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Predictive ability of sector-level QSBO data

Paper for 2011 NZAE Conference

16 June 2011

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NZIER is also known for its long-established Quarterly Survey of Business Opinion and Quarterly Predictions.

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1.1. Introduction

This paper assesses the predictive power of the New Zealand Institute of Economic Research's (NZIER) *Quarterly Survey of Business Opinion* (QSBO) by comparing its results with official New Zealand statistics at the industry level. QSBO survey results are used to produce a range of survey-based and industry-level performance indices on a quarterly basis. They cover the main industries in New Zealand including manufacturing, service, and construction. To assess the state of the economy, NZIER constructs performance indices for the manufacturing, services and construction sectors, although these indices are not publicly released. They are the Performance of Manufacturing Index (PMI), Performance of Service Index (PSI) and Performance of Construction Index (PCI). QSBO results are usually nine weeks ahead of the official statistics and the timeliness allows economists, analysts and commentators to use them as leading indictors for economic activities and turning points for the following quarter. In addition, these indices may provide additional information regarding the future state of the economy and turning points. In this article we will use the Granger causality test to assess how well PMI, PSI and PCI can predict official GDP and employment statistics in the corresponding sector.

This paper will examine the predictive power of QSBO indices in two ways. First, the paper will assess the ability of QSBO to provide information on the current and coming quarters' GDP growth in the manufacturing, service and construction sector. Secondly, the paper will assess the performance of the indices in predicting employment growth for the current and coming quarter in the manufacturing, service and construction sector.

Using the Granger causality test we found that PMI is a good indicator for GDP both in the current quarter and the coming quarter. PMI is also found to be useful in providing information on employment for the current quarter but less so in the coming quarter. PSI provides good contemporaneous information for the GDP and employment for the current quarter but is weak as a leading indicator. PCI is shown to be a good indictor for both the current and coming quarter's GDP and employment growth.

The next section provides an overview of the methodology used to construct the indices. Section 3 will review the international literature regarding the usefulness of these indices at predicting official statistics. Section 4 provides an overview of the trends in the indices over time and their correlation with official economic statistics. Section 5 tests the predictive ability of the indices using the Granger causality test. Test results will be discussed in section 6 and the final section presents some concluding remarks.

2. Related literature

Similar performance indices as QSBO are also produced in most developed countries. Given the indices produced elsewhere also share the timeliness nature of QSBO, they are widely used by economists, analysts and commentators as a leading indictors for economic activity and turning points. There is a substantial body of international literature that examine how well these indices perform at providing insights into the coming official statistics and predicting economic growth and turning points. Most of the studies focus on the usefulness of the manufacturing index. For example, from the United States literature we know (Kauffman, 1999 and Koenig, 2002) their manufacturing industry related index performs well in predicting economic activities and direction of monetary policies. In Europe, the manufacturing indices have succeeded at predicting recessions although the correlation between the index and official statistics has broken down since the recent recession according to Ellis (2010). Some research (Harding, 2001) found the Australian PMI works well when predicting business turning points but not general economic performance. In comparison, Aylmer and Gill (2003) concluded Australian PMI has no correlation with GDP but is significantly correlated with investment by the manufacturing industry. Recently some Australian research extended the test of the manufacturing index to include indices in both the service and construction sector (Chindamo, 2011). Results show the manufacturing index is good at providing information on both current and future period economic conditions but the indices for service and construction are weaker.

In general, prior assessments of the QSBO have tended to use an overall index. Industry-level research has focused on the construction sector. Holmes et al (2010) adopted a Markov-Switching Approach to test the predictive ability of the architect opinion component of QSBO. Results show the architect opinion component tracks official housing construction growth and deepness of the housing construction 'business cycle' well. Holmes et al (2007) also found the overall QSBO headline index is a good predictor for GDP growth. Hodgetts's (2003) study on the capacity utilization component of QSBO (CUBO) shows CUBO is a good leading indicator for both GDP growth and non-tradable inflation.

The most significant sectors of the New Zealand economy, especially services but also manufacturing, have not received the same scrutiny. This paper aims to fill the gap by testing the predictive power of QSBO's manufacturing and service sector indices using a Granger causality approach. The construction index will also be examined to confirm the results from other studies in this field.

3. Construction of the indices

The PMI, PSI and PCI are compiled from the results of the quarterly survey of 3,500 firms, conducted on a representative sample basis for the respective manufacturing, service and construction sector. Each quarter, chief executives or their nominees in the three main sectors – manufacturing, building, and services - are asked to

respond as to the actual performance of their business in the past three months with respect to a number of components that include production, new orders, employment, sales, supplier delivers and inventories. Respondents make a qualitative assessment about changes in the last three months (e.g. whether employment has increased, decreased or unchanged).

An aggregated diffusion index is then calculated from the information collected from the survey. A diffusion index indicates the degree to which the indicated changes from the survey are spread across the sample. To calculate the diffusion index, all of the responses are summed for each component (production, new orders, etc.) by assigning a value 1 to the respondents who said increase, 0.5 to who said no change and 0 to who responded decrease. The five components are then summed according to the weight of each component based on their importance to the business. The diffusion indices for the respective components in each of the PMI, PSI and PCI are also weighted according to the GDP share of their respective sub-sector.

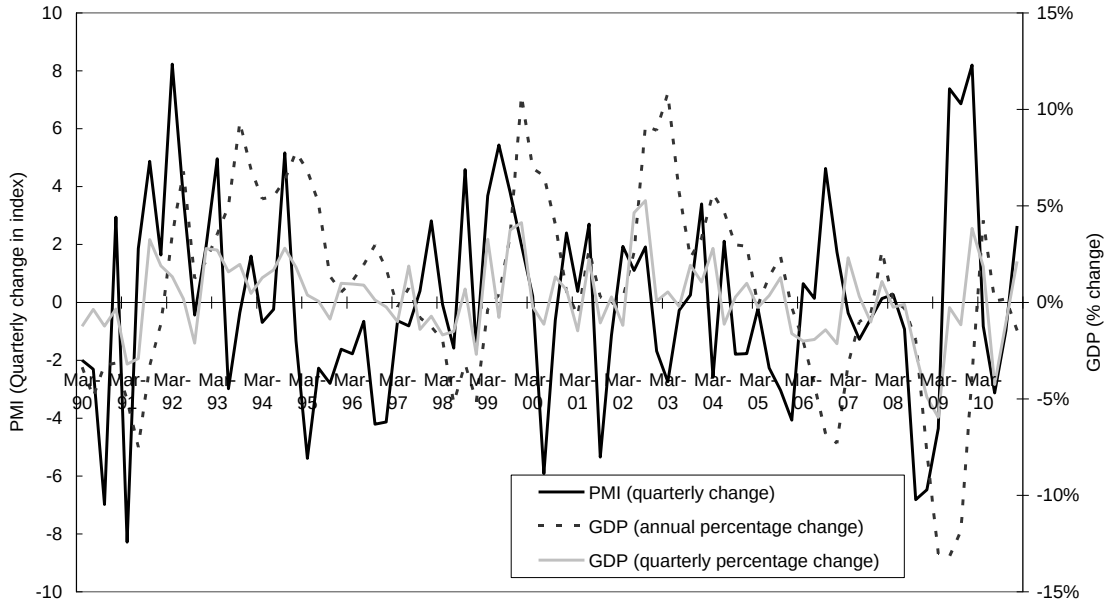
An aggregated diffusion index reading above 50 points indicates activity is generally expanding; below 50 indicates declining while 50 is the neutral mid-point. The distance from 50 indicates the strength of expansion or contraction. For example, at 100 points, all of the respondents indicate expansion while at 0 all of the respondents are indicating contraction.

4. Graphical assessment of performance

Figure 1 compares the quarterly change in the level of PMI with the annual percentage change and quarterly percentage change in manufacturing sector GDP. PMI tracks manufacturing sector GDP reasonably well throughout the 20-year horizon. However, generally PMI tends to track the quarterly change in GDP better than the annual change. In terms of predicting the magnitude of growth and downturns, PMI used to understate growth and downturns before the mid 1990s but since then the tendency has been to overstate growth and downturns.

Figure 1 PMI vs manufacturing sector GDP

Quarterly change in PMI level and GDP quarterly and annual percentage change

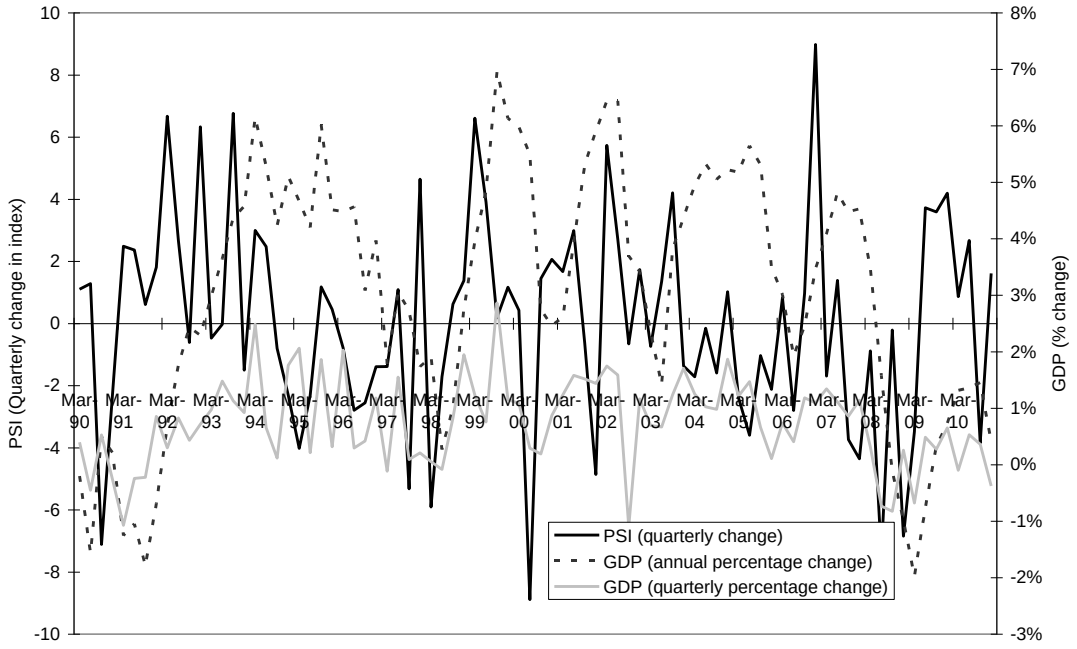


Source: NZIER

Figure 2 examines the quarterly change in the level of PSI with the service sector GDP in terms of both annual percentage change and quarterly percentage change. PSI tracks the annual percentage change in the service sector GDP better than the quarterly change in the period from 1994 to 2000, however from 2000 until 2007, PSI tracked closer to the quarterly change in GDP. After the recession hit New Zealand in 2007, there seemed to be a poor relationship between PSI and the service sector GDP. PSI's predictive power for the service sector GDP appears to be weaker compared to PMI for the manufacturing sector.

Figure 2 PSI vs services sector GDP

Quarterly change in PSI level and GDP quarterly and annual percentage change

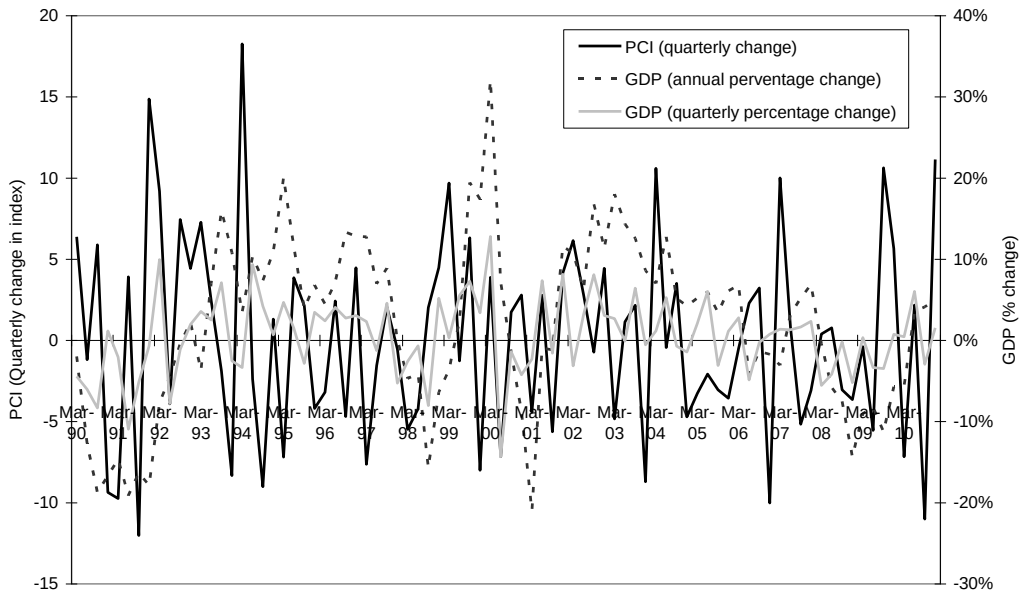


Source: NZIER

Figure 3 compares the quarterly change of PCI with the construction sector GDP in both annual percentage change and quarterly percentage change. It is difficult to discern the relationship between PCI and the official statistics of the construction sector. The volatility of the series makes it hard to match peaks and troughs between PCI and the official series. In this case, a more sophisticated statistical method such as Granger causality tests will be more useful.

Figure 3 PCI vs construction sector GDP

Quarterly change in PCI level and GDP quarterly and annual percentage change



Source: NZIER

5. Methodology of the Granger causality test

Bivariate Granger causality tests involve using econometric analysis to provide an indication of whether one variable x as well as its lagged values can be used to predict the current value of another variable y. The approach involves testing how much the current value of y can be explained by its own lags and then to test whether adding variable x and its lagged values can improve the explanation of y. Hence, variable y is said to be Granger-caused by x if x and its lagged values help in the prediction of y, or equivalently if the coefficients on x and lagged x's are statistically significant (Granger, 1969).

According to Asteriou and Hall (2007), there are four different potential results from a bivariate Granger causality test:

- lagged x terms (in a regression of y on lagged values of y and x) may be statistically different from zero as a group and the lagged y terms are not statistically different from zero. Hence, here we have x Granger causing y
- lagged y terms (in a regression of x on lagged values of y and x) may be statistically different from zero as a group and the lagged x terms are not statistically different from zero. Hence, here we have y Granger causing x
- both sets of x and y terms are statistically different from zero (in the two regressions outlined before) and so we have bi-directional causality
- both sets of x and y terms are not statistically different from zero (in the two regressions outlined before) and so x and y are independent of each other.

The Granger causality tests in the situation of a vector autoregressive model with two stationary variables y and x involves estimating the following time series regressions:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_k y_{t-k} + \beta_1 x_{t-1} + \ldots + \beta_k x_{t-k} + \varepsilon_t \quad (1)$$

$$x_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_k y_{t-k} + \beta_1 x_{t-1} + \ldots + \beta_k x_{t-k} + u_t. \quad (2)$$

Where ε_t and u_t ae uncorrelated error terms and involves testing the joint null hypothesis: $\beta_1 = \beta_1 = \ldots = \beta_k = 0$ in each regression equation.

In the case of assessing the predictive power of QSBO indices, we use PMI, PSI and PCI as the x variable and the official statistics (GDP and employment) as y variable. We consider two aspects when testing QSBO indices' predictive ability. First, we test the indices' predicative ability as a leading indicator. For example, the leading indicator test for PMI examines PMI's ability to predict the coming quarters' official GDP data (March PMI versus June GDP). Secondly, we test the ability of the indices to provide contemporaneous information. For example, the test for PMI's ability to provide contemporaneous information examines how close the current quarter PMI tracks to the GDP official data in the same current quarter although PMI is usually released nine weeks ahead of official GDP (March PMI versus March GDP).

6. Test results

6.1 Test results for the PMI

Table 1 and table 2 show the Granger test results for PMI as a leading indicator and contemporaneous information provider. The series are seasonally adjusted and include:

- PMI level and quarterly change (qc)
- annual percentage change (apc) or quarterly percentage change (qpc) of GDP for the manufacturing sector
- PMI employment sub-index level and quarterly change
- employment for the manufacturing industry in terms of apc and qpc.

Table 1 Granger causality tests – PMI as leading indicator

Performance of manufacturing index compared to official statistics

PMI (level) vs GDP	F stat	Prob	Causal?
PMI (level) does not Granger cause gdp(apc)	4.23	0.04	yes 5%
gdp(apc) does not Granger cause PMI (level)	2.32	0.13	no
PMI (level) does not Granger cause gdp(qpc)	2.14	0.15	no
gdp(qpc) does not Granger cause PMI (level)	37.6	3.E-08	yes 1%

PMI (qc) vs GDP	F stat	Prob	Causal?
PMI (qc) does not Granger cause gdp(apc)	16.9	9.E-05	yes 1%
gdp(apc) does not Granger cause PMI (qc)	1.69	0.20	no
PMI (qc) does not Granger cause gdp(qpc)	2.30	0.13	no
gdp(qpc) does not Granger cause PMI (qc)	11.95	0.0009	yes 1%

PMI (level) vs employment	F stat	Prob	Causal?
PMI (level) does not Granger cause emp(apc)	0.184	0.18	no
emp(apc) does not Granger cause PMI (level)	7.94	0.0061	yes 1%
PMI (level) does not Granger cause emp(qpc)	8.83	0.0039	yes 5%
emp(qpc) does not Granger cause PMI (level)	12.80	0.0006	yes 1%

PMI (qc) vs employment	F stat	Prob	Causal?
PMI (qc) does not Granger cause emp(apc)	0.07	0.77	no
emp(apc) does not Granger cause PMI (qc)	0.06	0.80	no
PMI (qc) does not Granger cause emp(qpc)	0.086	0.78	no
emp(qpc) does not Granger cause PMI (qc)	0.063	0.80	no

Source: NZIER

Table 2 Granger causality tests – PMI as contemporaneous information provider

Performance of manufacturing index compared to official statistics

PMI (level) vs GDP	F stat	Prob	Causal?
PMI (level) does not Granger cause gdp(apc)	26.98	2.E-06	yes 1%
gdp(apc) does not Granger cause PMI (level)	4.83	0.03	yes 5%
PMI (level) does not Granger cause gdp(qpc)	8.45	0.005	yes 1%
gdp(qpc) does not Granger cause PMI (level)	0.77	0.381	no

PMI (qc) vs GDP	F stat	Prob	Causal?
PMI (qc) does not Granger cause gdp(apc)	19.20	4.E-05	yes 1%
gdp(apc) does not Granger cause PMI (qc)	8.96	0.004	yes 5%
PMI (qc) does not Granger cause gdp(qpc)	5.01	0.03	yes 5%
gdp(qpc) does not Granger cause PMI (qc)	3.05	0.05	yes 10%

PMI (level) vs employment	F stat	Prob	Causal?
PMI (level) does not Granger cause emp(apc)	30.1	5.E-7	yes 1%
emp(apc) does not Granger cause PMI (level)	1.09	0.3	no
PMI (level) does not Granger cause emp(qpc)	14.88	0.0002	yes 1%
emp(qpc) does not Granger cause PMI (level)	5.76	0.02	yes 5%

PMI (qc) vs employment	F stat	Prob	Causal?
PMI (qc) does not Granger cause emp(apc)	1.12	0.29	no
emp(apc) does not Granger cause PMI (qc)	0.46	0.5	no
PMI (qc) does not Granger cause emp(qpc)	0.71	0.40	no
emp(qpc) does not Granger cause PMI (qc)	0.01	0.92	no

Source: NZIER

Unit root tests were performed for each series to ensure stationarity before Granger causality tests were applied. Lag length is selected as one based on both likelihood-ratio (LR) tests and judgmental determination. LR test results show the best-fitted lag lengths are one and six. However, given the series is mostly used for short-term forecasts, one lag is more appropriate than six in this case.

The leading indicator test results in Table 1 show PMI provides useful information for GDP growth in the coming quarters. There is a significant causal relationship between PMI level and apc GDP, as well as qc PMI and apc GDP. It appears that

PMI tracks closer to apc GDP than qpc GDP. This is probably because PMI is a trend indicator by nature, and therefore does not capture the volatile quarterly change very well. PMI is weaker in predicting the sector's employment and the only causal relationship is between PMI level and qpc employment, which runs both ways. In other words, the current PMI level can be used as a reliable tool for predicting next quarter's employment growth, and the previous quarter's employment growth has some impact on the current PMI level.

PMI performs better at providing contemporaneous information than as a leading indicator as outlined in Table 2. Both PMI level and qc PMI have a significant causal impact on GDP (both apc GDP and qpc GDP). The contemporaneous information Granger causality test results for PMI concludes similar results when compared to the leading indicator, that is PMI is weaker at providing information for employment than for GDP. Again there is clear evidence of two-way Granger causality between PMI and GDP and employment.

6.2 Test results for the PSI

Table 3 and table 4 show the Granger test results for PSI as a leading indicator and contemporaneous information provider. The series are seasonally adjusted and include:

- PSI level and quarterly change (qc)
- annual percentage change (apc) or quarterly percentage change (qpc) of GDP for the service sector
- PMI employment sub-index level and quarterly change
- employment for the service industry in terms of apc and qpc form.

Unit root tests were performed for each series to ensure stationarity before Granger causality tests were applied. Lag length is selected as one based on both likelihood-ratio (LR) tests and judgmental determination. LR test results show the best-fitted lag length is one and five. However, given the series is mostly used for short-term forecasts, one lag is more appropriate than five in this case.

PSI has some predictive power for the service sector GDP and employment but is significantly weaker when compared with PMI for the manufacturing sector. Table 3 shows for PSI and the service sector GDP, that the only causal relationship is between PSI level and qpc GDP. Similarly, there is only one causal relationship between PSI and employment with PSI level Granger causing qpc employment. This suggests there might be a need to re-examine or re-construct the design of the survey. This may include re-assigning the weights to the sub-industries as some of the industries may have grown faster than others and therefore is under-represented without any timely adjustments.

Table 4 shows PSI provides good contemporaneous information for the service sector GDP and employment. There's little evidence of bi-directional causality between PSI and the actual service sector GDP and employment statistics.

Table 3 Granger causality tests – PSI as leading indicator

Performance of service index compared to official statistics

PSI (level) vs GDP	F stat	Prob	Causal?
PSI (level) does not Granger cause gdp(apc)	1.47	0.23	no
gdp(apc) does not Granger cause PSI (level)	5.88	0.02	yes 5%
PSI (level) does not Granger cause gdp(qpc)	9.19	0.003	yes 1%
gdp(qpc) does not Granger cause PSI (level)	10.44	0.002	yes 1%

PSI (qc) vs GDP	F stat	Prob	Causal?
PSI (qc) does not Granger cause gdp(apc)	3.27	0.07	yes 10%
gdp(apc) does not Granger cause PSI (qc)	0.12	0.73	no
PSI (qc) does not Granger cause gdp(qpc)	2.37	0.13	no
gdp(qpc) does not Granger cause PSI (qc)	2.30	0.13	no

PSI (level) vs employment	F stat	Prob	Causal?
PSI (level) does not Granger cause emp(apc)	6.95	0.01	yes 1%
emp(apc) does not Granger cause PSI (level)	1.33	0.25	no
PSI (level) does not Granger cause emp(qpc)	9.15	0.003	yes 1%
emp(qpc) does not Granger cause PSI (level)	0.52	0.47	no

PSI (qc) vs employment	F stat	Prob	Causal?
PSI (qc) does not Granger cause emp(apc)	0.14	0.71	no
emp(apc) does not Granger cause PSI (qc)	0.30	0.58	no
PSI (qc) does not Granger cause emp(qpc)	0.65	0.42	no
emp(qpc) does not Granger cause PSI (qc)	0.009	0.92	no

Source: NZIER

Table 4 Granger causality tests – PSI as contemporaneous information provider

Performance of service index compared to official statistics

PSI (level) vs GDP	F stat	Prob	Causal?
PSI (level) does not Granger cause gdp(apc)	0.02	0.9	no
gdp(apc) does not Granger cause PSI (level)	13.8	0.0004	yes 1%
PSI (level) does not Granger cause gdp(qpc)	15.6	5.E-05	yes 1%
gdp(qpc) does not Granger cause PSI (level)	2.09	0.15	no

PSI (qc) vs employment	F stat	Prob	Causal?
PSI (qc) does not Granger cause gdp(apc)	11.2	0.001	yes 1%
gdp(apc) does not Granger cause PSI (qc)	2.34	0.13	no
PSI (qc) does not Granger cause gdp(qpc)	1.81	0.18	no
gdp(qpc) does not Granger cause PSI (qc)	0.01	0.91	no

PSI (level) vs GDP	F stat	Prob	Causal?
PSI (level) does not Granger cause emp(apc)	10.2	0.02	yes 5%
emp(apc) does not Granger cause PSI (level)	0.61	0.43	no
PSI (level) does not Granger cause emp(qpc)	11.3	0.001	yes 1%
emp(qpc) does not Granger cause PSI (level)	0.06	0.8	no

PSI (qc) vs employment	F stat	Prob	Causal?
PSI (qc) does not Granger cause emp(apc)	1.17	0.28	no
emp(apc) does not Granger cause PSI (qc)	0.93	0.34	no
PSI (qc) does not Granger cause emp(qpc)	0.14	0.70	no
emp(qpc) does not Granger cause PSI (qc)	0.20	0.66	no

Source: NZIER

6.3 Test results for the PCI

Table 5 and table 6 show the Granger test results for PCI as a leading indicator and contemporaneous information provider. The series are seasonally adjusted and include: PCI level and quarterly change (qc); annual percentage change (apc) or quarterly percentage change (qpc) of GDP for the construction sector; PCI employment sub-index level and quarterly change; and employment for the

construction industry in terms of apc and qpc form. Unit root tests were performed for each series to ensure stationarity before Granger causality tests were applied.

PCI level is a good leading indicator for the official construction sector GDP and employment statics although causality runs both ways. However, quarterly change in PCI has no predictive power at all.

PCI is useful at providing early information on GDP and employment growth for the current quarter although there's presence of bi-directional causality.

Table 5 Granger causality tests – PCI as leading indicator

Performance of construction index compared to official statistics

PCI (level) vs GDP	F stat	Prob	Causal?
PCI (level) does not Granger cause gdp(apc)	4.92	0.03	yes 5%
gdp(apc) does not Granger cause PCI (level)	4.69	0.03	yes 5%
PCI (level) does not Granger cause gdp(qpc)	6.52	0.01	yes 1%
gdp(qpc) does not Granger cause PCI (level)	5.46	0.02	yes 5%

PCI (level) vs employment	F stat	Prob	Causal?
PCI (qc) does not Granger cause gdp(apc)	0.99	0.32	no
gdp(apc) does not Granger cause PCI (qc)	0.21	0.65	no
PCI (qc) does not Granger cause gdp(qpc)	1.95	0.17	no
gdp(qpc) does not Granger cause PCI (qc)	1.72	0.19	no

PCI (level) vs GDP	F stat	Prob	Causal?
PCI (level) does not Granger cause emp(apc)	2.86	0.09	yes 10%
emp(apc) does not Granger cause PCI (level)	5.28	0.02	yes 5%
PCI (level) does not Granger cause emp(qpc)	4.48	0.04	yes 5%
emp(qpc) does not Granger cause PCI (level)	3.46	0.07	yes 10%

PCI (qc) vs employment	F stat	Prob	Causal?
PCI (qc) does not Granger cause emp(apc)	0.09	0.77	no
emp(apc) does not Granger cause PCI (qc)	0.55	0.46	no
PCI (qc) does not Granger cause emp(qpc)	2.00	0.16	no
emp(qpc) does not Granger cause PCI (qc)	0.22	0.63	no

Source: NZIER

Table 6 Granger causality tests – PCI as contemporaneous information provider

Performance of construction index compared to official statistics

PCI (level) vs GDP	F stat	Prob	Causal?
PCI (level) does not Granger cause gdp(apc)	11.9	0.0009	yes 1%
gdp(apc) does not Granger cause PCI (level)	2.85	0.10	yes 10%
PCI (level) does not Granger cause gdp(qpc)	14.7	0.0002	yes 1%
gdp(qpc) does not Granger cause PCI (level)	0.16	0.69	no

PCI (qc) vs employment	F stat	Prob	Causal?
PCI (qc) does not Granger cause gdp(apc)	1.19	0.28	no
gdp(apc) does not Granger cause PCI (qc)	1.00	0.32	no
PCI (qc) does not Granger cause gdp(qpc)	1.33	0.25	no
gdp(qpc) does not Granger cause PCI (qc)	2.44	0.12	no

PCI (level) vs GDP	F stat	Prob	Causal?
PCI (level) does not Granger cause emp(apc)	2.86	0.09	yes 10%
emp(apc) does not Granger cause PCI (level)	5.28	0.02	yes 5%
PCI (level) does not Granger cause emp(qpc)	22.0	1.E-05	yes 1%
emp(qpc) does not Granger cause PCI (level)	3.31	0.07	yes 10%

PCI (qc) vs employment	F stat	Prob	Causal?
PCI (qc) does not Granger cause emp(apc)	3.60	0.06	yes 10%
emp(apc) does not Granger cause PCI (qc)	1.85	0.18	no
PCI (qc) does not Granger cause emp(qpc)	6.30	0.01	yes 1%
emp(qpc) does not Granger cause PCI (qc)	0.08	0.77	no

Source: NZIER

7. Conclusion

This paper finds that after performing Granger causality tests on three NZIER QSBO performance indices that PMI is the most useful leading and timely contemporary indicator of economic activities . There is evidence of bi-directional between PMI and

official statistics, which indicates that the two series are good predictors of each other.

The results for PSI indicates that there is little evidence of Granger causality from the PSI to the corresponding official economic data for the service sector. It also indicates that the official statistics for the service sector do not Granger cause PSI, either. This result suggests that the PSI and the official data are poorly correlated with each other. There may be a need to examine the coverage and components of the PSI survey, if the goal is to have an index with good predictive ability.

The PCI tests suggest that PCI provides good value as both a leading indictor and a timely contemporary indicator for economic activity in the construction sector.

The tests show the value of getting a range of business information from respondents. In general, the indices performed better when the composite index with all five components was compared to GDP. By contrast, the employment component by itself was not as highly linked to the official employment information. The combination of components is therefore a better predictor.

The tests also show the strengths and weaknesses of the QSBO sectoral coverage. The survey appears to cover the manufacturing and construction sectors well. Based on this information, the full QSBO index has also been a good leading indicator of the New Zealand economy. However, the index for the services sector did not perform as well. This suggests an area for further research. Possible avenues to explore in order to strengthen the QSBO are the impacts of variability on forecasts for the sector, appropriate survey design for the sector, and construction of valid indices using available data.

8. References

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