Appendix only – Financial Conditions in Australia

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Financial Conditions in Australia

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This appendix provides further technical detail to *Financial Conditions in Australia* and includes sections on:

- Previous studies
- Data
- Method
- Robustness tests
- Discussion of results

Section A1: Previous studies

Table A1 highlights some of the definitions of financial conditions used in previous studies, what variables were used to calculate the Financial Conditions Indices (FCIs) and what some of the findings were in terms of the impact of financial conditions on the economy.

TABLE A1: DEFINITIONS OF FINANCIAL CONDITIONS, VARIABLES INCLUDED, FINDINGS

Study	Definition of financial conditions	Variables included	Findings
Hatzius et al (2010)	The current state of financial variables that influence economic conditions. For a clean read on how these financial series can affect future economic activity, the influence of current or past economic activity on the financial series needs to be removed.	Series which cover the price and quantity of credit; liquidity; credit market conditions; and lending perceptions	Financial conditions indices help forecast economic activity and interestingly, '*…most of the predictive power of financial conditions for real activity reflects influences other than the evolution of monetary policy*' (page 2)
Darracq Paries, Maurin & Moccero (2014)	The functioning of financial markets and access to credit	Bank lending rates, loans to households and businesses, money supply growth, yield curves, bank capital and liquidity, equity and debt issuance by financial and non-financial corporations, bank and corporate bond yields, stock market returns of financial and non-financial companies, volatility in equity and exchange rate markets, price of raw materials, exchange rates	Credit supply shocks had a significant influence on activity during the GFC
Brave & Butters (2011)	How conditions in financial markets impact the economy	Various bond market yields and spreads, measures of market functioning	Provide some predictive power for future economic conditions
Swiston (2008)	How conditions beyond just the setting of monetary policy influence economic activity	Lending standards, short and long-term interest rates, real exchange rate, equity returns and oil prices	If credit availability tightened by 20ppts the level of GDP would fall by ¾ percent after a year FCI's can accurately predict turning points in economic activity with a lead of six to nine months
Beaton, Lalonde & Luu (2009)	The extent to which developments in the financial sector impact the real economy	Varies across two approaches adopted	Financial conditions had a material negative impact on GDP growth during the GFC

Study	Definition of financial conditions	Variables included	Findings
Gauthier, Graham & Liu (2004)	A broader concept of how monetary policy impacts the economy	Short and long-term interest rates, high yield corporate bond spreads as well as real exchange rate, house and equity prices	Has explanatory power over GDP
English, Tsatsaronis & Zoli (2005)	How developments in the financial sector impact the real economy	Bank assets and lending activities, asset prices, leverage, various interest rates	Helpful in forecasting GDP but not inflation
Guichard, Haugh & Turner (2009)	Shows how monetary policy, exchange rates and other financial variables influence the economy	Short and long-term yields, exchange rate, corporate bond spreads, change in credit availability, household wealth	A one per cent tightening of financial conditions can lower the level of GDP by one per cent after five quarters
Arregui et al (2018)	Captures the costs, conditions, and availability of credit	Different yield spread measures (credit, term, inter-bank, sovereign), changes in long-term yields, equity and house prices, equity volatility, changes in the size of the financial sector, credit growth	Global financial conditions can explain between 20 and 40 per cent of the variation in domestic financial conditions
Arrigoni, Bobasu & Venditti (2020)	'*…a summary measure of how easily firms, households, and governments finance themselves*' and are '*…a function of various asset prices and of the quantity and price of credit in the economy*' (page 2)	Short and long-term yields, price-earnings ratio, real exchange rate, corporate bond spreads	Financial stress indicators can predict economic slowdowns and banking crises
Hartigan & Wright (2021)	Not defined	Asset prices, interest rates and spreads, credit and money, debt securities outstanding, leverage, banking sector risk, financial system complexity, financial market risk, and survey measures of businesses and consumers' views on financial conditions	Financial conditions provide predictive information about the five measures of economic activity considered in the paper, including GDP, consumption, the unemployment rate, employment and business investment

There are few publicly available estimates of financial conditions in Australia, a gap RBA economists Luke Hartigan and Michelle Wright sought to address with their paper 'Australia'. Their series is impressive in many ways; it is carefully constructed, it summarises the information from an extensive data set, and it has a long time series (starting in the mid-1970). Unfortunately, the RBA does not provide updates of this FCI though, with the publicly available data only up to Q3 2020.nIt is also estimated using quarterly data, which makes it difficult to assess rapid changes in financial conditions in real time. Further, Hartigan and Wright do not provide a time-series of what aspects of the financial sector are driving changes in financial conditions (though this would be possible to do using their framework). Therefore, there is an opportunity to estimate a more frequent and contemporary FCI for Australia which also provides some insight as to which financial sector developments might be the ones which could influence future economic activity.

In terms of how to go about this, there are different questions to consider including:

- The overall method
- What weights to give the different components of the FCI
- If the central bank policy rate should be one of the variables included
- Whether the impact of previous economic developments are removed from the financial series
- How the resulting Financial Conditions Index can be interpreted

Table A2 catalogues how various studies on financial conditions have addressed these issues.

TABLE A2: METHODOLOGICAL CHOICES AND RESULTING INTERPRETATION

Study	Overall method	Weighting method	Policy rate included	Remove impact of economy from financial series	Interpretation of FCI
Hatzius et al (2010)	Used Principal Components Analysis (PCA) to extract the common trend in residuals from equations of financial series on activity, inflation and policy rate variables. These regressions are designed to remove the impact of economic conditions from financial	Static weights based on the coefficient for each variable in the PCA	No	Yes	The relative ease or difficulty of financial conditions relative to those in the past

Study	Overall method	Weighting method	Policy rate included	Remove impact of economy from financial series	Interpretation of FCI
	series. The common trend from these residuals is then interpreted as the variation in financial series which is unrelated to the state of the economy.				
Darracq Paries, Maurin & Moccero (2014)	Used PCA to extract the common trend in residuals from equations of financial series on activity, inflation and policy rate variables	Static weights based on the coefficient for each variable in the PCA	No	Yes	The relative ease or difficulty of financial conditions relative to those in the past
Brave & Butters (2011)	Dynamic factor model	Dynamic weights	No, but other short-term rates are	Yes, in the 'adjusted' version of their index	The relative ease or difficulty of financial conditions relative to those in the past
Swiston (2008)	Use Impulse Response Functions (IRFs) from Vector Autoregressive Regressions (VARs) of activity, inflation and financial variables	Dynamic weights based on eight quarter impact of shocks to financial series on GDP (from IRFs) and shocks observed to those series over previous eight quarters	No, but the 3-month LIBOR was used here	No	The (annualised) contribution of financial conditions to GDP growth
Beaton, Lalonde & Luu (2009)	Two methods - VAR based approach - Large-scale macro model	Both methods use similar weighting procedures to Swiston (2008)	'Yes' in large-scale macro model. 'No' in VAR (commercial paper rate was used here though).	No	The (annualised) contribution of financial conditions to GDP growth
Gauthier, Graham & Liu (2004)	Three methods - Reduced form macro model (aggregate demand equation) - VAR based approach - Factor based approach	Reduced form model…Estimated from aggregate demand equation VAR… Dynamic weights based on eight quarter impact of shocks to financial series on GDP (from IRFs) and shocks observed to those series over previous eight quarters Factor based approach…Static weights based on coefficient for each variable in the PCA	No, but the commercial paper rate was used in each of the three approaches	No	VAR… The (annualised) contribution of financial conditions to GDP growth Other approaches… The relative ease or difficulty of financial conditions relative to those in the past
English, Tsatsaronis & Zoli (2005)	Factor based approach	Static weights based on the lambda coefficient for each variable in the PCA	No, but other short-term rates are	No	The relative ease or difficulty of financial conditions relative to those in the past
Guichard, Haugh & Turner (2009)	VAR and reduced form regressions	Weight based on impact of variable on US GDP after 4 to 6 quarters based on VAR and reduced form regressions	Yes	No	The relative ease or difficulty of financial conditions relative to those in the past
Arregui et al (2018)	Time-varying Parameter Factor Augmented Vector Autoregressive Model	Dynamic weights	Yes	Yes	The relative ease or difficulty of financial conditions relative to those in the past

Study	Overall method	Weighting method	Policy rate included	Remove impact of economy from financial series	Interpretation of FCI
Arrigoni, Bobasu & Venditti (2020)	Simple qualitative weighting of series which proxy for financial stress and conditions	Simple qualitative weighting	No	No	The relative ease or difficulty of financial conditions relative to those in the past
Hartigan & Wright (2021)	Dynamic factor model	Dynamic weights	Yes	No	The relative ease or difficulty of financial conditions relative to those in the past

In *Financial Conditions in Australia*, the approach used to these questions was as follows:

- The overall method – The Kalman Filter and PCA were used to separate the signal from noise across the range of series used to proxy for the different components of financial conditions.
- Component weights – The component weights chosen were the average of those derived from ordinary least squares and vector auto regressions as well as those that were subjectively chosen.
- Central bank policy rate – Not included
- Remove impact of previous economic developments – Yes
- Interpretation of FCI – The relative ease or difficulty of financial conditions relative to those in the past

More detail on the method used and robustness tests applied to some of the modelling choices can be found in sections A3 and A4 respectively below.

Section A2: Data

A range of data series, from which estimates of the components of financial conditions could be made, were considered with those ultimately included being done so based on whether:

- It made sense to do so
- The series has been included in previous studies on financial conditions
- The series complicated the estimation procedure in any way
- The data were available for a long enough period

The series were made stationary, standardised and, if required, smoothed prior to being included in the analysis. If applicable, the series were also multiplied by -1 to give a consistent interpretation of financial conditions.[1] Any quarterly series used were linearly interpolated to a monthly basis. The final data series used to estimate the components of the FCI are set out in Table A3.

TABLE A3: SERIES USED IN ESTIMATION OF FINANCIAL CONDITIONS INDEX

(Relative) cost of finance

Series	Frequency	Methodological note	Source
Fixed versus variable rate housing lending spreads	Monthly	–	RBA
Housing variable rate lending spread over cash rate	Monthly	–	RBA
Business lending rate spread over cash rate	Quarterly	Business interest rate calculated as private non-financial corporations' interest payable divided by debt outstanding	RBA, ABS
Bank bond to government yield spread	Monthly	–	Bloomberg
Corporate bond to government yield spread	Monthly	–	Bloomberg

Source: Bloomberg, Macrobond, QTC Economic Research

Note – Variable rate lending spreads were not included as these have increased structurally since the GFC. Bank and corporate bond yield spreads as well as new housing and business lending volumes were not included due to a short-time series.

[1] Specifically, an increase in the series would be consistent with a tightening of financial conditions

Availability of finance

Series	Frequency	Methodological note	Source
(Net) lending standards faced by business	Quarterly	3-month moving average	NAB Business Survey
Debt issuance	Quarterly	Two year moving average of net bond market transactions by other private non-financial corporations as a share of total debt outstanding for these issuers	ABS
New owner-occupier housing loans	Monthly	Calculated as the residual of a regression of the log of the value of new owner-occupier home loans on a constant and the log of CoreLogic dwelling prices.	ABS
New investor housing loans	Monthly	Calculated as the residual of a regression of the log of the value of new owner-occupier home loans on a constant and the log of CoreLogic dwelling prices.	ABS
Equity issuance	Monthly	Calculated as the residual of a regression of the log of the ASX 200 market capitalisation on a constant and the log of the ASX 200 price index.	Bloomberg
Private sector credit gap	Quarterly	See note below	BIS

Source: Bloomberg, Macrobond, QTC Economic Research

Note: The credit gap measure was based on the insight from Borio & Lowe (2002) that financial stability risks could increase the more that debt positively deviates from its trend. However, in the context of how changes in the stock of debt could contribute to altering financing conditions in the economy (as opposed to the stability of the financial system), a negative value for the gap measures was considered consistent with a tightening of financial conditions. For example, weaker credit growth would be consistent with lower credit availability. The trends used in the gap calculations were derived using Hamilton's alternative to the Hodrick-Prescott Filter.

Financial market stress

Series	Frequency	Methodological note	Source
AUD/USD 3-month cross-currency basis swap rate	Monthly	–	Bloomberg
AUD/USD 5-year cross-currency basis swap rate	Monthly	–	Bloomberg
AUD/USD 3-month risk-reversal option volatility	Monthly	–	Bloomberg
Realised volatility of nominal trade weighted exchange rate	Monthly	–	Bloomberg
Realised volatility of ASX 200	Monthly	–	Bloomberg
Implied volatility of ASX 200	Monthly	–	Bloomberg
One-year Bank Bill Swap Rate-Overnight Index Swap spread	Monthly	–	Bloomberg
USD/AUD 2-year net bond premium	Monthly	Calculated as per Du et al (2017)	Bloomberg
10-year bond term premium	Monthly	–	AoFM
10-year bond risk premium	Monthly	–	Leo Krippner Macro Finance Analysis
Equity risk premium	Monthly	Calculated as the difference between the earnings yield on the ASX 200 and the 10-year ACGB yield	Bloomberg
Realised volatility of idiosyncratic bank equity risk	Monthly	Bank equity risk calculated as the residual of a regression of the log of the ASX 200 financials sector market capitalisation on a constant and the log of the ASX 200 index.	Bloomberg
Credit risk proxy	Monthly	The residuals of a regression of the 12-month change in	Bloomberg

Series	Frequency	Methodological note	Source
		Australian corporate bond option-adjusted spreads on a constant and the annual change in both global credit spreads and 12-month ahead cash rate expectations	
Markit iTraxx Australia CDS Index	Monthly	–	Bloomberg

Source: Bloomberg, Macrobond, QTC Economic Research

Note: Realised volatility calculated using the formulae set out here. Two and five-year term and risk premia were considered but the 10-year was chosen to be consistent with what is more commonly referred to. Gross and net bond premia were considered, as were different maturities for these such as five and 10-years. The profiles of these are reasonably similar so the two-year net bond premia were chosen.

Monetary policy expectations

Series	Frequency	Methodological note	Source
Spread between 2-year ahead expected short-term rates and current RBA cash rate	Monthly	Based on two-year risk neutral yield less the RBA cash rate	AoFM
	Monthly	Based on two-year expected policy interest rate less the RBA cash rate	Leo Krippner Macro Finance Analysis
	Monthly	Based on two-year overnight indexed swap rate less the RBA cash rate	Bloomberg
Difference between three-year swap rate and 3-month Bank Bill Swap rate*	Monthly	–	Bloomberg
Monetary policy uncertainty**	Monthly	Based on the simple average of the stochastic volatility of 15 month ahead forecast errors of the cash rate (using from overnight indexed swaps and zero-coupon forward rates) as well as of the variables most which most closely influence monetary policy settings (headline and trimmed mean inflation, GDP and the unemployment rate) from the RBA and professional economists	RBA, ABS

Source: Bloomberg, Macrobond, Leo Krippner Macro Finance Analysis, QTC Economic Research

Note: Five and 10-year horizons were considered as maturities for monetary policy expectations, but not ultimately chosen as the most clarity about the prospects for monetary policy would seem to exist at shorter horizons. Yield curves slopes were also considered given the information they may contain about future monetary policy settings, but several issues were identified which meant these weren't included.

* - The three-year swap rate is an example of a fixed rate in a fixed-floating interest rate swap while the 3-month Bank Bill Swap rate is the floating rate in these transactions. The difference between the two thus gives a sense of how attractive it may be to lock in fixed rates via a swap and provides an indication of expectations regarding future interest rates.

** - Based on the approach outlined in Jurado et al (2015)

Other channels of monetary policy transmission

Series	Frequency	Methodological note	Source
House price growth	Monthly	–	Bloomberg
Equity price growth	Monthly	–	Bloomberg
Difference between 'shadow' policy rate and actual policy rate	Monthly	–	Leo Krippner Macro Finance Analysis
AUD over/under valuation	Monthly	Based on Chapman, Jääskelä & Smith (2018)	Bloomberg, Macrobond

Source: Bloomberg, Macrobond, Leo Krippner Macro Finance Analysis, QTC Economic Research

Section A3: Method

The key aspects of the method used to estimate financial conditions were:

- The impact of current and past economic activity, inflation and monetary policy developments were 'purged' from the series making up the non-monetary policy components of financial conditions.[2]
- The element of the financial series unrelated to these developments should represent that which could affect future economic conditions. The Kalman Filter was then applied to these items of residual variation – organised by their respective components of financial conditions – to estimate the common element amongst them. This common trend was then taken to be a proxy for the different component of financial conditions.
- The Kalman Filter was also independently applied to the series making up the monetary policy components of financial conditions (that is, monetary policy expectations and other channels of monetary policy transmission). These series were not purged of the impact of current and past economic, inflation and monetary policy developments as these directly shape the transmission of monetary policy via these expectations and other channels.
- The proposed monetary policy and non-monetary policy components of financial conditions were then weighted to arrive at an overall index.

To estimate the impact of the different components of financial conditions on the economy:

- A Vector Autoregression was set up with three monthly lags[3] of the FCI components as well as a monthly proxy for quarterly GDP growth[4]
- A historical decomposition was then performed to determine how shocks to the components of financial conditions impacted GDP growth
- The contributions of shocks to the FCI components to GDP growth were averaged over the previous 12 months
- A three-month moving average was then used to smoothed these

Section A4: Robustness Tests

Based on Section A3, the key aspects of the method that were tested for their robustness were:

- Which variables to include in the 'purging' process?
- What lag length to use as part of this process?
- How to weight the different components of the financial conditions index?

What variables to 'purge' the influence of?

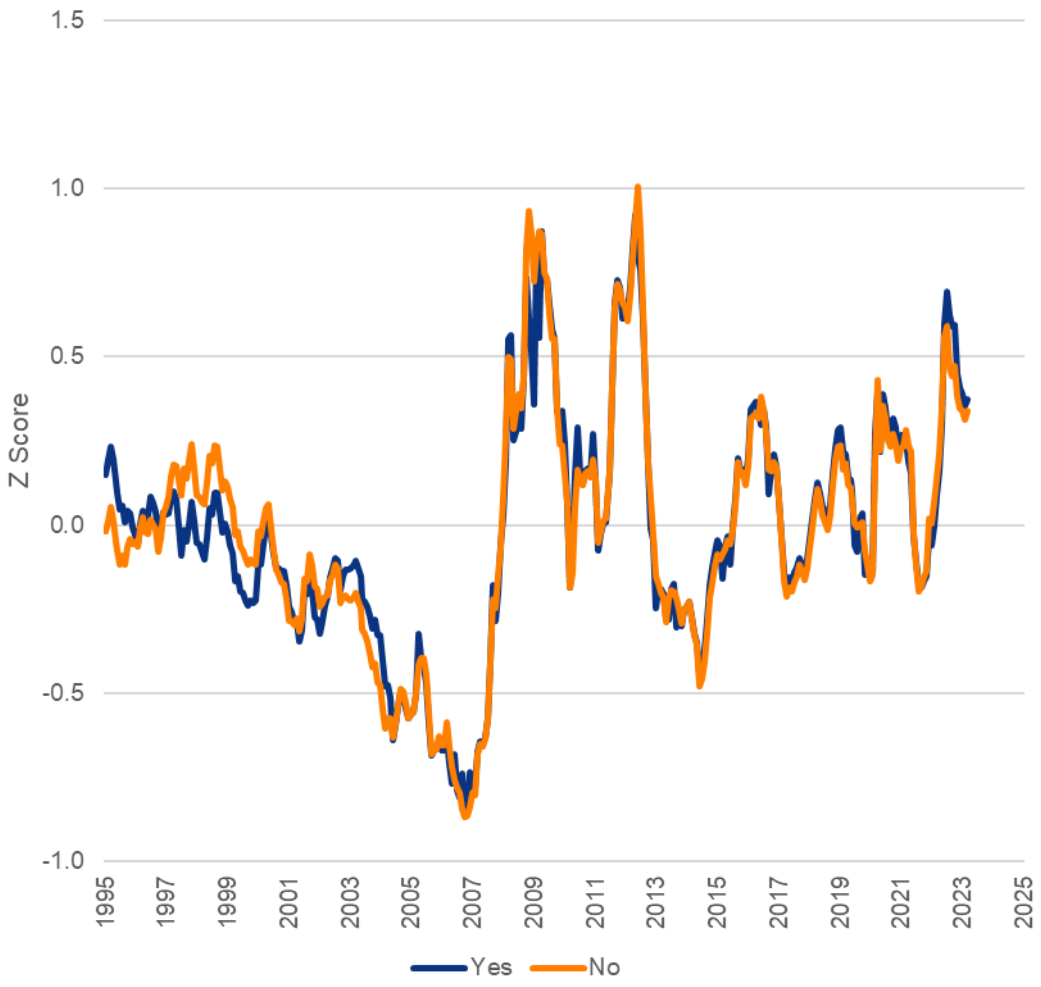
The 'purging' method in this context was devised by Hatzius et al (2010) who ran a series of regressions in which the dependent variable was a financial indicator and the independent variables were series which reflected contemporary and previous changes in economic activity and inflation. Darracq Paries, Maurin & Moccero (2014) added a short-term interest rate variable and a lag of the dependent variable. In *Financial Conditions in Australia*, I removed the impact of current and previous economic, inflation and monetary policy developments from the (relative) cost of credit, availability of credit and financial market stress components but not those related to monetary policy expectations or other aspects of the transmission of monetary policy. I also did not remove the impact of previous values of the financial series itself. There was very little difference in the results based on whether the impact of previous policy rates were or weren't included as a variable to be purged (Graph A1).

[2] This was done to ensure that a clean signal could be obtained around what changes in these financial series could mean for future economic activity. If this was not done, then these series could be providing a message about future economic activity that reflects simply previous economic and monetary policy developments as opposed to independent ones from changes in the financial sector. As noted by Hatzius et al (2010), one would not need a Financial Conditions Index in this case. Instead, previous information on the economy and monetary policy could just be used to determine the impact on future economic activity. In contrast, the series making up the monetary policy expectations and other aspects of the transmission of monetary policy were not purged of previous economic and monetary policy developments as these components are designed to capture how monetary policy, which is influenced by past economic and policy developments, might impact future economic activity.

[3] A lag length of up to four months could have been chosen based on the average lag length suggested by the Final Prediction Error as well as Akaike, Schwarz and Hannan-Quinn information criterion

[4] The three-month moving sum of the log-difference of monthly GDP (where this was linearly interpolated from quarterly data) was used for this

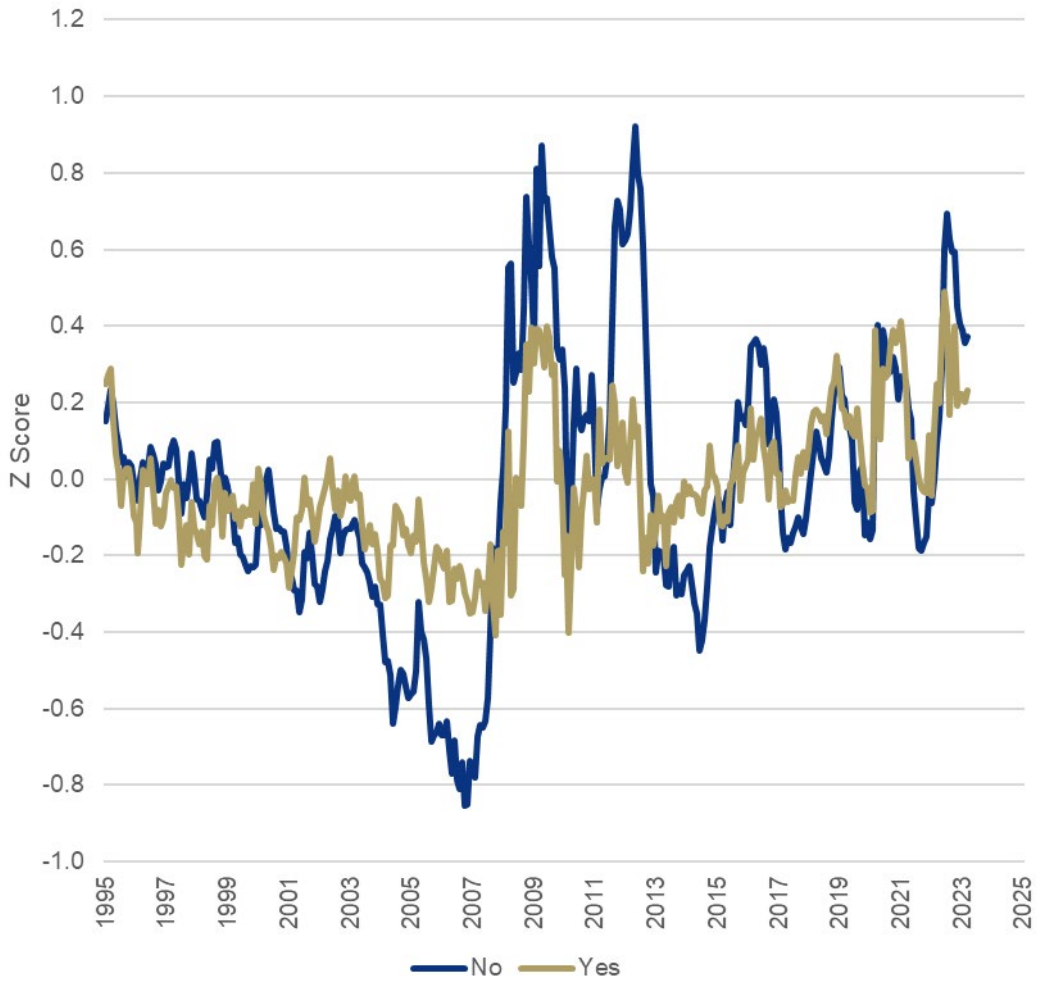
GRAPH A1: FCI BASED ON IF IMPACT OF PREVIOUS CASH RATES HAS BEEN PURGED FROM FINANCIAL SERIES



Source: QTC Economic Research

There was some more difference in the results based on whether a lag of the dependent variable was included as a purging variable (Graph A2). This reflects that financial series tend to have a good deal of persistence with the latest value being highly correlated to the previous value. If this persistence is controlled for via the purging process, then there is less variation left to exploit in constructing the index. This was not considered desirable.

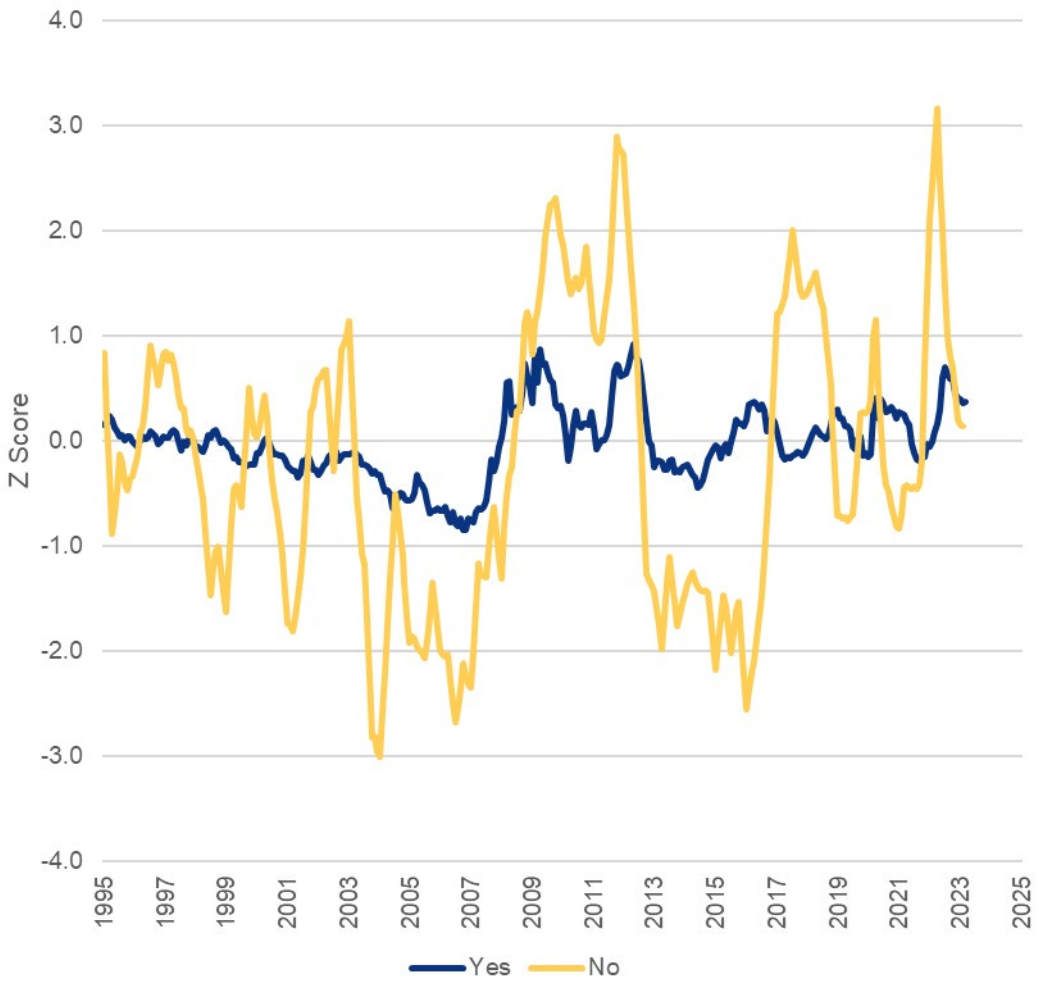
GRAPH A2: FCI BASED ON WHETHER IMPACT OF LAGGED VALUE OF FINANCIAL SERIES HAS BEEN PURGED OR NOT



Source: QTC Economic Research

As to whether to 'purge' the impact of previous economic and monetary policy developments, the literature is quite mixed (Table A2). Not purging these influences means that the FCI doesn't account for the impact of previous economic and monetary policy developments and instead means that the FCI simply reflects broad moves in financial series. This leads to a far more volatile measure (Graph A3), again an outcome which was not considered desirable.

GRAPH A3: FCI BASED ON IF ECONOMIC AND MONETARY POLICY INFLUENCES PURGED FROM FINANCIAL SERIES

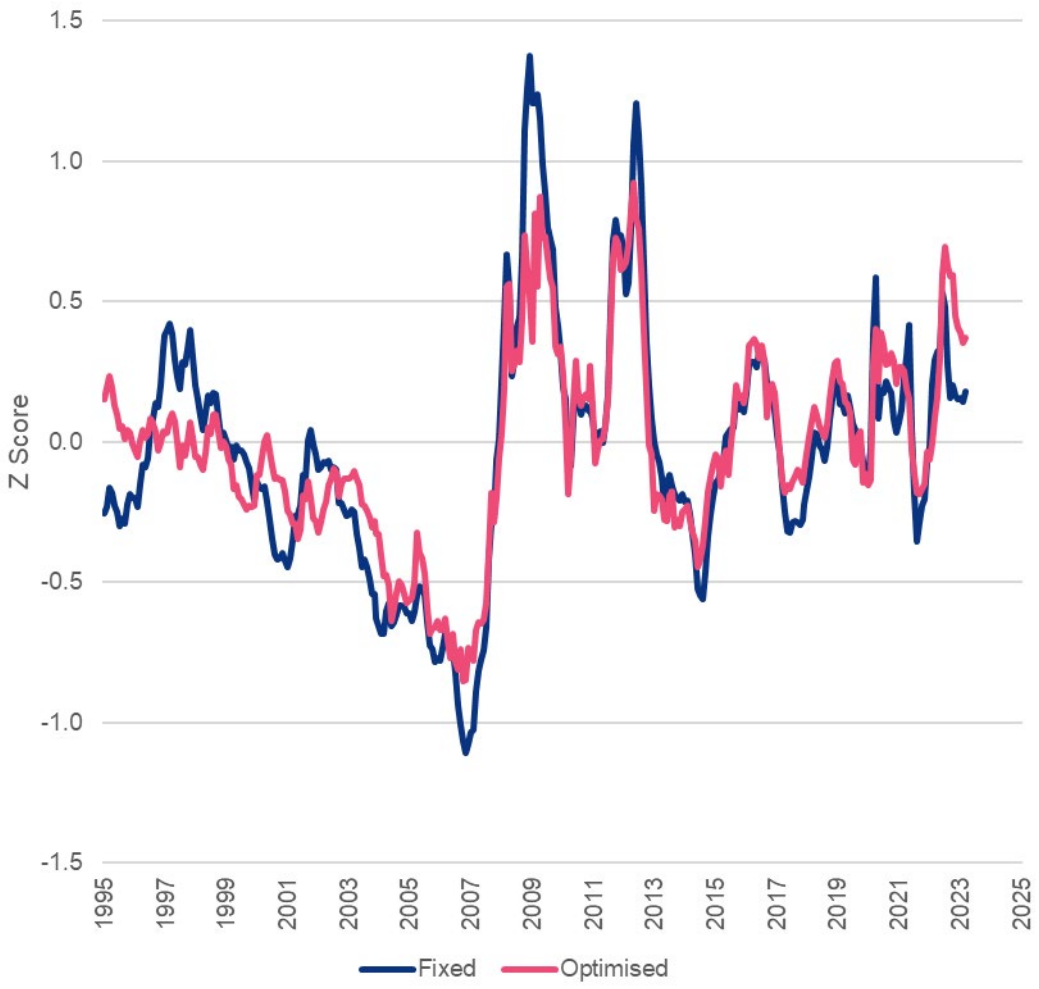


Source: QTC Economic Research

What lag length to use for the variables whose previous influence is being sought to be purged?

Hatzius et al (2010) use two quarterly lags of the independent variables in the purging regressions, while Darracq Paries, Maurin & Moccero (2014) use one to two monthly lags. In this piece, as in those others, I selected the number of lags based on that which minimises the Akaike Information Criteria (AIC). However, rather than have the same number of lags for each regression, I used the AIC to select the optimal number of lags for each. This meant that there were different lag lengths across the regressions but in a way that maximised the explanatory power of each. The number of lags selected ranged from one to 12 months with a median of four months. Relative to the FCI in which information criteria were used to determine the optimal lag length for the purging regressions, that which just used a fixed lag length commensurate with the median of the optimal lag selection process, produced an FCI which was more volatile (Graph A4). This appears to validate the approach used.

GRAPH A4: FCI BASED ON LAG LENGTH SELECTION PROCESS IN PURGING REGRESSIONS



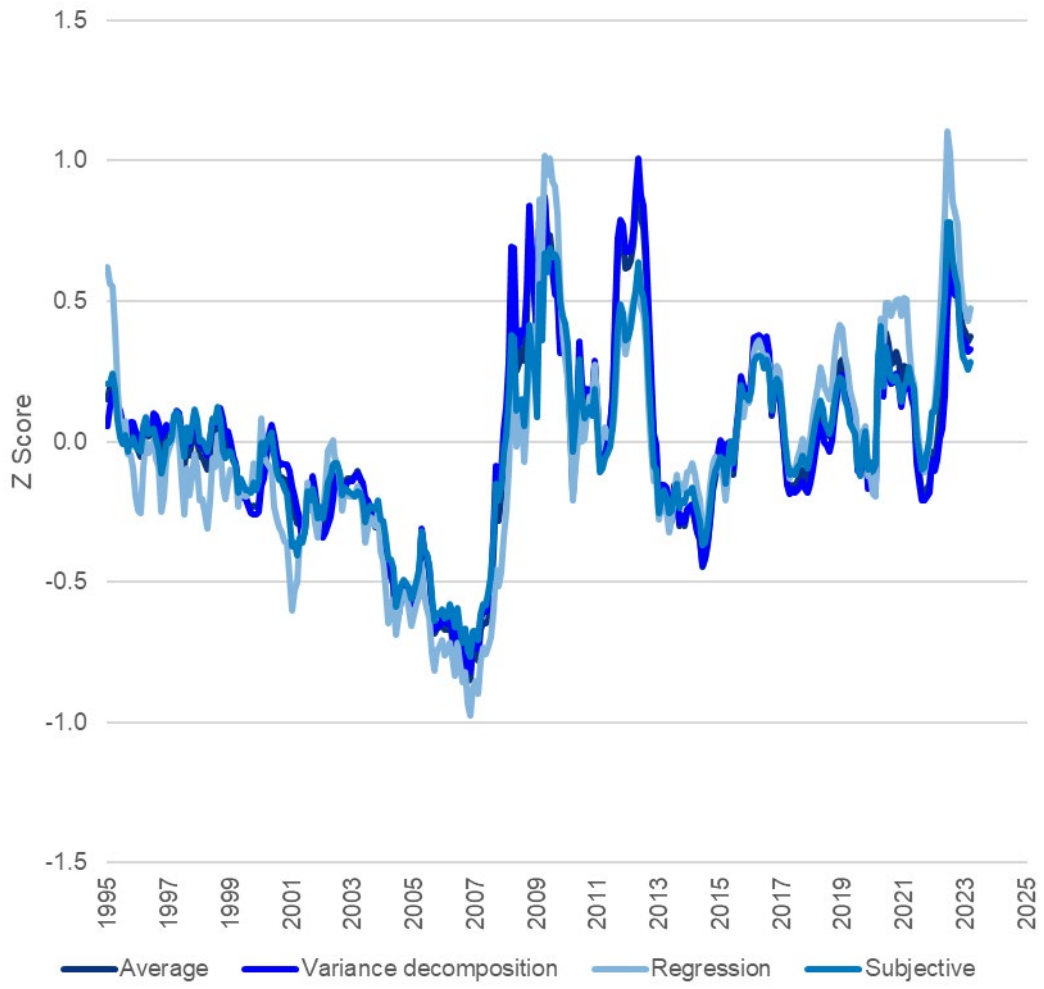
Source: QTC Economic Research

How to weight the different components of the financial conditions index?

When constructing financial conditions indices Arrigoni, Bobasu & Venditti (2020) find evidence in favour of simpler weighting schemes relative to very complicated ones (for example, Koop & Korobilis (2013)). Therefore, in *Financial Conditions in Australia*, I used three relatively simple approaches to determine the weights. Firstly, I ran a regression of my FCI components on the overall FCI estimated in Hartigan & Wright (2009) and then used the coefficients from that regression as the weights.[5] Secondly, I used a variance decomposition of the Vector Auto Regression above to determine what share of the forecast error variance of GDP growth can be explained by shocks to the FCI components after two years. Thirdly, I subjectively chose weights for the different components. Ultimately, I chose to use subjectively selected weights. The choice of weights did not make a material difference to the FCI (Graph A5).

[5] Note, the coefficients in this regression were constrained to be between 0 and 1

GRAPH A5: FCI BASED ON DIFFERENT COMPONENT WEIGHTS



Source: QTC Economic Research

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