

An Evaluation of Qualitative Data as Leading Indicators of Trends in the Australian Economy

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AGENDA

- The Nature of Qualitative Data
- Rational Expectations Theory
- The Qualitative Data Series
- VAR Models – Expanding and Rolling windows
- Multi Linear Analyses

The Nature of Qualitative Day

- Qualitative data – Business Surveys
- Overbridge shortcomings of quantitative data (official statistics)
- Long Delays
- Revision
- Measurement errors
- Volatile
- International Comparison difficult due to methodology differences
- First Originated in 1920's with “shippers forecast”
- In Australia NAB's Monthly and Quarterly Business Surveys, Westpac CCI's, Dun and Bradstreet National Business Surveys, Deloitte Access Economic Surveys, Melbourne Institute of Applied Economics and Social Research Surveys by MYOB and ACCI.

Rational Expectations Theory

- Economic agents form expectations by taking into account all relative information, including how policy will affect the economy.
- Expectations and outcomes differ only by a random forecast error.
- Classical, Keynesian, Monetarist, Neoclassical

The Qualitative Data Series – NAB’s Monthly and Quarterly Business Confidence and Business Conditions Indices

- Business Confidence – Expectations of respondents of business conditions in the upcoming month or quarter
- Business Conditions – A simple average of trading, profitability and employment indices in the upcoming month or quarter
- Index value – the difference between respondents nominating good, very good or a rise and those nominating poor, very poor or a fall
- Example – if 25 percent report that trading levels are good or very good and 10 percent state these levels are poor or very poor, the corresponding index will be 15.
- The index will be seasonally adjusted and no weightings are applied
- Monthly surveys – 400 small , medium to large sized companies
- Quarterly surveys – 500 plus respondents

Forecasting with Qualitative data

VAR Models

Methodology:

- Data Series tested for stationarity – Dicky Fuller
- Data tested for seasonal unit roots – HEGY
- Johansen Test for co integration
- Estimation of Lagging period according to SBIC criteria
- Diagnostic checking for serial correlation in error term – Lagrange multiplier
- Jarque Bera test for normal distribution of error terms
- Eigen Stability condition – inside unit circle
- Granger Causality Wald test
- Impulse Response functions

Does the inclusion of Qualitative Data improve VAR forecasts?

- Rolling Window VAR models
- Expanding window VAR models
- Diebold Mariano Test

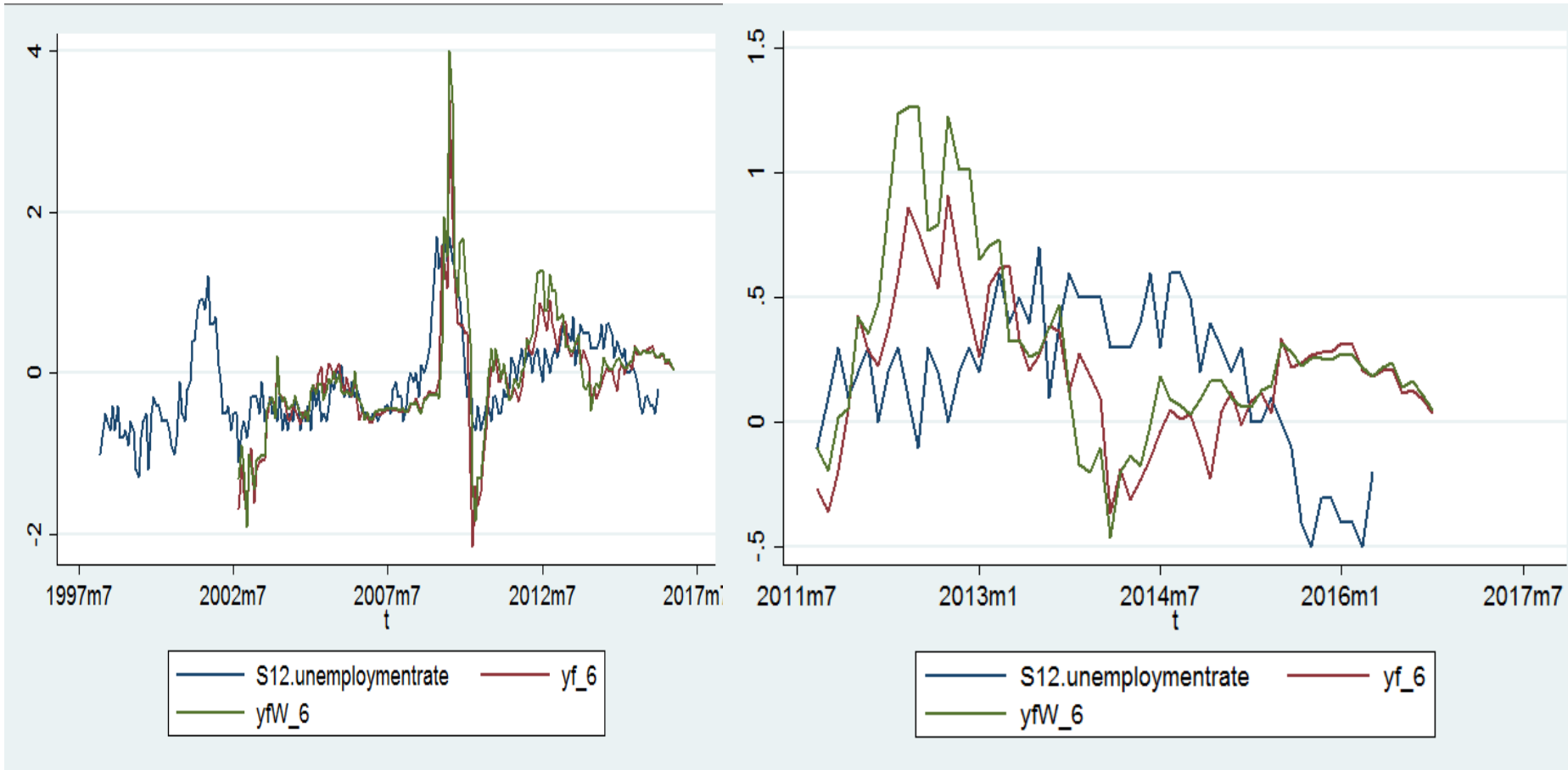
Rolling Window VAR Model – Unemployment Rate

$$\begin{bmatrix} \Delta_{12} unemp_t \\ \Delta_{12} jobsnews_t \\ \Delta_{12} housecr_t \\ \Delta_{12} cashrate_t \\ \Delta_{12} m1_t \\ \Delta_{12} m3_t \\ \Delta_{12} yeargov_t \\ \Delta_{12} vehsales_t \\ \Delta_{12} aunabc_t \\ \Delta_{12} aubusc_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \\ \alpha_7 \\ \alpha_8 \\ \alpha_9 \\ \alpha_{10} \end{bmatrix} + \begin{bmatrix} \emptyset_{11} & \emptyset_{12} & \dots & \emptyset_{1,10} \\ \emptyset_{21} & \emptyset_{22} & \dots & \emptyset_{2,10} \\ \emptyset_{31} & \emptyset_{32} & \dots & \emptyset_{3,10} \\ \emptyset_{41} & \emptyset_{42} & \dots & \emptyset_{4,10} \\ \emptyset_{51} & \emptyset_{52} & \dots & \emptyset_{5,10} \\ \emptyset_{61} & \emptyset_{62} & \dots & \emptyset_{6,10} \\ \emptyset_{71} & \emptyset_{72} & \dots & \emptyset_{7,10} \\ \emptyset_{81} & \emptyset_{82} & \dots & \emptyset_{8,10} \\ \emptyset_{91} & \emptyset_{92} & \dots & \emptyset_{9,10} \\ \emptyset_{10,1} & \emptyset_{10,2} & \dots & \emptyset_{10,10} \end{bmatrix} \begin{bmatrix} \Delta_{12} unemp_{t-1} \\ \Delta_{12} jobsnews_{t-1} \\ \Delta_{12} housecr_{t-1} \\ \Delta_{12} cashrate_{t-1} \\ \Delta_{12} m1_{t-1} \\ \Delta_{12} m3_{t-1} \\ \Delta_{12} yeargov_{t-1} \\ \Delta_{12} vehsales_{t-1} \\ \Delta_{12} aunabc_{t-1} \\ \Delta_{12} aubusc_{t-1} \end{bmatrix} + \begin{bmatrix} W_{t,1} \\ W_{t,2} \\ W_{t,3} \\ W_{t,4} \\ W_{t,5} \\ W_{t,6} \\ W_{t,7} \\ W_{t,8} \\ W_{t,9} \\ W_{t,10} \end{bmatrix}$$



Unemployment Rate

Rolling Window length 60 periods, lag length 1



Diebold Mariano Test Results

Unemployment Rate

Forecast Period	Data Series	Unemployment Rate with Business confidence and Conditions	Unemployment Rate without Business Confidence and Conditions		
	VAR	MSE	MSE	S(1)*	P - value
Yf1	0.376*	0.055	0.056	-0.375	0.708
Yf2	0.372*	0.091	0.091	-0.147	0.884
Yf3	0.366*	0.108	0.119	-0.785	0.433
Yf4	0.364*	0.153	0.191	-1.260	0.208
Yf5	0.359*	0.225	0.275	-1.293	0.196
Yf6	0.355*	0.274	0.351	-1.330	0.184
Yf7	0.353*	0.346	0.483	-1.399	0.162
Yf8	0.350	0.444	0.625	-1.288	0.198
Yf9	0.347	0.529	0.785	-1.191	0.234
Yf10	0.346	0.625	1.002	-1.174	0.240
Yf12	0.342	0.883	1.641	-1.074	0.283
Yf18	0.337	1.692	7.381	-1.084	0.279



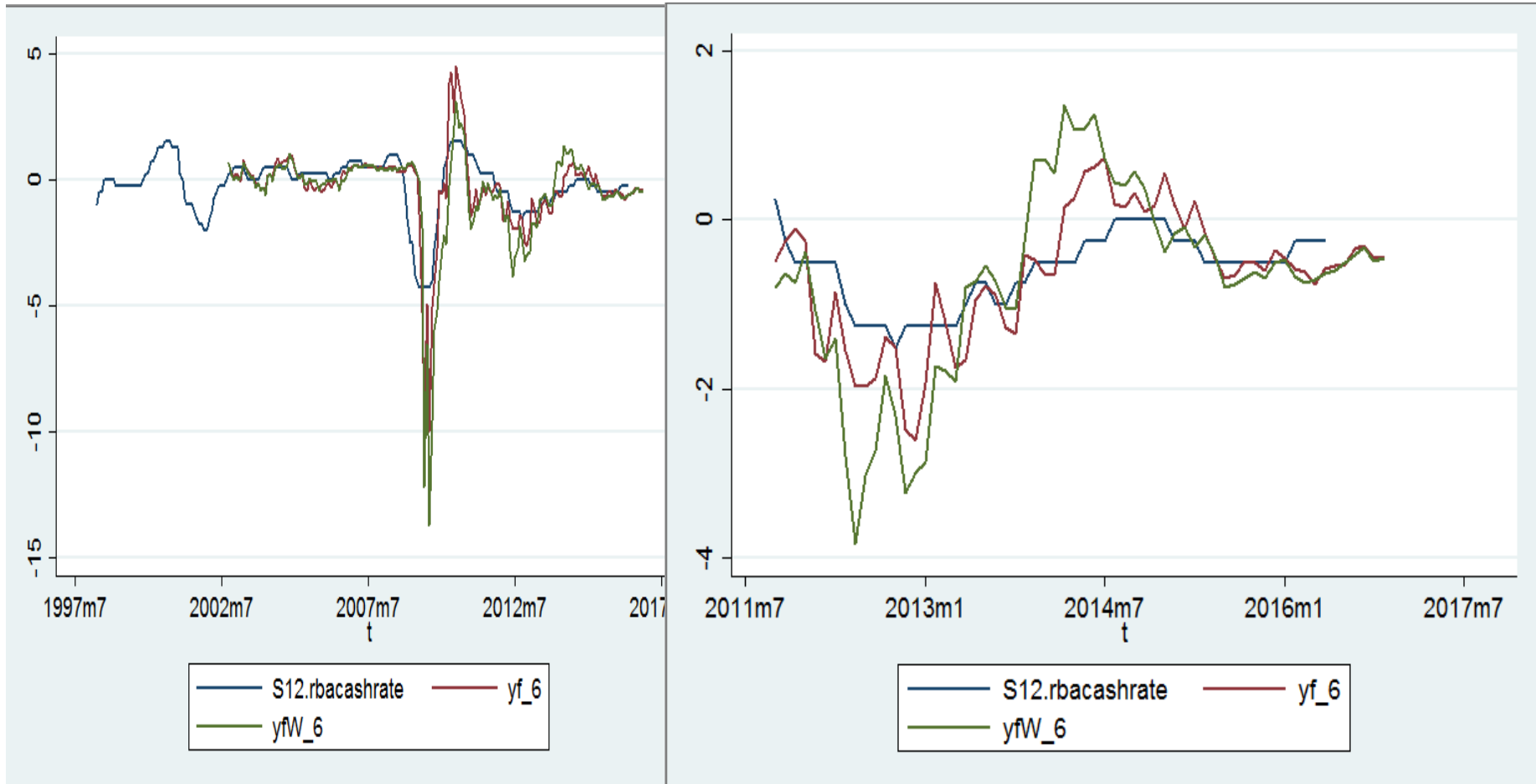
Rolling Window VAR Model

RBA Cash Rate

$$\begin{bmatrix} \Delta_{12} \text{ cashrate}_t \\ \Delta_{12} \text{ housecr}_t \\ \Delta_{12} \text{ privcr}_t \\ \Delta_{12} \text{ unemp}_t \\ \Delta_{12} \text{ yeargov}_t \\ \Delta_{12} \text{ loans}_t \\ \Delta_{12} \text{ aunncbc}_t \\ \Delta_{12} \text{ aubusc}_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \\ \alpha_7 \\ \alpha_8 \end{bmatrix} + \begin{bmatrix} \emptyset_{11} & \emptyset_{12} & \dots & \emptyset_{1,8} \\ \emptyset_{21} & \emptyset_{22} & \dots & \emptyset_{2,8} \\ \emptyset_{31} & \emptyset_{32} & \dots & \emptyset_{3,8} \\ \emptyset_{41} & \emptyset_{42} & \dots & \emptyset_{4,8} \\ \emptyset_{51} & \emptyset_{52} & \dots & \emptyset_{5,8} \\ \emptyset_{61} & \emptyset_{62} & \dots & \emptyset_{6,8} \\ \emptyset_{71} & \emptyset_{72} & \dots & \emptyset_{7,8} \\ \emptyset_{81} & \emptyset_{82} & \dots & \emptyset_{8,8} \end{bmatrix} \begin{bmatrix} \Delta_{12} \text{ cashrate}_{t-1} \\ \Delta_{12} \text{ housecr}_{t-1} \\ \Delta_{12} \text{ privcr}_{t-1} \\ \Delta_{12} \text{ unemp}_{t-1} \\ \Delta_{12} \text{ yeargov}_{t-1} \\ \Delta_{12} \text{ loans}_{t-1} \\ \Delta_{12} \text{ aunncbc}_{t-1} \\ \Delta_{12} \text{ aubusc}_{t-1} \end{bmatrix} + \begin{bmatrix} w_{t,1} \\ w_{t,2} \\ w_{t,3} \\ w_{t,4} \\ w_{t,5} \\ w_{t,6} \\ w_{t,7} \\ w_{t,8} \end{bmatrix}$$

RBA Cash Rate

Rolling Window length 60 periods, lag length 1



Diebold Mariano Test Results

RBA Cash Rate

Forecast Period	Data Series	RBA Cash Rate with Business confidence and Conditions	RBA Cash Rate without Business Confidence and Conditions		
	VAR	MSE	MSE	S(1)*	P - value
Yf1	2.193*	0.059	0.081	-2.373	0.018*
Yf2	2.206*	0.162	0.249	-2.571	0.010*
Yf3	2.218*	0.333	0.549	-2.326	0.020*
Yf4	2.231*	0.559	0.922	-1.921	0.055
Yf5	2.244*	0.890	1.651	-1.581	0.114
Yf6	2.256*	1.305	2.605	-1.357	0.175
Yf7	2.270*	1.850	4.066	-1.224	0.221
Yf8	2.283	2.515	6.320	-1.155	0.248
Yf9	2.296	3.266	9.701	-1.122	0.262
Yf10	2.310	4.236	14.900	-1.106	0.269
Yf12	2.337	6.137	33.230	-1.096	0.273
Yf18	2.423	7.808	347.70	-1.098	0.272



Rolling Window VAR Model

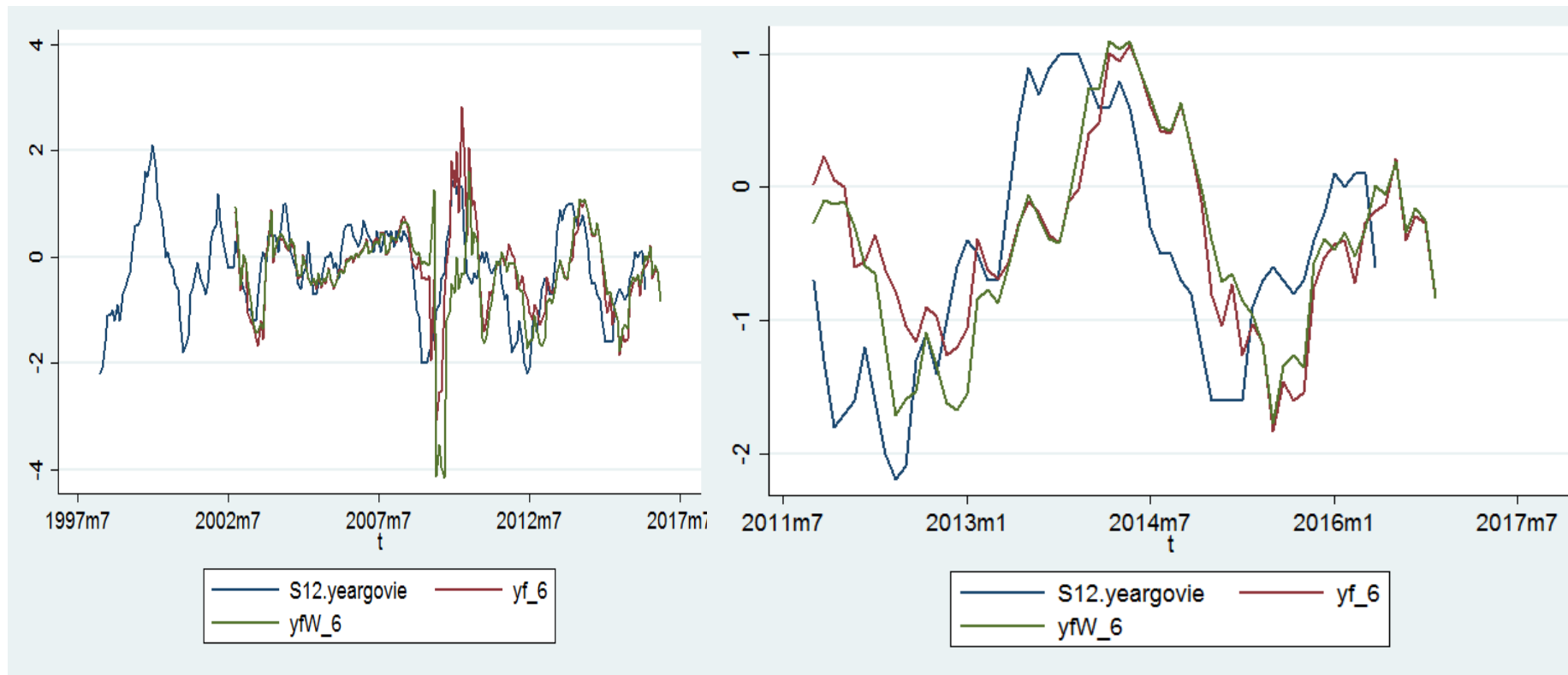
10 – Year Government Bond Yield

$$\begin{bmatrix} \Delta_{12} \text{ yeargov}_t \\ \Delta_{12} \text{ privcr}_t \\ \Delta_{12} \text{ cashrate}_t \\ \Delta_{12} \text{ unemp}_t \\ \Delta_{12} \text{ m3}_t \\ \Delta_{12} \text{ loans}_t \\ \Delta_{12} \text{ aunabc}_t \\ \Delta_{12} \text{ aubusc}_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \\ \alpha_6 \\ \alpha_7 \\ \alpha_8 \end{bmatrix} + \begin{bmatrix} \emptyset_{11} & \emptyset_{12} & \cdots & \emptyset_{1,8} \\ \emptyset_{21} & \emptyset_{22} & \cdots & \emptyset_{2,8} \\ \emptyset_{31} & \emptyset_{32} & \cdots & \emptyset_{3,8} \\ \emptyset_{41} & \emptyset_{42} & \cdots & \emptyset_{4,8} \\ \emptyset_{51} & \emptyset_{52} & \cdots & \emptyset_{5,8} \\ \emptyset_{61} & \emptyset_{62} & \cdots & \emptyset_{6,8} \\ \emptyset_{71} & \emptyset_{72} & \cdots & \emptyset_{7,8} \\ \emptyset_{81} & \emptyset_{82} & \cdots & \emptyset_{8,8} \end{bmatrix} \begin{bmatrix} \Delta_{12} \text{ yeargov}_{t-1} \\ \Delta_{12} \text{ privcr}_{t-1} \\ \Delta_{12} \text{ cashrate}_{t-1} \\ \Delta_{12} \text{ unemp}_{t-1} \\ \Delta_{12} \text{ m3}_{t-1} \\ \Delta_{12} \text{ loans}_{t-1} \\ \Delta_{12} \text{ aunabc}_{t-1} \\ \Delta_{12} \text{ aubusc}_{t-1} \end{bmatrix} + \begin{bmatrix} w_{t,1} \\ w_{t,2} \\ w_{t,3} \\ w_{t,4} \\ w_{t,5} \\ w_{t,6} \\ w_{t,7} \\ w_{t,8} \end{bmatrix}$$



10 – Year Government Bond Yield

Rolling Window length 60 periods, lag length 1



Diebold Mariano Test Results

10 – Year Government Bond Yield

Forecast Period	Data Series	Bond Yield with Business confidence and Conditions	Bond Yield without Business Confidence and Conditions		
	VAR	MSE	MSE	S(1)*	P - value
Yf1	1.306*	0.097	0.100	-0.436	0.662
Yf2	1.302*	0.206	0.248	-0.888	0.375
Yf3	1.301*	0.312	0.405	-0.970	0.332
Yf4	1.301*	0.425	0.578	-0.972	0.331
Yf5	1.304*	0.519	0.769	-1.013	0.311
Yf6	1.310*	0.632	0.973	-1.034	0.301
Yf7	1.312*	0.787	1.204	-1.035	0.301
Yf8	1.317*	0.954	1.507	-1.085	0.278
Yf9	1.322*	1.117	1.885	-1.113	0.266
Yf10	1.328*	1.298	2.351	-1.110	0.267
Yf12	1.342	1.480	3.427	-1.117	0.264
Yf18	1.383*	1.301	11.44	-1.104	0.270



Expanding Window VAR Models

- **Retail Sales**

- var s12.retailsales s12.housecredit s12.houseapprovals s12.unemploymentrate s12.vehiclesales s12.aunabc s12.aubusc, lags (1)

- **Vehicle Sales**

- var s12.vehiclesales s12.buildingsapproved s12.imports s12.housefinance s12.investmentfinance s12.houseapprovals s12.rbacashrate s12.aunabc s12.aubusc lags (1)

- **10-YearGovie**

- var s12.yeargovie s12.housecredit s12.privatesectorcredit s12.rbacashrate s12.unemploymentrate s12.m3 s12.indprod s12.loansandadvances s12.aunabc s12.aubusc, lags (1)

Expanding Window VAR Models

- **RBA Cash Rate**

- var s12.rbacashrate s12.housecredit s12.privatesectorcredit s12.unemploymentrate s12.yeargovie s12.m3 s12.indprod s12.loansandadvances s12.aunabc s12.aubusc, lags (1)

- **Unemployment Rate**

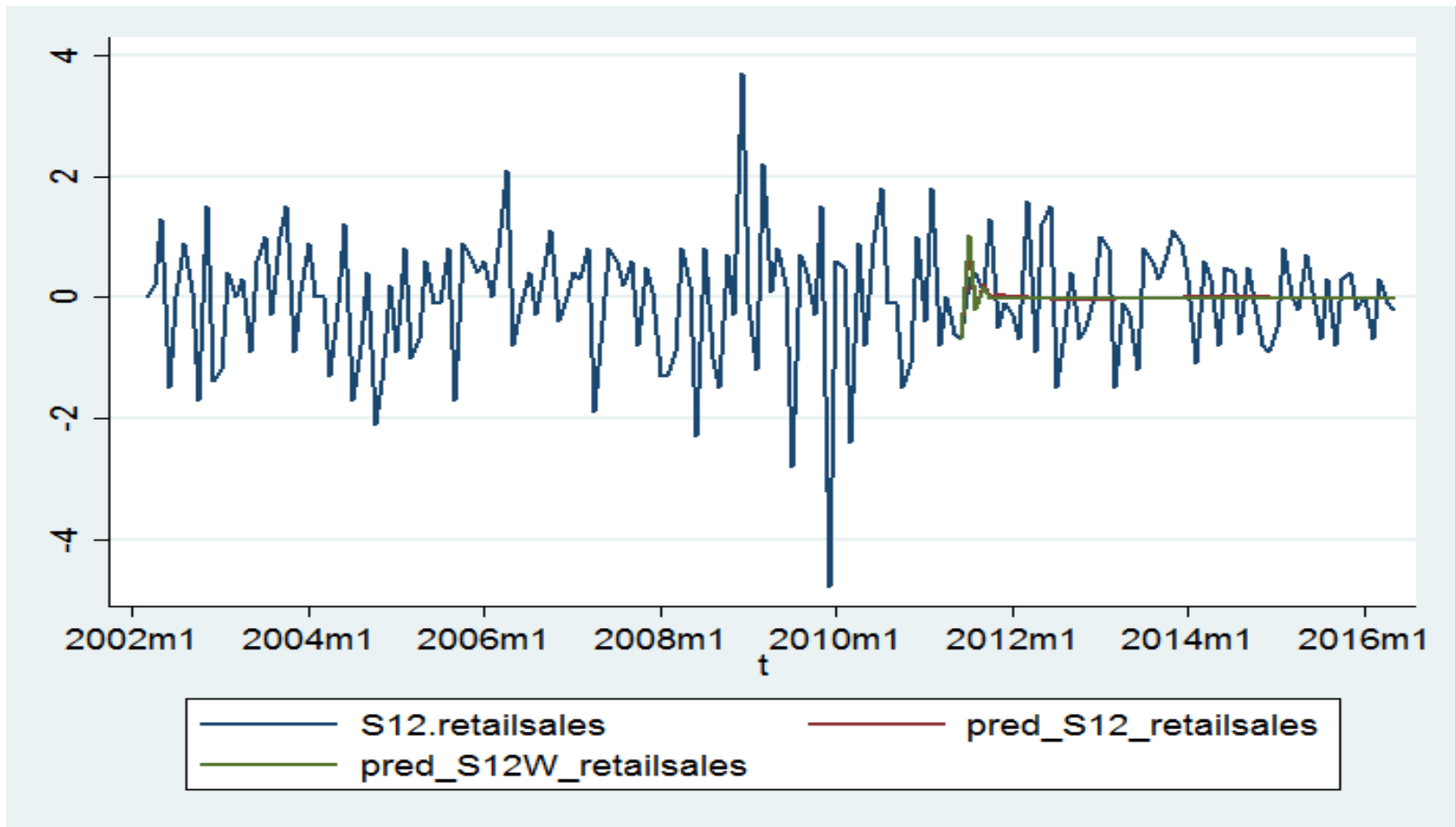
- var s12.unemploymentrate s12.anzjobsnews s12.housecredit s12.rbacashrate s12.retailsales s12.m1 s12.m3 s12.yeargovie s12.loansandadvances s12.vehiclesales, lags (1)

- **House Approvals**

- var s12.houseapprovals s12.buildingsapproved s12.housefinance s12.privatesectorcredit s12.rbacashrate s12.retailsales s12.m3. s12.yeargovie s12.loansandadvances s12.vehiclesales s12.westpaccurrentcond s12.aunabc s12.aubusc, lags (1)

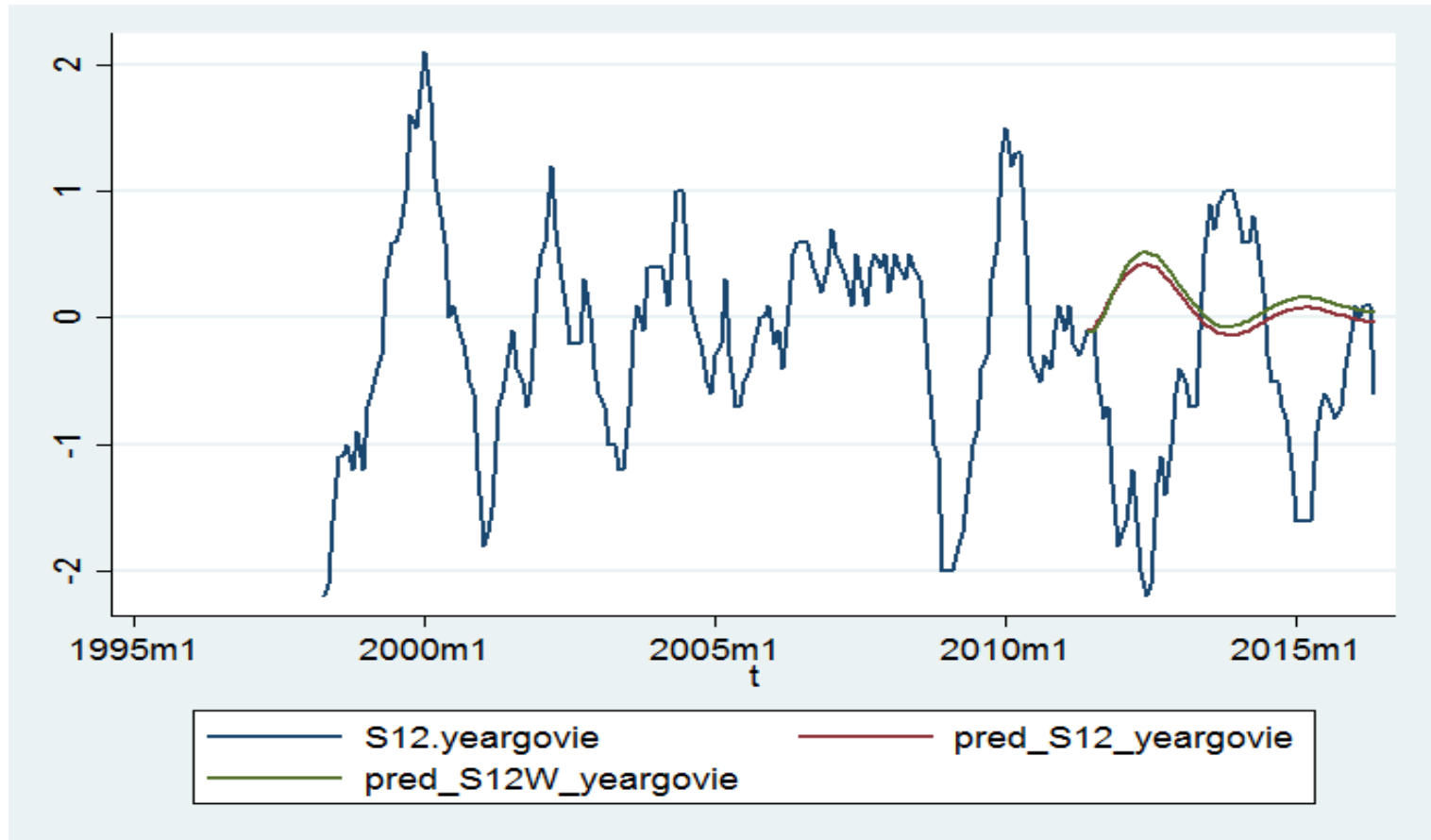
Expanding Window VAR Models

Retail Sales– with and without qualitative data



Expanding Window VAR Models

Ten Year Government Bond Yield With and Without qualitative data



Expanding Window VAR Models

Diebold Mariano Test Results

Monthly data set	MSE with	MSE without	S(1)*	P - value
Retail Sales	0.479	0.482	-1.501	0.133
Vehicles Sales	29.31	29.36	-0.604	0.546
10-YearGovie	1.133	1.216	-1.316	0.188
RBA Cash Rate	0.789	1.117	-2.344	0.019*
Unemployment Rate	.0291	0.335	-2.511	0.012*
House Approvals	27.86	27.96	-0.355	0.725

VAR Models - Expanding Windows versus Rolling Windows

10 Year Govie Yield

Forecast Period	Expanding Window	Rolling Window	DM - Statistic	
	MSE	MSE	S(1)*	P - value
Yf1	1.130	0.101	2.938	0.003*
Yf2	1.130	0.252	2.684	0.007*
Yf3	1.130	0.366	2.337	0.019*
Yf4	1.130	0.477	1.932	0.053
Yf5	1.130	0.561	1.791	0.073
Yf6	1.130	0.707	1.566	0.119
Yf7	1.130	0.864	1.143	0.233
Yf8	1.130	0.968	0.739	0.459
Yf9	1.130	1.075	0.258	0.798
Yf10	1.130	1.172	-0.202	0.839
Yf11	1.130	1.221	-0.479	0.632
Yf12	1.130	1.218	-0.527	0.597



Multi linear analyses

Models estimated with the inclusion of business confidence and conditions compared to models excluding the data

- Monthly data

$$\begin{aligned} \text{RBA cash rate} = & \beta_0 + \beta_1 \text{ house credit}_{t-6} + \beta_2 \text{ private sector credit} \\ & - \beta_3 \text{ unemployment rate} + \beta_4 \text{ year-govie} + \beta_5 \text{ M3} \\ & + \beta_6 \text{ Ind Prod} - \beta_7 \text{ loans and advances} \\ & - \beta_8 \text{ business confidence} + \beta_9 \text{ business conditions}_{t-4} + \mu \end{aligned}$$

With:

$$N = 221 \quad R^2 = 0.832 \quad \hat{R}^2 = 0.825$$

Without:

$$N = 221 \quad R^2 = 0.805 \quad \hat{R}^2 = 0.798$$

$$\text{Prob} > F = 0.000$$

Multi linear analyses

Models estimated with the inclusion of business confidence and conditions compared to models excluding the data

- Monthly data

$$\begin{aligned} 10\text{-Year-govie} = & \beta_0 + \beta_1 \text{ house credit} - \beta_2 \text{ private sector credit} \\ & + \beta_3 \text{ RBA cash rate} + \beta_4 \text{ unemployment rate} + \beta_5 \text{ M3} \\ & + \beta_6 \Delta \text{Ind Prod} + \beta_7 \text{ loans and advances} \\ & + \beta_8 \text{ business confidence} - \beta_9 \text{ business conditions}_{t-3} + \mu \end{aligned}$$

With:

$$N = 224 \quad R^2 = 0.809 \quad \hat{R}^2 = 0.801$$

Without:

$$N = 224 \quad R^2 = 0.777 \quad \hat{R}^2 = 0.769$$

$$\text{Prob} > F = 0.000$$

Multi linear analyses

Models estimated with the inclusion of business confidence and conditions compared to models excluding the data

- Quarterly data

$$\text{AUCPI} = \beta_0 - \beta_1 \text{GDP} + \beta_2 \text{gross company profits} - \beta_3 \text{retail trade} + \beta_4 \text{wage price index} + \beta_5 \text{business confidence} - \beta_9 \text{business conditions}_{t-6} + \mu$$

With:

$$N = 74 \quad R^2 = 0.494 \quad \hat{R}^2 = 0.448$$

Without:

$$N = 74 \quad R^2 = 0.421 \quad \hat{R}^2 = 0.388$$

$$\text{Prob} > F = 0.011$$

Multi linear analyses

Models estimated with the inclusion of business confidence and conditions compared to models excluding the data

- Quarterly data

$$\begin{aligned} \text{Unemp. rate} = & \beta_0 + \beta_1 \text{ ANZ Jobs Net}_{t-6} - \beta_2 \text{ Westpac CCI} \\ & + \beta_3 \text{ house credit} - \beta_4 \text{ house finance} + \beta_5 \text{ investment finance} \\ & - \beta_6 \text{ private sector credit}_{t-6} - \beta_7 \text{ RBA cash rate} - \beta_8 \text{ M3} \\ & + \beta_9 \text{ Year Govi}_{t-2} + \beta_{10} \text{ Ind prod.} + \beta_{11} \text{ loans and advances} \\ & - \beta_{11} \text{ Westpac CSI} + \beta_{10} \text{ business confidence} \\ & - \beta_{11} \text{ business conditions} + \mu \end{aligned}$$

With:

$$N = 61 \quad R^2 = 0.902 \quad \hat{R}^2 = 0.872$$

Without:

$$N = 61 \quad R^2 = 0.853 \quad \hat{R}^2 = 0.691$$

$$\text{Prob} > F = 0.000$$

Multi linear analyses

Models estimated with the inclusion of business confidence and conditions compared to models excluding the data

- Quarterly data

$$\begin{aligned} 10 \text{ Year-Govie} = & \beta_0 + \beta_1 \text{ ANZ Jobs Net} + \beta_2 \text{ ANZ Jobs news} \\ & - \beta_3 \text{ house approvals} - \beta_4 \text{ private sector credit} \\ & + \beta_5 \text{ RBA Cash Rate} + \beta_6 \text{ unemployment rate} \\ & + \beta_7 \text{ M3} - \beta_8 \text{ Westpac CCI} - \beta_9 \text{ Westpac Business} \\ & \text{Expectations} + \beta_{10} \text{ business confidence} \\ & - \beta_{11} \text{ business conditions} + \mu \end{aligned}$$

With:

$$N = 66 \quad R^2 = 0.856 \quad \hat{R}^2 = 0.827$$

Without:

$$N = 66 \quad R^2 = 0.827 \quad \hat{R}^2 = 0.799$$

$$\text{Prob} > F = 0.000$$

SUMMARY AND CONCLUSION

- Qualitative data proved to be valuable inputs in multi linear and VAR models.
 - Rolling window and expanding window VAR models with the inclusion of business confidence and conditions outperformed the same models that did not include the indices.
 - Multi linear models estimated with the inclusion of business confidence and conditions indices outperformed the same models that did not include the indices.
- Qualitative data definitely has a role to play as an early leading indicator of trends in the Australian economy