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Towards a better inflation forecast

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Towards a better inflation forecast

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Abstract

Making assumptions about future inflation rates (CPI, AWE or LPI) is an important part of many actuarial tasks, and is particularly relevant for long-tailed insurance valuations. Despite this, these estimates sometimes receive only cursory attention and choosing a good estimate is fraught with difficulties. This paper discusses desirable characteristics of an inflation forecast and reports some recent research into possible ways of choosing inflation assumptions. This includes discussion of available independent forecasts, market based methods and historic estimators.

Keywords: AWE, CPI, LPI, long range forecasts, economic assumptions

1. Introduction

1.1 Background

Setting inflation rates in actuarial contexts is both incredibly common and incredibly important. First, any model of future cashflows will generally require an assumption of an inflation rate. This may be to reflect the change in claim costs in an insurance portfolio, or to allow for increase of a company's expenses, or even cases where a series of cashflows are explicitly tied to an official inflation measure. Secondly, the choice of inflation can sometimes have profound implications, particularly when cashflows occur over a long time horizon. This discussion paper is primarily concerned with this long term forecast although short term considerations will also receive some attention. We focus on Australian inflation measures and how they can be accurately forecasted.

Adopting inflation assumptions in actuarial work often receives only a small amount of attention. Despite this, actually making good forecasts has considerable difficulties. First, there is no clear market signal for long term inflation, despite the existence of inflation link bonds, which are discussed below. Secondly, the adopted methodology can markedly add or subtract from volatility due to economic assumptions; too much error in either direction is usually undesirable. Also, there is not a clear consensus on best practice in the actuarial community, with assumptions often chosen to fit a particular circumstance, rather than being objectively best.

1.2 Inflation measures

The three most commonly used inflation benchmarks in Australia are the consumer price index (CPI), average weekly earnings (AWE), and the labour price index (LPI). A user of inflation forecasts will typically use one of these series as an underlying basis, to which superimposed inflation is added if needed. Each series is designed and measured by the Australian Bureau of Statistics (ABS). For readers not familiar with these indexes, the ABS definitions are provided below:

- *CPI:* The Consumer Price Index (CPI) measures quarterly changes in the price of a 'basket' of goods and services which account for a high proportion of expenditure by the CPI population group (i.e. metropolitan households). This basket covers a wide range of goods and services, arranged in the following eleven groups: Food, alcohol and tobacco, clothing and footwear, housing, household contents and services, health, transportation, communication, recreation, education and finally financial and insurance services.

- *AWE:* Average Weekly Earnings (AWE) statistics represent average gross (before tax) earnings of employees and do not relate to average award rates nor to the earnings of the 'average person'. Estimates of average weekly earnings are derived by dividing estimates of weekly total earnings by estimates of number of employees.
- *LPI:* The Labour Price Index (LPI) measures changes in the price of labour services resulting from market forces. The LPI is unaffected by changes in the quality or quantity of work performed, that is, it is unaffected by changes in the composition of the labour force, hours worked, or changes in characteristics of employees (e.g. work performance). The LPI is produced annually on a financial year basis and consists of two components: a Wage Price Index (WPI), published quarterly; and non-wage price index, which is available for each financial year.

One point of distinction between the AWE and LPI is that the former allows for changes in the composition of the workforce, change in hours worked, as well as changes in the quality of work. In contrast, the LPI aims to track how the price of a fixed unit of work changes over time.

Histories for each of these measures are freely downloadable from the ABS. We have focused most heavily on the history of the past dozen years, which corresponds to the period of explicit inflation targeting by the Reserve Bank of Australia, and has consequently been a period of relative stability. The success of this policy over the past decade suggests that clear inflation targeting will remain a vital part of the economic landscape for the foreseeable future, so an emphasis on this part of Australia's economic history seems appropriate.

1.3 Characteristics of a good inflation measure

In seeking to find good inflation forecasts, it is useful to identify characteristics that would be desirable. We list our view on what features are enviable below:

- *Updated regularly and consistently:* The ability to smoothly apply inflation forecasts from one year to the next is vital in many actuarial contexts, such as valuations.
- *Able to be split by State and by calendar quarters:* Much actuarial work makes allowance for differing inflation rates between states, and quarterly frequency of projection is often required.
- *Accurate, including reasonable long term accuracy:* A good estimate of inflation will lead to a better estimation of future cashflows, and better valuations. Further, many context require forecasts to be made for many years in the future.
- *Stable from year to year:* Large swings in the long-term inflation rate without justification cause undesirable and unnecessary volatility in calculations.
- *Actual rate stability versus yield-inflation differential stability:* We introduce a distinction here that will be an important focus later in the paper. A rate that has absolute stability, regardless of movements in the long term bond rate, will lead to the yield contributing volatility to a valuation. If by contrast, the difference between the inflation rate and bond yield is stable, then this effect can be dampened.
- *Easily understood:* Users of actuarial reports often want to understand the basis of a set of assumptions, so should ideally be simple to communicate.
- *Objective:* Rates are more easily justified if they are based on an objective set of forecasts, rather than being subjectively chosen for a particular piece of work.

- *Easy to implement:* Arguably having lesser importance than other items listed above, it is still desirable that a set of assumptions do not require an onerous amount of time and effort to create.

Some of the traits listed above will have to be traded off. For instance, absolute stability and stability with respect to the bond rate are to some extent mutually exclusive. Similarly, more accurate models of inflation are likely to have added complexity, making them harder to understand and implement.

1.4 Industry forecasts available for use

One possible means of adopting inflation assumptions is to use a commercially available forecast. There are a number of sources of inflation projections available in the open market. A brief summary of some of the investigated published forecasts is provided in Table 1.

Table 1: Published forecast comparison

Published Forecast	*Inflation Measures*	*By State*	*Forecast Horizon*	*Quarterly / Yearly Forecast*	*Regularly of Production*
Access Economics	CPI, LPI, AWE	Yes	10 years	Quarterly	Quarterly
State Budget Papers	CPI, LPI	Yes	Varies significantly 2-10 years	Annual	Annual
Consensus Economics	CPI, LPI	No	10 years	Quarterly for first year, annually thereafter	Quarterly short term forecasts, half yearly long term forecasts
RBA	CPI	No	2 ½ years	½ Yearly	½ Yearly
Major Aust. Banks	CPI, LPI	No	2 years	Varies	Varies
Treasury Intergenerational report (IGR)	CPI, AWE	No	40 years (constant assumptions)	Yearly	Varies

Inspection of the table reveals that most are not close to meeting the criteria listed in Section 1.3. For instance, only the Access and State budget papers give insight into differences between states. Also, the forecast horizon is too brief for many of the forecasts. Some only produce forecasts for a subset of the three measures, and some are updated fairly irregularly. Perhaps the most suitable based on the table are Access Economics forecasts, which are produced quarterly for all three measures, by state and for at least 10 years into the future. Because of these desirable features, we have devoted a portion of the paper to analysing the suitability of these forecasts.

1.5 Outline of remainder of paper

The remaining discussion has the following structure:

- *Section 2*: Examines the Access Economics forecasts, attempting to establish whether these are suitable for long range forecasting.

- *Section 3*: We examine with the simplest class of models (absolute constants), including an examination of their applicability.
- *Section 4*: Here we introduce an important generalisation of the constant model, which spans the range between absolute constants and constant differentials with respect to the observable bond yield.
- *Section 5*: This section examines evidence supporting this generalised model type.
- Section 6: Considers some specific issues related to the implementation of our forecasts.
- *Section 7*: This section contains final recommendations, with some additional discussion.

2. Suitability of Access Economics forecasts

2.1 Some illustrative examples

In order to give some insight into the accuracy of historic forecasts the following graphs show the cumulative inflation forecasts versus the cumulative actual CPI and AWE. There are also 90% confidence intervals placed around the actual inflation history to aid interpretation. These intervals assume normality and independence from quarter to quarter in the data, with the independence assumption causing these intervals to be conservative (wider), than in cases where time series dependence is modelled. We also include a plot of the cumulative changes if adopting a constant assumption. The parameters for the constant model are set at 2.5% p.a. for CPI and 4.25% p.a. for AWE, which were consistent with forecast quoted in the 2002 IGR (see Section 3.1).

Figures 1, 2 and 3 are similar plots for different inflation forecasts and time windows at an Australia wide level. Figure 1 is an example where the Access forecast outperforms the constant model in predicting inflation, correctly identifying a spurt of inflation up to 3 years in the future. The remaining two figures show situations where the Access forecasts underestimates and overestimates AWE growth respectively, whereas the constant model performs considerably better.

Figure 1: AUS cumulative change in CPI versus forecasts from June 2004

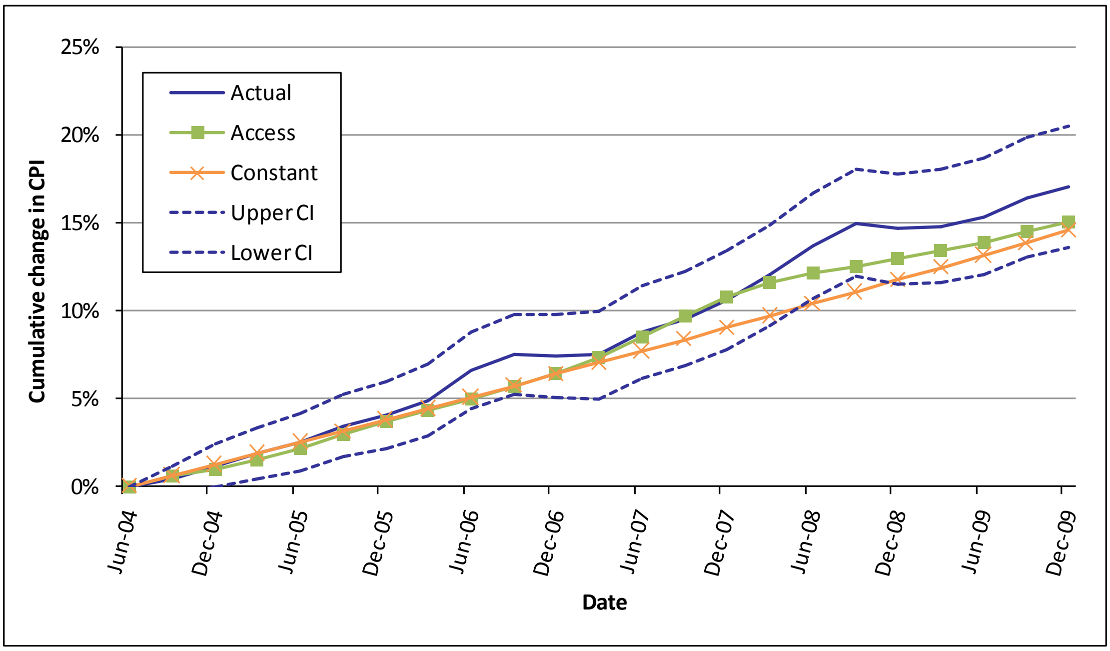


Figure 2: AUS cumulative change in AWE versus forecasts from June 2002

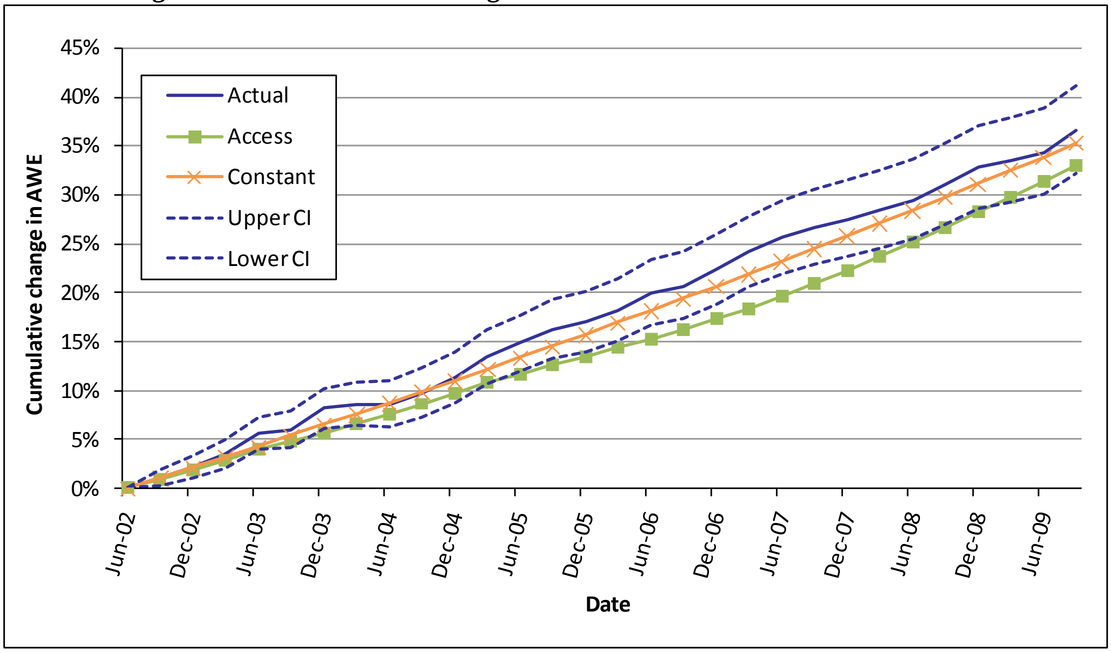
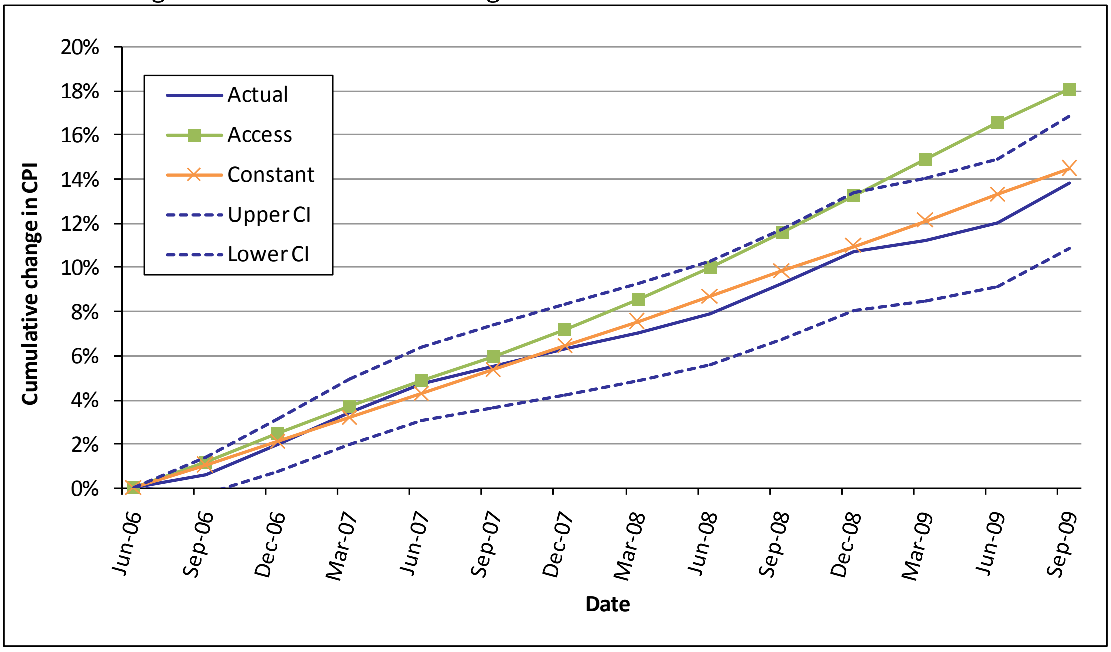


Figure 3: AUS cumulative change in AWE versus forecasts from June 2006



While graphical assessments such as those above cannot fail to be anecdotal, it gives some insight into the tabulated errors in the next section which suggest that Access forecasts do not give superior accuracy, particularly over the long term, when compared even to simple (constant models).

2.2 Tabulated cumulative percentage error

Tables 2 and 3 compare the cumulative percentage error for the Access Economics forecasts with the constant model taken from the IGR, for different two year windows, for Australian CPI and AWE inflation.

We make two observations; first, in medium to long term time windows (4-6 years, and to a lesser extent 2-4 years), the constant model performs better than the Access Economics forecasts in terms of accuracy. This supports the assertion that attempting to pick trends and cycles this far into the future is unrealistic. In fact, for these windows, the average absolute error for the constant model is about half of the Access Economics', for both inflation measures.

Secondly, for narrow time windows, the Access Economics numbers are more competitive (although not clearly superior), being more accurate in 4 out of 9 cases in the CPI forecast and 5 out of 9 cases in the AWE forecasts.

Table 2: Percentage Error for Australian CPI estimates. The more accurate of each pair is highlighted.

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-2.8%	-4.3%	-1.9%	-0.5%	-0.5%	0.0%
June 2000	-1.9%	-4.0%	-0.3%	-0.2%	-1.9%	-1.5%
June 2001	-0.9%	-0.5%	-0.9%	0.0%	-1.9%	-1.1%
June 2002	0.9%	-0.2%	-1.1%	-1.5%	-4.1%	-1.6%
June 2003	0.6%	0.0%	-1.5%	-1.1%	-3.0%	-1.0%
June 2004	-1.3%	-1.5%	-1.2%	-1.6%		
June 2005	-0.5%	-1.1%	-1.4%	-1.0%		
June 2006	-2.6%	-1.6%				
June 2007	-1.7%	-1.0%				

Table 3: Percentage Error for Australian AWE estimates. The more accurate of each pair is highlighted.

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	0.0%	0.4%	-0.8%	-0.7%	-0.6%	-0.1%
June 2000	-0.4%	0.7%	-1.2%	0.2%	-3.2%	-1.9%
June 2001	-2.6%	-0.7%	-2.3%	-0.1%	-2.0%	-0.8%
June 2002	0.1%	0.2%	-3.3%	-1.9%	-2.6%	0.8%
June 2003	-1.8%	-0.1%	-4.1%	-0.8%	-1.9%	1.7%
June 2004	-1.0%	-1.9%	-0.2%	0.8%		
June 2005	-0.5%	-0.8%	1.2%	1.7%		
June 2006	2.3%	0.8%				
June 2007	2.3%	1.7%				

Tables for each state are available in Appendix A. These generally show similar trends to those observed above, although the long term Access Economics forecasts are not always completely inferior to the constant model.

2.3 Other comments on Access Economics forecasts

It is worthwhile to briefly note some other characteristics of the Access inflation forecasts. First, it is not always clear when and why long term forecasts change; in some circumstances the short-term picture can change quite considerably and the long-term picture is held fixed, while at other times the long term projection can change considerably in a relatively short time. This suggests **caution** is required, rather than blindly applying such forecasts. Another comment relates to differences in forecasts between states. These usually take the form of fixed differentials. We think this is a reasonable simplification, and thus an appropriate design choice to consider in adopting inflation forecasts generally.

To summarise, it appears that Access forecasts unfortunately have **limited use for long term inflation forecasting**. While both objective and easy to implement, they do not have the accuracy or stability desirable in good estimates. However, they do appear to have a useful role in shorter-term predictions, where they can correctly capture the stage of the economic cycle. This latter property will be made use of later in the paper.

3. Constant estimates

3.1 Finding suitable constant estimates

The previous comparisons suggest that adopting the very simple assumptions of setting the long-term inflation rate to an absolute constant may be a reasonable starting point for an inflation model. If this is the case, the reasonable choices need to be made, consistent with some of the criteria listed in Section 1.3.

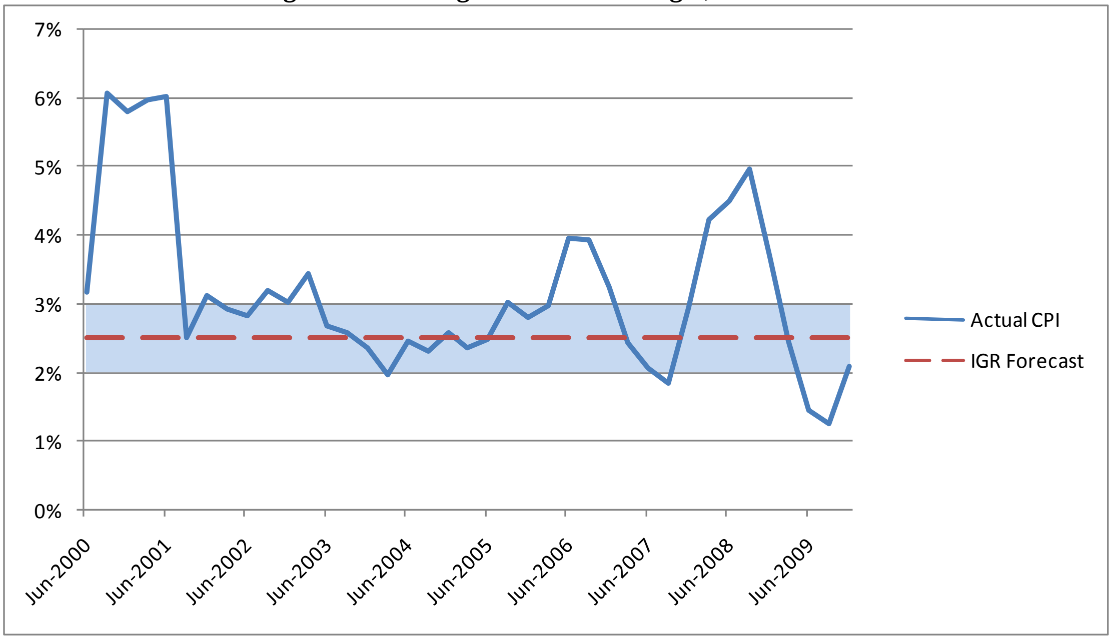
A possible choice, foreshadowed in Section 2, is to use the assumptions set out in the Treasury intergenerational reports. These have the advantage of having objectivity, and the tables in Section 2.2 suggest they also have good accuracy; the observed error was half that of the Access forecasts. The assumptions made in each of the three IGRs are reported in Table 4. CPI has always been assumed to be 2.5%, which represents the middle of the 2-3% target range of the Reserve Bank of Australia (RBA). The AWE inflation rate has been taken as the long term average increase in productivity plus assumed CPI. Thus for the 2002 and 2007 reports this productivity increase for historic data was found to be 1.75%, which was revised downwards slightly to 1.6% in the most recent IGR. For the purpose of historic validation we have used 4.25%, being the estimate available at the time, while for future forecasts we recommend using the latest forecast of 4.1%.

Table 4: Inflation assumptions adopted in intergenerational reports.

Measure	***IGR 2002***	***IGR 2007***	***IGR 2010***
CPI	2.5%	2.5%	2.5%
AWE	4.25%	4.25%	4.1%
LPI	N/A	N/A	N/A

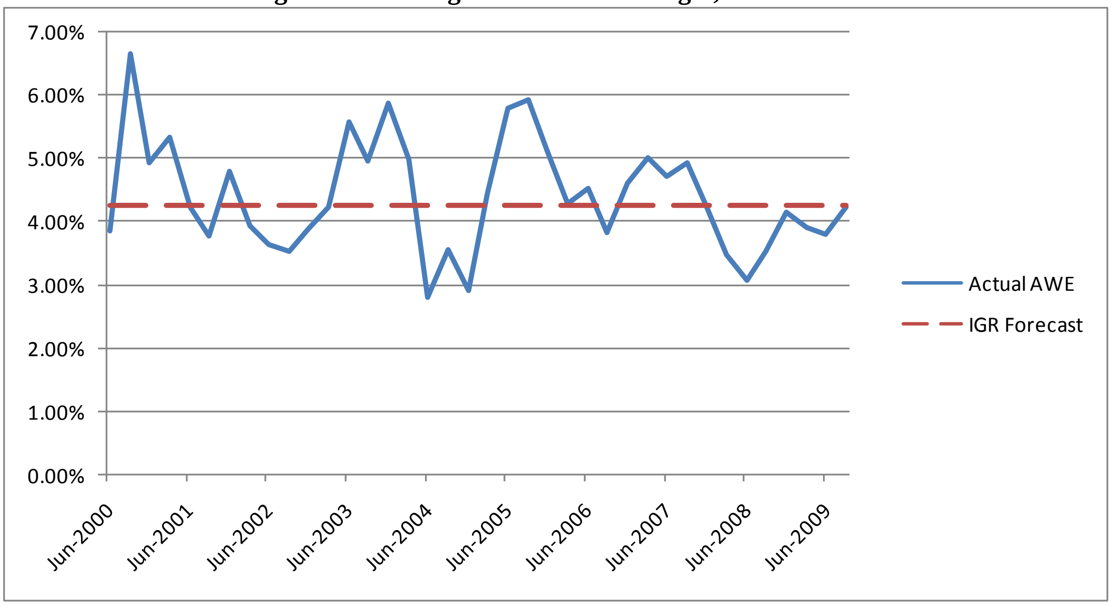
Figure 4 shows the annual change in CPI since June 2000, overlayed on the RBA target range. The Reserve Bank has done a commendable job in keeping inflation close to the desired range, and the historic average over this period, once excluding those measurements distorted by the introduction of the GST, of 2.8% is not a statistically different figure from the adopted 2.5% midpoint.

Figure 4: Running annual CPI changes, 2000 – 2009



Similarly the comparison between actual AWE and the IGR forecast in Figure 5 shows that the 4.25% level captures the overall level of wage movements fairly well. Interestingly, the residual error in the period plotted, when compared to the observed average of 4.5%, is the same difference as observed for CPI, suggesting that the forecast productivity changes were **very** accurate over the period.

Figure 5: Running annual AWE changes, 2000 – 2009



The IGR report makes no explicit estimate of LPI growth, so a constant assumption requires estimation. The historic trend average rate of growth based on all available data (the RBA has maintained the index since 1997) is 3.6%, which we feel to be a reasonable figure to adopt.

3.2 Issues associated with IGR based constant estimates

Are constant estimates sufficient for inflation forecasting? Unfortunately a number of issues suggest that extensions are necessary. One issue, foreshadowed in Secion 1.3, is that such an estimate is invariant to other observable changes in the economy. In particular, the long-term risk free lending rate can and does vary over time. Actuarial valuations generally include inflated future cashflows using an inflation forecast and then discount according to the risk free rate. If the inflation forecast is constant while the bond yield varies, then volatility is introduced into the valuation. Much of this volatility is arguably unnecessary, as inflation is generally believed to be related to investment returns. Methods to extend our forecasts to allow for this issue are examined in Sections 4 and 5.

Another potential concern is that constant estimates are not responsive enough to changes in economic conditions. A related concern is the presence of autoregression in economic statistics, where a large shock in the recent past can persist in some form in future years. Simple methods for addressing this are presented in Section 6.

Finally, the comparisons in Section 2.2 suggest that a constant assumption is not always appropriate for short-term forecasting; in many circumstances a more complex model will be able to better predict the economic cycle in the near term. The tables suggest this is particularly relevant for the first two years of forecasting, so for this period we recommend something more dynamic, such as Access Economics forecasts, be adopted.

3.3 State differentials

A further question arising from adopting the constant model is determining whether the forecasts should vary by state, and by how much. Table 5 and Table 6 present the average annual changes in inflation by state. The column excluding the September 2000 quarter (the introduction of the GST) in the CPI table is more relevant than the overall average.

Table 5: Average change in CPI since June 1993

	Average CPI increase	*Excl. Sep-00*
NSW	2.73%	2.55%
VIC	2.53%	2.34%
QLD	2.86%	2.66%
SA	2.64%	2.46%
WA	2.85%	2.66%
TAS	2.66%	2.47%
NT	2.59%	2.42%
ACT	2.68%	2.48%
AUS	2.69%	2.51%

Table 6: Average change in AWE

	Change since Sep-94		*Change since May-00*	
	Average increase	*State diff.*	*Average increase*	*State diff.*
NSW	3.62%	-0.13%	3.77%	-0.53%
VIC	3.17%	-0.58%	3.88%	-0.42%
QLD	4.42%	0.67%	5.19%	0.89%
SA	3.43%	-0.32%	4.06%	-0.24%
WA	4.58%	0.84%	5.90%	1.60%
TAS	3.00%	-0.74%	3.83%	-0.47%
NT	3.89%	0.15%	4.35%	0.05%
ACT	4.14%	0.40%	4.38%	0.08%
AUS	3.74%		4.30%	

In general there is very little variation among states for CPI, although there is some slight correlation between CPI inflation and the relative growth of states. For this reason we recommend that no state based differential is needed when using CPI inflation.

However, there is much more variation between states for AWE inflation. Further, this variation is dynamic over time; the mining boom in Queensland and Western Australia has been particularly pronounced over the last few years. As such, it is appropriate to introduce state based modifiers here, but it is very difficult to do this effectively without some subjective judgement being applied. We recommend using a balance between the overall AWE assumption and the differences observed in Table 6. In particular we propose additive factors of -0.25% for NSW, VIC and TAS, +0.50% for QLD and WA, and 0% for other states and territories. These numbers are tabulated in Section 7.

4. A model incorporating fixed and floating interest rates

Section 3.2 introduced the issue of how an inflation rate relates to the adopted bond yield. One alternative to the constant model that is often used in actuarial contexts that incorporates information concerning bond yields is an inflation estimate where the long term projection moves in accordance with the long term bond rate. In its most common form this takes the form of a fixed "differential", defined as the difference between the long term bond rate and the long term inflation rate. Thus under a fixed differential, or "fully floating" inflation model, the movements in inflation will exactly match those in bond yields.

We take this opportunity to define a richer class of floating inflation models, where the long term inflation and bond rates are still perfectly correlated, but the differential is not necessarily fixed:

$$r = r_0 + \theta(Y - Y_0) \tag{1}$$

Here r is the adopted (long range) inflation rate, r_0 is the historic average/average forecast of this rate, Y and Y_0 are the corresponding long term bond yield and historic average of the long term bond rate, while θ is the "floating factor" indicating how strongly the inflation rate should react to movements in the bond rate. Observe that if $\theta = 0$ then we recover the constant model, while $\theta = 1$ is the fixed differential model. Between these two extremes, θ indexes a model with increasing dependence on the bond rate.

Implementation of formula (1) is relatively straightforward. The choice of r_0 can be taken to be the constant assumptions found in Section 3. The long term bond rate Y_0 can be set to the level assumed in the IGRs too; this was 6% in the most recent report, which tallies well with recent experience. The term Y is easily found at any point in time by examining the yield curve for government bonds. Thus the only term that we need to find an appropriate value for is θ. This is the focus of the next section.

We reiterate one point here for clarity. The rate in (1) is "constant" in the sense that for a particular valuation date, the yield is found and then r is derived. This value is then used as a constant for future forecast periods. Thus the "floating" nature of r refers to the fact that it can change from valuation to valuation as the long-term bond yield Y changes.

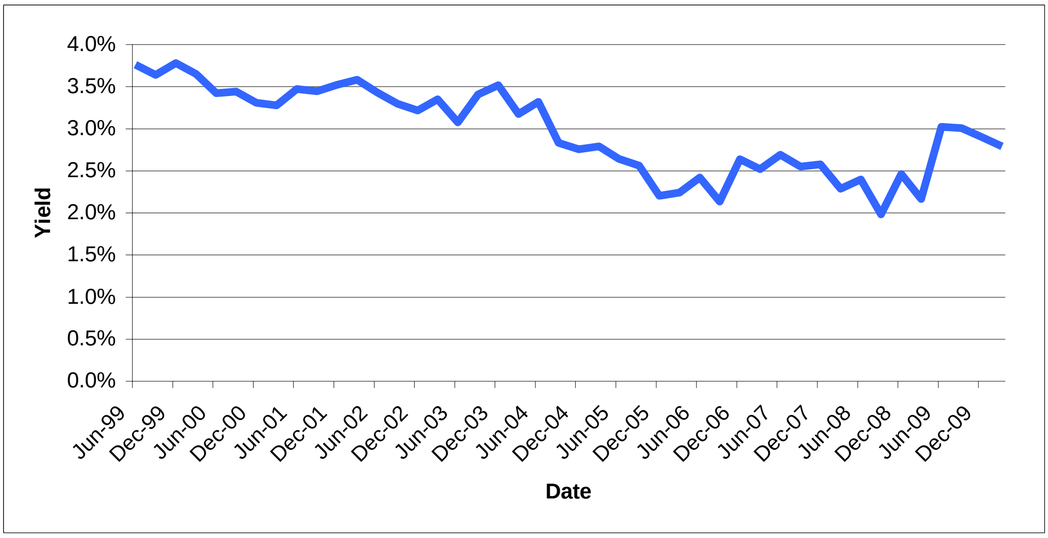
5. Evidence for fixed and floating interest rates

5.1 Index linked government bonds

The Australian Office of Financial Management, the government body that manages debt issuance, maintains a portfolio of indexed bonds, whose face value and coupon payments rise with CPI. At first glance, it would appear that these are ideal for calculating a market based forecast curve for CPI. The difference between the yield on an index bond and the corresponding rate on a standard bond gives a "raw" (unadjusted for abnormal market effects) inflation rate estimate, along with a corresponding term structure. However, the reality is that the indexed bond market is generally regarded as inefficient, for the following reasons:

- There appears to be a heavy scarcity premium that has increased substantially in recent years. Figure 6 shows the long term yields on index linked bonds over the past 10 years, a time of very stable CPI growth. With the exception of the past 12 months, the downward trend in yields indicate a situation of increased demand. This demand has largely come from superannuation companies seeking to match liabilities.
- The daily turnover in index bonds is low relative to other bonds, hence there is a potentially large liquidity premium effect too.

Figure 6: Long term yields on inflation linked treasury bonds



These factors make the inflation-linked bond market unsuitable for use in direct forecasting of inflation rates. However, relative movements in yields can offer some insight into the relationship between yields and inflation, and in particular give an estimate for θ in equation (1).

To estimate θ, we performed a linear regression of the raw inflation rate, as implied by the difference between standard and index bonds, against the long term bond yield. Using quarterly data from the past 10 years, we obtained an overall linear parameter estimate of 0.4. However, it should be noted that this estimate is somewhat lower than the corresponding estimates over shorter time windows; if we look at 2 year windows over the past 10 years, the median estimate is 0.72. In reality, anywhere between these two values would appear justifiable from the observed data.

5.2 Historic accuracy for choices of θ

We can use the historic data combined with the historic bond yield forecasts to assess which choice of θ provides the most accurate estimates of future inflation. To attempt this we performed the following experiment. Firstly, the median of the asymptotic bond yield was found for the last 10 years (6.25%). For a given forecast period and for all available forecast years excluding the initial two (to ignore the impact of the GST), we considered the accuracy of the inflation models for various choices of θ, ranging from the constant inflation model to the constant differential model. In the latter model the differential was taken to be:

- 6.25%-2.5% = 3.75% for CPI, and
- 6.25%-4.25% = 2.00% for AWE.

We considered cumulative error (to the present date) for forecasts from June 30 for the years 1999 through to 2006. Results are presented in Tables 7 and 8.

For CPI, the different choices of θ performed best for different time periods. Overall we found that the constant model (θ=0) had the greatest accuracy, but the result is highly dependent on the choice of years – for instance if the June 2003 projection is excluded then θ=0.5 becomes the most accurate choice. In most situations however, the model would appear to deteriorate in performance once θ>0.6.

Table 7: Cumulative errors for CPI projections by forecast data and choice of θ, where 0% represents constant inflation and 100% represents a constant (yield – inflation) differential

θ	***Projection start date***								***Avg***
	Jun99	***Jun00***	***Jun01***	***Jun02***	***Jun03***	***Jun04***	***Jun05***	***Jun06***	
0%	0.75%	0.69%	0.66%	0.72%	0.78%	0.22%	0.46%	0.59%	0.61%
10%	0.61%	0.65%	0.63%	0.71%	0.95%	0.25%	0.57%	0.57%	0.62%
20%	0.47%	0.62%	0.60%	0.70%	1.12%	0.28%	0.67%	0.55%	0.63%
30%	0.33%	0.59%	0.57%	0.70%	1.29%	0.30%	0.78%	0.53%	0.64%
40%	0.19%	0.56%	0.54%	0.69%	1.46%	0.33%	0.89%	0.50%	0.65%
50%	0.05%	0.53%	0.51%	0.68%	1.62%	0.36%	1.00%	0.48%	0.65%
60%	0.09%	0.50%	0.48%	0.67%	1.79%	0.38%	1.11%	0.46%	0.69%
70%	0.24%	0.47%	0.45%	0.67%	1.96%	0.41%	1.21%	0.43%	0.73%
80%	0.38%	0.44%	0.42%	0.66%	2.12%	0.44%	1.32%	0.41%	0.77%
90%	0.53%	0.40%	0.39%	0.65%	2.29%	0.46%	1.43%	0.39%	0.82%
100%	0.67%	0.37%	0.35%	0.65%	2.46%	0.49%	1.54%	0.37%	0.86%

Table 8: Cumulative errors for AWE projections by forecast data and choice of θ, where 0% represents constant inflation and 100% represents a constant (yield – inflation) differential

θ	***Projection start date***								***Avg***
	Jun99	***Jun00***	***Jun01***	***Jun02***	***Jun03***	***Jun04***	***Jun05***	***Jun06***	
0%	0.05%	0.14%	0.29%	0.22%	0.36%	0.51%	0.80%	0.26%	0.33%
10%	0.19%	0.11%	0.32%	0.21%	0.19%	0.49%	0.69%	0.23%	0.30%
20%	0.33%	0.08%	0.35%	0.20%	0.02%	0.46%	0.58%	0.21%	0.28%
30%	0.48%	0.05%	0.39%	0.20%	0.15%	0.43%	0.47%	0.19%	0.29%
40%	0.62%	0.02%	0.42%	0.19%	0.32%	0.40%	0.36%	0.17%	0.31%
50%	0.76%	0.01%	0.45%	0.18%	0.49%	0.38%	0.26%	0.15%	0.33%
60%	0.90%	0.04%	0.48%	0.17%	0.66%	0.35%	0.15%	0.12%	0.36%
70%	1.05%	0.08%	0.51%	0.17%	0.83%	0.32%	0.04%	0.10%	0.39%
80%	1.19%	0.11%	0.54%	0.16%	1.00%	0.30%	0.07%	0.08%	0.43%
90%	1.34%	0.14%	0.57%	0.15%	1.16%	0.27%	0.18%	0.06%	0.48%
100%	1.49%	0.17%	0.60%	0.15%	1.33%	0.24%	0.29%	0.04%	0.54%

The situation for AWE points to an intermediate value of θ. The overall average suggests a choice of around 20%, however this too is highly dependent on the choice of years considered; when the June 1999 data is excluded, then the best overall choice is θ =0.4.

5.3 Access Economics insight into differentials

In a similar fashion to the analysis in Section 5.1, we may form a linear regression of long term inflation forecasts by Access Economics against the long term bond yield, in an effort to estimate θ. We derived the inflation forecast by taking the average forecast rate for 4-8 years in the future, for June forecasts from 1999 through to 2009. This data is presented in Table 9.

Table 9: Comparison of the geometric average of the 4 to 8 year forward rates for bond yields as well as Access Economics projections for CPI and AWE.

Forecast date	*Bond yield*	*CPI Forecast*		*AWE Forecast*	
		Average	*Differential*	*Average*	*Differential*
Jun-99	6.88%	2.74%	4.14%	4.14%	2.74%
Jun-00	6.41%	2.58%	3.82%	4.10%	2.31%
Jun-01	6.46%	2.11%	4.35%	4.47%	1.99%
Jun-02	6.39%	2.02%	4.36%	4.30%	2.09%
Jun-03	5.40%	2.08%	3.32%	4.13%	1.27%
Jun-04	6.28%	2.44%	3.84%	4.45%	1.83%
Jun-05	5.18%	2.02%	3.16%	3.63%	1.55%
Jun-06	5.86%	2.13%	3.74%	4.30%	1.56%
Jun-07	6.27%	2.35%	3.91%	4.78%	1.48%
Jun-08	6.39%	2.37%	4.02%	4.60%	1.80%
Jun-09	6.18%	2.24%	3.94%	3.84%	2.34%

Performing the regression yielded estimates of $\theta = 0.33$ for both AWE and CPI inflation rates. This once again points to an intermediate value of θ, rather than being at an extreme; inflation does respond to changes in yield, but the change is not to the same absolute degree.

5.4 Conclusions

The above analysis motivates a number of further observations:

- The analysis has only been performed over at most 12 years of history, so care should be taken when inferring results for periods longer than this. Indeed, for longer terms it can be argued that the constant model is once again to be preferred, and some study could be done to investigate whether the volatility associated with long term yield projections is inaccurate.
- Using an intermediate choice of θ involves some subjectivity as to the best choice, which may be more difficult to justify in practice, since no objective source can be cited for its use. As such, in some contexts it may be preferable to simply adopt a constant model, which still gives relatively good accuracy.
- The accuracy improvement associated with non-zero choices of θ is relatively small compared to the difference between Access forecasts and the constant model. Analysis similar to that undertaken in Table 8 suggests that while the constant model can halve the absolute error of the Access forecasts, the incremental improvement in moving from constant to non-zero θ for AWE projections is about 15%.
- The results also suggest that adopting a fixed differential (θ=1) is difficult to justify from historic data. Although attractive from a rolling volatility standpoint, it is very unlikely that changes in the yield curve will be matched by corresponding changes in wages.

The above caveats aside, there does seem to be strong empirical and practical reasons to adopt a value of θ somewhere in the middle of the range [0,1]. While making a final choice of θ contains some degree of subjectivity, the above evidence suggests that a choice in the range of 0.3-0.6 seems credible. For valuation purposes, where the difference between inflation and yield forecasts are of greatest importance, we feel it is reasonable to adopt a choice that reduces some of the rolling volatility, and so adopting θ=0.5 seems reasonable.

6. Other considerations

6.1 Moving between short-term and long-term forecasts

The long term forecast described in equation (1) does not make any allowance for short term economic conditions that may be present, affecting inflation rates. For this reason it seems prudent to include a "dynamic" (i.e. non-constant) short term forecast as part of the term structure of inflation forecasts, before reverting back to the stable long-term rate. The analysis of Access Forecasts suggests that 2-3 years seems a reasonable period to adopt short term forecasts before reversion. Also, the transition between the two should be relatively smooth, to avoid peculiarities caused by an abrupt switch.

Although this could be achieved in a number of ways, one method which appears reasonable when considering quarterly forecasts is to:

- use a dynamic forecast for the first 2 years;
- gradually shift from the dynamic forecast in the 3rd year, by giving the forecasts weights of 0.8, 0.6, 0.4 and 0.2 in the four quarters of that year, with the remaining weight given to the constant long term forecast of (1);
- Adopt the constant rate for all years thereafter.

6.2 Autoregression

It is well known that economic time series such as inflation measures display autoregression properties, in that after an inflation shock, it will usually take a number of time periods before inflation returns to historic levels. The simplest means of expressing this statistically is in the AR(1) model:

$$R_t = r_0 + \rho(R_{t-1} - r_0) + e_t \qquad (2)$$

Here r_0 is again the overall mean for inflation, R_t is the inflation in the *t*th year, and e_t is a time series innovation or error term, typically taken to be sampled independently from some distribution with zero mean and fixed variance. Of interest here is the autoregression parameter ρ, which dictates how quickly an outlier will decay back to historic performance.

Estimating the factor ρ based on historic data is problematic, because of the changes in price and wage inflation over the past few decades. If we consider only the past decade, then the estimated ρ are quite modest and not statistically significant from zero for either AWE or CPI. If however, we consider the past 27 years, then we obtain significant estimates of 0.7 for CPI and 0.5 for AWE. Thus a choice of ρ amounts to a decision on how reproducible the low-inflation environment Australia has enjoyed for the past decade is in the future.

If the most recent changes in inflation are significantly different from normal and an analyst is concerned about possible autoregression effects, it is relatively straightforward to extend the constant arising from equation (1) to allow for this – simply replace this constant series by one that starts at the current levels and decays towards the level in (1), using an adopted decay factor ρ (or $\rho^{0.25}$ if applying to quarterly forecasts). However, recent experience suggests that such a change will probably have at most a marginal effect on accuracy, and we do not pursue the topic further here.

7. Summary and conclusions

7.1 Summarised recommendations

We recommend using the appropriate variation of equation (1) to calculate a long term inflation rate:

$$\text{CPI} = 2.5\% + 0.5(Y\text{-}6.0\%) \qquad (3)$$

$$\text{AWE} = 4.1\% + 0.5(Y\text{-}6.0\%) \qquad (4)$$

$$\text{LPI} = 3.6\% + 0.5(Y\text{-}6.0\%) \qquad (5)$$

The first term in each equations corresponds to constant estimates consistent with the most recent Intergenerational Report, except for LPI, where a historic average has been taken. *Y* is the long term bond rate calculated at the time of forecast, and the 6.0% represents an average value for this rate, consistent with the **most recent** Intergenerational Report. The factor of 0.5 is taken from the analysis in Section 5 and represents a balance between choosing a forecast that is independent of changes in the long term bond yield and a forecast that moves in complete lockstep.

The term structure of the inflation forecast should use a dynamic model for the first two years, to capture potential improvements in accuracy from identifying short-term economic cycles. An industry estimate, such as that provided by Access economics, would be appropriate here too. In the third year transition between the dynamic model and the constant estimates arising from equations (3)-(5), and in the fourth and subsequent years use this rate alone.

We also think state based modifiers should be applied to AWE and LPI estimates where appropriate, as presented in Table 10. This represents a portion of the historic differences observed over the recent history.

Table 10: Long Term Constant Rate State Wage Differentials

State	*State Wage Differential*	*Resulting State AWE Rate*	*Resulting State LPI Rate*
NSW	-0.25%	3.85%	3.35%
VIC	-0.25%	3.85%	3.35%
QLD	+0.5%	4.60%	4.10%
SA	+0.0%	4.10%	3.60%
WA	+0.5%	4.60%	4.25%
TAS	-0.25%	3.85%	3.35%
NT	+0.0%	4.10%	3.60%
ACT	+0.0%	4.10%	3.60%

Finally, users can optionally make an allowance for autoregression in circumstances where the most recent inflation changes have significantly departed from the long term average. In such circumstances the constant assumption arising from equations (3)-(5) should be replaced by a decaying AR(1) model, with a quarterly autoregression quarterly factor chosen appropriately.

7.2 Discussion

It is worthwhile to revisit here the desirable characteristics of a good inflation forecast introduced in Section 1.3, and see how they apply to our recommendations:

- *Updated regularly and consistently:* The formulae are easy to update, as they only require an estimation of the long-term government bond rate. Other numbers sourced from the IGR are not updated regularly, but are expected to be very stable over time.
- *Able to be split by State and by calendar quarters:* The model is easily split into quarters, and we have what we believe to be reasonable state modifiers to apply the forecasts to specific locations.
- *Accurate, including reasonable long term accuracy:* We have shown that these relatively simple long term forecasts have good predictive accuracy
- *Stable from year to year/Actual rate stability versus yield-inflation differential stability:* We have struck a reasonable balance between the two extremes of "stability", and produced a more accurate model as a result.
- *Easily understood:* While the extensions to the models to allow for short-term trends, autoregression, and changes in bond yields add some complexity to the model, it remains more transparent than many forecasting approaches.

- *Objective:* The use of the Intergeneration Reports as the basis of some assumptions gives the forecasts some objectivity, although the extensions add some degree of subjectiveness to the assumptions.
- *Easy to implement:* The formulae in (3)-(5) are relatively straightforward to apply. The transition between short and long forecasts is also easily done in a spreadsheet.

We recognise that there is some subjectivity in the final recommendations; to some extent this is unavoidable, as assumptions about how past and future time periods relate to each other will always need to be made. However, we believe that through a range of analyses and historic back-testing we have arrived at an estimate that is likely to be much more accurate than many existing inflation assumptions. We hope that this paper can contribute to the use of robust, accurate inflation forecasts in years to come.

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References

Access Economics Business Outlook, June Forecast (1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007 and 2008).

Australian Treasury. Intergenerational Report 2002-03. Canberra, Commonwealth of Australia. http://www.budget.gov.au/2002-03/bp5/download/BP5_Combined_PDF.zip (accessed Mar 2010)

Australian Treasury. Intergenerational Report 2007. Canberra, Commonwealth of Australia. http://www.treasury.gov.au/documents/1239/PDF/IGR_2007_final_report.pdf (accessed Mar 2010) .

Australian Treasury. Intergenerational Report 2010. Canberra, Commonwealth of Australia. http://www.treasury.gov.au/igr/igr2010/report/pdf/IGR_2010.pdf (accessed Mar 2010) .

Appendix A: Comparison of Access forecasts against the constant model by state.

A.1 CPI tables by state

Each table compares looks at the deviation from the actual change in CPI for the Access and the constant forecasts. Australia wide table was reported in Table 2 of the main report. In each case the constant forecast assumed a rate of 2.5%. The most accurate of each pair is shaded.

Table A.1 NSW CPI

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-2.6%	-4.7%	-1.6%	-0.3%	-0.5%	0.3%
June 2000	-1.8%	-4.2%	-0.4%	0.2%	-1.4%	-1.3%
June 2001	-0.1%	-0.3%	-0.2%	0.3%	-1.0%	-0.6%
June 2002	2.0%	0.2%	-0.1%	-1.3%	-2.1%	-1.0%
June 2003	1.2%	0.3%	-0.7%	-0.6%	-1.4%	-0.6%
June 2004	-1.6%	-1.3%	-2.9%	-1.0%		
June 2005	-0.1%	-0.6%	-0.7%	-0.6%		
June 2006	-2.2%	-1.0%				
June 2007	-2.6%	-4.7%				

Table A.2 VIC CPI

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-2.3%	-4.4%	-1.8%	-0.9%	0.2%	0.8%
June 2000	-1.6%	-3.9%	-0.1%	-0.1%	-1.1%	-1.0%
June 2001	-0.5%	-0.9%	0.2%	0.8%	-0.8%	-0.9%
June 2002	1.4%	-0.1%	-0.3%	-1.0%	-2.9%	-1.4%
June 2003	1.5%	0.8%	-0.5%	-0.9%	-1.4%	-0.6%
June 2004	-1.4%	-1.0%	-3.1%	-1.4%		
June 2005	-0.2%	-0.9%	-0.8%	-0.6%		
June 2006	-2.5%	-1.4%				
June 2007	-1.4%	-0.6%				

Table A.3 QLD CPI

Forecast Date	0-2 years		2-4 years		4-6 years	
	Access	Constant	Access	Constant	Access	Constant
June 1999	-2.9%	-3.8%	-2.3%	-0.8%	-1.3%	-0.7%
June 2000	-2.6%	-4.2%	-1.1%	-0.9%	-3.1%	-1.7%
June 2001	-2.0%	-0.8%	-2.4%	-0.7%	-3.8%	-1.7%
June 2002	-0.5%	-0.9%	-2.3%	-1.7%	-6.8%	-2.7%
June 2003	-0.5%	-0.7%	-3.0%	-1.7%	-6.1%	-2.2%
June 2004	-1.5%	-1.7%	-4.6%	-2.7%		
June 2005	-1.0%	-1.7%	-3.0%	-2.2%		
June 2006	-3.6%	-2.7%				
June 2007	-2.7%	-2.2%				

Table A.4 SA CPI

Forecast Date	0-2 years		2-4 years		4-6 years	
	Access	Constant	Access	Constant	Access	Constant
June 1999	-3.6%	-4.2%	-3.6%	-1.7%	-1.9%	-0.1%
June 2000	-2.1%	-4.0%	-1.6%	-1.8%	-2.9%	-1.0%
June 2001	-2.5%	-1.7%	-2.3%	-0.1%	-2.5%	-0.5%
June 2002	-1.7%	-1.8%	-2.6%	-1.0%	-5.8%	-1.3%
June 2003	0.3%	-0.1%	-0.9%	-0.5%	-3.1%	-1.2%
June 2004	-0.6%	-1.0%	-2.2%	-1.3%		
June 2005	0.1%	-0.5%	-0.8%	-1.2%		
June 2006	-2.2%	-1.3%				
June 2007	-2.1%	-1.2%				

Table A.5 WA CPI

Forecast Date	0-2 years		2-4 years		4-6 years	
	Access	Constant	Access	Constant	Access	Constant
June 1999	-4.3%	-3.7%	-2.0%	0.5%	-1.0%	-1.4%
June 2000	-2.3%	-3.5%	0.6%	0.3%	-3.5%	-3.6%
June 2001	-2.3%	0.5%	-2.9%	-1.4%	-5.4%	-2.9%
June 2002	-0.4%	0.3%	-3.7%	-3.6%	-8.5%	-2.7%
June 2003	-2.0%	-1.4%	-5.4%	-2.9%	-7.5%	-0.9%
June 2004	-3.4%	-3.6%	-6.1%	-2.7%		
June 2005	-2.9%	-2.9%	-3.9%	-0.9%		
June 2006	-3.5%	-2.7%				
June 2007	-1.2%	-0.9%				

Table A.6 TAS CPI

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-2.5%	-3.8%	-1.3%	-0.5%	0.1%	-0.6%
June 2000	-2.1%	-3.2%	0.2%	-0.3%	-1.9%	-1.7%
June 2001	-2.7%	-0.5%	-2.8%	-0.6%	-2.9%	-0.7%
June 2002	-1.1%	-0.3%	-2.4%	-1.7%	-5.3%	-0.7%
June 2003	-1.3%	-0.6%	-2.4%	-0.7%	-4.0%	-0.2%
June 2004	-1.0%	-1.7%	-2.1%	-0.7%		
June 2005	0.2%	-0.7%	0.2%	-0.2%		
June 2006	-1.4%	-0.7%				
June 2007	-1.4%	-0.2%				

Table A.7 NT CPI

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-1.6%	-2.7%	1.3%	0.8%	5.1%	1.2%
June 2000	-1.4%	-2.3%	2.8%	1.7%	0.5%	-1.8%
June 2001	-1.1%	0.8%	0.7%	1.2%	-2.1%	-3.0%
June 2002	1.4%	1.7%	-0.6%	-1.8%	-5.1%	-2.7%
June 2003	0.7%	1.2%	-3.0%	-3.0%	-5.4%	-1.5%
June 2004	-1.5%	-1.8%	-4.2%	-2.7%		
June 2005	-2.6%	-3.0%	-4.3%	-1.5%		
June 2006	-3.5%	-2.7%				
June 2007	-1.9%	-1.5%				

Table A.8 ACT CPI

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-2.7%	-4.7%	-1.4%	-0.4%	0.4%	0.0%
June 2000	-2.1%	-3.9%	-0.2%	-0.5%	-2.4%	-1.9%
June 2001	-1.0%	-0.4%	-0.9%	0.0%	-2.2%	-1.8%
June 2002	0.0%	-0.5%	-1.7%	-1.9%	-5.1%	-1.5%
June 2003	0.6%	0.0%	-1.7%	-1.8%	-4.2%	-1.5%
June 2004	-0.9%	-1.9%	-3.0%	-1.5%		
June 2005	-0.9%	-1.8%	-1.8%	-1.5%		
June 2006	-1.9%	-1.5%				
June 2007	-1.9%	-1.5%				

A.2 AWE tables by state

Each table compares looks at the deviation from the actual change in AWE for the Access and the constant forecasts. Australia wide table was reported in Table 2 of the main report. In each case the constant forecast assumed a rate of 4.25%. The most accurate of each pair is shaded.

Table A.9 NSW AWE

Forecast Date	0-2 years		2-4 years		4-6 years	
	Access	Constant	Access	Constant	Access	Constant
June 1999	-3.4%	-1.4%	-4.7%	-1.0%	-4.9%	-0.3%
June 2000	-0.3%	1.6%	-3.0%	-1.9%	-3.2%	0.1%
June 2001	-3.8%	-1.0%	-3.9%	-0.3%	-3.0%	-0.1%
June 2002	-2.1%	-1.9%	-3.5%	0.1%	-1.2%	2.6%
June 2003	-3.9%	-0.3%	-5.4%	-0.1%	1.4%	6.5%
June 2004	0.1%	0.1%	2.9%	2.6%		
June 2005	-3.1%	-0.1%	3.2%	6.5%		
June 2006	2.9%	2.6%				
June 2007	3.7%	6.5%				

Table A.10 VIC AWE

Forecast Date	0-2 years		2-4 years		4-6 years	
	Access	Constant	Access	Constant	Access	Constant
June 1999	2.9%	3.6%	-3.9%	-6.0%	-1.2%	2.6%
June 2000	-2.2%	-1.5%	-3.1%	0.5%	-3.3%	0.2%
June 2001	-6.5%	-6.0%	-3.5%	2.6%	-0.8%	1.9%
June 2002	0.2%	0.5%	-1.4%	0.2%	2.0%	3.7%
June 2003	2.1%	2.6%	2.1%	1.9%	5.0%	2.6%
June 2004	3.8%	0.2%	7.8%	3.7%		
June 2005	6.8%	1.9%	9.3%	2.6%		
June 2006	7.8%	3.7%				
June 2007	6.6%	2.6%				

Table A.11 QLD AWE

Forecast Date	0-2 years		2-4 years		4-6 years	
	Access	Constant	Access	Constant	Access	Constant
June 1999	2.0%	1.3%	7.1%	4.2%	4.1%	-4.0%
June 2000	0.8%	0.9%	1.5%	1.4%	-5.8%	-7.5%
June 2001	2.5%	4.2%	-0.7%	-4.0%	-1.8%	-2.5%
June 2002	2.3%	1.4%	-6.3%	-7.5%	-5.0%	0.6%
June 2003	-6.6%	-4.0%	-10.1%	-2.5%	-11.7%	-2.5%
June 2004	-6.8%	-7.5%	-5.0%	0.6%		
June 2005	-4.1%	-2.5%	-5.6%	-2.5%		
June 2006	-2.6%	0.6%				
June 2007	-2.0%	-2.5%				

Table A.12 SA AWE

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	3.2%	-0.4%	6.4%	4.9%	8.7%	2.8%
June 2000	-0.9%	-1.4%	5.3%	8.8%	-2.6%	-7.0%
June 2001	2.0%	4.9%	3.9%	2.8%	0.4%	-3.4%
June 2002	5.9%	8.8%	-3.2%	-7.0%	-4.0%	0.1%
June 2003	9.1%	2.8%	3.0%	-3.4%	1.8%	-0.7%
June 2004	-6.6%	-7.0%	-6.6%	0.1%		
June 2005	-4.2%	-3.4%	-6.3%	-0.7%		
June 2006	2.0%	0.1%				
June 2007	0.2%	-0.7%				

Table A.13 WA AWE

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	-0.2%	-1.6%	0.4%	-2.0%	-0.8%	-2.7%
June 2000	1.7%	-1.0%	0.6%	-1.5%	1.4%	-0.4%
June 2001	-0.7%	-2.0%	-1.9%	-2.7%	-6.7%	-7.3%
June 2002	3.4%	-1.5%	2.5%	-0.4%	-8.8%	-12.9%
June 2003	-3.4%	-2.7%	-11.0%	-7.3%	-12.8%	-4.1%
June 2004	2.5%	-0.4%	-9.0%	-12.9%		
June 2005	-3.1%	-7.3%	-6.4%	-4.1%		
June 2006	-6.3%	-12.9%				
June 2007	-3.2%	-4.1%				

Table A.14 TAS AWE

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	2.6%	2.6%	2.5%	1.3%	-2.3%	-3.7%
June 2000	6.9%	5.5%	-3.1%	-6.8%	-2.0%	2.7%
June 2001	-2.6%	1.3%	-7.6%	-3.7%	-5.7%	2.2%
June 2002	-7.8%	-6.8%	-7.1%	2.7%	-6.9%	1.9%
June 2003	-3.2%	-3.7%	-4.3%	2.2%	-0.7%	4.8%
June 2004	-2.2%	2.7%	-1.8%	1.9%		
June 2005	6.1%	2.2%	8.6%	4.8%		
June 2006	6.2%	1.9%				
June 2007	8.2%	4.8%				

Table A.15 NT AWE

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	3.6%	-4.9%	6.3%	1.2%	7.4%	0.4%
June 2000	2.3%	7.4%	6.2%	2.4%	0.7%	-7.9%
June 2001	0.5%	1.2%	3.6%	0.4%	5.0%	-2.1%
June 2002	4.0%	2.4%	-3.4%	-7.9%	-4.3%	-3.0%
June 2003	0.5%	0.4%	-1.3%	-2.1%	-2.6%	-3.8%
June 2004	-5.4%	-7.9%	-7.5%	-3.0%		
June 2005	-2.4%	-2.1%	-5.5%	-3.8%		
June 2006	-1.3%	-3.0%				
June 2007	-4.8%	-3.8%				

Table A.16 ACT AWE

Forecast Date	*0-2 years*		*2-4 years*		*4-6 years*	
	Access	*Constant*	*Access*	*Constant*	*Access*	*Constant*
June 1999	5.2%	-3.3%	5.0%	-0.1%	1.7%	-4.2%
June 2000	6.0%	9.3%	0.8%	-5.1%	-8.8%	-9.7%
June 2001	1.7%	-0.1%	-1.9%	-4.2%	-0.7%	0.1%
June 2002	-6.0%	-5.1%	-16.3%	-9.7%	-10.9%	4.7%
June 2003	-6.9%	-4.2%	-8.3%	0.1%	-9.5%	-1.0%
June 2004	-6.8%	-9.7%	-1.8%	4.7%		
June 2005	2.1%	0.1%	0.5%	-1.0%		
June 2006	8.0%	4.7%				
June 2007	7.4%	-1.0%				