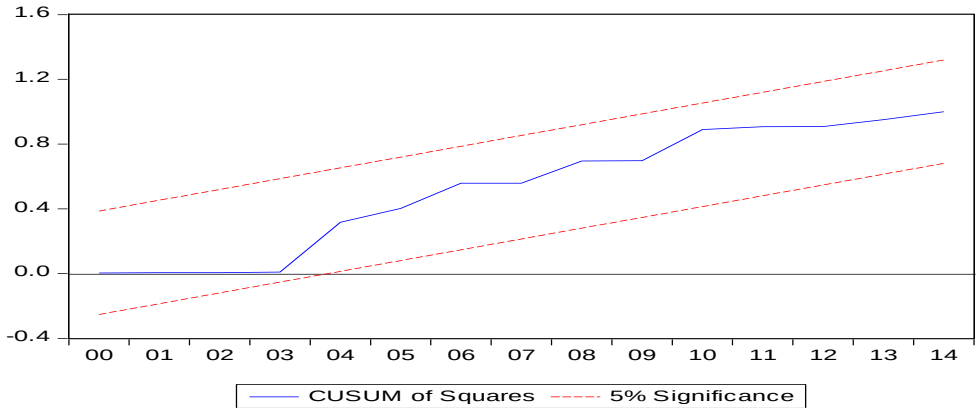


Figure6. Plot of cumulative sum of recursive residuals [**Model 2 without real interest rate (IR)]**

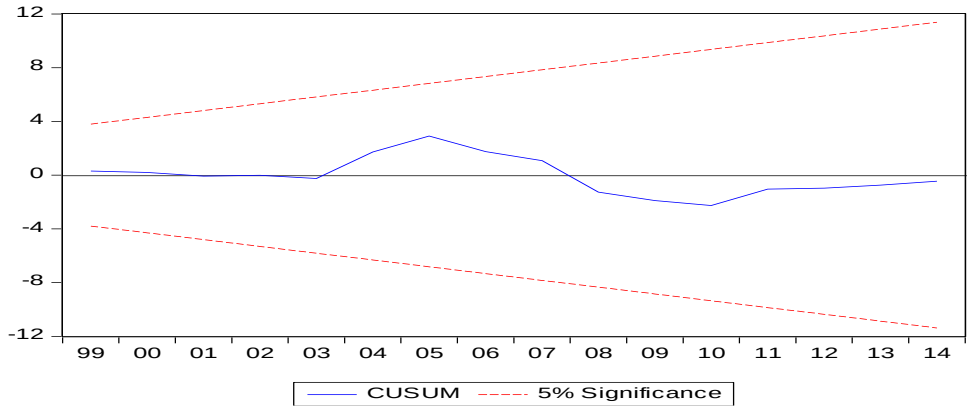


Figure 7. Plot of cumulative sum of squares of recursive residuals

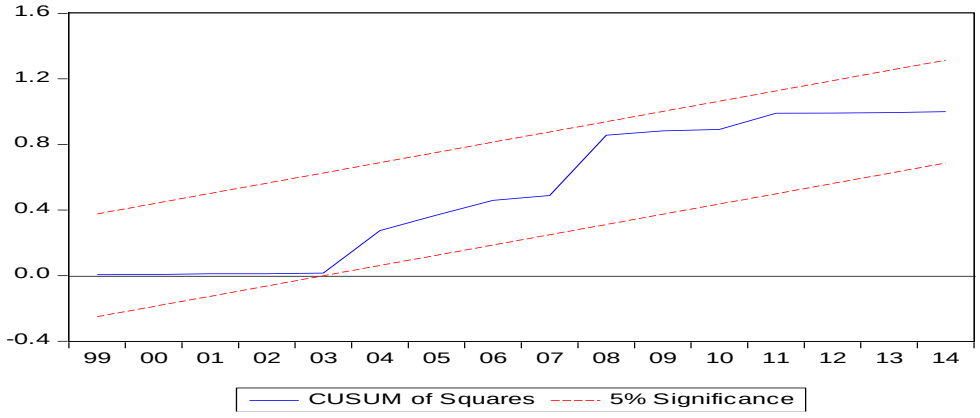


Table 8: Long run and short run ARDL results

Dependent variable- PRI				
Long run analysis	1	2	3	4
Variable	Coefficient	T-statistic	Coefficient	T-statistic
OP_t	-0.072*	-5.050	-0.070*	-6.813
PUI_t	-0.710*	-8.936	-0.712*	-11.689
FD_t	0.241*	3.938	0.258*	6.302
GR_t	0.408*	2.906	0.540*	4.850
IR_t	-0.155	-1.662	-	-
$GLOBAL_t$	0.192*	4.189	0.185*	4.916
D_t	2.808**	2.769	2.589*	3.868

Constant	10.232*	1.794	8.238*	6.098
Short run analysis				
Variable	Coefficient	T-statistic	Coefficient	T-statistic
OP_t	-0.035***	-1.893	-0.004	-0.211
PUI_t	-0.971*	-7.185	-1.067*	-8.844
FD_t	0.247*	3.286	0.101	0.778
GR_t	-0.008	-0.113	0.044	0.640
IR_t	0.001	0.015	-	-
$GLOBAL_t$	0.197*	3.694	0.034	0.290
D_t	2.884*	3.100	3.878*	4.147
ECM_{t-1}	-0.780*	-5.009	-0.706*	-4.603

Note: *,** and ***denote the significance at 1%, 5 % and 10% levels, respectively. 'D_t' represents the dummy for measuring structural break in the intercept term.

In order to check for the robustness of our long-run results, we have also applied the FMOLS and DOLS on our private investment model. However, Kao and Chiang (2001) showed that both OLS and FMOLS exhibit small sample biases and the DOLS estimator appears to outperform both the estimators. Since DOLS procedure also allows for variables integrated of alternative orders (including the higher order of integrated variables), as well as tackling the problem of simultaneity amongst the regressors and regressand (Stock and Watson, 1993), we estimated the model using FMOLS and DOLS. The results of FMOLS and DOLS are presented in Table 9. It is observed that the results obtained from both the FMOLS and DOLS are almost similar to the long-run ARDL model estimates shown in Table 8, the only exception is found with respect to the sign and significance level of real GDP growth. It shows a positive and significant impact of real GDP growth on the private investment in the long-run model derived from the ARDL estimation in Table 8, whereas the results of both FMOLS and DOLS reveal that the real GDP growth rate has a negative and insignificant impact on private investment in India. Overall, the sign of other long-run parameters obtained from the ARDL model is closely similar to the results obtained from the FMOLS and DOLS estimators. This supports us in direction of establishing the robustness of our results across different estimation techniques.

Table 9: Results of FMOLS and DOLS

Dependent variable- PRI				
Long run analysis				
Fully Modified Ordinary Least Squares (FMOLS)				
Variable	Coefficient	T-statistic	Coefficient	T-statistic
OP_t	-0.052*	-3.792	-0.054*	-3.865
PUI_t	-0.735*	-8.140	-0.711*	-7.691
FD_t	0.154**	2.571	0.161**	2.628
GR_t	-0.059	-0.734	-0.065	-0.784
IR_t	0.002	-0.004	-	-
$GLOBAL_t$	0.270*	5.190	0.270*	5.059
D_t	3.944*	3.550	3.982*	3.558
Constant	11.686*	5.584	11.375*	5.546
Dynamic Ordinary Least Squares (DOLS)				
Variable	Coefficient	T-statistic	Coefficient	T-statistic
OP_t	-0.046*	-2.773	-0.046*	-2.829
PUI_t	-0.789*	-6.611	-0.789*	-6.702
FD_t	0.149***	1.982	0.149***	2.011
GR_t	-0.046	-0.434	-0.046	-0.442
IR_t	-0.006	-0.059	-	-
$GLOBAL_t$	0.264*	3.826	0.264*	3.881
D_t	3.744**	2.539	3.760**	2.630
Constant	12.165*	4.474	12.123*	4.679

Note: *,** and ***denote the significance at 1%, 5 % and 10% levels, respectively. 'D_t' represents the dummy variable captures the structural break at intercept term.

All of these above results confirm that oil price movements play a vital role in influencing the private investment in India both in the short-run as well as in the long-run. As India is highly depending on the oil imports from oil exporting countries, any large fluctuation in the international crude oil price can significantly affect the private investment in India. So in order to sustain the private investments and hence the growth rate especially during the period

of high oil prices, the government should adopt effective policy measures to control and smoothen the domestic oil price fluctuations and not letting it reach excessively high levels in the domestic market. At the same time, the priority should also be given to the heavy investment of both renewable and alternative sources of energy to reduce the dependence of India's oil imports which will contribute towards maintaining a stable current account balance along with achieving the higher growth rate of the Indian economy. This would help us to a larger extent in minimizing the adverse impact of oil price rise on the private investment in India and external balance over the long run. As far as the role of public investment is concerned, we find that public investment crowds out the private investment in the Indian case. On the policy ground, this finding suggests that Indian government has to be strategic in its sectoral investments policies, where it should not crowd out the growth of private investment. Rather, it should complement the private investment which is going to be the key to India's success in achieving a sustainable and faster growth rate over the long-run.

6. Conclusion and Policy Implications

By using annual data for the period 1980-2014, this study examined the impact of crude oil prices on private investment in India by controlling public investment, financial development, real interest rate, economic growth and economic globalization as the key determinants of the private investment function. This framework also helps us to re-examine whether the public investment ''crowds out'' or ''crowds in'' private investment in developing economy like India and whether interest rate as a monetary policy channel variable is effective in raising private investment in the economy. In order to verify these propositions, the study applied Pesaran's et al. (2001) ARDL bounds testing approach to cointegration in order to confirm whether there is a presence of long-run relationships among the macro variables in our model. In addition, the combined cointegration test recently proposed by Bayer-Hanck (2013) is further utilized in order to check the robustness of cointegrating results with ARDL model. Finally, the dynamic OLS and FMOLS techniques are also employed to check the robustness of the long-run empirical estimates obtained from ARDL model.

In terms of empirical results, the ARDL bounds testing approach confirms the existence of long-run equilibrium relationships among private investment, oil price, interest rate, public investment, financial development, economic growth, and globalization. The Bayer-Hanck (2013) combined cointegration approach used as an alternative technique also confirmed the similar cointegrating relationship among the variables in the model. Further, the long-run results estimated from the ARDL model show that oil price, real interest rate, and public

investment negatively affect the private investment, whereas financial development, economic growth, and globalization positively influence the private investment in the long-run. In the short run, the oil price and public investment are found to have negative and significant impacts on private investment, whereas both financial sector development and globalization are found to have positive and significant impacts on private investment in India. In the short-run, this study also finds no significant impacts of economic growth and interest rate on private investment in India.

Further, the use of both FMOLS and DOLS estimation techniques also provided similar long-run results confirming the robustness of our empirical estimates obtained from ARDL bounds testing method. The finding of an adverse impact of public investment on private investment, helped us to infer that public investment ‘‘crowds out’’ private investment in India. This finding is similar with results of Pradhan et al. (1990), Mitra (2006), Sahu and Panda (2012) and Bahal et al. (2015) who reported that public investment crowds out private investment for the Indian economy. However, our finding is not consistent with the recent finding of Rath and Bal (2014) who reported that public investment neither ‘‘crowds out’’ nor ‘‘crowds-in’’ private investment in case of Indian economy. Our key finding on the relationship between crude oil price and private investment showed that that crude oil price adversely affects private investment, indicating that energy prices are detrimental to private investment in India. This evidence is consistent with the recent finding of Sadath and Acharya (2015) who reported the negative and significant effect of energy price on selected number of manufacturing firms' investment in India. In addition, this study reports the adverse and significant effect of real interest rate on private investment, indicating that interest rate (cost of borrowing) is retarding private investment in India. Thus, this finding is similar to the results of Green and Villanueva (1991) for developing countries, Misati and Nyamongo (2011) for a panel of 18 Sub-Saharan African economies and Dreger and Reimers (2016) for Euro area, who reported that interest rate adversely affected the private investment.

These findings have significant policy implications. First, our study reports that crude oil price impedes private investment in India. Thus, it can be argued that since crude oil is not only being consumed by the end users but also used by investors as one of the production inputs, a rise in international crude oil price is going to make the import bills quite expensive for investors and thereby it discourages them not to increase the level of investment for producing higher output. And in the event of India's heavy and increasing reliance on crude oil over the years, the result of the study further implicates that when the international price of crude oil would shoot up to a new higher level, it can produce huge oil import bill associated

with huge imports of crude oil from oil exporting countries and thereby it would not only affects its balance of payments (BoPs) with those exporting countries but also can hinder private investment and hence economic growth. This issue has engulfed the minds of policy makers in recent times and there are ongoing debates about oil price adversely affecting the future economic growth of India. It also suggests that government should make the investment in areas where the private sector is abysmally small and, rather it should encourage private investment in areas where private investment is absent and should invest where private investment is already present but it requires a big push from its present level for the Indian economy. This requires identification of areas where private investment has the huge potential to make the economy most vibrant, thereby reinvigorating the economy to attain higher growth to fast catch up with the most advanced nation's living standard or at least to catch up with the economic standards of other emerging countries in the very short run. On the policy front, the finding of this study urged the attention of policy makers and government authorities to evolve a comprehensive energy policy strategy to ensure a continuous supply of adequate energy catering to the Indian investors and the entire economy at large at affordable prices.

Second, the study indicates that public investment is detrimental to the growth of private investment in India. Hence, it can be further argued that the Indian economy needs to enhance her growth and prosperity with the help of both public and private sector investments. If the public investment does not complement with private investment in the process of enhancement of physical infrastructures and creating a level-playing field for the latter, then the Indian economy would not be in a position to achieve sustainable and inclusive growth in the long-run. In this context, one question arises that the Indian government invests so much in the creation of physical infrastructures, but it does not yielding to encourage the private investment to an optimum or desired potential level, which puts a bigger and serious question mark for the government and policy makers in the years to come.

Subsequently, our result also indicates that interest rate is detrimental to private investment in India. This is an indication of the fact that a rise in interest rate by the financial institutions increases the cost of borrowing and thereby it prevents the private investors in India to access the bank credit for the expansion of their own existing and new business ventures. As a consequence, lower private investment results in lowering of output at the macro level. From a policy perspective, this study suggests that policy makers should bring in some dynamism with regards to the features of interest rate, while designing investment and monetary policies of the Indian economy. But since only recently the Central Bank of India has started to pursue

inflation targeting approach similar to many other inflation targeting countries, at this juncture, it needs greater scrutiny how private investment is reacting to such monetary policy approaches. Given that there is no much change in policy stance of the Reserve Bank of India during the post inflationary targeting phases, the current monetary policy might not be having desired effect on private investment and economic growth.

Finally, it is also empirically observed that financial development, economic growth, and globalization are the additional factors which stimulate private investment in India. Thus, policy makers in India should put their utmost emphasis on private investment stimulating factors while formulating the long-run investment policy towards enhancing physical infrastructure and poverty reducing-driven sustainable economic growth and development. Overall, this study also highlights some fertile areas for future research. It demonstrates that the future research should address understanding the channels through which both crude oil price and public investment are affecting the private investment for other countries' context from a comparative perspective by using both the time series and panel frameworks. This issue remain unaddressed or unresolved as this is beyond the scope of the present study.

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Appendix

Table A1: Crude oil imports by countries (1000 bbl/day)

Country Rank (2014)	Countries/ Year	1980	1985	1990	1995	2000	2005	2010	2011	2012	2013	2014
1	USA	8459	6755	9633	11165	13879	15620	13705	13236	12003	11493	10342
2	China	-349	-620	-478	373	1564.9	3161.9	5109.9	5769.3	6445.4	6919.8	7344.7
3	Japan	4950	4425	5282	5648	5473	5291.4	4323	4340	4625	4499.3	4262.2
4	India	461	275	508	872	1481	1847	2554	2679	2839	2884	2968
5	Korea, South	537	552	1048	2008	2135	2191	2269	2259	2322	2328	2348
6	Germany	--	--	--	2823	2703	2557	2418	2341	2338	2383	2326
7	France	2230	1703	1766	1865	1972	1969	1804	1761	1723	1698	1677
8	Spain	957	814	994	1174	1428.2	1603.9	1438.4	1382.8	1298	1200.7	1193.8
9	Italy	1896	1660	1781	1849	1764	1666	1448	1395	1269	1158	1160
10	Netherlands	767	534	664	701	826	977	1010	1003	977	969	962
11	UK	103	-913	-44	-673	-510	170	393	556	647	726	733

Source: U.S. Energy Information Administration.

Link: http://www.eia.gov/petroleum/data.cfm

Table A2: Sectoral Shares in Consumption of Crude Oil in India (%)

Year	Consumption in Agriculture & Allied activities to total crude Oil consumption Allied Activities	Industrial consumption to total crude Oil consumption	Consumption in Transport and power generation to total crude Oil consumption	Consumption for Miscellaneous services including private sales to total crude Oil consumption
1985-86	1.44	26.61	66.94	5.01
1990-91	1.72	24.74	69.91	3.63
1995-96	2.41	22.73	69.81	5.06
1999-00	14.93	23.65	51.59	9.82
2005-06	13.07	11.29	47.71	27.94
2006-07	14.10	11.28	49.60	25.02
2007-08	14.76	8.37	46.05	30.82
2008-09	0.85	8.64	12.93	77.59
2009-10	2.34	8.79	10.36	78.50
2010-11	0.96	7.52	10.92	80.60
2011-12	1.01	7.02	9.73	82.24
2012-13	0.90	5.83	8.84	84.42
2013-14	0.67	3.55	6.30	89.48
2014-15	0.83	3.56	7.88	87.73

Source: Ministry of Petroleum & Natural Gas, Govt. of India.

Table A3: Trend in crude oil consumption and imports by India

Year	Crude oil imports (1000 bbl/day)	Crude oil consumption (1000 bbl/day)	Crude oil imports (% of total crude oil consumption)
1980-81	461	643	71.695
1985-86	275	895	30.726
1990-91	508	1168	43.493
1995-96	872	1575	55.365
2000-01	1481	2127	69.629
2005-06	1847	2512	73.527
2006-07	2002	2691	74.396

2007-08	2103	2801	75.080
2008-09	2170	2864	75.768
2009-10	2433	3113	78.156
2010-11	2554	3305	77.277
2011-12	2679	3461	77.405
2012-13	2839	3618	78.469
2013-14	2884	3656	78.884
2014-15	2968	3735	79.465

Source: U.S. Energy Information Administration.

Link: http://www.eia.gov/petroleum/data.cfm