REPORT TO THE AER ON ESTIMATING EXPECTED INFLATION

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September 15, 2017

Index

Author's Background

This report has been prepared by Professor Shaun P. Vahey. I am an academic macroeconomist and have published many research papers in empirical macroeconomics. I have extensive experience as a researcher and research director at central banks, with a particular expertise in measuring inflation, expectations formation and real-time forecasting of inflation. My curriculum vitae can be found in Appendix 2. I have read the document "Expert witnesses in proceedings in the Federal Court of Australia" which are attached as Appendix 3. This report has been prepared in accordance with those guidelines. An expert witness compliance declaration can be found following the reference list at the end of the report.

CONTEXT OF THE REPORT

The AER has requested advice in relation to the stakeholders' perspectives of the current method of estimating expected inflation.

The specific requests were as follows:

A. Review and make comments on the 16 submissions by stakeholders, received in response to the AER Discussion Paper, which was part of the Review of Expected Inflation 2017.

B. Expert opinion on the extent to which the AER's current approach and other approaches proposed in the submissions are appropriate as methods to extract the best estimate of expected inflation.

As described in the Terms of Reference (see Appendix 1), the current approach (adopted by the AER in 2008) involves the following steps.

1. Calculate the expected annual inflation for the next two years from the RBA's published forecasts.

2. Assume that expected annual inflation beyond the RBA's published forecast horizon up to ten years is the midpoint of the RBA's inflation target. That is, 2.5 percent.

3. Construct the geometric average of these ten observations for expected inflation, with the ten-year focus consistent with the existing benchmark nominal rate of return.

In December 2016, the AER published an update of its Roll Forward Model (RFM) and some stakeholders requested a reconsideration of the method used to estimate expected inflation. In April 2017, the AER published a Discussion Paper (AER DP) on the "Regulatory Treatment of Inflation". An important input into this document in terms of estimating expected inflation was the ACCC/AER Working Paper No. 11 (ACCC/AER WP) entitled "Consideration of Best Estimates of expected Inflation: Comparing and Ranking Approaches".

Submissions from the stakeholders in the light of the AER DP have focused on both (i) the methodology for estimating expected inflation, and (ii) whether the current revenue and pricing model provides an efficient risk allocation. This report is concerned with the first aspect only.

ESTIMATING EXPECTED INFLATION

The AER DP describes in Section 4 various methods for estimating inflation expectations. This section draws heavily on the ACCC/AER WP considering the best estimates of expected inflation. The ACCC/AER WP compares four different approaches:

1. The AER's current method;
2. The bond breakeven inflation rate (BBIR);
3. Expectations derived from zero coupon inflation swaps; and,
4. Expectations from surveys.

The ACCC/AER WP concludes that the current approach (based on the RBA's inflation forecasts and the midpoint of the target band) is the "best" approach to estimating expected inflation. Correctly in my view, the AER DP argues that this is the most appealing of the approaches, based on the selection criteria.

The AER DP stresses that the aim of the exercise is to assess ex ante expected inflation, and makes a distinction with the inflation realisations. With rational agents, then the former should be efficient forecasts of latter. There is no reason to think that expectations will always be rational in practice however.

Both the AER DP and the ACCC/AER WP rank the four approaches (described above) to assess the best estimate of expected inflation by considering five assessment criteria:

1. Relative congruence with the market-expected inflation rate;
2. Robustness;
3. Transparency;
4. Replicability; and,
5. Simplicity.

There are trade-offs between the criteria, all of which are appealing on an individual basis. For example, a measure that ranks well in terms of simplicity may not be congruent with the market expected inflation rate. The AER DP sensibly takes a broad perspective of the candidates and applies appropriate judgement to produce the ranking. Economic theory is silent on what represents the best measure of expected inflation and absent a generally accepted econometric procedure to estimate the theoretical concept, the pragmatic perspective shared by both the ACCC/AER WP and the AER DP seems right.

Generally, the academic literature treats expected inflation as a single expected value for inflation -- the equivalent of a point estimate -- rather than as a probability distribution over realisations. This is somewhat of a legacy of pre-GFC macroeconomic models, which generally avoided consideration of shifting

dependencies (between inflation and other macroeconomic variables), and focused on time-invariant inflation volatility. Since the financial crisis, there has been a renewed academic interest in non-linear and non-Gaussian models of inflation; see, for example, Smith and Vahey (2016).

Agents undoubtedly differ in their inflation expectations in practice so strictly speaking one should talk about the (unknown) distribution of inflation expectations. One approach to assessing uncertainty in inflation forecasts, summarised by Tulip and Wallace, 2012), limits consideration to symmetric risks to inflation. Meaning (crudely) that the upside and downside risks are similar and the three well-known candidate measures of the central tendency (the mean, median and mode) are equal. But as Smith and Vahey (2016) emphasise, this approach gels poorly with commonplace statements by central banks about asymmetric risks to inflation, and also with survey respondents who periodically report asymmetric risk assessments e.g. the US Survey of Professional Forecasters. To my knowledge, there has been no academic work on assessing Australian inflation expectations from the perspective of asymmetric predictive densities. The section below on the (historical) distribution of inflation in Australia takes a small step in this direction. Nevertheless, at this point with research on Australian data in this area in its infancy, the AER sensibly takes the pragmatic option of focusing on the point estimate of expected inflation.

A related issue arises with the congruency criterion. The theoretical concept known as the "market-expected inflation rate" is never observed in practice, even as a point estimate. There are many markets in practice, and not a single market, with imperfect arbitrage between markets. Furthermore, the views of people who do not trade in financial markets matter when assessing expected inflation.

Since "expected inflation" constitutes a theoretical construct, in practice there exist many extant candidate ways to estimate this latent theoretical object. Selection of the best estimate in these circumstances, inevitably becomes a subjective search for a good compromise estimate. And, some stakeholders will argue to re-examine the AER's treatment of expected inflation, periodically, regardless of which measure the

AER selects. Consensus across stakeholders on the best measure would be too much to hope for.

A further concern for the AER is whether the public feel able to trust the methodology used to estimate expected inflation. Since the GFC, the public are more aware that financial markets often misprice financial assets. Arguably, the mispricing of assets caused the GFC. The RBA enjoys the trust of both the financial markets and the public. Convincing the Australian public that financial markets provide better guidance than the RBA about the path of post-GFC inflation would be difficult.

CURRENT AER APPROACH

With picking the single best estimate of expected inflation boiling down to balancing the criteria, the AER DP (buttressed by the ACCC/AER WP) makes a strong case for the current approach as "the simplest to apply, most transparent and easily replicable". The AER DP also notes that the resulting estimates are typically close to the mid-point of the RBA's inflation target band, with no evidence to support the idea that long-term inflation expectations have deviated persistently from the RBA target band in the data.

The ACCC/AER WP provides considerable detail on the current approach in Section 4, with further technical aspects covered in Appendix 1. The image below shows the key paragraph from the Appendix.

231. The AER's current method provides whole year estimates of the expected inflation rate 1 to 10 years ahead. Whole year estimates include the RBA forecast of inflation 1 and 2 years ahead and the midpoint of the RBA inflation target band from 3 to 10 years ahead. Where RBA forecasts a range of possible inflation outcomes, a simple midpoint of the range is chosen. The AER calculates the geometric annual average of whole year estimates of expected inflation over a 10 year horizon:

$$\pi_G^e = \sqrt[10]{\left(1+\pi_1^{\text{RBA}}\right)*\left(1+\pi_2^{\text{RBA}}\right)*\left(1+\pi_3^{\text{midpoint}}\right)*,\ldots,*\left(1+\pi_{10}^{\text{midpoint}}\right)}-1 \quad \text{(A1)}$$

where:

π_1^{RBA} is the RBA forecast CPI inflation rate, 1 year ahead.

π_2^{RBA} is the RBA forecast CPI inflation rate, 2 years ahead.

$\pi_3^{midpoint},\ldots,\pi_{10}^{midpoint}$ are the midpoints of the RBA target inflation band of 2 to 3 per cent, each year from 3 to 10 years ahead.

The ACCC/AER WP discusses the pros and cons for the current approach in an even-handed and open manner in sections 4.1 and 4.2, respectively. In summary, the current methodology ranks well in terms of congruency (mostly), robustness, simplicity, transparency and replication. The weakest feature, the ACCC/AER WP argues, is that one can envisage circumstances where congruency will break down. As discussed below, the circumstances where congruency could breakdown seem very unusual. These circumstances haven't occurred in the Australian data since the RBA adopted an inflation target.

The key issues on congruency include: (i) the accuracy of the RBA's forecasts and (ii) the nature of the inflation target (discussed in the next section of this report). In general, RBA forecasts tend to be at least as good as comparable forecasts from professional economists and financial markets in terms of accuracy. The ACCC/AER WP notes several academic studies supporting this hypothesis.

Central banks around the world monitor the BBIR and use the information in their own forecasts, in combination with (amongst other sources) survey information and swaps. In this sense, the RBA forecast is a subjective assessment of the inflation path, implicitly weighting many indicators, including those discussed as feasible alternatives to the current approach adopted by the AER.

Beyond the horizon of the RBA's published forecasts, the use of the mid-point of the target represents a pragmatic response to inferring the longer-term inflation expectations. The midpoint of the RBA's inflation target band is credible, given the historical evolution of inflation in Australia. It represents the best available estimate of inflation expectations in the longer term, being simple, reliable, transparent and easily verified. The section below on the historical distribution of inflation in Australia confirms that inflation realisations centre (approximately) on the midpoint of the inflation target.

RBA TARGET

The ACCC/AER WP notes that academic studies support the view that long-term inflation expectations have been anchored to the RBA's target band in the existing data. However, an issue with congruency would arise if the RBA inflation targeting lost its effectiveness in anchoring expectations. This hasn't happened since inflation targeting was introduced in Australia.

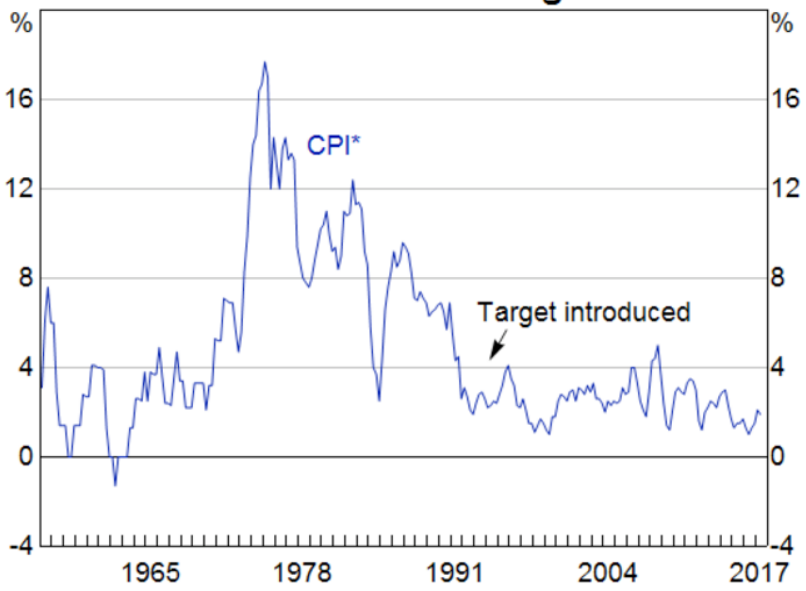
The RBA inflation target is described on the RBA's website (http://www.rba.gov.au/inflation/inflation-target.html) as follows:

Inflation Target

The Governor and the Treasurer have agreed that the appropriate target for monetary policy in Australia is to achieve an inflation rate of 2–3 per cent, on average, over time. This is a rate of inflation sufficiently low that it does not materially distort economic decisions in the community. Seeking to achieve this rate, on average, provides discipline for monetary policy decision-making, and serves as an anchor for private-sector inflation expectations.

Graph 1

Inflation over the Long Run



* Excludes interest charges prior to September quarter 1998 and adjusted for the tax changes of 1999–2000

Sources: ABS; RBA

The inflation target is defined as a medium-term average rather than as a rate (or band of rates) that must be held at all times. This formulation allows for the inevitable uncertainties that are involved in forecasting, and lags in the effects of monetary policy on the economy. Experience in Australia and elsewhere has shown that inflation is difficult to fine-tune within a narrow band. The inflation target is also, necessarily, forward-looking. This approach allows a role for monetary policy in dampening the fluctuations in output over the course of the cycle. When aggregate demand in the economy is weak, for example, inflationary pressures are likely to be diminishing and monetary policy can be eased, which will give a short-term stimulus to economic activity.

This approach to monetary policy in Australia commenced in the early 1990s. The earliest references to it were contained in speeches by the then Governor in August 1992 and March and August 1993.

Defined in terms of the "medium-term" average, the target doesn't commit the RBA to keeping inflation within the target band (in the medium to long run) with any specific probability. Nor does it rule out short-term inflation fluctuations outside the target band. As the plot above from the RBA shows, since the GFC, inflation has regularly fluctuated outside the two to three percent interval in the short term. See the section below on the historical distribution of inflation in Australia for further discussion.

There are circumstances in which a central bank can lose control of inflation. One of these involves the fiscal authority adopting a plan for taxation and spending that can only be made sustainable if general prices adjust. The associated academic literatures on unpleasant monetarist arithmetic and the fiscal theory of the price level stress the scope for fiscal explanations of high inflation. It is hard to see this being a practical concern in Australia over the next 10 years, given the emphasis of Treasury on fiscal consolidation since the GFC.

On the other side, there exists a risk that the RBA will undershoot its target in the future. If global aggregate demand falls sufficiently, nominal interest rates could fall to very low levels, where further cuts would provide a very small (perhaps zero) stimulus. Arguably, the Federal Reserve, the Bank of England and the European Central Bank reached this threshold in the aftermath of the GFC. The radical monetary and fiscal policies adopted in response have kept inflation expectations roughly on track in the longer term in these countries, despite the deviations from the preferred inflation path. There are good reasons then to suspect that RBA credibility would survive a prolonged period of low nominal interest rates, associated perhaps with negative real interest rates.

Like other central banks, the RBA uses survey information and financial markets to help assess the public's expectations. If the public attach a high probability to a deviation from the target in the medium term, monetary policy will be used to restore the credibility of the inflation target in the long run. Overall a loss of credibility by an independent RBA only seems plausible if interest rates are very low (i.e. near zero) and Australia faces prolonged deflationary pressure.

Furthermore, should the unlikely events associated with low inflation (relative to the target) arise in the future, it isn't clear how the alternatives methodologies proposed -- discussed in the next section -- would rank in terms of congruency.

PROPOSED ALTERNATIVES

The AER DP discusses three alternatives to the current approach, again pointing to the ACCC/AER WP for further details. These alternative approaches are:

1. Inflation swaps

Using market information to assess inflation expectations offers a route to produce a measure congruent with the market-expected inflation. But, in practice, potential biases and premia can distort the resulting estimates. The swaps markets can also be sensitive to the market turmoil associated with deflationary pressures in recessions. The approach isn't particularly appealing in terms of the other criteria used by the AER.

2. Bond Break-even Inflation Rate (BBIR)

The ACCC/AER WP argues that the bond breakeven estimates are less appealing than the current approach. As with the swaps route, the idea appeals because expectations are derived from market prices -- in this case of nominal and inflation-indexed government securities -- so that the method is conceptually closer to the "market-expected inflation" rate, than say, survey expectations. The ACCC/AER WP argues that there are more potential biases and premia in this methodology than with swap-based estimates, however, with BBIR estimates the more volatile of the two. Again, issues are likely to arise with liquidity and premia should prolonged deflationary pressures arise. The ACCC/AER WP describes the time-varying biases in the breakeven approach and emphasises that the net bias is not easy to gauge over time. As such, the break-even approach lacks transparency and simplicity, as well as robustness.

Historically, the BBIR approach has particular importance. As AER DP section 2.2 notes, prior to 2008, the AER used the breakeven method to estimate expected inflation. Motivated by concerns that illiquidity in the indexed securities market were distorting the breakeven inflation estimate, the AER switched to the current approach -- using RBA forecasts and the midpoint of the inflation target. Although indexed security liquidity has increased substantially over the last decade, the risks of further distortions to relative liquidity are considerable, as the ACCC/AER WP discusses.

In my view, the public would struggle to see the overall appeal of the BBIR, especially given the well-known financial market associated with the GFC and its aftermath.

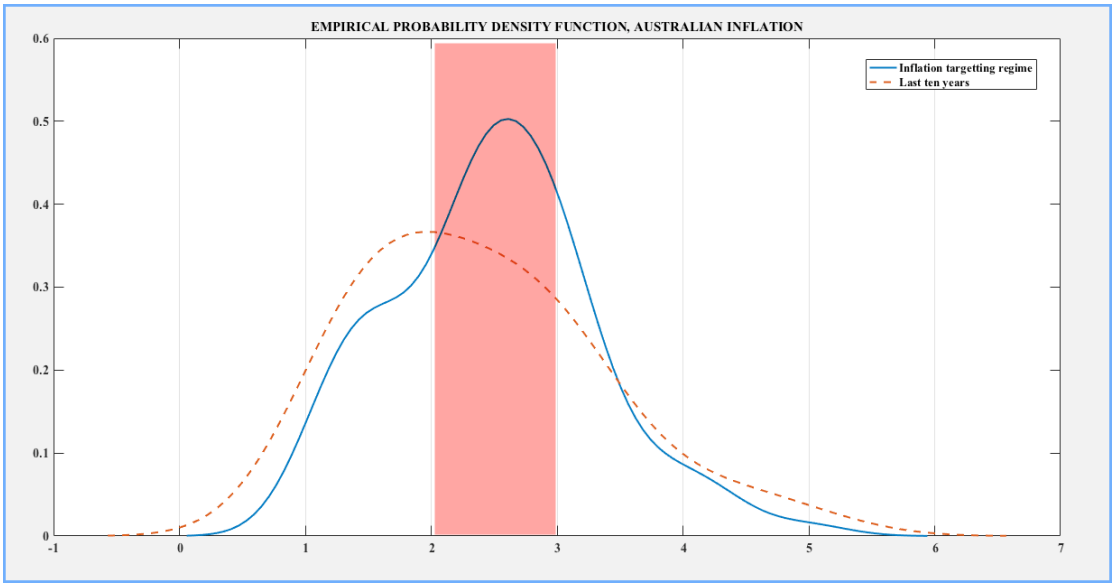
3. Surveys

The ACCC/AER WP notes the absence of survey data beyond the two-year horizon. In principle, survey evidence could be substituted for the RBA forecasts up to two years, and like the existing AER approach, the midpoint of the RBA's target band could be used thereafter. The trouble with that route is explaining to the public why the expectations of professional forecasters are preferred to the opinions of the central bank. Especially given that the RBA has access to the survey information. In my view, this approach would add complexity (relative to the existing AER approach) for no particularly obvious advantages in terms of the other criteria.

DISTRIBUTION OF AUSTRALIAN INFLATION

Since the distribution of inflation realisations under the RBA's inflation targeting regime is of interest, this section describes the historical distribution. Data were downloaded from the RBA's website for the CPI (excluding adjustments for tax and

interest charges), plotted below as quarterly measurements of annual inflation from 1993Q1 through 2017Q2. The resulting historical distribution is shown in blue. In effect, the empirical probability density function (EPDF) -- a smoothed histogram with inflation realisations on the x-axis and the (standardised) frequency on the y-axis. For comparison, the EPDF for the last ten years is also shown in red (a dashed line). (Although not shown, including tax and interest charges just adds mass to the tails of the EPDFs.)_



There are a number of striking features about this plot. First, the narrowness of the RBA's inflation target, relative to the realisations. The RBA's target band is 2 to 3 percent (on average) over the medium term: the range shaded red on the plot. Realisations sit outside of this range for around 55 percent of the sample (based on the full sample, blue line). With approximately 25 percent probability, inflation exceeds the upper bound of 3 percent (see the discussion of Professor Quiggin's suggestion below). This illustrates clearly that inflation realisations should not be expected to lie within the target band all of the time.

Second, although there is some skew in inflation during the targeting regime (blue line), the EPDF is unimodal near the centre of the target band. The mean, the mode and the median are all at 2.5 percent (based on the raw data). The midpoint of the

inflation target band coincides with the centre of the historical distribution of Australian inflation.

Third, appears to be more skew in the density over the last ten years (red, dashed line). With some evidence that the centre of the distribution of inflation has shifted lower, to around 2 percent, for the last decade. However, given the apparent right skew in the plot, the mean of inflation (over the last ten years) still lies close to the midpoint, at just 2.4 percent (based on the raw data). Even in the last ten years then, taking the mean as the centre of the distribution, the midpoint of the target band isn't that far from an "average" inflation realisation.

REVIEW OF STAKEHOLDER SUBMISSIONS

There are 16 submissions by stakeholders, grouped below according to their preferred methodology. Given the subjective nature of assessing the best estimate of expected inflation, stakeholders should be expected to have different and time-varying perspectives. Several of the submissions emphasise that some inflation realisations since the GFC have been below ex ante expectations (see the red line on the plot above). Others draw attention to the likelihood of low inflation realisations in the future, given that nominal interest rates are at historically low levels by Australian standards (although not from the perspective of the US and Europe). Much of this reflects an anxiety about the weakness of aggregate demand in the Australian economy during recent years. In other circumstances -- perhaps a few years down the line -- aggregate demand will be unexpectedly strong (although perhaps with lower persistence). It is important that the AER concerns itself with longer term expectations and avoids switching measures of expected inflation with high frequency.

1. Current AER approach

CCP and Transgrid both support the current methodology, based on the RBA's forecast in the short term, and the RBA's target in the longer term. Both stakeholders

find the approach appealing in terms of the criteria, in particular transparency, simplicity, replicability and robustness. Neither stakeholder was concerned that the AER DP ranks swaps highest (following by the BBIR) in terms of congruency. Given the emphasis on regulatory consistency and predictability, the CCP conclude that "...there is not a strong enough case to change from the current AER approach".

2. Potential modifications to the AER approach

Four stakeholders support (relatively) modest reforms to the existing methodology. One suggestion, from Professor John Quiggin (prepared on behalf of ECA), uses the upper bound of the RBA's inflation target in the longer term, in place of the midpoint of the inflation target used in the current AER approach. UC also support the Quiggin proposal. Professor Quiggin's idea is to provide consumers with greater protection against unexpected inflation. Unfortunately, the RBA doesn't actually commit to keeping inflation within the target band (at any horizon) with any particular probability. We don't know, therefore, the degree of insurance the upper bound would provide, even on average, in the future. The analysis in the previous section, based on the historical distribution of Australian inflation, indicates that roughly 25 percent of the unconditional distribution lies above the upper bound of the RBA's target. More importantly perhaps, the proposed modification wouldn't be consistent with the centre of the distribution of inflation, which the public think of as “expected inflation”.

A second modification, from CEPA consulting (prepared on behalf of ENA), proposes smoothing the transition horizon between the RBA's forecast and the midpoint of RBA's inflation target using linear interpolation. Jemena also support this "glide path" approach. Although in principle, a straightforward and transparent modification, in practice the glide path would add some uncertainty relative to the existing AER approach. How long should the transition period be? Should linear interpolation be used? Should faster adjustment happen at the start of the transition, and if so, how fast? There are many feasible glide paths and the criteria used to select the best estimate of expected inflation in the AER DP would provide no

guidance on the optimal glide. The approach would, in my opinion, open up a further round of stakeholder concerns about the calculation of the glide path.

3. BBIR

Seven submissions support the BBIR approach that returns to the pre-2008 AER methodology. The submissions from ActewAGL, ENA, Ausgrid, EE, QTC, SAPN (and others), together with Spark, emphasise (to varying degrees) that the path of inflation realisations since the GFC have surprised (some analysts). There are concerns that the RBA target will be undershot consistently in the future. This hypothesis is discussed in section 2.2 of the AER DP.

Unfortunately, the relative liquidity of the indexed securities market is sensitive to expected inflation. As a result, should aggregate demand soften further, the robustness of the BBIR would be an issue. People tend to want indexed securities when they need protection from inflation and demand for the indexed securities can drop if inflation falls. Furthermore, market distortions more broadly, vary by country, as well as through time and there isn't much comfort for the public in the idea that the BBIR has being found useful (at times) as an indicator of expected inflation in other countries.

It is, perhaps, puzzling that so many stakeholders wish to turn back the clock and return to the AER's previous methodology. Some of the appeal, in my view, stems from a misunderstanding about the meaning of the term "market-expected" inflation. This means (to economists, at least), the estimate of inflation that is used to price forward-looking assets. Since the BBIR uses the prices in two financial markets (conventional and indexed government securities), there is some correspondence between the market expectation and the BBIR. For this reason, the AER/ACCC WP sensibly ranks the BBIR measure well in terms of congruency.

The notion of the "market-expected" inflation rate is a theoretical concept though. In reality, there are many financial markets and many traders with different views of inflation. Moreover, there are many members of the public who are not directly active in financial markets (although pension funds are) and their beliefs about future

inflation matter too. The conceptual mismatch between the theoretical construct of "market-expected" inflation and any measure derived from two (very particular) financial markets weakens greatly the congruency appeal of the BBIR in practice. And, in terms of the other criteria used in the AER/ACCC WP, the BBIR ranks poorly.

4. Ex post

Three submissions argue for an ex post approach to estimating inflation expectations: Ausnet (also in favour of the BBIR), MEU and APA. It is possible to assume that agents have perfect foresight and then simply use the historical inflation realisations (once released, with a delay) as an ex post measure of expected inflation. Unfortunately, actual inflation almost always differs from the real-time measures of inflation expectations in the data, so the approach would generate considerable unease among most stakeholders and the public. It may also open up disputes with stakeholders along the lines of "what is the best measure of inflation?" -- a topic as contentious as the best estimate of expected inflation.

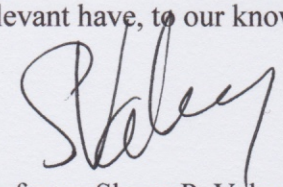
References

Smith and Vahey (2016) "Density Forecasting of U.S. Macroeconomic Variables Using a Gaussian Copula Model of Cross-sectional and Serial Dependence", Journal of Business and Economic Statistics

Tulip and Wallace (2012) "Estimates of Uncertainty around the RBA's Forecasts", RBA Research Discussion Paper 2012-07

Expert Witness Compliance Declaration

I have read "Expert witnesses in proceedings in the Federal Court of Australia" which are attached as Appendix 3. This report has been prepared in accordance with those guidelines. As required by the guidelines, I have made all the inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to our knowledge, been withheld from the Court.



Professor Shaun P. Vahey

Warwick University

September 15, 2017

APPENDIX 1 Terms of Reference

Contract Annexure 1 – Supplementary Information

Terms of Reference

The AER requires expert advice on the approach to estimating expected inflation as set out below. The request is for a capped-price contract.

Our current inflation estimation method was first applied in 2008. We estimate an expected rate of inflation over a 10 year period to ensure consistency with the benchmark term of our nominal rate of return. The inflation estimation method involves calculating the geometric mean of 10 annual inflation rates. The RBA's inflation forecasts – generally available over a 2 year forward period – are used as the annual inflation rates for the first few years of the 10 year period. The mid-point of the RBA's inflation target band (2.0 to 3.0 per cent) is used as the annual rate for the remaining years.

Recently, the AER's method for estimating expected inflation has been the subject of debate in our regulatory determinations. In December 2016 the AER published an update on its asset base Roll Forward Model (RFM). In the process of updating the RFM, stakeholders requested us to reconsider our method for estimating expected inflation and its implications. Consequently, the AER issued a communications notice of its intention to review the current method of estimating expected inflation.[1] On 18 April 2017, the AER published its Discussion Paper – Regulatory treatment of inflation.[2]

The network service providers (NSPs) have raised a number of concerns with the AER's current method for estimating expected inflation. These can be largely divided into two high level aspects. One is whether the current method derives the best estimate of expected inflation. The other is that, irrespective of the method chosen, whether the AER's revenue and price modelling provides an efficient level of inflation risk, appropriate compensation for this efficient level of inflation risk, and efficient allocation of inflation risk between NSPs and end users. The Consultant is engaged to advise the AER on the former of the NSPs' concerns, that is, the best estimate of expected inflation.

Services required

Expert advice is sought to assist the project team in understanding and analysing the stakeholders' perspective on the AER's current method of estimating expected inflation.

The Consultant's advice should be provided in the form of a publishable report to the standard of the Federal Court requirements for expert reports. The advice required, without in any manner directing the Consultant, should include the following:

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1 https://www.aer.gov.au/communication/2017-review-of-expected-inflation

2 https://www.aer.gov.au/system/files/AER%20inflation%20review%202017%20-%20discussion%20paper%20-%2018%20April%202017.pdf

- Review of and comments on the 16 stakeholder submissions[3] the AER received in response to its Discussion Paper as part of stakeholder engagement for the AER's Review of Expected Inflation 2017.
- Expert opinion (and reasons) regarding the extent to which the AER's current estimation method and any other method canvassed in the submissions are likely to result in the best estimate of expected inflation and are appropriate in the context of the NER and NGR rule requirements (specifically NER rule 6.4.2 and NGR rule 74).

The consultant's advice should be provided following consideration of:

- The ACCC/AER Working Paper Series, Paper No. 11 "Consideration of best estimates of expected inflation: comparing and ranking approaches".[4]
- The AER discussion paper published on 18 April 2017.
- Submissions provided to the AER in response to the AER's discussion paper and the ACCC working paper.
- The relevant National Electricity Rules and National Gas Rules requirements outlined below.

The relevant clauses of the Rules are as follows:

- National Electricity Rules:

> *"6.4.2 Contents of post-tax revenue model (electricity distribution)*
>
> *(a) The post-tax revenue model must set out the manner in which the Distribution Network Service Provider's annual revenue requirement for each regulatory year of a regulatory control period is to be calculated.*
>
> *(b) The contents of the post-tax revenue model must include (but are not limited to):*
>
> *(1) A method that the AER determines is likely to result in the best estimates of expected inflation"*
>
> **"6A.5.3 Contents of post-tax revenue model *(electricity transmission)***
>
> (b) the post-tax revenue model must specify:
>
> (1) a methodology that the AER determines is likely to result in the best estimates of expected inflation"
>
> **"6.5.2 Return on capital *(electricity distribution)***
>
> (e) In determining the allowed rate of return, regard must be had to:
>
> *(3) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt".*

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[3] The submissions are available at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/review-of-expected-inflation-2017/initiation under the 'Submissions' heading.

[4] https://www.accc.gov.au/system/files/Working%20Paper%20no.%2011%20-%20Best%20estimates%20of%20expected%20inflation%20-%20v3.pdf

"6A.6.2 Return on capital *(electricity transmission)*

(e) In determining the allowed rate of return, regard must be had to:

(3) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt".

- National Electricity Law:

"7—National electricity objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—

(a) price, quality, safety, reliability and security of supply of electricity; and

(b) the reliability, safety and security of the national electricity system."

"7A—Revenue and pricing principles

(5) A price or charge for the provision of a direct control [regulated] network service should allow for a return commensurate with the regulatory and commercial risks involved in providing the direct control network service to which that price or charge relates."

- National Gas Rules:

'74 Forecasts and estimates

(1) Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.

(2) A forecast or estimate:

(a) must be arrived at on a reasonable basis; and

(b) must represent the best forecast or estimate possible in the circumstances."

"87 Rate of return

(5) In determining the allowed rate of return, regard must be had to:

(c) any interrelationships between estimates of financial parameters that are relevant to the estimates of the return on equity and the return on debt."

- National Gas Law:

"23—National gas objective

The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas."

Project Deliverables

The key deliverable is a publishable report providing the advice as per the services required in this annexure.

Timeline

Contract signed	Work commences

APPENDIX 2 Curriculum vitae of author

Shaun P. Vahey

Experience

2013 – Current, Warwick Business School, University of Warwick

Professor

2010 – 2013, Research School of Economics, Australian National University

Professor

Centre for Applied Macroeconomic Analysis, Director (2010 – 2012)

2008 – 2009, Melbourne Business School, University of Melbourne

Associate Professor

2004 – 2007, Reserve Bank of New Zealand

Nowcasting Manager and Special Adviser, Norges Bank (secondment, 2006 – 2007)

Research Manager (acting, 2004 – 2005)

Senior Research Adviser (from 2005)

Research Adviser

1995 – 2003, University of Cambridge

Senior Assistant in Research, Faculty of Economics and Politics

College Lecturer, Christ's College (1995 – 2002)

1991 – 1995, Bank of England

Bank Official (from March 1995)

Economist

Education

1987 – 1995 PhD Economics, University of British Columbia (UBC), Canada
1986 – 1987 MA Economics, University of Essex, UK

1983 – 1986 BA (Hons) Economics, University of Essex, UK

Journal publications

"Density Forecasting of U.S. Macroeconomic Variables Using a Gaussian Copula Model of Cross-sectional and Serial Dependence", with M. Smith, Journal of Business and Economic Statistics, 2016

"Measuring Output Gap Nowcast Uncertainty", with A. Garratt and J. Mitchell, International Journal of Forecasting, April–June 2014

"Forecast Densities for Economic Aggregates from Disaggregate Ensembles", with F. Ravazzolo, Studies in Nonlinear Dynamics and Econometrics, September 2014

"UK World War I and Interwar Data for Business Cycle and Growth Analysis", with J.M. Nason, Climoetrica, January 2012

"Combining VAR and DSGE Forecast Densities", with I.W. Bache, A.S. Jore and J. Mitchell, Journal of Economic Dynamics and Control, October 2011

"Real-time Inflation Forecast Densities from Ensemble Phillips Curves" with A. Garratt, J. Mitchell, and E. Wakerly, North American Journal of Economics and Finance, January 2011

"Combining Forecast Densities from VARS with Uncertain Instabilities", with A.S. Jore and J. Mitchell, Journal of Applied Econometrics, February 2010

"RBCs and DSGEs: The Computational Approach to Business Cycle Theory and Evidence" with O. Karagedlikli, T. Matheson and C. Smith, Journal of Economic Surveys, February 2010

"Real-time Prediction with UK Monetary Aggregates in the Presence of Model Uncertainty", with A. Garratt, E. Mise and G. Koop, Journal of Business and Economic Statistics, October 2009

"Real-time Probability Forecasts of UK Macroeconomic Events", with A. Garratt and K. Lee, National Institute Economic Review, January 2008

"Forecasting Substantial Data Revisions in the Presence of Model Uncertainty" with A. Garratt and G. Koop, Economic Journal, July 2008

"The McKenna Rule and UK World War I Finance", with J.M. Nason, American Economic Review, Papers and Proceedings, May 2007

"UK Real-time Macro Data Characteristics", with A. Garratt, Economic Journal, February 2006

"Debt and Budget Surpluses with a Tax Habit and Balanced Budget Hawks", with E. Loukoianova, Public Finance and Management, March 2006

"The Cost Effectiveness of the UK's Sovereign Debt Portfolio", with P. Coe and M.H. Pesaran, Oxford Bulletin of Economics and Statistics, August 2005

"Signalling Ability to Pay and Rent Sharing Dynamics", Journal of Economic Dynamics and Control, October 2004

"'Keep it Real': A Real-time UK Macro Data Set", with A. Pick and D.M. Egginton, Economics Letters, September 2002

"The Great Canadian Training Robbery: Evidence on the Returns to Educational Mismatch", Economics of Education Review, April 2000

"Measuring Core Inflation", with D.T. Quah, Economic Journal, September 1995

Completed research papers

"Probabilistic Interest Rate Setting With A Shadow Board: A Description of The Pilot Project", with T. Henckel and E. Wakerly, CAMA Working Papers 2011-27, Australian National University, Centre for Applied Macroeconomic Analysis.

Work in progress

"Over the Top! WWI and its Aftermath", with J. Nason

"Predicting US Federal Debt Crises and the Policy Responses", with A. Garratt and E. Wakerly

"Assessing the Economic Value of a Probabilistic Forecast for Inflation in the Presence of an Inflation Target", with C. McDonald, C. Thamotheram and E.Wakerly

Other completed papers

"Lessons From Down Under for the Bank of England", with A. Garratt and E. Wakerly, letter to Financial Times, February 13, 2014

"Uncertainty Helps Communicate Risk", with J. Mitchell, letter to Financial Times, August 19, 2013

"Probabilistic Forecast Paths in Economics and Finance", with E. Wakerly, paper prepared for the World Statistical Congress, April 2013

"Moving Towards Probability Forecasting", with E. Wakerly, Globalisation and Inflation Dynamics in Asia and the Pacific, BIS Paper No. 70b, February 2013

"Nowcasting and Model Combination", with K. Lees, editorial for North American Journal of Economics and Finance, special issue, January 2011

"Measuring Core Inflation in Australia with Disaggregate Ensembles", with F. Ravazzolo, Reserve Bank of Australia Conference Volume 2010

"Macro Modelling with Many Models" with I.W. Bache, J. Mitchell, and F. Ravazzolo, Norges Bank Working Paper 2009/15, Norges Bank Conference Volume 2009

"Model Uncertainty and Macroeconomics" with S.N. Durlauf, editorial for Journal of Applied Econometrics, special issue, January 2010

"'Last Quarter's GDP Growth Rate Revised Up by O.3pp: A Typical Revision?" with A. Garratt, in J. Mitchell "Revisions to Economic Statistics", Statistics Commission Report 17, April 2004

"A Real Time Tax Smoothing Based Fiscal Policy Rule" with E. Loukoianova and E.C. Wakerly, Department of Applied Economics Working Paper 0235, September 2002

"The Transparency and Accountability of UK Debt Management: A Proposal", with P. Coe and E.C. Wakerly, Department of Applied Economics Working Paper 0028, University of Cambridge, November 2000

"Transparent and Accountable Debt Management? A Look at the UK DMO's Cost and Risk Objectives", in The Treasury Committee Report on Government's Cash and Debt Management, Appendix 20, House of Commons, The Stationery Office, London, May 2000

"Some Thoughts on the Neutral Counterfactual Technique", in The Treasury Committee Report on Government's Cash and Debt Management, Appendix 21, House of Commons, The Stationery Office, London, May 2000

Grants

"Probability Forecasting with Macro Variables", Chief Investigator (with Partner Investigator E. Wakerly), Warwick Business School, funded jointly with Norges Bank and the Bank of England, January 2014 to December 2014, £80k.

"Helping Central Banks Measure Unobserved Variables with Real-time Forecasts", Chief Investigator (with Partner Investigators, A. Garratt, J. Mitchell and F. Ravazzolo), LP0991098, July 2009 to June 2011, Australian Research Council (ARC) Linkage Grant, ARC AUD 176k,

"Producing Robust Density Forecasts: Applications to Monetary Policy", A. Garratt, S. Hall, and J. Mitchell, international collaborator, RES-062-23-1753, July 2009 to June 2011, £240k

"Real-time Data and Monetary Policy", A. Garratt and G. Koop, international collaborator, ESRC RES-000-22-1342, June 2005 to May 2007, £42k

"Tax Smoothing, Gladstonian Orthodoxy and UK Fiscal Policy", Principal Investigator (with J. Nason as international collaborator), ESRC RES-000-23-0413, awarded June 2003, declined, £44k

"Debt Management and the Evolving Macroeconomy", Award holder and Principal Investigator, ESRC Award L38251021, April 2000 to July 2002, £100k

Seminars, conference presentations and discussions (from 2005)

2017 North Carolina State, FRB Cleveland, FRB Richmond, Norges Bank, Reserve Bank of New Zealand, Warwick University

2016 CFE meetings Seville, CAMA (Australian National University), University of Melbourne

2015 CFE meetings London, Warwick University, Reserve Bank of New Zealand, CAMA (ANU), CIRANO Data Revisions Workshop (Montreal), Bank of Canada

2014 Norges Bank, European Central Bank, Bank of England, University of Glasgow, Narodowy Bank Polski

2013 CIRANO Data Revisions Workshop (Montreal), European Central Bank, Norges Bank, Reserve Bank of New Zealand, Carleton University, Bank of Canada, World Statistics Congress, Joint Statistical Meetings (Montreal), Australian Macro Workshop (Canberra), Probability Forecasting Institute Nowcasting Workshop (Birkbeck, London)

2012 Heidelberg University, European Central Bank, Deutsche Bundesbank, Bank of England, Reserve Bank of Australia, Reserve Bank of New Zealand, Norges Bank, Society for Non-linear Dynamics and Econometrics meetings (Istanbul), Australian National University, University of New South Wales, Sydney University, Bank of International Settlements (BIS)

2011 Reserve Bank of New Zealand, Australian Macro Workshop (Hobart), Bank of England, Deakin University, Sveriges Riksbank, Royal Economic Society meetings (Royal Holloway, University of London),

2010 Joint Statistical Meetings (Vancouver), University of Melbourne, Norges Bank, Reserve Bank of New Zealand, Money Macro and Finance Annual Meeting (Cyprus), Bank of England, University of Adelaide Workshop in Quantitative Macro

2009 Reserve Bank of Australia, European Central Bank, Norges Bank Inflation Targeting Conference, University of Manchester Growth and Business Cycle

Workshop, Reserve Bank of New Zealand, Annual Reserve Bank of Australia Conference, City University, University of Adelaide

2008 Reserve Bank of Australia, BIS and Bank Indonesia DSGE Workshop, Reserve Bank of New Zealand, Econometric Society Australasian Meeting (Wellington), Money, Macro and Finance Conference (London), CIRANO Data Revisions Workshop (Montreal)

2007 North American Economic Association Winter Meeting (Chicago), Melbourne Business School, Australian National University, Reserve Bank of New Zealand, FRB Philadelphia Real-time Data Conference, Society for Computational Economics Meetings (Montreal), Macro Modelling Workshop (Norges Bank), ECB Forecasting Workshop, RBA Workshop on Monetary Policy in Open Economies

2006 North American Econometric Society Summer Meeting (Minneapolis), Australasian Macro Workshop (Sydney), University of Melbourne, Norges Bank, Bank of England, FRB San Francisco

2005 CIRANO Data Revisions Workshop, Society for Computational Economics Meetings (Washington DC), Summer Workshop in Macro (Auckland), Australasian Macro Workshop (Melbourne), Australian National University, University of New South Wales, University of Sydney, University of Otago, University of Canterbury, Claremont McKenna College, Reserve Bank of New Zealand, Norges Bank

Conference and workshop organisation

“Macroeconomic Forecasting, Analysis and Policy with Data Revision”, workshop organizing committee member, Bank of Spain, Madrid, October 2017

"Computational and Financial Econometrics International Conference", session organiser and chair, Seville, December 2016

“Macroeconomic Forecasting, Analysis and Policy with Data Revision”, workshop organizing committee member, FRB Philadelphia, October 2016

“The Economic Value of Macroeconomic Forecasts with Big Data”, Monash-Warwick Alliance Workshop, organizing committee member, June 2015

“Macroeconomic Forecasting, Analysis and Policy with Data Revision”, workshop organizing committee member, CIRANO Montreal, October 2015

“Macroeconomic Forecasting, Analysis and Policy with Data Revision”, workshop organizing committee member, FRB Philadelphia, October 2014

“Macroeconomic Forecasting, Analysis and Policy with Data Revision”, workshop organizing committee member, CIRANO Montreal, October 2013

"Probability Forecasting Institute Nowcasting Workshop", Birkbeck, University of London, conference organizer, January 2013

"Society for Nonlinear Dynamics and Econometrics Annual Symposium", Istanbul, program committee member, March 2012

"Quantitative Macro Workshop", program committee member, Reserve Bank of Australia, 2011

Royal Economic Society Annual Conference, Special Session on “Probability Forecasts and Monetary Policy Communication”, session organiser, April 2011

Bank of England and CAMA workshop on “Probability Forecasts and Monetary Policy Communication”, program committee member, April 2011

"Society for Nonlinear Dynamics and Econometrics Annual Symposium", Washington DC, program committee member, March 2011

"University of Adelaide Workshop in Quantitative Macro", organizer and program committee member, December 2010

“Nowcasting with forecast combination", workshop co-organizer, Reserve Bank of New Zealand, December 2008, forthcoming North American Journal of Economics and Finance special issue, 2010

"Prediction and monetary policy in the presence of model uncertainty", workshop organizer and session chair, Norges Bank, June 2007

"Real-time forecasting", and "Monetary policy in real time", session proposals for the Society for Computational Economics meeting, Montreal, June 2007

"Wars, finance and war finance", session organiser and chair, North American Economic Association Winter Meeting, Chicago, January 2007, session published in American Economic Review, Papers and Proceedings, May 2007

"Macroeconomic forecasting, analysis and policy with data revision", workshop organizing committee member, CIRANO Montreal and FRB Philadelphia, 2007-2011

"Macroeconometrics and model uncertainty", conference organiser and session chair, Reserve Bank of New Zealand, June 2006, forthcoming Journal of Applied Econometrics, special issue, 2010

"Dynamic stochastic general equilibrium models", conference organiser and session chair, Reserve Bank of New Zealand, August 2005

Refereeing experience

Journal of Econometrics, Annals of Applied Statistics, Journal of the Society for Nonlinear Dynamics and Econometrics, Review of Economics and Statistics, International Journal of Central Banking, Journal of Economic Surveys, Journal of Money Credit and Banking, North American Journal of Economics and Finance, Journal of Business and Economic Statistics, Economic Journal, Journal of Applied Econometrics, Oxford Bulletin of Economics and Statistics, Economics of Education Review, Public Finance and Management, European Journal of Finance, Economics Record, New Zealand Economic Papers, IMF Staff Papers, Oxford University Press, ESRC, Bank of England Working Papers, Reserve Bank of New Zealand Working Papers

Journal editorial experience

Associate editor Journal of Business and Economic Statistics, 2015-2017.

Guest editor, North American Journal of Economics and Finance, special issue on "Nowcasting with forecast combination", 2012.

Guest editor, Journal of Applied Econometrics, special issue on "Macroeconometrics and model uncertainty", 2010.

APPENDIX 3 "Expert witnesses in proceedings in the Federal Court of Australia"

FEDERAL COURT OF AUSTRALIA

Practice Note CM 7

EXPERT WITNESSES IN PROCEEDINGS IN THE FEDERAL COURT OF AUSTRALIA

Practice Note CM 7 issued on 1 August 2011 is revoked with effect from midnight on 3 June 2013 and the following Practice Note is substituted.

Commencement

1. This Practice Note commences on 4 June 2013.

Introduction

2. Rule 23.12 of the Federal Court Rules 2011 requires a party to give a copy of the following guidelines to any witness they propose to retain for the purpose of preparing a report or giving evidence in a proceeding as to an opinion held by the witness that is wholly or substantially based on the specialised knowledge of the witness (see Part 3.3 - Opinion of the *Evidence Act 1995* (Cth)).

3. The guidelines are not intended to address all aspects of an expert witness's duties, but are intended to facilitate the admission of opinion evidence[75], and to assist experts to understand in general terms what the Court expects of them. Additionally, it is hoped that the guidelines will assist individual expert witnesses to avoid the criticism that is sometimes made (whether rightly or wrongly) that expert witnesses lack objectivity, or have coloured their evidence in favour of the party calling them.

[75] As to the distinction between expert opinion evidence and expert assistance see *Evans Deakin Pty Ltd v Sebel Furniture Ltd* [2003] FCA 171 per Allsop J at [676].

Guidelines

1. General Duty to the Court[76]

1.1 An expert witness has an overriding duty to assist the Court on matters relevant to the expert's area of expertise.

1.2 An expert witness is not an advocate for a party even when giving testimony that is necessarily evaluative rather than inferential.

1.3 An expert witness's paramount duty is to the Court and not to the person retaining the expert.

2. The Form of the Expert's Report[77]

2.1 An expert's written report must comply with Rule 23.13 and therefore must

(a) be signed by the expert who prepared the report; and

(b) contain an acknowledgement at the beginning of the report that the expert has read, understood and complied with the Practice Note; and

(c) contain particulars of the training, study or experience by which the expert has acquired specialised knowledge; and

(d) identify the questions that the expert was asked to address; and

(e) set out separately each of the factual findings or assumptions on which the expert's opinion is based; and

(f) set out separately from the factual findings or assumptions each of the expert's opinions; and

(g) set out the reasons for each of the expert's opinions; and

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[76] The "*Ikarian Reefer*" (1993) 20 FSR 563 at 565-566.
[77] Rule 23.13

(ga) contain an acknowledgment that the expert's opinions are based wholly or substantially on the specialised knowledge mentioned in paragraph (c) above[78]; and

(h) comply with the Practice Note.

2.2 At the end of the report the expert should declare that "[the expert] has *made all the inquiries that* [the expert] *believes are desirable and appropriate and that no matters of significance that* [the expert] *regards as relevant have, to* [the expert's] *knowledge, been withheld from the Court.*"

2.3 There should be included in or attached to the report the documents and other materials that the expert has been instructed to consider.

2.4 If, after exchange of reports or at any other stage, an expert witness changes the expert's opinion, having read another expert's report or for any other reason, the change should be communicated as soon as practicable (through the party's lawyers) to each party to whom the expert witness's report has been provided and, when appropriate, to the Court[79].

2.5 If an expert's opinion is not fully researched because the expert considers that insufficient data are available, or for any other reason, this must be stated with an indication that the opinion is no more than a provisional one. Where an expert witness who has prepared a report believes that it may be incomplete or inaccurate without some qualification, that qualification must be stated in the report.

2.6 The expert should make it clear if a particular question or issue falls outside the relevant field of expertise.

2.7 Where an expert's report refers to photographs, plans, calculations, analyses, measurements, survey reports or other extrinsic matter, these must be provided to the opposite party at the same time as the exchange of reports[80].

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[78] See also *Dasreef Pty Limited v Nawaf Hawchar* [2011] HCA 21.
[79] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565
[80] The *"Ikarian Reefer"* [1993] 20 FSR 563 at 565-566. See also Ormrod *"Scientific Evidence in Court"* [1968] Crim LR 240

3. **Experts' Conference**

3.1 If experts retained by the parties meet at the direction of the Court, it would be improper for an expert to be given, or to accept, instructions not to reach agreement. If, at a meeting directed by the Court, the experts cannot reach agreement about matters of expert opinion, they should specify their reasons for being unable to do so.

J L B ALLSOP

Chief Justice

4 June 2013