Estimating the Government Consumption and Investment Multipliers Using the US Data from 1966 to 2020

Abstract

Government spending, one of the major components of Gross Domestic Product (GDP), is composed of government consumption, investment, and transfer payments. Fiscal stimulus is additional government spending to stimulate economic activity whereas fiscal austerity is a cut in government spending to limit the budget deficit. The fiscal multiplier measures the change in a country's GDP due to a change in government spending. Many recent studies have focused on identifying parts of economy that responds more to a stimulus under variety of circumstances. I use the US dataset from 1966 to 2020 and a linear Vector Auto Regression (VAR) model assuming standard identification method (Blanchard & Perotti 2002) to estimate the multipliers. I include private consumption, private investment in the model and control for forecasted spending, interest rate, Consumer Price Index (CPI), export, import, and level of public debt. I find the investment multipliers to be positive and larger than the consumption multipliers. This result is driven by the cross effects as well as the own effects. Private investment consistently gets crowded out after a public consumption shock and that leads to smaller consumption multipliers. Also, much of the positive Investment multipliers are generated during expansion periods. These results are not consistent with the current literature.

Introduction

Accurate estimation of government spending multiplier is important because fiscal policy has been used to stimulate a flagging economy or act as a break for a booming economy. For example, if fiscal multiplier is positive and larger, then additional spending may be more effective. Government spending, one of the major components of Gross Domestic Product (GDP), is composed of government consumption, investment, and transfer payments. Fiscal stimulus is additional government spending to stimulate economic activity whereas fiscal austerity is a cut in government spending to limit the budget deficit. The fiscal multiplier measures the change in a country's GDP due to a change in government spending. Increasing numbers of empirical studies have reported larger multipliers in recessions than in expansions (e.g., Ramey and Zubairy 2018; Auerbach and Gorodnichenko 2012). In addition, consumption multipliers have been found to be larger than the investment multipliers for a temporary increase in spending (e.g., Perotti 2004; Boehm 2020). This paper tries to connect these ideas. First, I estimate separate multipliers for government consumption and investment using linear Vector Auto Regression (VAR) models on quarterly US data from 1966 to 2020. Then I split the dataset and estimate both multipliers for recessions and expansions separately.

Keynesian theory predicts that private consumption, real wage and output increase after a positive government spending shock. If government spending increases, labor demand gets stimulated. As a result, real wage, employment, output and subsequently private consumption will increase via substitution effect or credit constraints. However, Keynesian theory is inconclusive about the sign of investment change (Blanchard and Perotti 2002).

Neoclassical theory says the opposite that private consumption, investment and real wage will fall after a positive government spending shock. Consumers experience a negative wealth effect and

intertemporal substitution effect because of higher tax and increased interest rate respectively. So, consumption and leisure will fall. Hence, increase in labor supply will cause an increase in output and a decline in real wage (Aiyagari, Christiano, and Eichenbaum 1992; Perotti 2008). Therefore, the multiplier should be smaller.

Many studies have focused on identifying parts of the economy that respond more to a stimulus under a variety of circumstances i.e., recession (Auerbach and Gorodnichenko 2012), monetary policy is restricted by zero lower bound (Christiano et al. 2011; Eggertsson 2011), high public debt (Favero, 2007). However, most studies have measured multipliers for aggregate government spending whereas government consumption and investment multipliers are different. The few studies that estimated separate multipliers either used smaller United States datasets or did not control for anticipated variables. For example, Perotti (2004) estimated both the consumption and investment multipliers for quarterly US data from 1960 to 2000 but did not control for forecast variables. The number of observations is important as VAR gets more stable with a larger dataset. Ilzetzki et al. (2013) used a panel dataset for OECD countries with 2,500 observations from 10 years, but it does not fully represent the US context. Both these studies did not control for the business cycle.

Similarly, Boehm (2020) used a non-parametric local projection method but used OECD panel data from 10 years. Ramey and Zubairy (2018) used larger dataset using local projection method and controlled for slack periods but estimated aggregate spending multiplier. Another study that used larger dataset and estimated separate multipliers using both linear and non-linear VARs is Auerbach and Gorodnichenko (2012). They used quarterly US data from 1947 to 2008 to estimate separate consumption and investment multipliers for recessions and expansions using non-linear VAR. However, regime switching VAR models are complicated and their results are found to be

sensitive to the recession identification. Also, they did not add private consumption, investment, interest rate, and debt level in their model.

In my research, I use forecasted government spending, private consumption, private investment, Export, Import, interest rate, Consumer Price Index (CPI), and GDP in the VAR. In addition, I include the market value of accumulated public debt which is rarely done in the literature but found to be an important variable to control for endogenous components of the shock. Also, I split the dataset into recession and expansion samples based on a continuous recession probability indicator. Then I use linear VAR on both samples to estimate separate multipliers for government consumption and investment. I find that investment multipliers are positive and larger than the consumption multipliers. This result is driven by the cross effects as well as the own effects. Private investment consistently gets crowded out after a public consumption shock and that produces smaller consumption multipliers. Also, much of the positive Investment multipliers are generated during expansion periods.

Literature Review

I start this section with a major theoretical debate about the multiplier size and empirical approaches to support the theoretical predictions. Then I point out few important factors that influence the size of multipliers as well as the need to estimate separate multipliers for consumption and investment. Perotti (2008) investigated the robustness of dummy variable and Structural VAR (SVAR) approaches to estimate the effects of fiscal stimulus. The empirical studies that have used the SVAR approach found evidence in favor of Keynesian models whereas other studies using a dummy variable approach found results that are consistent with neoclassical predictions. After removing two restrictions, Perotti (2008) concluded that the dummy variable

approach produces similar results to SVAR approach. In addition, using data from the US input output tables, sectors that experienced the most intensive government spending shock also saw higher increases in real wage consistent with the two-sector version of the neo-Keynesian model. However, this study ignored private investment, inflation rate and anticipated variables. Ramey (2011b) solved this puzzle and included forecast variables in the SVAR model that produced consistent results with neo-classical predictions.

Most studies have found multipliers to be modest and often smaller than one. If multipliers are much smaller than one and close to zero, they find that government spending increases do not stimulate the aggregate demand and fiscal contractions are not likely to affect private activity (Ramey & Zubairy, 2018). Private investment has generally been found to be 'crowded out' after increases in the aggregate government spending (e.g., Ramey and Shapiro, 1998; Blanchard and Perotti 2002; Mountford and Uhlig, 2009; Ramey 2011b). In response to disaggregated spending shocks, private investment gets crowded out more than that of private consumption (Perotti 2004; Boehm 2020). But, when the economy is in recession and unemployment is high, crowding out is found to be smaller (Michaillat, 2014).

Auerbach & Gorodnichenko (2012) estimated much larger multipliers in recessions using regime switching non-linear VAR. This study ignored the possibility that the business cycle can respond to government spending shock. Ramey and Zubairy (2018) used the same method but allowed for the business cycle to be endogenous and showed that the multiplier gets reduced to be around unity. Ramey and Zubairy (2018) also used a local projection method to estimate multipliers to be below unity during recessions. However, the evidence still suggests that multipliers are larger during recessions because of very small or close to zero multiplier size in expansions.

The persistence of the shock plays a major role in generating large multipliers. Aiyagari, Christiano, and Eichenbaum (1992) showed a theoretical framework that more persistent shocks produce larger multipliers. Many empirical studies have confirmed this prediction (e.g., Blanchard and Perotti 2002; Ramey 2011b; Perotti 2004). However, once possible exception may be a study done on Germany data from 1960 to 2000 where more persistent consumption shock resulted in smaller consumption multiplier than that of investment (Perotti 2004). How government spending is financed has also been found to play a role. If spending is financed by debt instead of current taxes, labor supply will increase, and output will be larger in the short run. If agents are aware of higher future taxes, they intertemporally substitute more labor in present (Ramey 2011a). Favero (2007) reported that fiscal variables and long-term interest rates respond to the level of public debt. If debt level is not explicitly included in the SVAR, then a component of shock will remain endogenous. This paper pointed out that private consumption responds to the fiscal stabilization motive and it is consistent with the theory that consumers respond differently to a tax or spending shock depending on whether they expect the government to adjust the budget in the future.

However, it is not the aggregate spending multiplier that has been a focus of recent studies. Perotti (2004) and Ilzetzki et al. (2013) measured disaggregated spending multipliers for government consumption and investment. The productivity enhancement of public capital makes the longer run investment multipliers higher than multipliers for government "consumption" (Baxter & King,1993). However, Boehm (2020) estimated consumption multiplier to be larger than the investment multiplier for a transitory shock. This study used a Dynamic Stochastic General Equilibrium (DSGE) framework to examine the size of investment and consumption multipliers. He reports that private investment is more inter-temporally substitutable than the private consumption. Hence, a short-lived government investment shock generates a bigger crowding out

effect to private investment than that a short-lived government consumption shock does to private consumption. Crowding out happens mostly through own interest rate effect and this is the channel that makes investment multipliers smaller in magnitude than the consumption multiplier. For a long-lived shock, the channel is not effective, and results are reversed.

Also, Pereira (2000) suggests not all types of public investments have equal effect on private output and finds core infrastructure investment has the highest rate of return. Aschauer (1989b) reports 'core' infrastructure capital has the most influence on aggregate productivity. However, Boehm (2020) does not investigate the 'crowd in' effect of public capital that complements private capital in the production and distribution of private goods and services (Aschauer, 1989a).

In fact, it is inaccurate to estimate aggregate multiplier directly because composition of total purchase is not constant. Since aggregate multipliers are approximately weighted average of disaggregated multipliers, a change in the composition of spending may lead to a change in aggregate multiplier. So, it is clear that a change in the aggregate multiplier can simply be the effect of a change in the composition. Therefore, it is better to estimate an aggregate multiplier for total spending as a weighted average of the disaggregated multipliers (Boehm, 2020).

A major stream of recent literature has estimated the magnitude of multiplier under alternative assumptions and found it can be larger than one given different assumption. For example, if there is a significant set of rule-of-thumb consumers (Galí et al. 2007), if the economy is in the recession (Auerbach & Gorodnichenko 2012), if nominal interest rate is restricted by zero lower bound (Christiano et al. 2011; Eggertsson 2011), when consumption and labor enter non-separably in the utility function (Bilbiie 2011), if there is a the presence of an active fiscal policy and a passive monetary policy (Davig and Leeper 2011), or if government spending is financed with cash (Gali 2020). In my research, I use longer US dataset, estimate separate multipliers for government

consumption and investment for both recessions and expansions, and control for variables that have been found to be important in the literature.

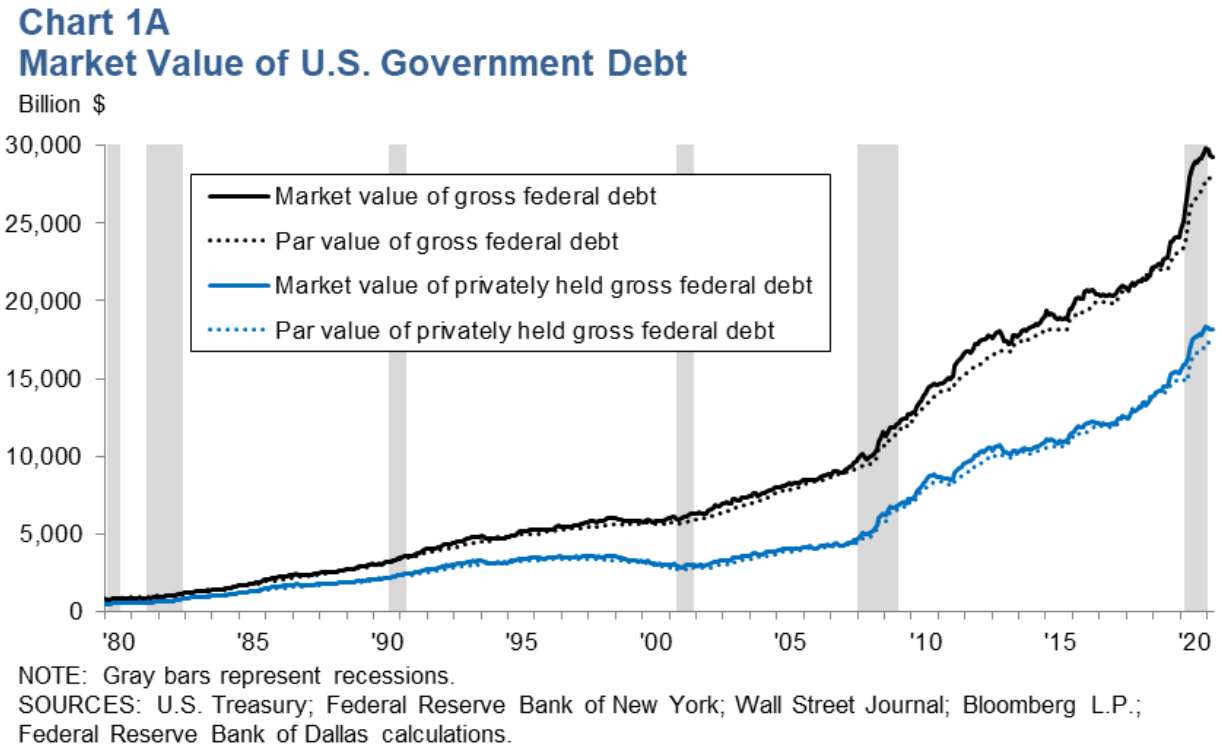
Data

I collect seasonally adjusted Private consumption (C), Private investment (I), Export (Ex), Import (IM), GDP, Government consumption (GC), Government investment (GI), and Tax revenue (TR) data from the US Bureau of Economic Analysis (BEA). These macro aggregates are available for the period 1947: Q1 to 2021: Q1 on table 1.5.5 and table 3.2 at the BEA website.[1] All variables are converted in real terms using the price index from table 1.5.4. I construct a continuous recession probability variable 'F_Z' following Auerbach & Gorodnichenko (2012) and use this variable to split recession sample from the expansion sample instead of NBER dates.

I use mean Forecasted Government Spending (FGS) data from Survey of Professional Forecasters for the period 1981: Q4 to 2020: Q2.[2] Then I stack the data of forecasted government spending from Auerbach & Gorodnichenko (2012) for the period 1966: Q4 to 1981: Q3. I use market value of public debt (D) instead of par value. Market value of debt captures the actual debt burden to the government as it accounts for changing interest rate. This data is available at the website of Federal Reserve Bank of Dallas for the entire study period.[3]

[1] https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey
[2] https://www.philadelphiafed.org/surveys-and-data/rslgov
[3] https://www.dallasfed.org/research/econdata/govdebt.cfm#tab3

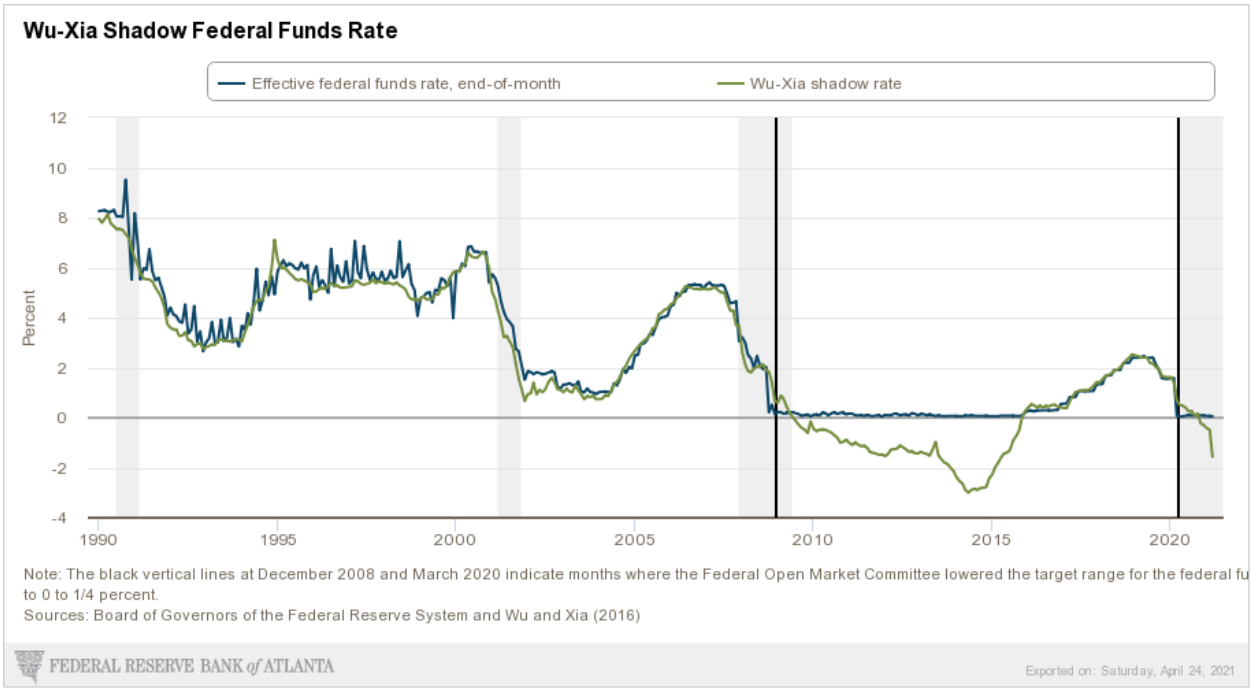
Figure 1: Market Value and Par Value of U.S. Government Debt



I use the interest rate (i) from effective federal funds rate for the period before 2009 and shadow interest rate for the period after 2009 to control zero lower bound (ZLB) environment. Shadow interest rate estimate by Wu and Xia (2016) matches with effective federal funds rate for the non-ZLB period (before).[4] Consumer Price Index (CPI) data are collected from FRED website and data are available for the entire sample period.[5]

[4] https://www.atlantafed.org/cqer/research/wu-xia-shadow-federal-funds-rate?panel=2
[5] https://fred.stlouisfed.org/series/CPIAUCSL

Figure 2: Effective Federal Funds Rate and Wu-Xia Shadow Rate



Model

Private consumption (C), Private investment (I), Export (Ex), Import (IM), GDP, Government consumption (GC), Government investment (GI), Tax revenue (TR), and Debt (D) are log linearized. I use impulse responses from log-linearized VAR (1) model to compute the multipliers. Most data are available for the entire period from 1947: Q1 to 2020: Q4. However, forecasted government spending (FGS) data is available for only the period 1966: Q4 to 2020: Q4. Since it is clear from the literature that government expenditures are anticipated by the private sector, I truncate the entire dataset to match the forecasted spending variable. Also, I remove the last three quarters from 2020 because businesses and activities got disrupted due to COVID-19 pandemic which is different from other recessions.

Identification: Endogenous variables can affect each other contemporaneously. I assume standard identification strategy following Blanchard & Perotti (2002) that fiscal variables do not respond to macro variables within the same quarter. Hence, I put fiscal variables at the top of the Cholesky decomposition matrix followed by macro aggregates Private Consumption (C), Private Investment (I), and GDP. B & P (2002) also says that the order of the fiscal variables doesn't matter. However, the order of the macro aggregates can matter. So, I also estimated my model with an alternative order of macro variables i.e., GDP followed by Private Consumption (C) and Private Investment (I). To choose the lag order for the VAR, I use Schwarz Criterion (SC) to choose the number of lags. Exogenous variables are lagged to avoid simultaneity.

$\boldsymbol{Model\ 1}$: $\boldsymbol{Structural\ VAR\ (1)\ Equation(Full\ Sample)}$: $\boldsymbol{Y_t = Y_{t-1} + X_{t-1} + U_t}$

Y_t= Endogenous variables [GC GI TR C I GDP] ´ ordered accordingly for Cholesky Decomposition.

Y_{t-1} = Lagged variables.

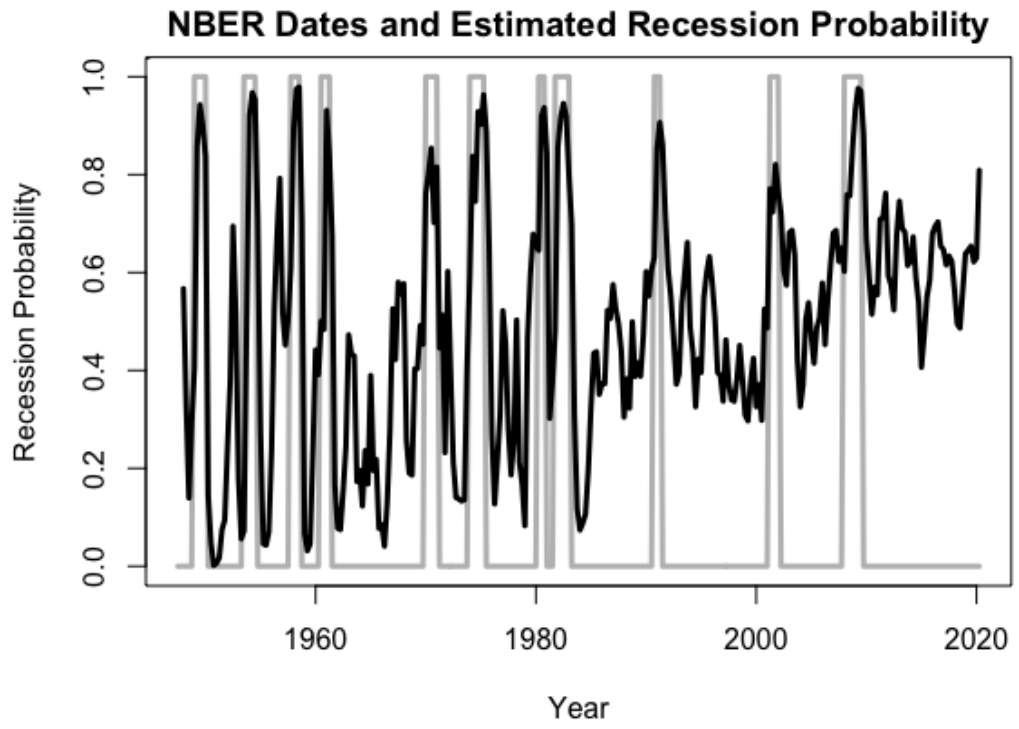
X_t= Exogenous variables [i CPI FGS EX IM D] ´

U_t = Error [u_t^{GC} u_t^{GI} u_t^{TR} u_t^{C} u_t^{I} u_t^{GDP}] ´

I compute a new index variable 'z' which is three quarter moving average of GDP growth rate. Then I use this index variable to estimate recession probability for each observation following Auerbach and Gorodnichenko (2012). This continuous recession probability variable (F_Z) is constructed as following:

$F\_Z = \frac{\exp(-g*z)}{(1+\exp(-g*z))}$; where g=1.5

Figure 3: NBER dates and Estimated Recession Probability



I simply split the dataset into recession and expansion samples using this new recession probability variable F_Z (i.e., if F_Z>0.5, then sample is recession). This is useful because National Bureau of Economic Research (NBER) announced dates have a small number of recession observations

and VAR results might not be stable with such a small sample. I also use F_Z>0.6, F_Z>0.7, and F_Z>0.8 to complete the robustness check. However, F_Z>0.7 or F_Z>0.8 criteria when used will produce small number of observations for recession sample, but it would be more consistent with NBER announced recession periods. Then I use VAR (1) on both the recession and expansion samples to estimate separate multipliers for government consumption and investment.

***Model* 2**: ***Structural VAR* (1)*Equation* (*Recession Sample*)**: $\boldsymbol{Y_t = Y_{t-1} + X_{t-1} + U_t}$

Y_t= Endogenous variables [GC GI TR C I GDP] ´ ordered accordingly for Cholesky Decomposition.

Y_{t-1} = Lagged variables.

X_t= Exogenous variables [i CPI FGS EX IM D] ´

U_t = Error [u_t^{GC} u_t^{GI} u_t^{TR} u_t^{C} u_t^{I} u_t^{GDP}] ´

***Model* 3**: ***Structural VAR*(1) *Equation*(*Expansion Sample*)**: $\boldsymbol{Y_t = Y_{t-1} + X_{t-1} + U_t}$

Y_t= Endogenous variables [GC GI TR C I GDP] ´ ordered accordingly for Cholesky Decomposition.

Y_{t-1} = Lagged variables.

X_t= Exogenous variables [i CPI FGS EX IM D] ´

U_t = Error [u_t^{GC} u_t^{GI} u_t^{TR} u_t^{C} u_t^{I} u_t^{GDP}] ´

Impulse responses produced from these VAR (1) models are in percentage terms. So, I scale them holding the first impulse as one percent. Then I convert the GDP responses from percentage terms

to USD equivalent for one dollar increase in government consumption or investment. I estimate it by multiplying the scaled percentage responses of GDP with average GDP per government consumption/investment.

$$\frac{\Delta GDP}{\Delta GC} = Elasticity * \frac{GDP}{GC}$$

Where $Elasticity = \frac{\log(GDP)}{\log(GC)}$

Similarly,

$$\frac{\Delta GDP}{\Delta GI} = Elasticity * \frac{GDP}{GI}$$

Where $Elasticity = \frac{\log(GDP)}{\log(GI)}$

To estimate the cumulative multiplier over the horizon, I take sum of the responses of government consumption or investment in USD from its own impulse of 1 USD. Then I divide the cumulative responses of GDP in USD by the cumulative responses of government consumption or investment in USD.

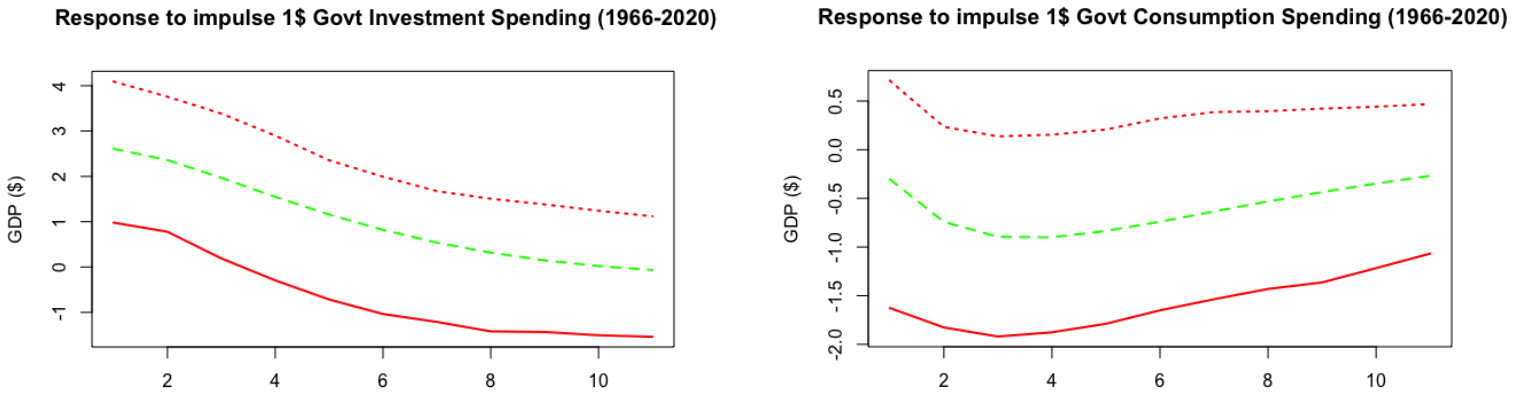
$$Cumulative\ Multiplier\ for\ Government\ Consumption = \frac{\sum GDP}{\sum GC}$$

$$Cumulative\ Multiplier\ for\ Government\ Investment = \frac{\sum GDP}{\sum GI}$$

Results

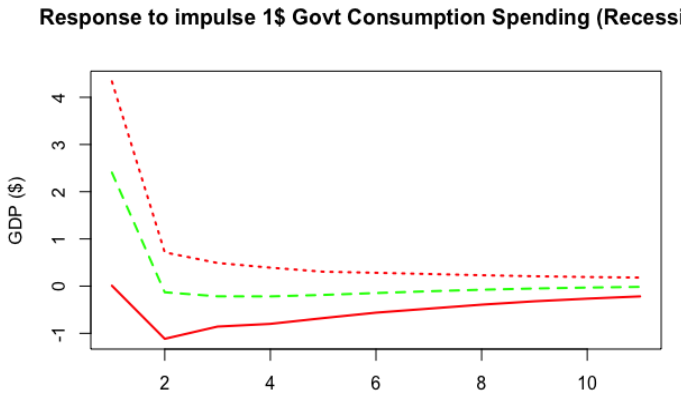
Government consumption and investment multipliers are significantly different from each other. In the literature, consumption multipliers have been consistently found to be larger than the investment multipliers for the US and the OECD countries. In my research, I find that government investment spending has significant positive effects on output for the first three quarters whereas government consumption spending has no such effects on output. Additionally, government investment multiplier is significantly larger than one for the first two quarters.

Figure 4: GDP responses to $1 impulse using full data 1966-2020 (99% Bootstrap CI, 1000 runs)



I divided the recession sample from the expansion sample using the continuous recession probability criteria (F_Z>0.5). Both the multipliers are significantly positive and larger in recessions. This finding is consistent with the Keynesian predictions. I see no significant positive effects of spending on GDP during expansion, rather significant negative effects are observed after the first quarter. Also, investment spending has larger effects on GDP than the consumption spending during recessions. However, the positive effects die out quickly after the first quarter.

Figure 5: GDP responses to $1 impulse during recession (F_Z>0.5) (99% Bootstrap CI, 1000 runs)



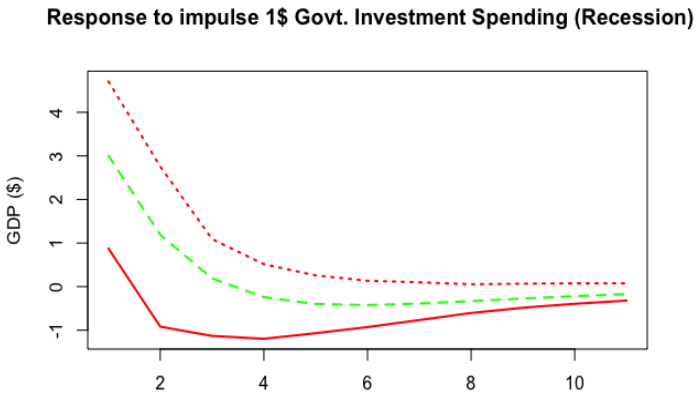
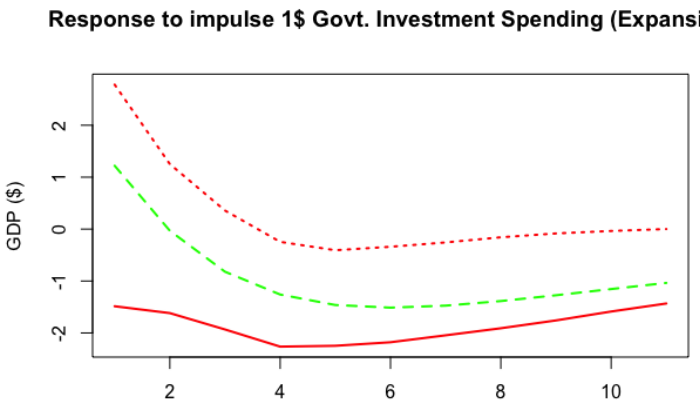
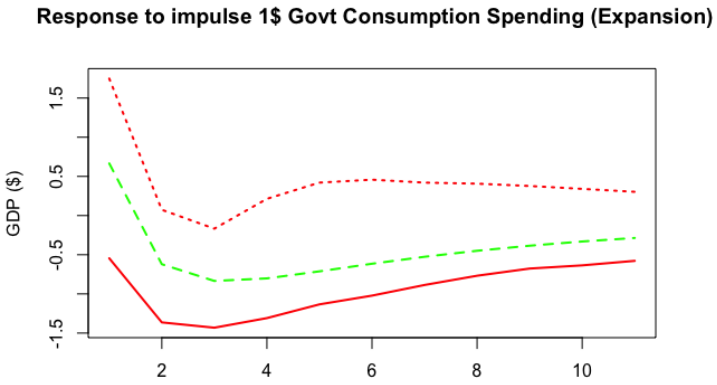


Figure 6: GDP responses to $1 impulse during expansions (F_Z<0.5) (99% Bootstrap CI, 1000 runs)





I find similar results when I use the criteria (F_Z>0.6) to split the recession sample from the expansion sample. If higher probability cut-off is used to split recession sample, it will produce smaller samples that are more comparable to NBER announced dates. For example, if (F_Z> 0.8) criteria is used, it approximately includes only NBER announced recession observations (Figure-3). However, impulse responses from this sample may not be stable due to small number of recession observations (Figure-7). But expansion sample using the same criteria should be stable

as it has more observations, and it will be consistent with the NBER announcements. I find that investment spending has significant positive effects on GDP for at least 5 quarters whereas consumption spending has no such effects.

Figure 7: GDP responses of 1$ impulse during recessions (F_Z>0.8) (99% Bootstrap CI, 1000 runs)

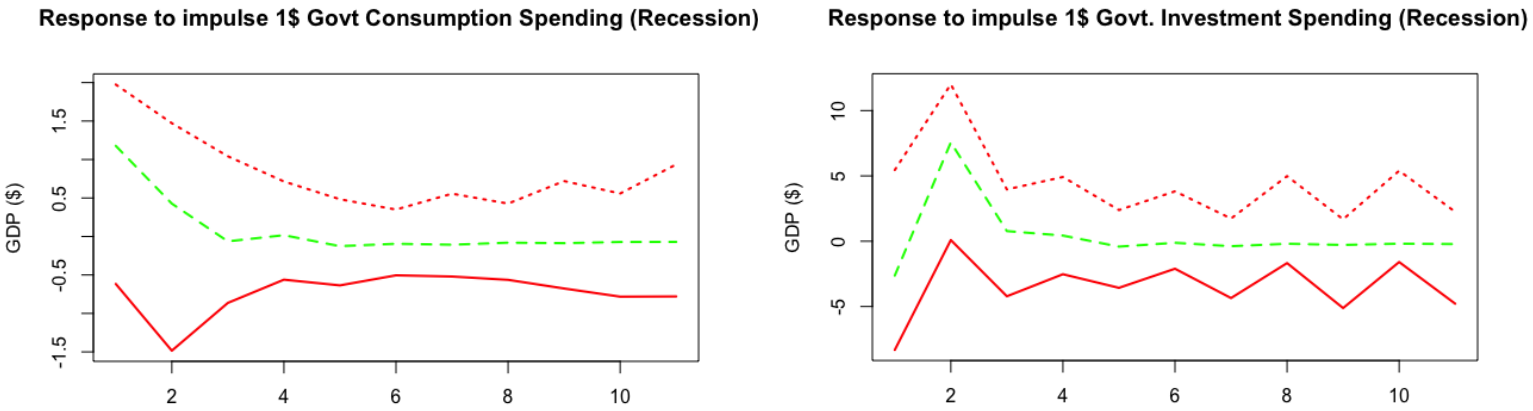
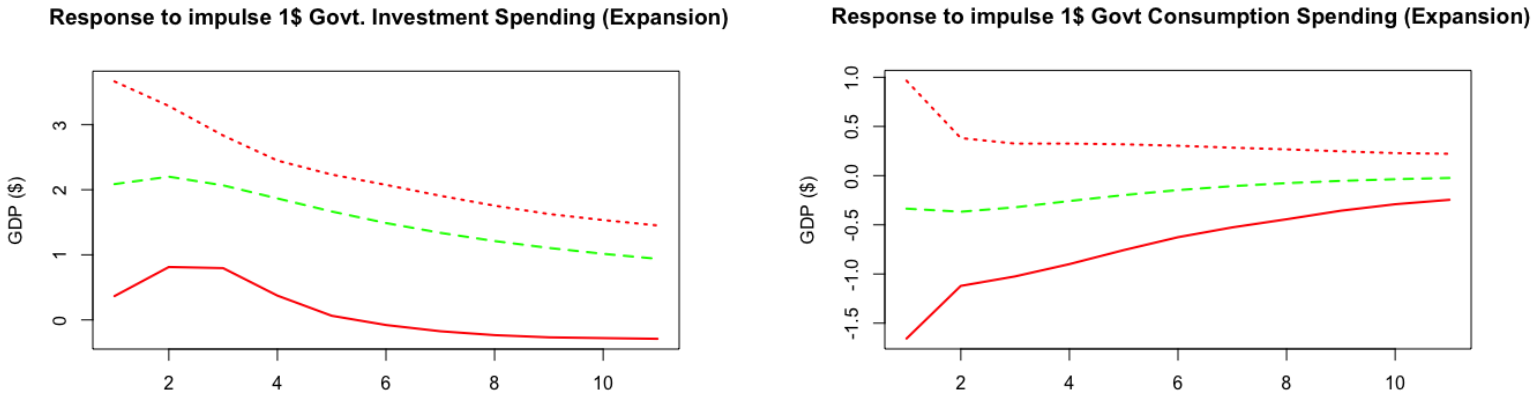


Figure 8: GDP responses of 1$ impulse during expansions (F_Z<0.8) (99% Bootstrap CI, 1000 runs)



Boehm (2020) concludes that investment multiplier is smaller because private investment is more intertemporally substitutable than private consumption. Hence, private investment gets crowded out more by a public investment shock than private consumption gets crowded out after a public

consumption shock and results are mostly driven by own effects. I find that cross effects (crowding in/crowding out) are more important than own effects in driving the results. I see evidence that private investment consistently gets more crowded out by a private consumption shock whereas private consumption gets crowded in after a public investment shock. I don't see any significant crowding in/crowding out of private consumption or private investment by their own shocks (Figure-9 &10). Therefore, these cross effects are working in favor of public investment spending and against public consumption spending to generate larger multipliers.

Figure 9: Responses of $1 increase in government consumption (99% Bootstrap CI, 1000 runs)

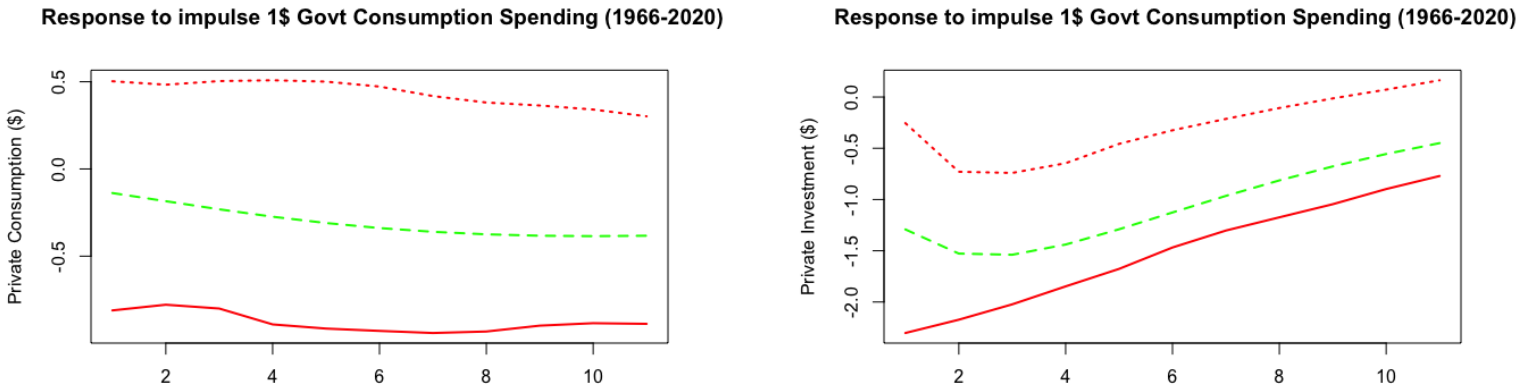
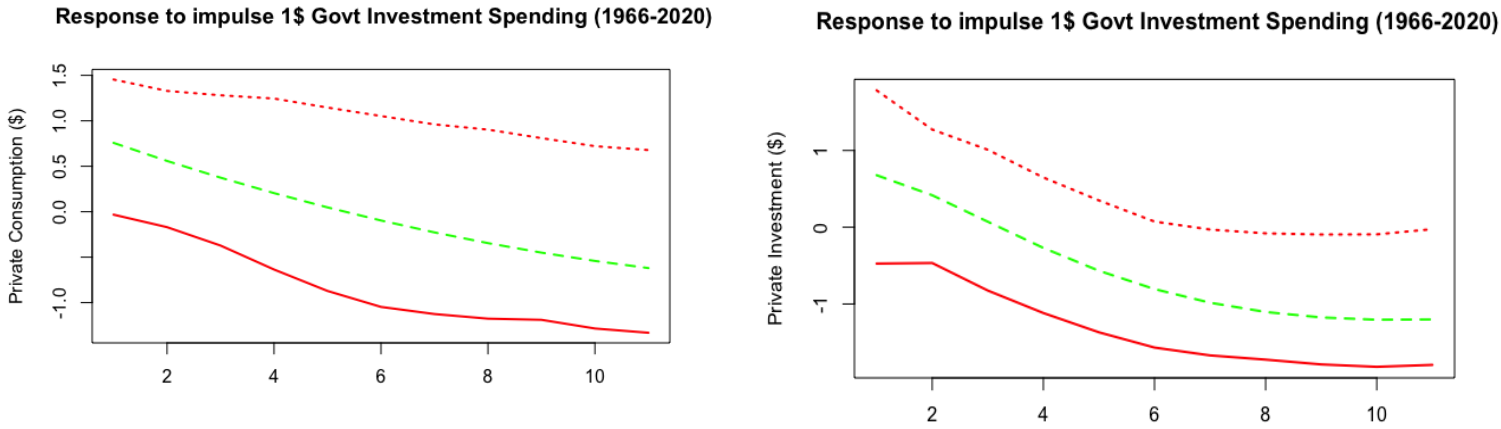


Figure 10: Responses of $1 increase in government investment (99% Bootstrap CI, 1000 runs)



I find that similar cross effects are also driving the results in the split samples when I use the criteria (F_Z>0.5) to separate the recession sample from the expansion sample (See Appendix). In expansion (F_Z<0.8), cross effects (crowding in) are driving the positive and larger multiplier size for public investment shock whereas no such cross crowd in effects are observed after a public consumption shock (Figure-14). The effects also exist during recession (F_Z>0.8) for an investment shock, but it is very short lived (Figure-12)

Figure 11: Responses of $1 increase gov consumption (F_Z>0.8) (99% Bootstrap CI, 1000 runs)

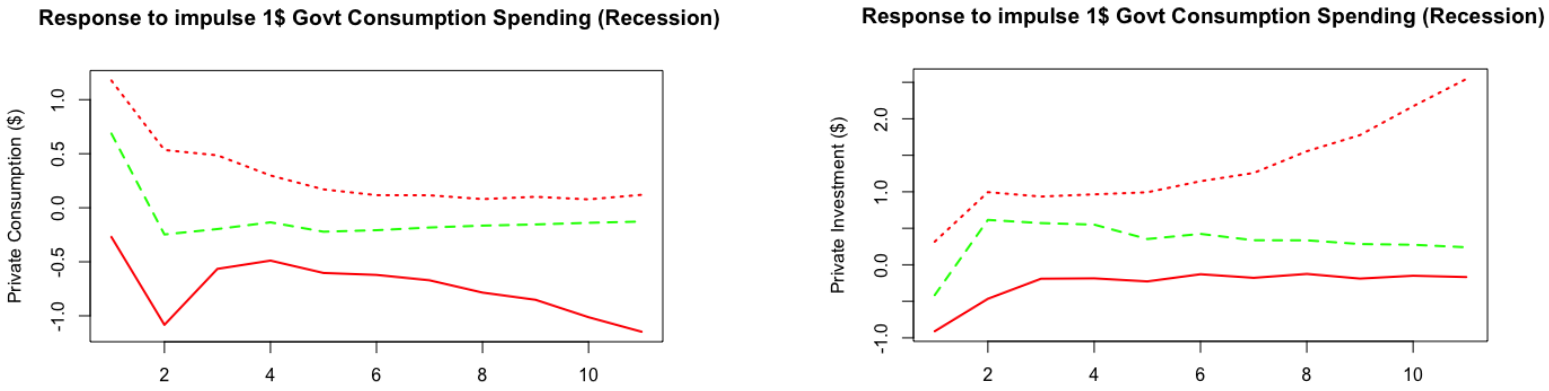


Figure 12: Responses of $ 1increase gov investment (F_Z>0.8) (99% Bootstrap CI, 1000 runs)

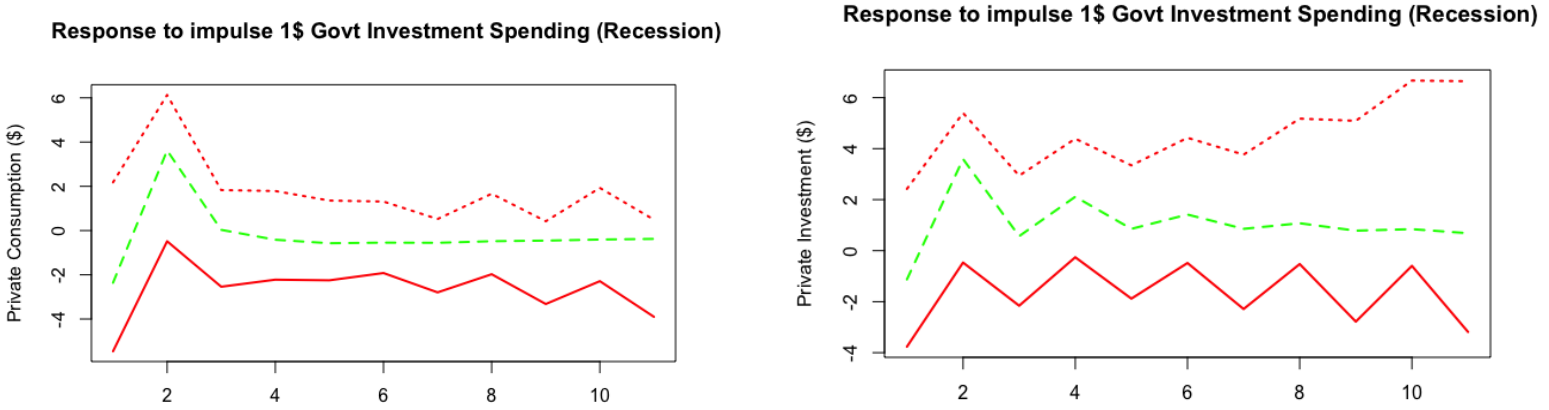
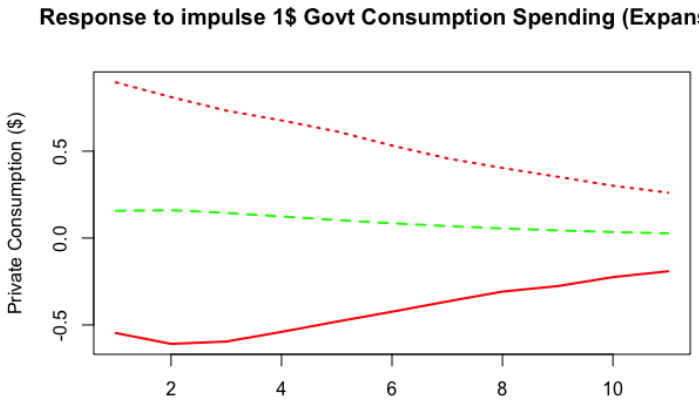


Figure 13: Responses of $1increase gov consumption (F_Z<0.8) (99% Bootstrap CI, 1000 runs)



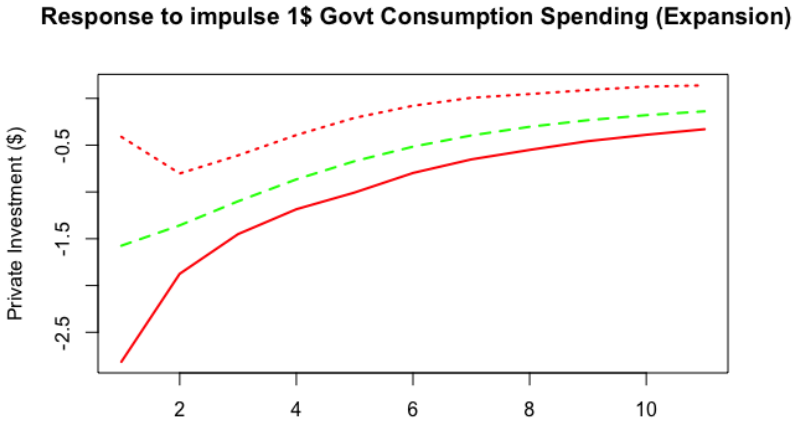
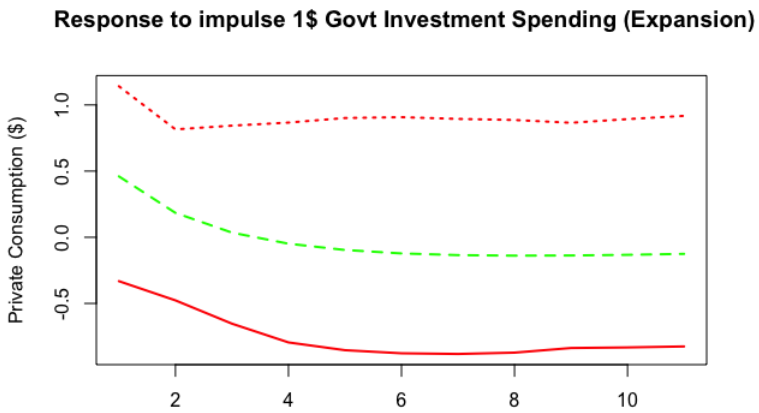
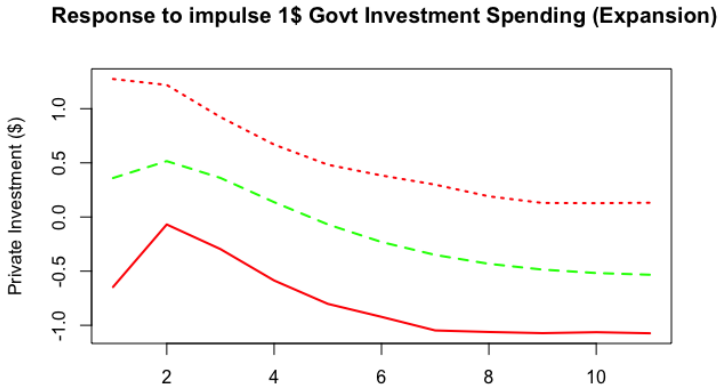


Figure 14: Responses of $1 increase gov investment (F_Z<0.8) (99% Bootstrap CI, 1000 runs)

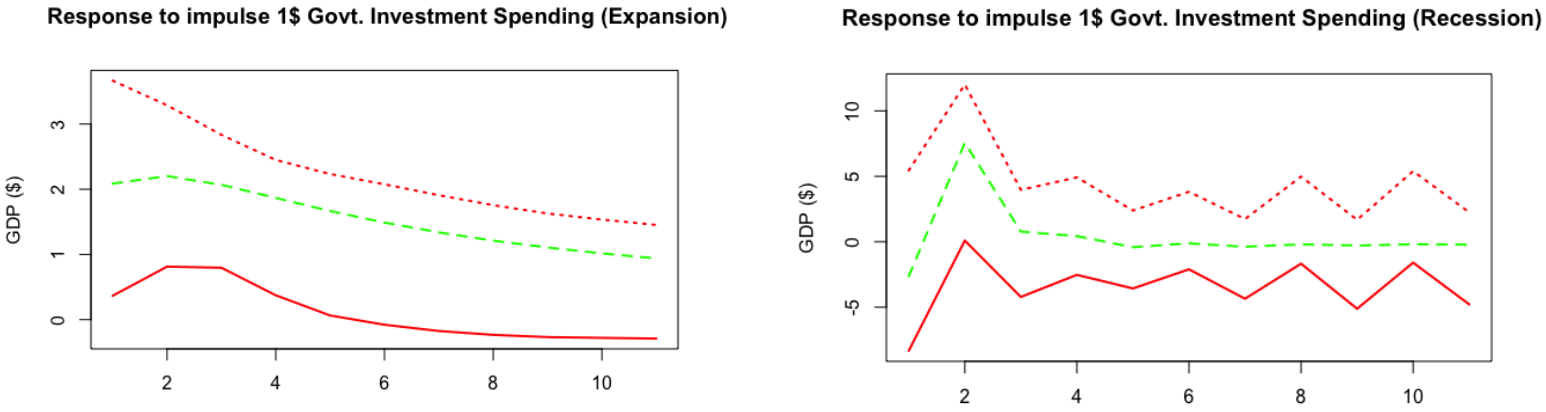




When I use stricter but reasonable criteria (F_Z>0.8) to split the recession sample from the expansion sample, I find that investment spending has significant positive effects on output for both recessions and expansions (Figure 7). In expansion, significant positive effects last for at least first five quarters and the effects approximately stay positive for the entire forecasting periods (Figure-8). However, the effects on GDP are not same for consumption shock. Also, it is clear that

much of positive multipliers for public investment shock is actually generated during the expansion periods (Figure-15). This finding is not consistent with the traditional theory that predicts more crowding out of private activity during expansion leading to smaller multipliers

Figure 15: GDP responses to $1 increase in investment spending during recession and expansion.



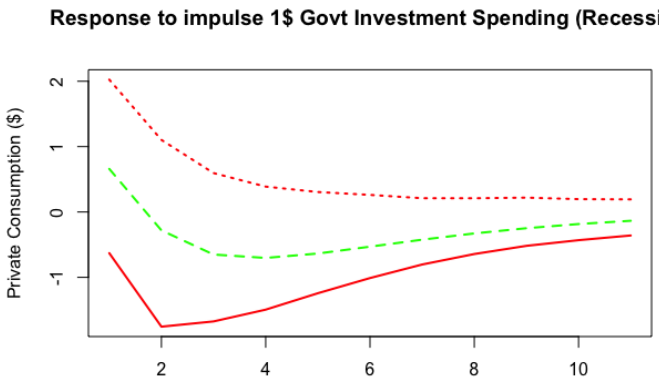
Conclusion

Using US data from 1966 to 2020, investment multipliers are found to be positive and larger than the consumption multipliers. Cross effects (crowd out/ crowd in) are driving these results and generating smaller multipliers for consumption. This finding is true for both recessions and expansions. Much of the positive and prolonged effects of investment spending on GDP are seen during the expansionary periods. Surprisingly, both these results are not consistent with the traditional theories or findings from prominent literature on this topic. However, there are limitations of this research. I have used linear VAR models to estimate the effects. Parametric linear models ignore nonlinearity in the data, assumes symmetry, and are often vulnerable to misspecification. Also, I have used lagged control variables to avoid simultaneity problem in the

model and contemporaneous control variables are ignored which can create omitted variable bias in the model. Finally, due to small number of observations, results from recession sample using the criteria (F_Z>0.8) are not stable.

Appendix

Figure A: Effects of $1 increase in consumption (Recession: F_Z>0.5) (99% Bootstrap CI, 1000 runs)



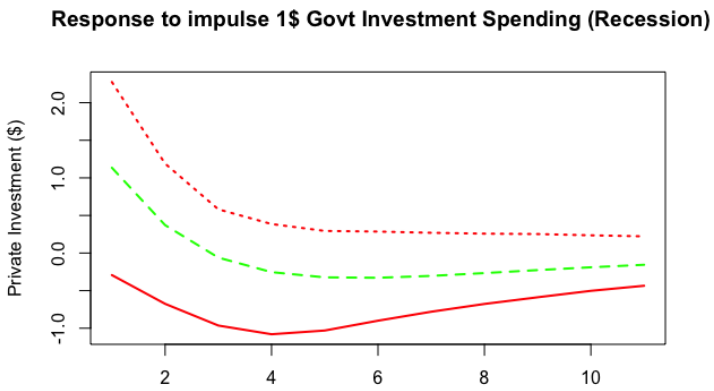
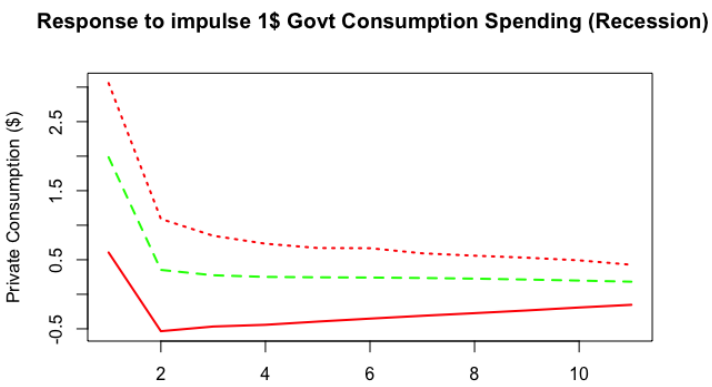


Figure B: Responses of $1 increase in investment (Recession: F_Z>0.5) (99% Bootstrap CI, 1000 runs)



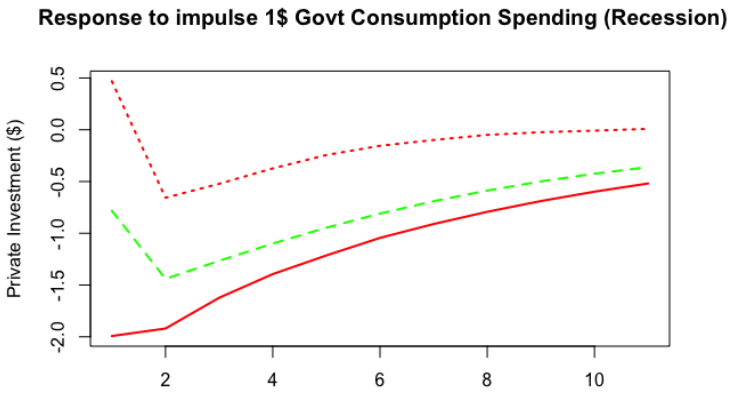
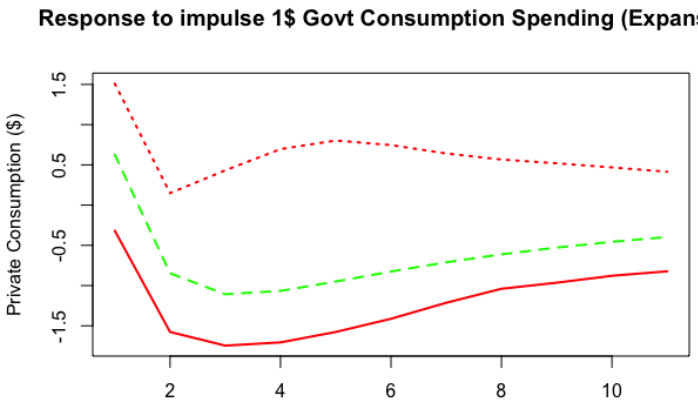


Figure C: Effects of $1 increase in consumption (Expansion: F_Z<0.5) (99% Bootstrap CI, 1000 runs



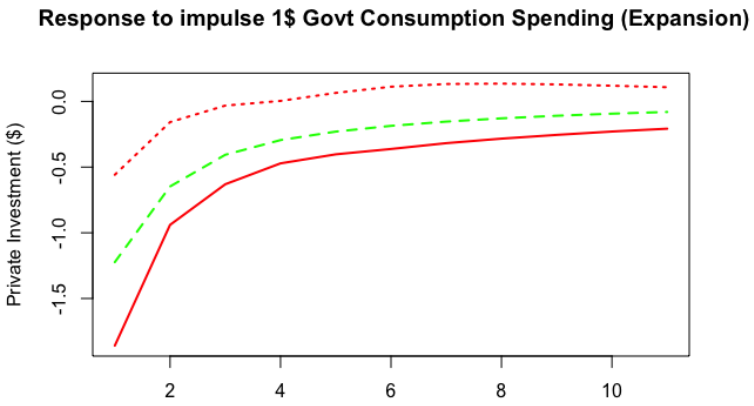
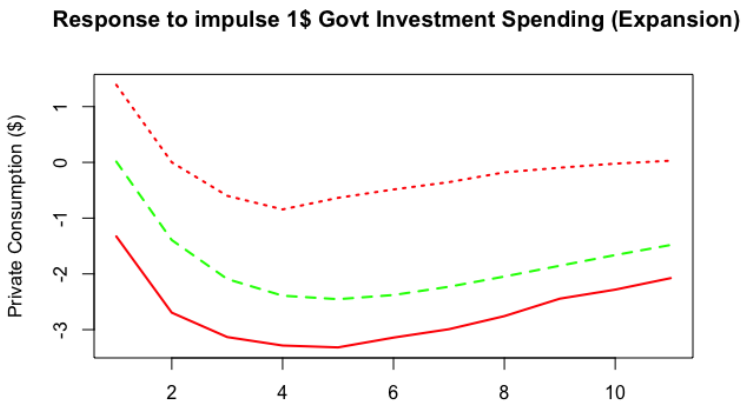
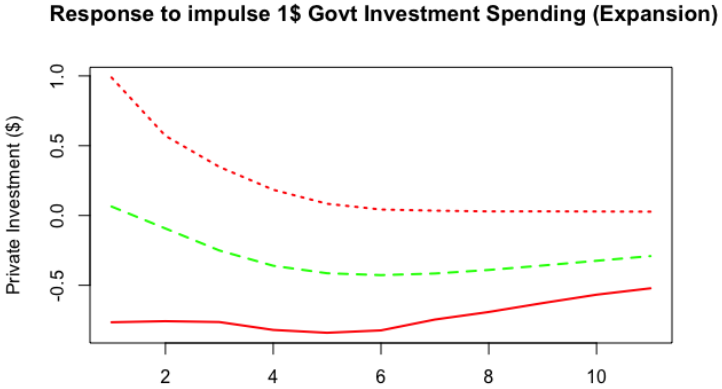


Figure D: Responses of $1 increase in investment (Expansion: F_Z<0.5) (99% Bootstrap CI, 1000 runs)





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