

Technical appendix to
**Minding our business: Drivers of
New Zealand business investment
over the last 20 years**

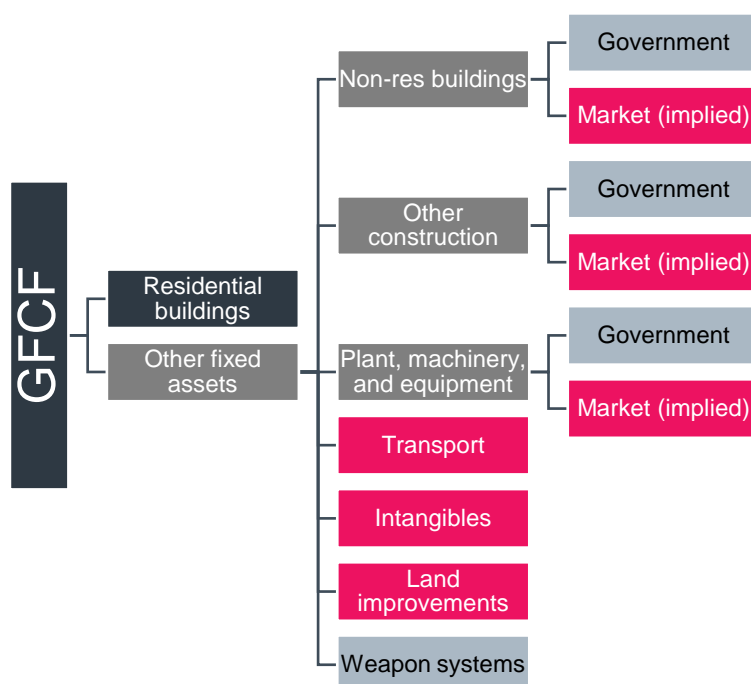
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Data

Investment and aggregate demand

Investment is measured by private business investment and aggregate demand is proxied by expenditure GDP. Private business investment is calculated as the sum of the pink boxes in Figure A.1. That is, total investment (gross fixed capital formation) minus residential investment and non-market (government) investment. The dependent variable is the logarithmic difference in investment. The first two lags of the quarterly difference in GDP and investment are included as independent variables. Investment and GDP are both real and seasonally adjusted.

Figure A.1: Gross fixed capital formation (GFCF)



Financial conditions

To proxy for financial conditions, we use a range of indicators including commodity prices, excess equity returns, the change in the short-term interest rate, and the term spread on government bonds. Together, these variables represent the cost and availability of credit for investment.

New Zealand is a commodity-exporting country, so the inclusion of commodity prices may capture the importance of export income in driving New Zealand demand and therefore firms' investment decisions. The New Zealand dollar exchange rate also tends to appreciate with an increase in commodity prices, changing the cost of capital. We use the ANZ World Commodity Price Index as our measure of commodity prices.

Excess equity returns are measured by returns in the New Zealand Stock Exchange All Index less the 90-day bank bill yield and links to Tobin's q theory of investment. It allows us to test if higher stock prices are correlated with higher investment.

The short-term interest rate is the 90-day bank bill yield and is used as a proxy for monetary policy changes, or changes in the Official Cash Rate (OCR). This is because the short-term interest rate and the OCR co-move very closely. In line with Banerjee et al. (2015), we also include a term spread, measured as the difference between the 10-year government bond yield and the 90-day bank bill yield.

Uncertainty

In the baseline model we use the New Zealand Economic Uncertainty (NEU) index from Sense Partners (2020). The index measures the number of New Zealand media articles that contain words related to both uncertainty and the economy. The uncertainty criteria are “concern*, fear*, pressure*, confusion, turmoil, challenge*, uncertain*, risk*, dubious, unclear, dispute*, issue*, potential*, probabl*, predict*, and danger**”, and the economy criteria are "economic" or "economy". The index represents the percentage of total articles published online that contain the economic uncertainty terms.

International events indeed impact the New Zealand economy, but these events are still captured by the New Zealand media to the extent that they are deemed relevant by reporters. Therefore the index captures both domestic and international events sufficiently. The work by Sense Partners complements existing work by Rice et al. (2018) in that both show that uncertainty (as proxied by various indices) has impacts on the New Zealand economy.

Robustness checks

A range of robustness checks were performed. These include, but are not limited to, the following:

- testing lag length;
- testing other proxies for financial conditions, such as mortgage rates, mortgage spreads, the Goldman Sachs Financial Conditions Index, and credit default swap spreads;
- testing other proxies for uncertainty, including forecast disagreement and QSBO business uncertainty from Rice et al. (2018).
- testing a variant of Tobin’s q model using Bloomberg financial data; and
- testing different sample periods.

Broadly put, the results of these tests are consistent with the benchmark results. The robustness checks results are available upon request.

Alternative models

To account for model uncertainty, we have also estimated a vector autoregression (VAR) model that is motivated by Lawrence and Siow (1985). The results are presented below.

We estimate a VAR to capture any endogenous relationships among variables. The variables in the VAR include the CPI, GDP, investment, the short-term interest rate, commodity prices, and the uncertainty index. The CPI, GDP, and investment are entered as logarithmic variables. Two lags are selected based on AIC and BIC criteria. The estimated VAR is stable, in the sense that all eigenvalues lie within the unit circle. Timing restrictions are imposed to identify the impulse responses. The Cholesky order is assumed as listed above, such that shocks to the first variable affects others within the same quarter, but not vice versa. Our ordering is consistent with the fact that economic variables move relatively slow compared to financial variables.

Below are the impulse responses of investment to shocks in GDP, the short-term interest rate, uncertainty, and commodity prices respectively. The horizontal axis spans from zero to 12 quarters. The grey area represents 90% confidence bands, such that responses are significant if the entirety of the grey area is positive or negative. Bootstrapping (1000 repetitions) is used to retrieve the confidence bands.

The results are consistent with our benchmark estimation. We find that a positive shock to GDP leads to a significant increase in investment (Figure A.2). Equivalently, shocks to the short-term interest rate and uncertainty lead to a significant decrease in investment (Figures A.3 and A.4). However, the interest rate shock takes longer to significantly impact investment than in the baseline model, and the

uncertainty shock is much more persistent in the VAR (though coefficients in the baseline regression follow a similar evolution). The impact of a commodity price shock on investment has a similar evolution across both models (figure A.5). These results confirm that all three factors are important in driving investment over the time horizon.

Figure A.2: Impulse response of investment to a GDP shock

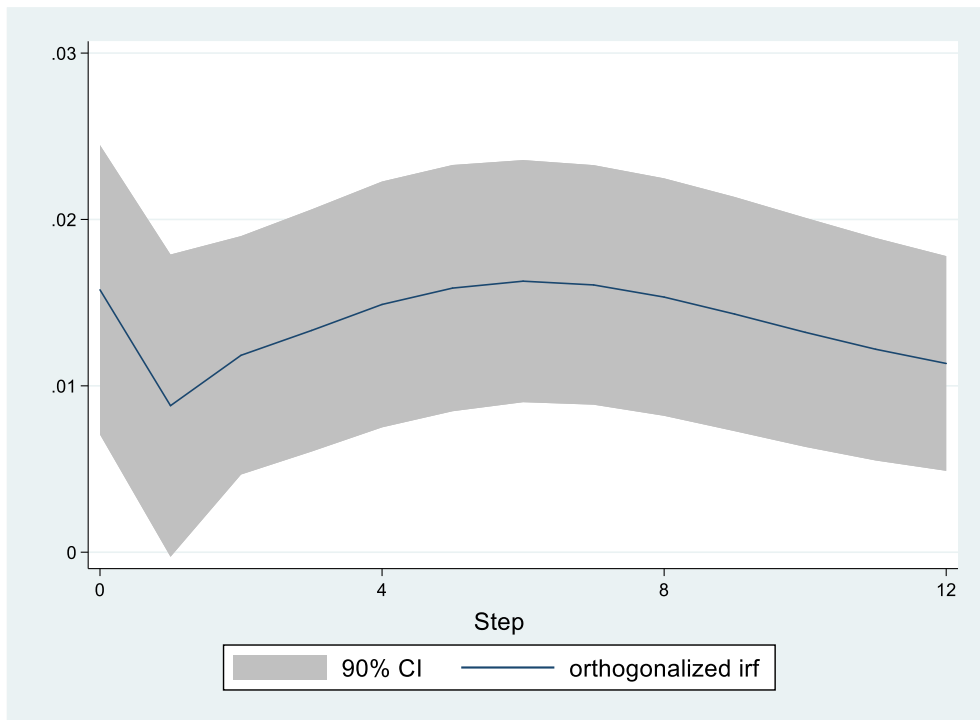


Figure A.3: Impulse response of investment to a short-term interest rate shock

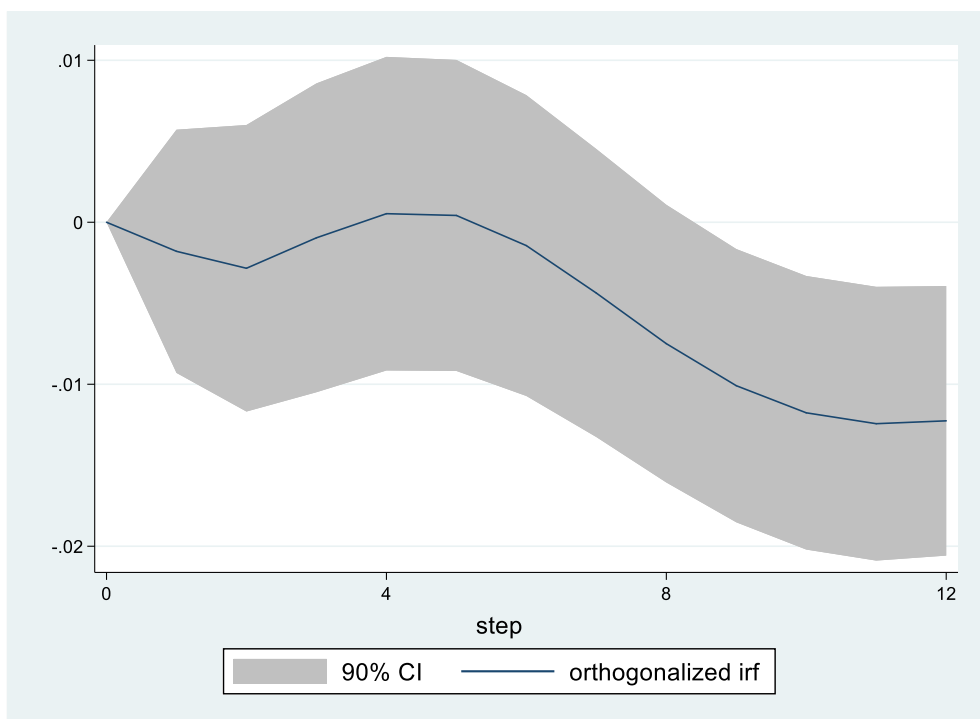


Figure A.4: Impulse response of investment to an uncertainty shock

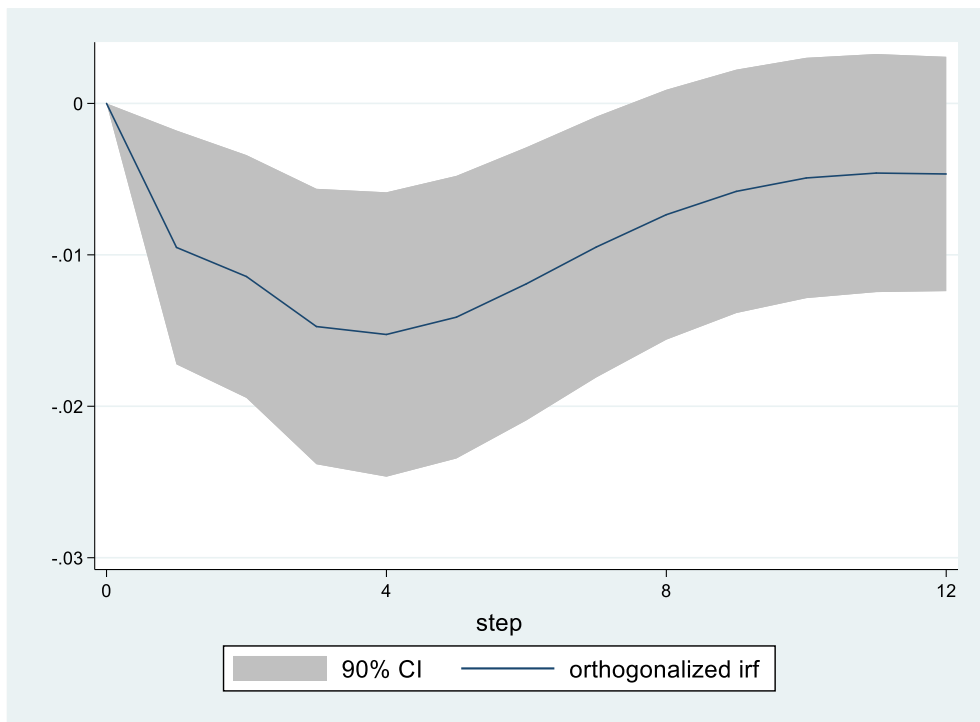
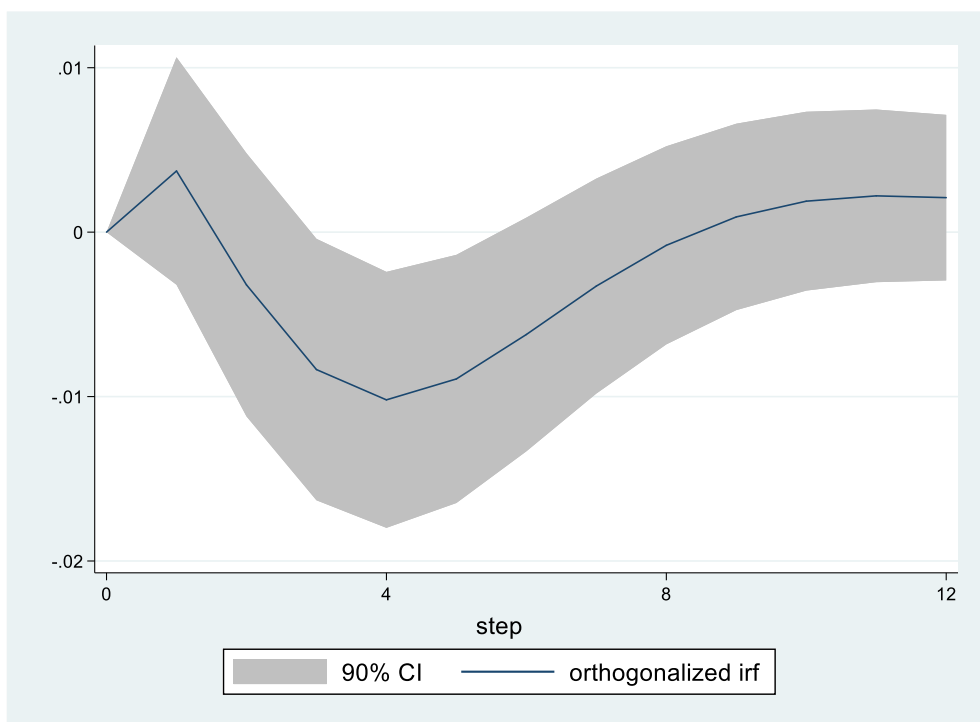


Figure A.5: Impulse response of investment to a commodity price shock



References

Banerjee, R., Kearns, J., & Lombardi, M. J. (2015). [\(Why\) Is investment weak?](#). *BIS Quarterly Review* (March).

Rice, A., Vehbi, T., & Wong, B. (2019). [Measuring uncertainty and its impact on the New Zealand economy.](#) *Reserve Bank of New Zealand Analytical Note*, AN2018/01.

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