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## The macroeconomic effects of government spending shocks in New Zealand

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# The Macroeconomic Effects of Government Spending Shocks in New Zealand

Yifei Lyu

New Zealand Treasury Working Paper 21/02

June 2021

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The Macroeconomic Effects of Government Spending Shocks  
in New Zealand

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# Abstract

This paper estimates the macroeconomic effects of government spending shocks in New Zealand. Using a structural vector autoregression (SVAR) model, I find small output multipliers for government consumption but large multipliers for government investment. Importantly, the real exchange rate appreciates after positive government spending shocks, consistent with classic theory. Private consumption and private investment decrease after government consumption shocks, but increase after government investment shocks. I show that selecting the appropriate series for government investment is important to estimating its effects.

## JEL CLASSIFICATION

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E32  
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H30  
H54

## KEYWORDS

government consumption, government investment, New Zealand, multiplier, VAR

# Executive Summary

This paper estimates the macroeconomic effects of government consumption shocks and government investment shocks in New Zealand. In a low interest rate environment, central banks are often constrained by the zero lower bound, so fiscal policy has become more important. In particular, policy makers are keen to know the effects of government investment, which is usually a key component of fiscal stimulus packages. Unfortunately, there are few studies on the effects of government spending in New Zealand, with the majority not differentiating between government consumption and government investment.

Most estimates of government spending multipliers from developed countries are smaller than 1, suggesting that government purchases crowd out private demand. On the one hand, as a small open economy with a flexible exchange rate regime, New Zealand is supposed to have small multipliers. On the other hand, New Zealand has a low public debt level, a high foreign share in public debt, and a highly indebted household sector, all of which may lead to large multipliers. As a result, the size of government spending multipliers in New Zealand remains an empirical question.

In this paper, I employ a structural vector autoregression (SVAR) model for analysis. I find that the output effect of a positive government consumption shock is small and even negative after a few years. This is partly attributed to subdued private economic activity. In contrast, a positive government investment shock results in significant increases in output, tax revenue, and the short-term interest rate, while the change in inflation is very small. Private consumption and investment increase, possibly due to higher overall productivity. It is also worth noting that the New Zealand dollar appreciates following an increase in government spending, which is consistent with economic theory.

I calculate cumulative government spending multipliers, defined as the cumulative change in output divided by the cumulative change in government consumption or investment, for different time horizons. I find that the government consumption multiplier is only 0.4 at the 1-year horizon, then decreases over time and turns negative after three years. The government investment multiplier is around 1.4 at the 1-year horizon and remains above 2 in the following years.

I highlight the importance of selecting the appropriate series for government investment when estimating its impact. I argue that a commonly used interpolated series for government investment is problematic, and it explains why an important previous study obtains negative government investment multipliers in New Zealand.

An immediate policy implication of my result is that government investment is a powerful stimulus tool in New Zealand. However, my result should be interpreted with caution. First, there are usually significant delays inherent in infrastructure projects. In particular, there are delays between appropriations and actual outlays, and it takes time for infrastructure projects to be completed and ready for use. Because my model does not consider the implementation delays, it may overestimate the stimulative effect of government investment in the short-run. Second, my model estimates the average effect of government investment since the 1990s, but the current effect may depend on specific economic circumstances, including the infrastructure investment gap. If New Zealand is facing a big infrastructure investment gap, then government investment may be more beneficial in the long-run.

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# The Macroeconomic Effects of Government Spending Shocks in New Zealand

## 1. Introduction

This paper estimates the macroeconomic effects of government spending shocks in New Zealand. In particular, I calculate government spending multipliers, the quantitative effects on aggregate output of government purchases. Ramey (2019) surveys the evidence from developed countries and finds that the bulk of the multiplier estimates lie in the range of 0.6 to 1, suggesting that government spending in general is very likely to crowd out private demand.

The size of government spending multipliers in New Zealand remains an empirical question. On the one hand, as a small open economy with a flexible exchange rate regime, New Zealand may have small multipliers because (i) a significant portion of government spending leaks overseas in the form of higher imports; and (ii) the real exchange rate appreciation following higher interest rates and inflow of foreign capital reduces net exports; see Ilzetzki, Mendoza and Végh (2013) and Born, Juessen and Müller (2013) among others. On the other hand, recent empirical evidence suggests that the output responses to government spending shocks are larger when the government is in a sound fiscal position (Ilzetzki, Mendoza and Végh 2013, Nickel and Tudyka 2014, Huidrom et al. 2019), when public spending is financed with foreign capital (Broner et al. 2018, Priftis and Zimic 2020), and when household debt overhangs (Andrés, Boscá and Ferri 2015, Klein 2017, Bernardini and Peersman 2018, Demyanyk, Loutskina and Murphy 2019). These studies imply large government spending multipliers in New Zealand, a country with a low public debt-to-GDP ratio, a high share of public debt held by foreigners, and high household indebtedness.

Unlike most studies in the literature, I estimate the effects of government consumption shocks and government investment shocks separately. As opposed to government consumption, researchers and policy-makers are particularly interested in government investment as it is usually an important component of large fiscal stimulus packages and may have remarkably different macroeconomic effects. For example, Ilzetzki, Mendoza and Végh (2013) find government investment multipliers larger than government consumption multipliers based on international evidence. Bachmann and Sims (2012) also find that government investment associated with future productivity increases is more stimulative than government consumption. In addition, Bouakez, Guillard and Roulleau-Pasdeloup (2017) find that government investment is nearly twice as effective as government consumption in stimulating output in a liquidity trap. However, Boehm (2019) finds multipliers much smaller for government investment than for government consumption based on evidence from OECD countries. Using a stylised neoclassical model and a New Keynesian model, Ramey (2020) finds that government investment is usually less stimulative than government consumption in the short-run but much more stimulative in the long-run.

This paper employs a structural VAR with identifying assumptions similar to those in Blanchard and Perotti (2002) for analysis. After a government consumption shock, output rises on impact, but then declines and turns negative. Private activity declines, possibly due to the negative wealth effect on the optimising households. After a government investment shock, there are significant increases in output, tax revenue, and the short-term interest rate. Private consumption and investment also increase, possibly because

of higher economy-wide productivity. Importantly, the real exchange rate appreciates as predicted by economic theory. In other words, I do not observe the domestic currency depreciating after positive government spending shocks, a puzzle documented by many studies for open economies (Corsetti and Müller 2006, Ravn, Schmitt-Grohé and Uribe 2007, Kim and Roubini 2008, Monacelli and Perotti 2010, Enders, Müller and Scholl 2011).

Based on the impulse responses of output and government spending, I estimate a 1-year, 3-year, and 5-year cumulative government consumption multiplier of 0.4, 0.1, and -1, respectively. The estimates of cumulative government investment multipliers remain above 2 from the second year onward. The multiplier estimates are robust to a series of different modelling choices. I show evidence that the shocks identified are not likely to be anticipated, so the results in this paper should be interpreted as the effects of unanticipated government spending shocks. It is worth noting that my model does not take into account the implementation delays associated with government infrastructure spending, as pointed out by Leeper, Walker and Yang (2010), so my result may overestimate the stimulative effect of government investment in the short-run.

New Zealand has attracted little attention so far in the literature. To my best knowledge, there are very few papers estimating the macroeconomic effects of government spending shocks in New Zealand, including Claus et al. (2006), Dungey and Fry (2009), Fielding (2014), Parkyn and Vehbi (2014), and Hamer-Adams and Wong (2018) which all find multipliers smaller than 1 or even negative. Among these studies, Hamer-Adams and Wong (2018) is the only one distinguishing between government consumption and investment. They find multipliers for the former smaller than 1 and multipliers for the latter negative. This paper contributes to the literature by providing new evidence that government investment in New Zealand is more stimulative than previously estimated. In particular, I show that Hamer-Adams and Wong (2018) observe negative government investment multipliers because they use an inappropriately interpolated series for central government investment that is subject to measurement error and spurious dynamics. If they instead use the official series for general government investment as I do, they would also obtain large multipliers.

The remainder of this paper is organised as follows. Section 2 describes the econometric model and data. Section 3 shows the main results and robustness checks. Section 4 discusses New Zealand’s economic features and fiscal foresight, and compares this paper to some previous studies. Section 5 concludes.

## 2. Econometric model

To estimate the macroeconomic effects of government spending shocks, I build a structural vector autoregression (SVAR) model. The reduced-form is:

$$Y_t = \sum_{i=1}^4 C_i Y_{t-i} + u_t \quad (1)$$

where  $Y_t$  includes (in order) a government spending variable, tax net of transfers, GDP, inflation, interest rate, the real effective exchange rate, private consumption, and private investment. Except for the three “price” variables, all the variables enter in log real per capita terms.  $u_t$  is the vector of reduced-form residuals. I use quarterly data and include 4 lags of  $Y_t$  on the right-hand-side as suggested by the likelihood-ratio test. A constant and a linear time trend are also included in the model, but are omitted from system (1) for brevity.

As suggested by Blanchard and Perotti (2002), identification of structural government spending shocks can be achieved based on institutional information. In particular, Blan-



chard and Perotti (2002) argue that it takes the government more than a quarter to make and implement decisions in response to changes in economic activity, so I employ a recursive identification strategy (Cholesky decomposition). The government spending shock is identified as the innovation in the first equation in system (1).

I estimate the model with ordinary least squares (OLS). Then I calculate impulse responses to government spending shocks and compute cumulative multipliers at different horizons following Gordon and Krenn (2010) and Ramey and Zubairy (2018). Because the impulse-response functions of government spending and output are denoted in percentage changes, I compute the government spending multiplier as the ratio of the cumulative response of output to the cumulative response of government spending scaled by the sample average of the ratio of output to government spending.

My sample starts in 1991Q1 and ends in 2019Q4. In fact, most data are available as of the early 1980s, however, following Fielding (2014) and Hamer-Adams and Wong (2018), I do not use the earlier period because it is characterised by radical economic reforms, major policy changes, and a reduction in inflation. For example, both the *Reserve Bank of New Zealand Act* and the *Public Finance Act* were passed in 1989, making New Zealand the first country to adopt inflation targeting in 1990 and start to stabilise public debt at prudent levels. As a result, the economy was likely to be in a different regime after the early 1990s.

I obtain data from various sources, including Statistics New Zealand, the Treasury, and the Reserve Bank of New Zealand. Government (private) consumption is measured by chain-volume general government (private) final consumption expenditure. Government (private) investment is measured by chain-volume general government (private) gross fixed capital formation. To obtain the real aggregate government spending variable, I aggregate nominal government consumption and investment and then deflate it using the GDP implicit price deflator. Following Hamer-Adams and Wong (2018), I exclude purchases of weapon systems, which are very volatile and different from other investment in nature, from the government investment series.<sup>1</sup> Tax revenue is sourced from the Treasury's monthly tax outturn data, and transfer spending is sourced from the Treasury's monthly and yearly financial statements. Then I calculate tax revenue less transfers, aggregate the series into quarterly, and deflate it by the GDP implicit price deflator. Following Claus et al. (2006) and Hamer-Adams and Wong (2018), I exclude departmental goods and services tax (GST) and the GST on imported frigates in 1997 and 1999 from the tax revenue series. GDP is measured by Statistics New Zealand's chain-volume expenditure GDP series. Inflation is measured by the log percentage change in the CPI. All these variables are seasonally-adjusted. The 90-day bank bill rate is used to measure the short-term interest rate, and the real trade-weighted exchange rate index constructed by the Reserve Bank is used to measure the real effective exchange rate. More details on the data can be found in Appendix A.

## 3. Results

### 3.1 Macroeconomic effects of government spending shocks

First, I use government consumption as the government spending variable in the model. Figure 1 shows the dynamic effects of a 10% shock to government consumption on impact. The solid lines represent the point estimates of impulse-response functions and the dashed lines are the 90% confidence intervals based on 1,000 wild bootstraps. Output rises on

<sup>1</sup> It would be ideal to exclude all military-related expenditure from government investment, however, the data is not available.

impact, however, the effect declines over time and turns negative at the two-year horizon. This is partly driven by subdued private economic activity, as implied by the negative wealth effect. Inflation and the short-term interest rate increase, although the responses are statistically insignificant.

Consistent with classic theory, the real New Zealand dollar appreciates. The change is both economically and statistically significant. The higher exchange rate leads to lower exports, which also contributes to lower output. This result stands in contrast with the observation in many empirical studies that the domestic currency of an advanced economy with a flexible exchange rate regime depreciates after an increase in government spending. Forni and Gambetti (2016) argue that such a depreciation puzzle exists for unanticipated government spending shocks and can be explained by the spending reversal: government spending decreases quickly after the initial increase and falls below the pre-shock level after a few years. If agents anticipate the reversal, then the interest rate declines and the real exchange rate depreciates. Compared to the US case in Forni and Gambetti (2016), the timing of the spending reversal is much later in New Zealand. This partly explains why I do not observe the depreciation puzzle.

Next, I use government investment as the government spending variable in the model. Figure 2 shows the dynamic effects of a 10% shock to government investment on impact. Different from the effects of a government consumption shock, the investment shock leads to statistically significant increases in output, tax revenue, and the short-term interest rate. The real exchange rate appreciates again. Private investment increases dramatically. One possible reason is that the government investment shock raises economy-wide productivity, thus encouraging firms to invest more in capital and hire more labour. Private consumption also increases, although by a smaller magnitude. This is possibly because rule-of-thumb households in the economy raise their consumption due to higher income. In addition, the negative wealth effect on the optimising households may be muted by the positive wealth effect associated with higher future productivity. Finally, it is worth noting that the response of inflation is quite small and statistically insignificant at most horizons. Whereas a positive government investment shock raises aggregate demand and thus creates inflation pressure, it may also exert downward pressure on the marginal cost of production and inflation by raising private productivity. As a consequence, the sign of the change in inflation is not clear a priori.

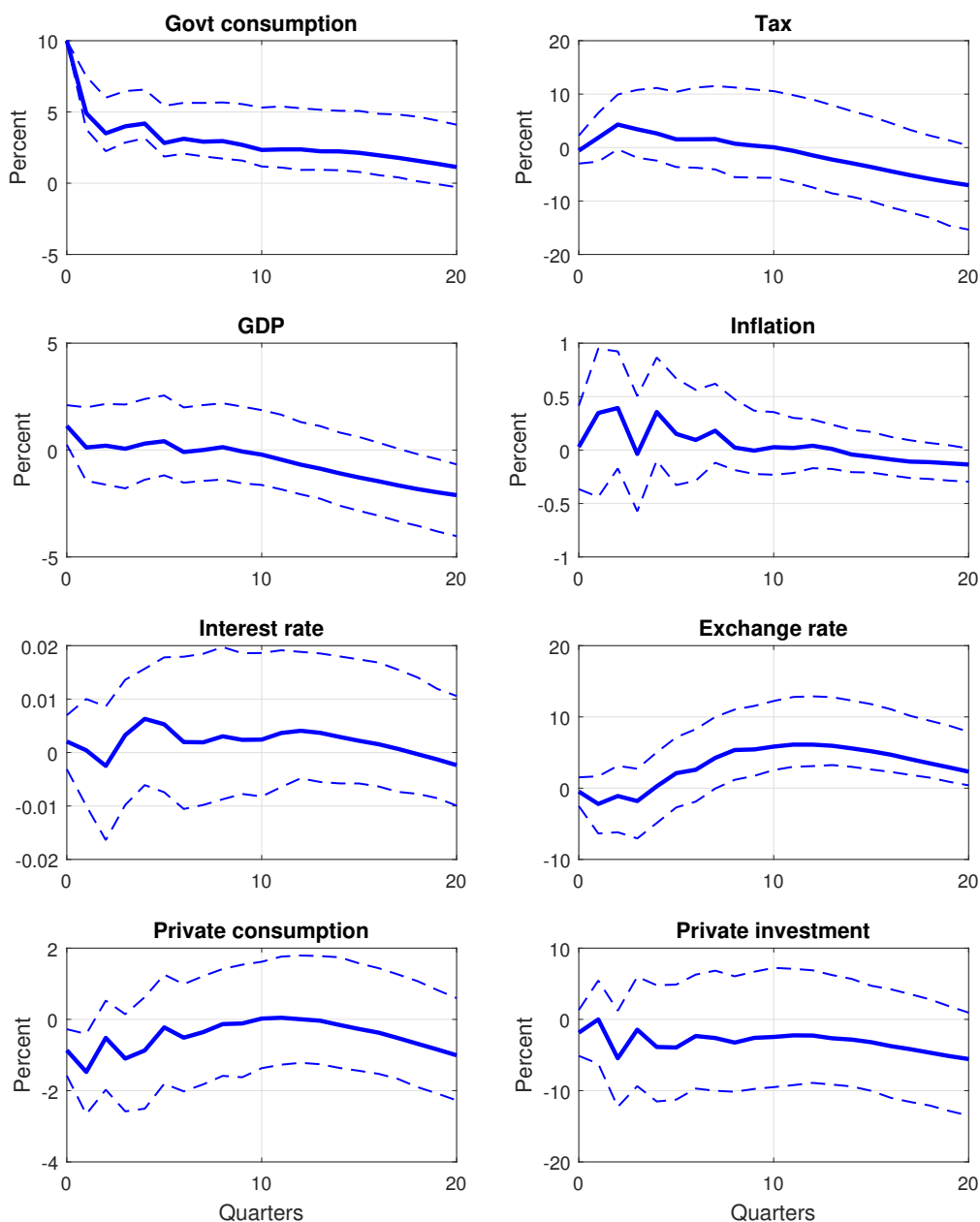
Table 1 shows the multipliers at various horizons ranging from 1-year to 5-years. For a government consumption shock, the multiplier is 0.4 at the 1-year horizon, then decreases over time and becomes negative after three years. For a government investment shock, the multiplier is 1.4 at the 1-year horizon, and remains above 2 in the next few years. Note that the consumption multipliers are much less precisely estimated than the investment multipliers, as government consumption is much less volatile. To better compare to previous literature, I also examine the effects of aggregate government spending shocks.<sup>2</sup> The aggregate spending multiplier, as shown in the last column of Table 1, falls between 0.6 and 1 at most horizons, which is consistent with international evidence (Ramey 2019). My results highlight the importance of distinguishing government investment from government consumption: using aggregate government spending multipliers to inform policy making may significantly downplay the stimulative effect of government investment.

The short-run government investment multiplier should be interpreted with caution. Leeper, Walker and Yang (2010) note that there are usually implementation delays associated with government infrastructure spending. In particular, there are delays between appropriations

<sup>2</sup> I do not show the impulse-response functions in order to save space. The result is available upon request.

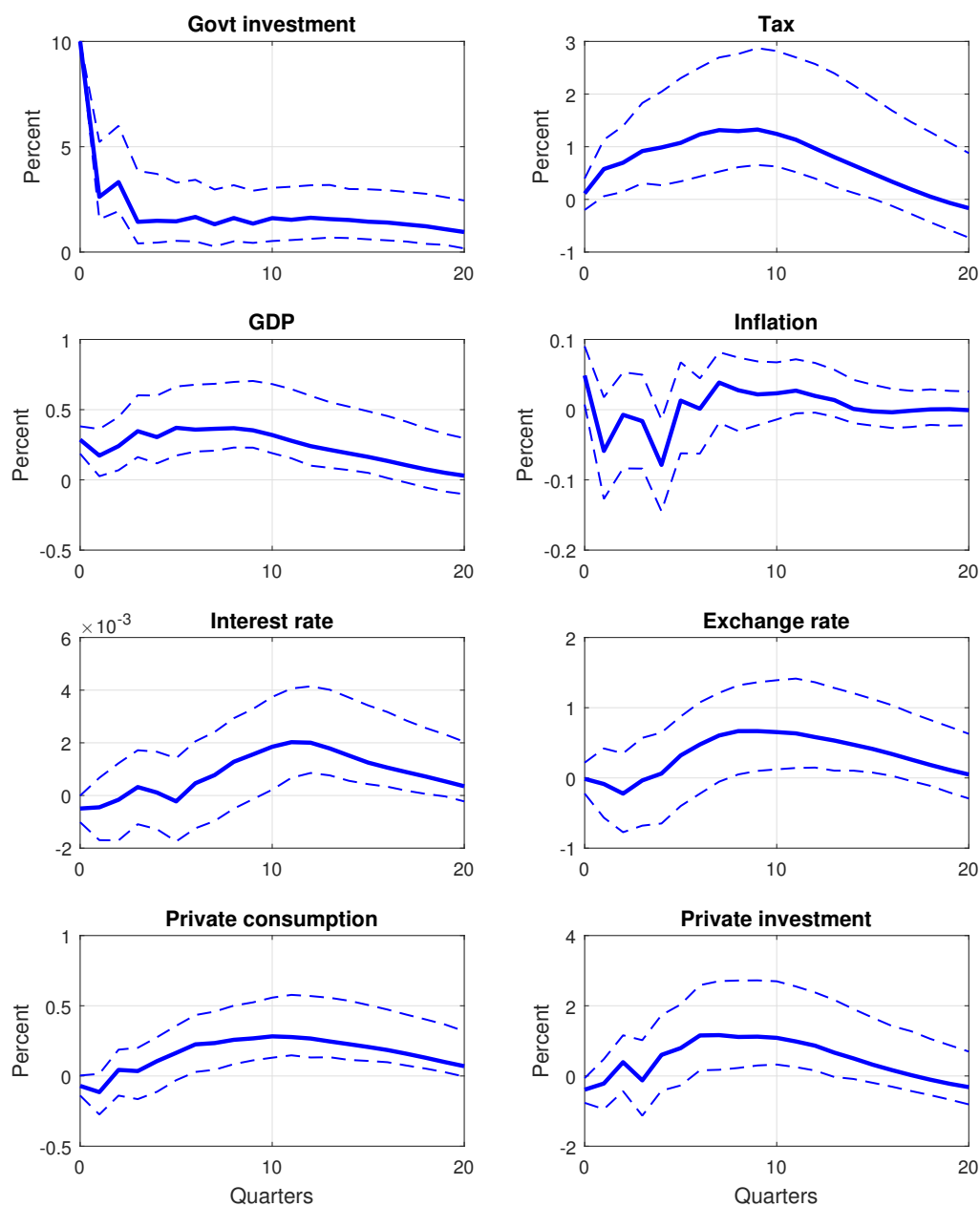
and actual outlays, and it takes time to complete infrastructure projects and for them to become part of the public capital stock. They argue that such implementation delays can reduce the stimulative effect of government investment in the short-run. Ramey (2020) also shows that the implementation delays significantly shrink the short-run multiplier for government investment without affecting the long-run multiplier. As a result, in the absence of implementation delays, my model tends to overestimate the power of government investment as a short-run stimulus.

**Figure 1 – Impulse responses to a 10% government consumption shock.**



Note: Solid lines are point estimates of impulse-response functions. Dashed lines give the 90% confidence intervals based on 1,000 bootstrap replications. An increase in the exchange rate represents a real appreciation.

**Figure 2 – Impulse responses to a 10% government investment shock.**



Note: Solid lines are point estimates of impulse-response functions. Dashed lines give the 90% confidence intervals based on 1,000 bootstrap replications. An increase in the exchange rate represents a real appreciation.

**Table 1 – Baseline estimates of cumulative government spending multipliers**

Horizon	Govt consumption	Govt investment	Aggregate spending
1-year	0.4 [-1.1, 1.9]	1.4 [0.4, 2.2]	0.6 [0.0, 1.1]
2-year	0.3 [-1.5, 2.8]	2.3 [0.8, 3.5]	0.8 [-0.1, 1.7]
3-year	0.1 [-1.9, 3.5]	2.6 [1.2, 4.3]	0.7 [-0.2, 2.0]
4-year	-0.4 [-2.4, 4.1]	2.5 [1.2, 4.5]	0.6 [-0.3, 2.1]
5-year	-1.0 [-3.1, 5.3]	2.4 [1.1, 4.7]	0.4 [-0.6, 2.3]

Note: The estimates are based on the baseline VAR. The values in brackets give the 90% confidence intervals based on bootstrap replications.

### 3.2 Robustness checks

In this subsection, I explore the sensitivity of my results to some of my modelling choices. Table 2 summarises the alternative estimates of government spending multipliers.

First, I restrict the sample to start in 1993. Interest rates were still high and inflation was high but falling in the early 1990s. In addition, severe economic downturns occurred in 1991 and 1992, so I abandon the pre-1993 period.<sup>3</sup> Second, I exclude the time trend from the baseline model. Third, I include the world industrial production series constructed by Baumeister and Hamilton (2019) as an exogenous variable to control for the impact of global economic activity.<sup>4</sup> Fourth, I include both government consumption and investment in the model, and identify both spending shocks at the same time recursively. Table 2 shows that my estimates of the multipliers, especially the multipliers for government investment, are robust to these changes.

Last but not least, I employ the local projection approach proposed by Jordà (2005) to compute impulse-response functions. Compared to the VAR method, the local projection method is supposedly more robust to misspecification. Following Ramey and Zubairy (2018), I run the following regression for each horizon  $h$ :

$$\sum_{l=0}^h y_{t+l} = \alpha_h + \beta_h \sum_{l=0}^h g_{t+l} + \Psi_h X_{t-1} + \varepsilon_{t+h}. \quad (2)$$

$y$  is output and  $g$  is either government consumption or government investment.  $X_{t-1}$  contains 4 lags of the endogenous variables in the baseline VAR and a linear time trend. I use  $g_t$  as an instrumental variable to estimate  $\beta_h$ .  $\beta_h$  multiplied by the sample average of the ratio of output to government consumption (or investment) gives the cumulative multiplier at horizon  $h$ . The local projection estimates in Table 2 reinforce my conclusion that the output effects of government investment are much larger than the effects of government consumption in New Zealand.

<sup>3</sup> I do not cut the sample before the global financial crisis, otherwise more than 40% of the data observations would be lost and the coefficients would be imprecisely estimated given the size of the model.

<sup>4</sup> The original series is monthly. I construct a quarterly series by averaging the monthly values.

**Table 2 – Robustness checks: cumulative government spending multipliers**

	Government consumption multiplier		
	1-year	3-year	5-year
Sample starting in 1993	0.2	-0.4	-1.6
Trend excluded	0.2	-0.5	-2.1
World industrial production controlled	0.1	-0.2	-1.4
Both govt spending variables included	0.8	0.9	-0.1
Local projection estimation	-0.1	0.3	-3.0
	Government investment multiplier		
	1-year	3-year	5-year
Sample starting in 1993	1.5	2.8	2.7
Trend excluded	1.3	2.1	1.8
World industrial production controlled	1.3	2.1	2.1
Both govt spending variables included	1.4	2.2	2.5
Local projection estimation	1.2	4.2	3.8

## 4. Discussion

### 4.1 New Zealand's economic conditions

**Infrastructure investment gap.** Note that my model assumes that the effect of government investment is constant over time. However, the effect could vary depending on where the economy is relative to the socially optimal level of public capital. Ramey (2020) shows that the long-run multiplier will be substantially higher if the economy starts from a state where the government investment-to-GDP ratio is below the social optimum. According to the *Global Infrastructure Outlook* by Oxford Economics published in 2017, New Zealand's overall infrastructure investment gap from 2016 to 2040 is projected to be roughly 9.5 percent of GDP, which translates into a gap of around 0.3 percent of GDP per year until 2040. This is smaller than Australia and the United States, but larger than other key advanced economies and China. Using an overlapping generations dynamic stochastic general equilibrium (DSGE) model, International Monetary Fund (2018) show that closing the gap has substantial benefits, not just because it is a short-term stimulus to aggregate demand, but because of permanent effects on productivity, benefiting all sectors of the economy. In the long term, real GDP would be as much as 0.8 percent higher than otherwise, for a long-term multiplier of around 2.7.

**Debt.** New Zealand has been in a very sound fiscal position owing to the *Fiscal Responsibility Act* (FRA) introduced in 1994.<sup>5</sup> The FRA requires fiscal policy to comply with a set of principles of responsible fiscal management, a key one being fiscal sustainability. As a result, government needs to achieve and maintain prudent public debt levels so as to provide a buffer against economic shocks that would raise the level of debt in the future.<sup>6</sup> New Zealand's public debt level has remained below 50% of GDP since 1994. In 2019,

<sup>5</sup> The FRA was incorporated into the *Public Finance Act* as Part 2 in 2004.

<sup>6</sup> The FRA does not prescribe numerical fiscal rules as in many other countries, however, the government must determine its debt objectives and articulate in its *Fiscal Strategy Report* how the objectives are consistent with the principles of responsible fiscal management.

New Zealand's public debt-to-GDP ratio was 30%, which was only higher than those of Luxembourg, Estonia, and Hong Kong among advanced economies, according to IMF data. Another feature of New Zealand's public debt conditions is that a large portion of the debt is held by foreigners: more than half of government securities have been held by non-residents since the mid-2000s according to data from Haver. However, Broner et al. (2018) find that the foreign share of public debt holdings were below 50% during the past two decades in many developed countries, including US, UK, Australia, Canada, Sweden, and Japan. In contrast to the fiscally sound public sector, New Zealand's household sector is highly indebted: household debt has remained around 90% of GDP since the mid-2000s. In 2018, the ratio was 94%, ranking 8th in the world according to IMF data. Without these factors, the multipliers in New Zealand might have been lower, based on the studies mentioned in the introduction.

## 4.2 Fiscal foresight

It is widely recognised in the fiscal literature that many changes in government spending are anticipated before they actually occur. Leeper, Walker and Yang (2013) show that SVARs that fail to model this type of fiscal foresight will obtain biased estimates of fiscal multipliers. In this section, I argue that the government spending shocks identified in this paper are unlikely to be anticipated.

First, my model includes the short-term interest rate and the real exchange rate, both of which are “forward-looking” variables. Yang (2007) shows that movements in interest rates and prices reflect agents' foreknowledge about fiscal changes. As a result, including such variables in a VAR helps control for fiscal foresight.

Second, the impulse-response functions of the government spending variables shown in Figures 1 and 2 indicate that the shocks are likely to be unanticipated. Ramey (2011) and Forni and Gambetti (2016) show that unanticipated government spending shocks and anticipated government spending shocks have very different dynamic effects on government spending. While government spending increases on impact and then declines over time following an unanticipated shock, the impulse-response function of government spending is hump-shaped following an anticipated shock.

Third, I test whether real-time forecasts of New Zealand government spending have predictive power for the shocks identified in the present paper. My source of forecasts is the OECD Economic Outlook's Statistics and Projections database. The forecast data for New Zealand is quarterly from 2004 onward. The OECD publishes their forecasts of real government consumption and investment for the next few quarters biannually based on information up until late May and late November, respectively. Based on this dataset, I construct real-time quarterly forecasts of the growth of government spending (in real per capital terms) for New Zealand from 2004Q1-2019Q4.<sup>7</sup> Then I regress the government consumption (investment) shock estimated from the VAR on four of its own lags and the forecast of government consumption (investment) growth. The coefficients of the forecast variables are not statistically significant even at the 10% level, suggesting that the OECD forecasts do not have predictive power for the VAR shocks.

## 4.3 Comparison to previous studies

Claus et al. (2006), Dungey and Fry (2009), Fielding (2014), and Parkyn and Vehbi

<sup>7</sup> I use the November edition of projections in the previous year to construct forecasts of growth in Q1 and Q2, and use the May edition of projections in the current year to construct forecasts of growth in Q3 and Q4.



(2014) estimate the macroeconomic effects of total government spending in New Zealand, using sign restrictions for identification or identification strategies similar to the one in the present paper. However, they do not differentiate between government consumption and government investment, which have distinct dynamic effects as illustrated in Figures 1 and 2. As far as I am aware, Hamer-Adams and Wong (2018) is the first study in the literature estimating separately the effects of government consumption and the effects of government investment in New Zealand. Moreover, none of these papers, except Dungey and Fry (2009) and Fielding (2014), examine the impact on the exchange rate.

Whereas the present paper finds multipliers larger than 1 for government investment, Hamer-Adams and Wong (2018) find negative multipliers. The main reason is that we use different series for government investment. While the present paper uses the official series for quarterly general government investment published by Statistics New Zealand, Hamer-Adams and Wong (2018) use an interpolated series for quarterly central government investment following Parkyn and Vehbi (2014). Specifically, the latter series is constructed by multiplying the former by the annual ratio of nominal central government investment to nominal general government investment. For the post-2015 period when annual central government investment data is not available, they use the average ratio from 2000-2015.

The official series for general government investment is superior to the other series in a few dimensions. First, the general government investment series is updated on a regular basis by Statistics New Zealand, while data on central government investment is no longer reported as of 2015. Second, most studies in the fiscal literature use general government purchases, so using the general government series makes the results more comparable to the existing studies. Third, the interpolated series is subject to substantial measurement error as well as spurious dynamics.<sup>8</sup> By construction, the interpolated central government investment has the same growth rates as general government investment in the last three quarters of a fiscal year, and its growth rate in the first quarter could be totally spurious. Figure 3 is an illustrated example that shows why the interpolation method is problematic. Suppose in reality, general government investment grows at a constant rate and central government investment keeps constant over time, then the interpolated series would always have a (spurious) negative growth rate in the first quarter and mimic the general government investment series in the other quarters. Moreover, in the post-2015 period, the interpolated series is a simple rescaling of the official series. As a result, the interpolated series should be best thought of as the official series plus measurement errors.

To highlight the importance of selecting the right series for government investment, I first replicate relevant results in Hamer-Adams and Wong (2018) and then replace their interpolated central government investment series with general government investment. Table 3 shows the estimated output multipliers for government investment. When using central government investment, I obtain negative multipliers. Nevertheless, when using general government investment, I obtain positive multipliers that are larger than 1.

## 5. Conclusion

Since the global financial crisis, the effects of fiscal policy shocks have attracted much attention. Because different components of government spending may have distinct effects, using aggregate spending multipliers to inform policy making may be misleading. This paper estimates separately the macroeconomic effects of government consumption shocks and government investment shocks in New Zealand. Using a structural VAR, I find that government consumption multipliers are small but government investment multipliers

<sup>8</sup> I have communicated with one author of Hamer-Adams and Wong (2018), and she agrees that the interpolated series presents issues.



**Figure 3 – Illustration example of spurious dynamics in the interpolated central government investment series.**



Note: The purple line represents general government investment that grows at a constant rate. The green line represents central government investment that keeps constant over time. The red dashed line represents interpolated central government investment based on the method in Hamer-Adams and Wong (2018) and Parkyn and Vehbi (2014). In New Zealand, Q2 is the first quarter in a fiscal year.

**Table 3 – Estimates of cumulative government investment multipliers based on the specification in Hamer-Adams and Wong (2018)**

Horizon	Series for government investment	
	Interpolated central govt investment	Official general govt investment
1-year	-0.9 [-2.6, 0.4]	0.7 [-0.4, 1.5]
2-year	-1.8 [-5.3, 1.5]	1.1 [-0.5, 2.6]
3-year	-3.4 [-9.1, 4.8]	1.4 [-0.3, 3.6]
4-year	-5.6 [-14.8, 10.2]	1.5 [-0.1, 4.4]
5-year	-8.9 [-35.6, 15.6]	1.6 [0.0, 4.9]

Note: This table shows VAR estimates of government investment multipliers based on the seven-variable specification in Hamer-Adams and Wong (2018). The second column uses the interpolated quarterly series for central government investment constructed by Hamer-Adams and Wong (2018). The third column uses the official quarterly series for general government investment. The values in brackets give the 90% confidence intervals based on bootstrap replications.

are large. The results are largely driven by the dynamic responses of the private sector: private consumption and investment decline after an increase in government consumption, but rise after an increase in government investment. The main possible reason is that government investment raises overall economic productivity. The real exchange rate appreciates after government spending shocks, consistent with standard economic theory.

A contribution of this paper is that I highlight the importance of selecting the appropriate series for government investment when estimating its impact. I argue that a commonly used interpolated series for government investment is problematic, and it explains why Hamer-Adams and Wong (2018), an important study in the literature, obtain negative government investment multipliers.

There are two issues which this paper does not cover. First, I show that the shocks identified in the paper are likely to be unanticipated. However, due to the nature of the fiscal policy making process, anticipated shocks are probably more intriguing. Second, I do not consider the implementation delays inherent in infrastructure projects, so my result tends to overestimate the short-run effect of government investment. Both issues are left for future research.

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## A. Data Sources

Series	Description	Source
Government consumption	Final consumption expenditure - general government	Statistics NZ
Government investment	Gross fixed capital formation - total market and non-market - general government	Statistics NZ
Tax	Total tax receipts	Treasury
Government transfer	Transfer payments and subsidies	Treasury
GDP	Gross domestic product - expenditure measure	Statistics NZ
CPI	Consumers price index - all groups	Statistics NZ
Interest rate	90-day bank bill rate	Reserve Bank NZ
Real exchange rate	Real trade-weighted exchange rate index (Oct 2014=76.57)	Haver
Private consumption	Final consumption expenditure - private non-profit organizations and households combined	Statistics NZ
Private investment	Gross fixed capital formation - total market and non-market - private	Statistics NZ
Weapon spending	Gross fixed capital formation - weapon systems	Statistics NZ
GDP deflator	Implicit price deflator for GDP (expenditure measure)	Statistics NZ
Population	Estimated resident population	Statistics NZ
World industrial production	Industrial production of OECD countries plus six major non-OECD countries	Baumeister and Hamilton (2019)
Government spending forecast	Forecast of quarterly real government consumption and investment in NZ	OECD Economic Outlook's Statistics and Projections