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Nowcasting national GDP growth using small business sales growth

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SMALL BUSINESS INSIGHTS

Nowcasting national GDP growth using small business sales growth

Research Note

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Sales data bridges GDP reporting delays

This study shows that the Xero Small Business Index (XSBI) monthly sales growth data can be used to predict the same period's nominal gross domestic product (GDP) growth (year-on-year) in the United Kingdom, Australia and New Zealand.[1] Assuming that the small business sector can be used as a representative sample of the national economy,[2] this paper presents simple equations relating the small business real-time sales growth to GDP growth indicators.

One of the frustrations of GDP measurement is that it takes statistical offices many weeks to collate GDP data. This means it is often released months after the end of the relevant time period. The relationship with XSBI sales growth data, which is published more timely, could prove useful for economists and analysts as an early indication of GDP results weeks ahead of the release of official data. This analysis does not relate to using XSBI data to forecast future GDP. Rather it is to take advantage of the timeliness of XSBI data, over the national accounts release, and provide an early indication of the GDP data after the end of the relevant month/quarter but before the official GDP data is released.

Key findings

- XSBI sales growth can predict the same month's GDP growth with high accuracy in the UK,[3] around two weeks earlier than the official release. We predict that the September GDP growth was between -1.5% and -2.1% in the UK using the sales growth data in September 2022.

- The three month average of the XSBI sales growth can predict the same quarter's GDP growth with very high accuracy in New Zealand, around 6 weeks earlier than the official release. We predict that the September quarter GDP growth was around 8.6% in New Zealand using the average sales growth in July, August and September 2022.

- The three month average of the XSBI sales growth can predict the same quarter's GDP growth with very high accuracy in Australia, around 5 weeks earlier than the official release. We predict that the September quarter GDP growth was around 9.1% in Australia using the average sales growth in July, August and September 2022.

[1] We use nominal sales growth (y/y) measured at time t (real-time). XSBI sales growth is based on sales revenue of small businesses operating in the private sector. But, relevant sample weighting calculations are carried out to ensure that the metric is representative of the entire small business sector in each country. See the XSBI methodology for more information.

[2] GDP growth can simply be calculated as the sales growth minus the inventories growth using the output approach for the entire economy. Small business refers to "small and medium-sized businesses." See Kalemli-Ozcan et al. (2022)

[3] Prediction accuracy is higher when Adjusted R^2 is larger and Root-mean-squared-error is smaller.

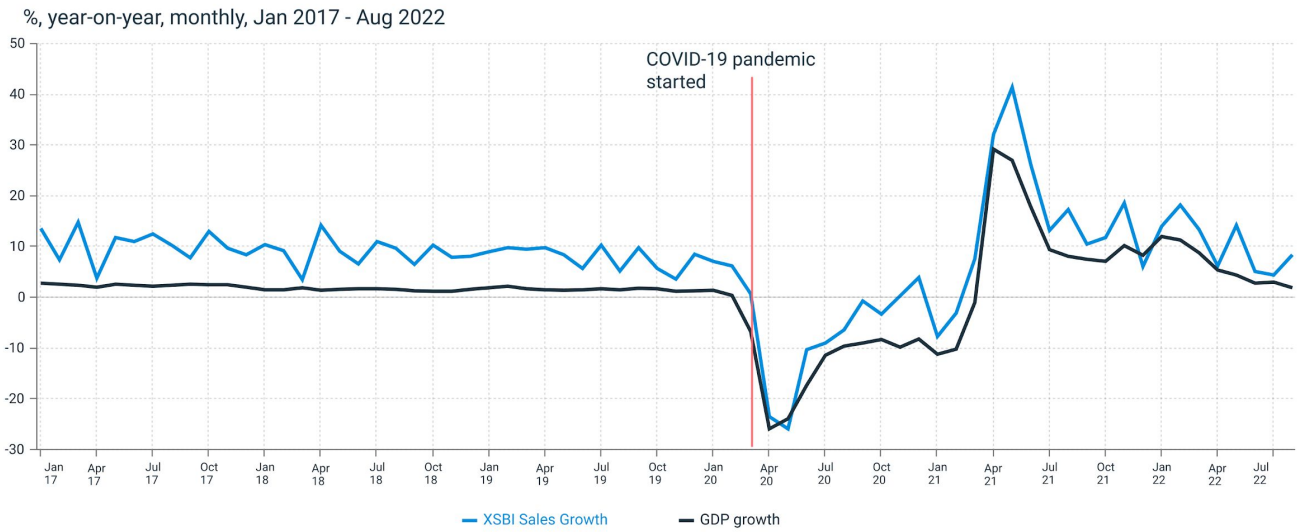
XSBI sales growth can predict monthly GDP growth in the United Kingdom

The United Kingdom (UK) releases monthly GDP data based on large administrative datasets and survey's of around 34,000 businesses each month. Office for National Statistics (ONS) releases monthly GDP data around 40 days after the end of the reference month. XSBI releases the monthly sales growth data around two weeks earlier, on the last Thursday of each month following the reference month.[4]

Simple correlations between sales growth and monthly GDP growth

The analysis began by looking at the simple correlations between monthly XSBI sales growth and the ONS's nominal GDP growth - both measured in the same month. Figure 1 shows that the relationship between these indicators is very strong between January 2017 and August 2022 and the correlation coefficient is 0.94.

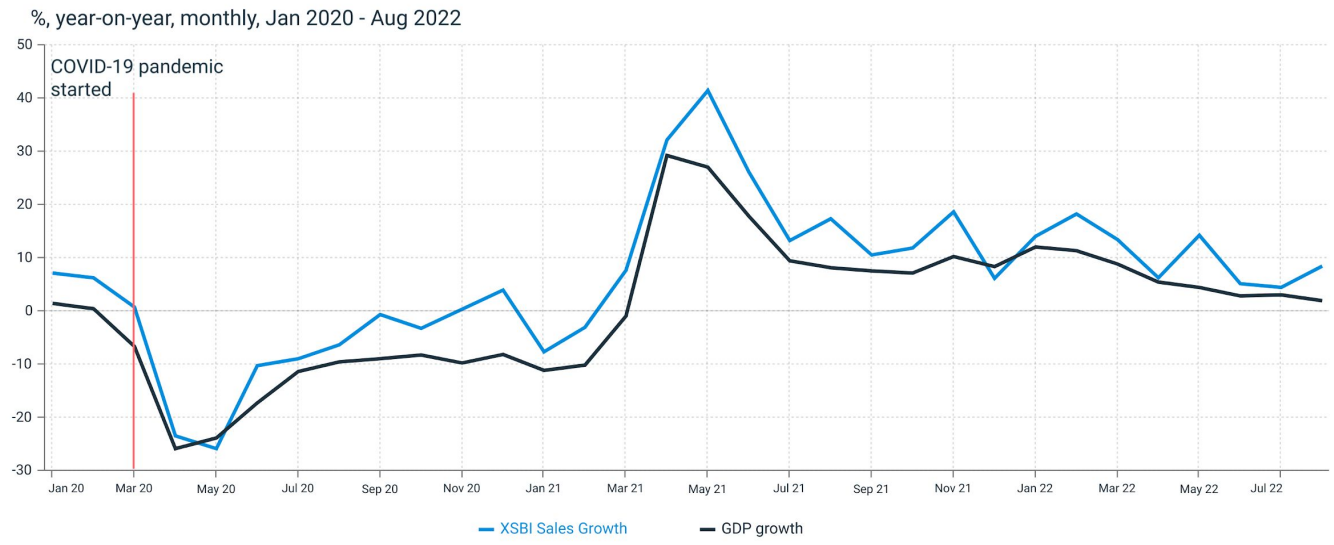
Figure 1: Small business sales growth vs GDP growth, United Kingdom



Source: Xero Small Business Insights, Office of National Statistics

Figure 2 shows that the relationship between XSBI sales growth and the same month's nominal GDP growth is even stronger between January 2020 and August 2022 and the correlation coefficient is 0.96.

Figure 2: Small business sales growth vs GDP growth, United Kingdom



Source: Xero Small Business Insights, Office of National Statistics

Based on these promising results, additional regression analysis was done to determine if XSBI sales data can be used to predict the same month's nominal GDP growth.

[4] *Reference month is the calendar month for which the GDP and sales growth data are reported.*

Predictive power of XSBI sales growth in explaining monthly GDP growth

The results of simple linear regressions show that the XSBI sales growth can predict the same month's GDP growth with high accuracy (Adjusted R2=0.89, RMSE=2.95) between Jan 2017 and August 2022. (See Appendix Table 1 for full results). The relationship between the two indicators (Appendix Figure 1) can be calculated as follows:

Equation (1): UK GDP Growth$_t$=(0.836*XSBI Sales Growth$_t$)-5.079

The predictive power of the XSBI sales growth metric is even greater (Adjusted R^2=0.93, RMSE=3.45) between Jan 2020 and August 2022. The formula which shows the relationship between sales growth and the same month's GDP growth (Appendix Figure 2) is slightly different in this case as follows:

Equation (2): UK GDP Growth$_t$=(0.882*XSBI Sales Growth$_t$)-4.666

This means that entering the value of the XSBI sales growth in these formulas can predict the GDP growth for the same month in the UK. For instance, entering the September 2022 sales growth in this formula will calculate a statistically reasonable estimate for the September GDP growth rate in the UK.

XSBI sales growth could be used for predicting monthly GDP growth in Australia and New Zealand

Analysis found that the XSBI sales growth data can be used to help researchers in predicting the same month's nominal GDP growth in the UK. Indeed, XSBI produces sales growth data not only for the UK but also for Australia and New Zealand using the same methodology. The XSBI sales growth data, therefore, could be a useful proxy for the same month's GDP growth in the absence of official monthly national accounts reports in Australia and New Zealand.

XSBI sales data is a useful proxy for less timely GDP quarterly reporting in Australia and New Zealand

We next investigate whether we can use XSBI sales growth to predict the same quarter's GDP growth rates in Australia and New Zealand. We specifically look at the relationship between the three month average of the sales growth and the same quarter GDP growth in these two countries. The three month average of the XSBI sales growth data can be produced around 5 weeks earlier than the official release in Australia and 6 weeks earlier than the official release in New Zealand.

Relationship between three month average sales growth and the same quarter GDP growth

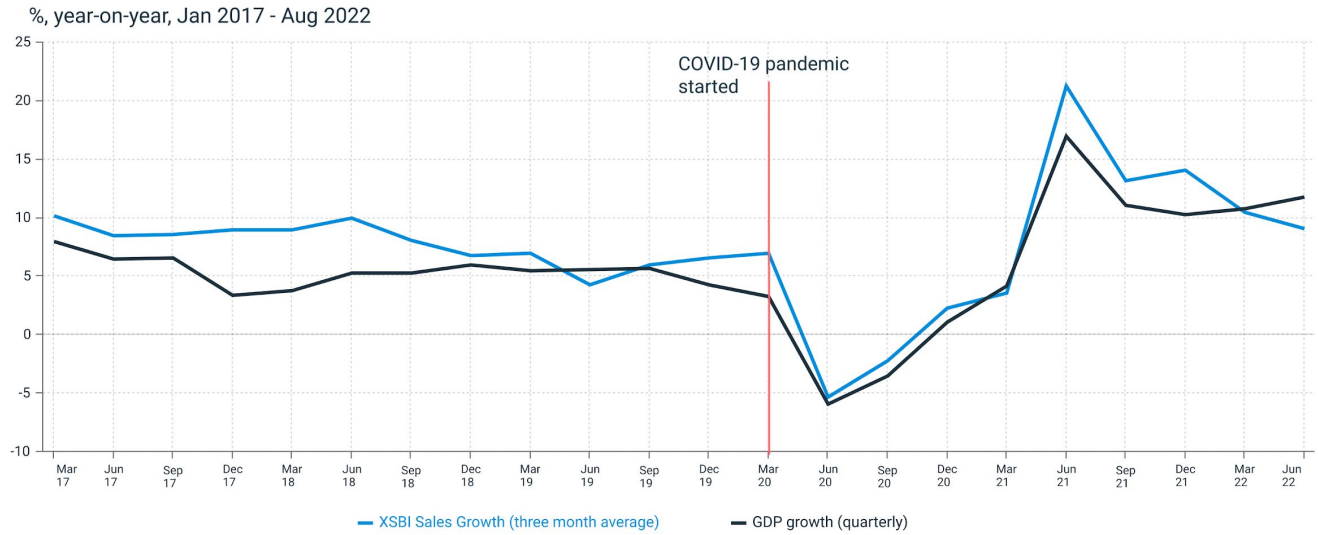
Figure 3 and Figure 4 show there is a strong relationship between the three month average of the XSBI sales growth and the same quarter nominal GDP growth for Australia and New Zealand.

For completeness, the analysis also looked at the relationship between the first month and the average of the first and second months to nominal GDP growth. The relationship was stronger for New Zealand than Australia under these two scenarios. These results are presented in detail in the Appendix.

In summary, these findings imply that the sales growth data can be useful in predicting the same quarter GDP growth rates in these countries. Subsequently, we turn to regression analysis in the next section for estimating the nowcasting equations.[5]

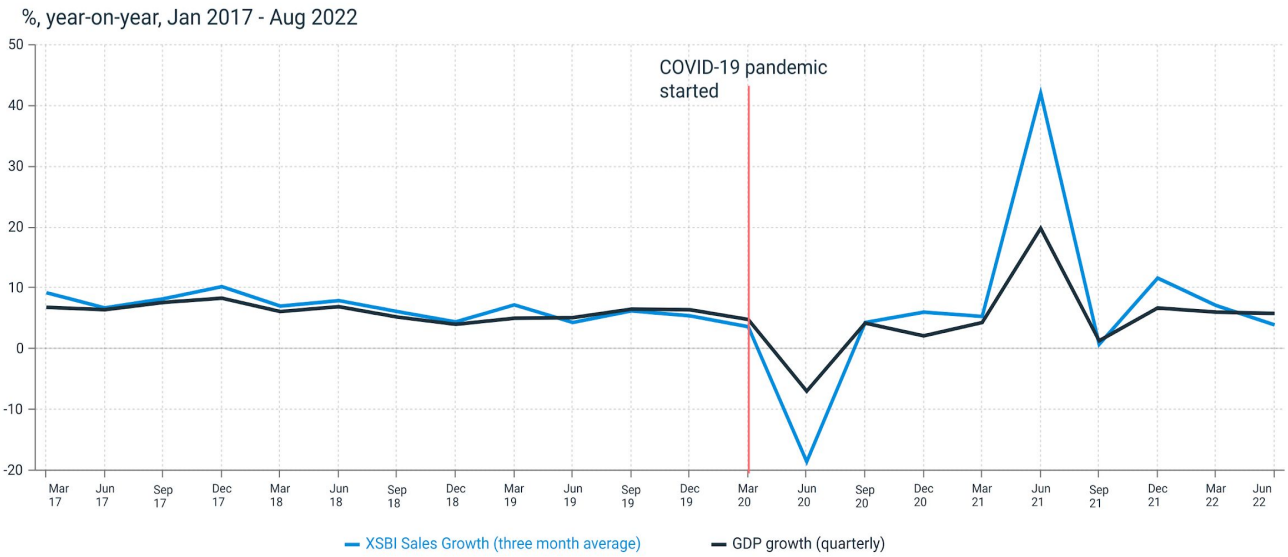
[5] *Nowcasting is the prediction of the present, the very near future, and the very recent past state of an economic indicator.*

Figure 3: Small business sales growth vs GDP growth, Australia



Source: Xero Small Business Insights, Australian Bureau of Statistics

Figure 4: Small business sales growth vs GDP growth, New Zealand



Source: Xero Small Business Insights, Stats NZ

Predicting the same quarter GDP growth using three month average XSBI sales growth

The results of simple linear regressions show that three month average of the sales growth can predict the same quarter nominal GDP growth with a very high accuracy in Australia (Appendix Table 2 Column 3, Adjusted R^2=0.84, RMSE=1.98) around 5 weeks earlier than the release of GDP official statistics. The relationship between the two indicators can be calculated as follows:

Equation (3): AU GDP Growth$_t$=(0.836*Three Month Average of XSBI Sales Growth$_t$)

The predictive power of the three month average sales growth is even greater in New Zealand (Appendix Table 2 Column 6, Adjusted R^2=0.93, RMSE=1.22) where the three months average XSBI sales growth can be produced around 6 weeks earlier than the release of GDP official statistics. The predicted equation in this case can be written as follows:

Equation (4): NZ GDP Growth$_t$=(0.438*Three Month Average of XSBI Sales Growth$_t$)+2.643

This means that we can predict the same quarter GDP growth rates in New Zealand and Australia using the three month average of the XSBI sales growth in these Equations (3)-(4).

For completeness, the analysis also looked at the predictive power of using XSBI sales growth from only the first month in the quarter and the first and second month of the quarter. This analysis showed greater predictive power for New Zealand than Australia (See the Appendix for the full results).

Conclusion and future research

This study used simple linear regression models, for the first time, to examine the predictive nature of XSBI sales growth with respect to same period's nominal GDP growth. The analysis found that the XSBI sales growth had statistically significant predictive capacity to nowcast nominal GDP growth for the same time period.

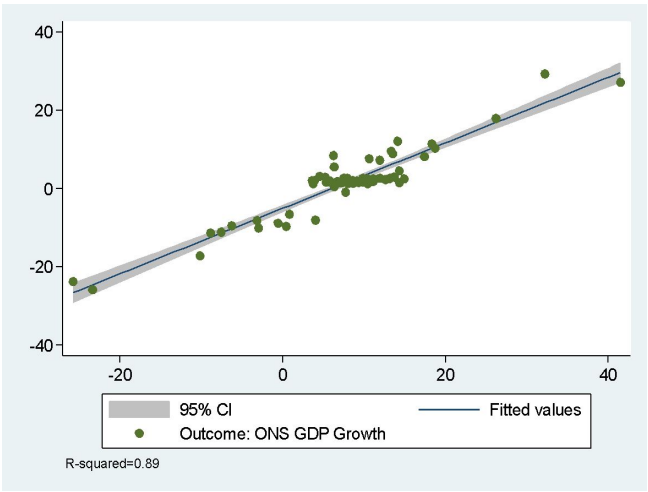
Future research using more sophisticated models (including other XSBI metrics with lags) and alternative regression methods (such as polynomial regressions) could enhance the prediction accuracy in these countries. It could also be beneficial to investigate the predictive nature of XSBI sales growth in these countries at region and industry levels, or to extend the analysis to the United States or Canada once sales growth is available on a monthly basis.

More information about Xero Small Business Insights can be found at www.xero.com/xerosbi.

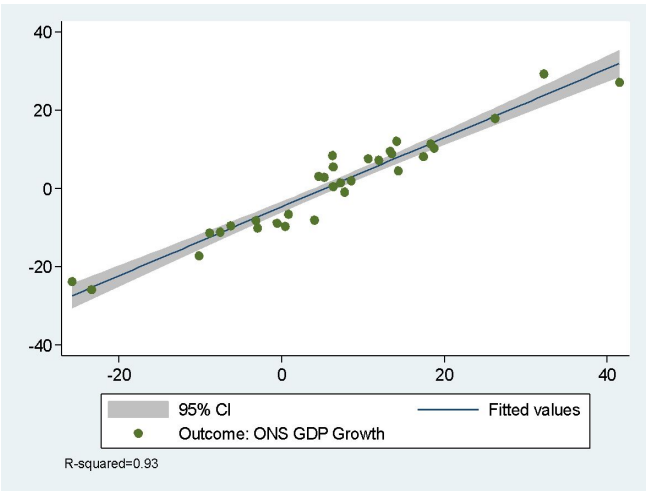
Appendix

This appendix section provides the full econometric analysis for the findings presented in the paper. Appendix Figures 1 and 2 present the testing results for the United Kingdom regression analysis. Both figures show that XSBI sales growth is highly statistically significant in predicting the same month's GDP growth. Most observations are very close to the linear regression line with 89% and 93% R^2 indicating a high predictive power for the sales growth data.

Appendix Figure 1: Relationship between ONS GDP growth and XSBI sales growth. Simple linear regression. 2017-2022



Appendix Figure 2: Relationship between ONS GDP growth and XSBI sales growth Simple linear regression. 2020-2022



Appendix Table 1 presents the simple linear regression results where the dependent variable is the ONS GDP growth and the independent variable is the XSBI sales growth. Column 1 shows that sales growth is highly significant in predicting the same month's GDP growth between 2017 and 2022 with high explanatory power. Column 2 shows that the statistical significance stays similar but the explanatory power is greater between 2020 and 2022. Column 3 tests for the differential effects of the sales growth before and after 2020. This interaction variable is statistically significant and also increases the explanatory power implying that the XSBI sales growth data fits the data better in post-2020 period than pre-2020 period.

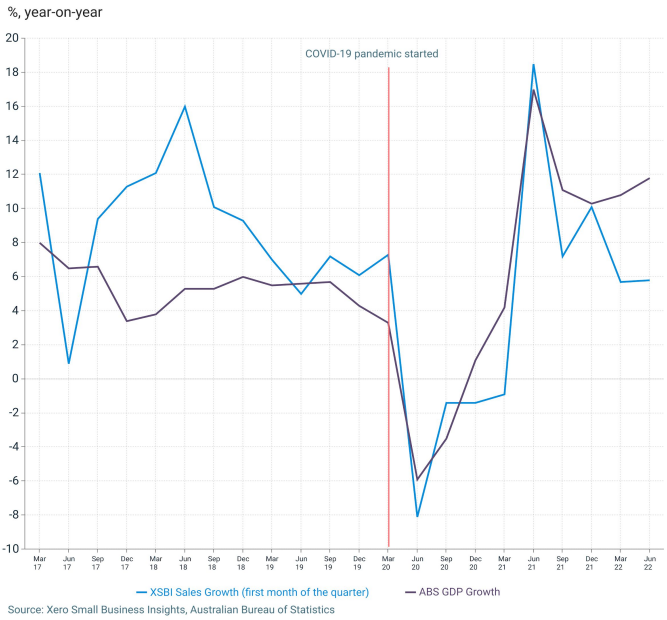
Appendix Table 1: Dependent Variable: ONS GDP Growth. Linear regressions.

	(1)	(2)	(3)
Sample period	Jan 2017-August 2022	Jan 2020-August 2022	Jan 2017-August 2022
XSBI sales growth	0.836***	0.882***	0.605***
	(22.83)	(19.87)	(8.92)
XSBI sales growth*Post 2020 Dummy			0.260***
			(3.91)
constant	-5.079***	-4.666***	-4.046***
	(11.10)	(6.94)	(8.22)
Number of observations	68	32	68
Adjusted R^2	0.886	0.927	0.906
Root-mean-squared-error (RMSE)	2.951	3.461	2.676
Robust standard errors are used in the estimations, absolute *t*-statistics are presented in parentheses. * p<0.10, ** p<0.05, *** p<0.010			

Appendix Figure 3: Sales growth in the first month of the quarter vs same quarter GDP growth in New Zealand

Source: Xero Small Business Insights, Stats NZ

Appendix Figure 4: Sales growth in the first month of the quarter vs same quarter GDP growth in Australia

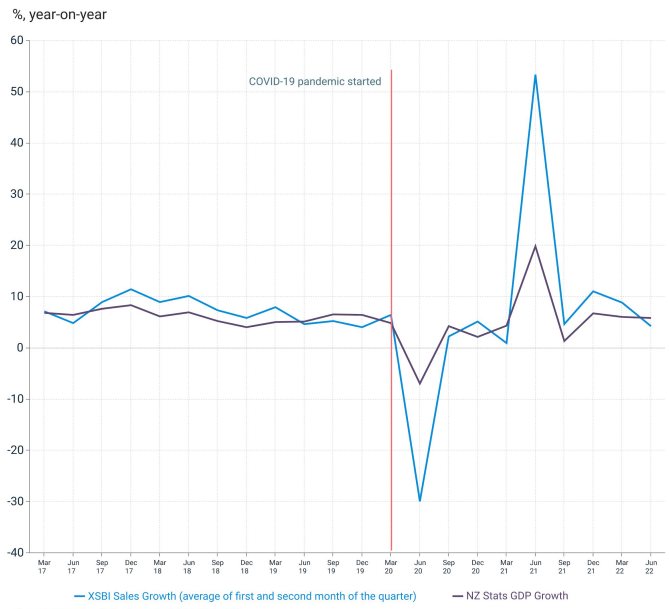


Source: Xero Small Business Insights, Australian Bureau of Statistics

Appendix Figure 3 shows that the XSBI sales growth in the first month of the quarter has a strong relationship with the same quarter nominal GDP growth in New Zealand. But, this relationship is weak in Australia (Appendix Figure 4).

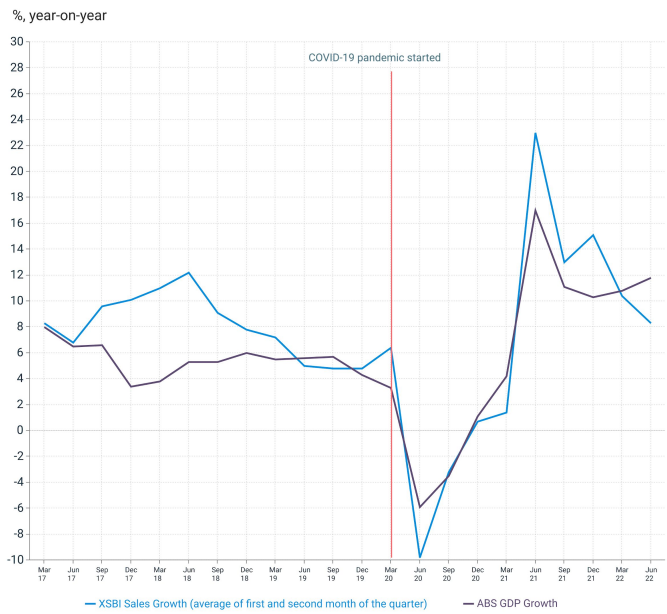
Appendix Figures 5 and 6 shows that the relationship between average sales of the first and second month of the quarter and the same quarter GDP growth is stronger in New Zealand than in Australia. Comparing Appendix Figures 5-6 to 3-4 shows that average sales of the first and second month of the quarter could be better proxy for quarterly GDP growth than the sales growth in the first month of the quarter for both countries.

Appendix Figure 5: Sales growth average of the first and second month of the quarter vs same quarter GDP growth in New Zealand



Source: Xero Small Business Insights, Stats NZ

Appendix Figure 6: Sales growth average of the first and second month of the quarter vs same quarter GDP growth in Australia



Source: Xero Small Business Insights, Australian Bureau of Statistics

Appendix Table 2 presents the simple linear regression results for predicting the quarterly GDP growth rates in Australia and New Zealand. Column 1 uses the first month of the quarter sales growth data as the independent variable for Australia (released around 13 weeks earlier than official GDP release). The results show that sales growth in the first month of the quarter is statistically significant while the intercept coefficient is also significant. The R^2 is only 0.42 while the RMSE is 3.76 suggesting that the predictive power is moderate.

Column 2 shows that the R^2 increases significantly to 0.76 while the RMSE drops to 2.42 when we use the average sales growth of the first and the second month of the quarter as the independent variable-available around 9 weeks earlier than official release.

Column 3 shows that the highest predictive power is attained using the three month average sales growth as the independent variable. In any event, the predicted equations in columns 1 and 2 can be written as follows:

Equation (1): AU GDP Growth prediction=(0.533*First month of the quarter XSBI Sales Growth)+2.119

Equation (2): AU GDP Growth prediction=(0.655*Average of first and second month of the quarter XSBI Sales Growth)

Column 4 uses the first month of the quarter sales growth data as the independent variable for New Zealand (released around 14 weeks earlier than official GDP release). The results show that sales growth in the first month of the quarter is statistically significant while the intercept coefficient is also significant. The R^2 is only 0.84 while the RMSE is 1.79 suggesting that the predictive power is high.

Column 5 shows that the R^2 increases significantly to 0.90 while the RMSE drops to 1.39 when we use the average sales growth of the first and the second month of the quarter as the independent variable-available around 10 weeks earlier than official release.

Column 6 shows that the highest predictive power is attained using the three month average sales growth as the independent variable. In any event, the predicted equations in columns 4 and 5 can be written as follows:

Equation (3): NZ GDP Growth=(0.221*First month of the quarter XSBI Sales Growth)+4.048

Equation (4): NZ GDP Growth=(0.320*Average of first and second month of the quarter XSBI Sales Growth)+3.399

Appendix Table 2: Dependent Variable: Quarterly GDP Growth. Linear regressions.

Sample Period: Q1 2017-Q2 2022	(1)	(2)	(3)	(4)	(5)	(6)
XSBI Sales growth	Australia	Australia	Australia	New Zealand	New Zealand	New Zealand
first month of the quarter	0.533***			0.221***		
	(3.98)			(10.45)		
average of first and second month of the quarter		0.655***			0.320***	
		(8.15)			(13.95)	
average of all three months of the quarter			0.836***			0.438***
			(10.47)			(16.12)
constant	2.119*	0.906	-0.637	4.048***	3.399***	2.643***
	(1.75)	(1.15)	(0.86)	(9.83)	(10.06)	(8.26)
Number of observations	22	22	22	22	22	22
Adjusted R^2	0.414	0.757	0.838	0.838	0.902	0.925
Root-mean-squared-error (RMSE)	3.759	2.422	1.978	1.793	1.392	1.219

Robust standard errors are used in the estimations, absolute *t*-statistics are presented in parentheses. * p<0.10, ** p<0.05, *** p<0.010

Additional Details

Data sources

- XSBI sales growth data is released on the last Thursday of every month
- Release dates for the UK monthly GDP data can be found here
- Release dates for the Australian quarterly GDP data can be found here
- Release dates for the New Zealand quarterly GDP data can be found here
- ONS monthly GDP growth for the UK can be found here
- Quarterly GDP levels were sourced from the OECD and are measured in nominal terms, we then calculated the percentage change from the same quarter in the previous year.
- Empirical analysis were carried out using STATA 17
- We tested using revised sales growth metric (measured in September 2022) rather than real-time sales growth data in the regression analysis and the results are similar in this case.
- We also tested adding the squared sales growth metric in the regression analysis but the results remained similar.

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Xero is a global small business platform with 3.5 million subscribers which includes a core accounting solution, payroll, workforce management, expenses and projects. Xero also has an extensive ecosystem of connected apps and connections to banks and other financial institutions helping small businesses access a range of solutions from within Xero's open platform to help them run their business and manage their finances. For three consecutive years (2020-2022) Xero was included in the Bloomberg Gender-Equality Index. In 2021, Xero was included in the Dow Jones Sustainability Index (DJSI), powered by the S&P Global Corporate Sustainability Assessment. Xero is a FIFA Women's Football partner under FIFA's new commercial structure.

About Xero Small Business Insights

The aim of Xero Small Business Insights is to create insights to help inform decision makers in support of the small business economy as a whole. The principal source of small business insights in this report is customer data from Xero - a small business platform that supports online accounting and a range of other applications. Xero is a responsible custodian of our customers sensitive data and does not release any data that could identify individual businesses. The data used is aggregated and anonymized to ensure the privacy of Xero subscribers, and their counterparts.

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