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The Regional Appropriateness of Monetary Policy: An Application of Taylor's Rule To Australian States and Territories

by

Javier D. Hernandez and Allan P Layton[1]

ABSTRACT

In recent years Taylor's rule has become a widely used tool for assessing the stance of monetary policy. Not only has it been used to evaluate the U.S. Federal Reserve's monetary policy, but also, for example, to evaluate the appropriateness of the European Central Bank's monetary policy for each individual member nation of the European Monetary Union. This paper builds on this work and uses Taylor's rule to evaluate the degree of appropriateness of Australia's national monetary policy to each of Australia's states and territories. National monetary policy is represented by the overnight cash rate and this is compared to a notional cash rate calculated for each individual state and territory. The aim is to illustrate the extent to which national monetary policy historically may have deviated from what might have been most appropriate for the economic conditions of each state and territory. To this end, three different recent monetary policy episodes are analysed from a regional perspective. Moreover, an analysis of the disparities between the Australian states' and territories' notional cash rates with the actual national cash rate suggests – perhaps not too surprisingly - that the Reserve Bank of Australia implicitly sets national cash rates in close accordance with the economic conditions of Australia's two most populous states.

Key words: Taylor's rule, monetary policy, Reserve Bank of Australia, regional appropriateness of national monetary policy, short-term interest rates.

1. Introduction

Given their reasonably wide acceptance, Taylor-type rules are a good starting point for a discussion of issues relating to the degree of appropriateness of monetary policy. This paper will outline a method for using a Taylor-type rule as a means to evaluate the regional appropriateness of Australia's national monetary policy.

The aim is to illustrate the extent to which Australia's national monetary policy might, at different times, deviate from what might be most appropriate for the individual economic conditions for each state and territory. This issue has been of interest for a number of years with many in regional Australia believing that monetary policy in Australia is set in too close accordance with the economic situation of NSW (more specifically, Sydney). Anecdotally there is some evidence of this. For instance, recently Richardson (2002) argued there was at least casual empirical evidence to suggest such has been the case in recent years. The purpose of this paper is to suggest a more rigorous framework within which this question might be analysed more comprehensively.

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More specifically, the stance of monetary policy may be measured by the overnight cash rate. For each state and territory then, a notional cash rate may be calculated which – conditional on the underlying assumptions involved – may be regarded as being most appropriate for the economic conditions prevailing in that region. Substantial differences between the observed national cash rate and a state's calculated notional cash rate for different periods could then be taken to indicate that monetary policy may not have been most appropriate for that region during that time.

Potentially, this type of analysis may be useful in illustrating the relative strain on each region of the nation's monetary policy adjustments and possibly also the extent to which other state-based policies may need to compensate for monetary policy which is not ideally suited to local conditions. Moreover, a "by-product" of this exercise is that, in comparing the differences between regional notional cash rates and the actual national cash rates, it is also possible to rank them according to which state or territory's notional cash rate seems closest to "tracking" the actual national cash rate.

2. Theoretical and Practical Considerations

2.1 Theoretical Background

Taylor (1993) argued that central banks should set (where it is practically possible) the relevant short term interest rate (in the US it is the Federal Funds Rate) in response to inflation and output gaps. Many have found the simple monetary rule proposed by Taylor as a useful and widely accepted benchmark for monetary policy. Given the short run non-neutrality of MP, and given that one may wish to follow a rules-based approach (as opposed to a discretionary approach), a reasonable objective would be to implement MP so as to keep aggregate demand sufficiently stable to bring about the dual benefits of keeping both inflation and output volatility low.

Studies in search of direct evidence of a negative correlation between output variability and inflation variability however have been somewhat inconclusive. The simple correlations reported by Debelle and Fisher (1994) did not find a negative relationship. However, more recent empirical studies done by Debelle based on individual countries using simulations of small estimated macroeconomic models found some evidence of a negative relationship" (Debelle, 1999:p.7).

Owyong (1996) also found that there was a significant negative correlation when the regressions used were modified to take into account the level of central bank independence to represent differences in the efficiency of central banks. An estimate of the trade-off depends on the model being used. However, Taylor (1998) argued that, provided both macroeconomic variables – inflation and output - are given a non-negligible weight in society's preferences, the optimal policy rule will aim for similar proportional fluctuations in real GDP and inflation.

In support of Taylor's findings, Debelle (1999) found there to be a short run inflation and output variability trade-off for Australia and that the appropriate relative weights to give to each variable appeared to be approximately equal. Furthermore, according to Debelle, these results have been found in other countries such as Canada and the United Kingdom (1999:p.8). Finally, de Brouwer and O'Regan (1997) evaluated the performance of a range of possible MP rules in terms of their effect on inflation and output variability using a model of

the Australian economy. They found the Taylor rule outperformed other MP rules in terms of decreasing both inflation and output variability (p.11).

Taylor's original simple rule is reproduced below:

$$r = p + .5y + .5(p - p^*) + 2 \qquad (2.1)$$

Where

r is the relevant short term interest rate - the cash rate in Australia,
p is the rate of inflation over the previous four quarters
p* is some target for inflation
y is the percent deviation of real GDP from some estimate of trend GDP.

According to equation (2.1), for the US, for example, the prescribed US federal funds rate in nominal terms is to be set by monetary authorities as a function of the deviation of inflation from its target rate (set by the FED at 2%) and the percent deviation of real GDP from its trend value. The fourth term is the long run equilibrium real funds rate, assumed to be approximately two. Taylor's simple policy rule has the feature that the federal funds rate (or overnight cash rate as it is referred to in Australia) rises if the inflation rate is above the targeted rate of inflation or if real GDP rises above trend GDP.

Judd and Rudebusch (1998) have suggested that a Taylor-rule framework is a useful way to summarise key elements of monetary policy. This view is also supported by Kozicki (1999):

"Because the Taylor rule incorporates the overall characteristics of sound monetary policy generally agreed on by analysts and policy makers, Taylor rules provide a good starting point for discussions of issues that concern policy makers" (Kozicki 1999:p. 6).

Aside from being implemented as a means to evaluate historical MP by the U.S. Federal Reserve, Taylor's Rule has also recently been utilised to evaluate the appropriateness of the European Central Bank's monetary policy to each individual member nation of the European Monetary Union. In fact, prior to the European Union implementing the final stage of transition towards a monetary union, there were a number of studies that utilised Taylor's Rule to assess what policies the European Central Bank (ECB) might pursue with regard to formulating short–term interest rates. Other studies have used Taylor's rule to estimate reaction functions of both the US Federal Reserve and the ECB.

For example, Bjorksten and Syrjanen (2000) utilised Taylor's simple rule as a means to evaluate the appropriateness of the common ECB monetary policy for individual member countries. The authors constructed an indicator called a "monetary thermometer" which attempted to determine whether the MP stance set by the European central bank was too 'hot' or too 'cold' for individual members of the European Monetary Union (EMU). Notional "optimal" monetary policy settings for each country in the Euro area were calculated using a suitable variant of Eqn 2.1. The estimated output gaps were taken from the OECD Economic Outlook.

Gerlach and Smets (1999) used Taylor's Rule to estimate reaction functions in the EU area and found that a Taylor rule in which the Central Bank responds to inflation and output gaps

accounted for recent movements in interest rates for the EMU-area[2]. In another study, using historical data from 1990-98, Gerlach and Smets (1999) also used Taylor's Rule to calculate benchmark interest rates and then compared them to the average interest rates in the countries that now form the EMU. They found that the Taylor rule estimates were very close to the average interest rates in the EMU[3]. Furthermore, they concluded that if the ECB were to conduct monetary policy using Taylor's Rule, it would not in fact deviate much from past (weighted) interest rate setting behaviour in the countries now forming the EMU area (p.4).

Finally, Taylor (1999) has also proposed that the ECB should implement Taylor type rules. He argued, on the basis of US experience, that when the Fed deviated significantly from the Rule recommendation, economic conditions deteriorated. He further argued that his rule adequately described recent pre-EMU interest rate decisions made by the Bundesbank and that because the Bundesbank at least implicitly used such a rule, inflation was not only much lower but also more stable compared to other European countries.

Taylor's rule has also been used as a means to estimate policy reaction functions. For example, Judd and Rudebusch (1998) used a modified version of Taylor's Rule to estimate the reaction function of the Federal Reserve. They econometrically estimated the reaction function weights rather than simply choosing the values of the parameters as Taylor did. They concluded that the estimates in their paper indicated that a Taylor-type reaction function appeared to capture some important elements of monetary policy during Alan Greenspan's tenure to date as Federal Reserve Chairman[4].

2.2 Some Practical Considerations for Taylor-type rules

Kozicki (1999) and Bjorksten and Syrjanen (2000) have questioned whether the policy response parameters (in Eqn 2.1) are the correct size. However, Taylor (1998) acknowledges the uncertainty regarding the appropriate size of the coefficients and proposed that the simple benchmark rule (ie Eqn 2.1) be supplemented with a portfolio of other rules with both higher and lower coefficients.

Despite its apparent success in "mirroring" past performances of the Federal Reserve, there are a number of significant limitations regarding the use of Taylor-type rules by Central Bankers that are faced with real time policy decisions. One major problem is that, given the quite significant lag it takes for MP to impact on the economy, policy-setting needs to be very much forward-looking. The existence of lags in acquiring information on output and inflation gaps makes it very difficult for policy makers to make "real time" decisions in the setting of MP using such policy rules. On this issue, Smets (1998) has argued that when there is serious uncertainty about the measured values of inflation or the output gap, policy responses should be more "muted" or, in other words, the coefficients of Eqn 2.1 should be lower.

Deviations of output from its trend are sometimes defined using the output growth rate consistent with the so-called Non-Accelerating Inflation Rate of Unemployment (NAIRU) as the trend rate of output growth. However, calculating the NAIRU is a complex exercise.

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[2] See Gerlach and Smets *"Output Gaps and monetary policy in the EMU area"* European Economic Review, April 1999 v43.

[3] See Gerlach and Smets "*The Taylor Rule and Interest Rates In The EMU Area: A Note"* BIS Working Papers, August 1999, N0.73.

[4] For a more detailed discussion, see Judd and Rudebusch *"Taylor's Rule and the Fed: 1970-1997"* FRBSF Economic Review 1998, Number 3.

Furthermore, even if one accepts the concept of the NAIRU there is the question of it changing over time. There are others who even question the very existence of a NAIRU. Assuming that one accepts that the NAIRU exists, there are quite a number of different approaches to calculate "output potential" and each may yield substantively different estimates.

If inflation and output are both on target, the Central Bank has to determine what value to use for the equilibrium funds rate (r*) in order to determine its "neutral" nominal rate. The equilibrium real rate is not "directly observable" and has to be estimated. Again, there will be alternative estimates of the equilibrium real rate that would depend on the choice of inflation measure, the choice of sample period, and the choice of estimation method.

3. A Methodology to apply Taylor's Rule to determine notional cash Rates for Australian States and Territories

The previous section proposed that, despite shortcomings, Taylor's Rule (as embodied in Eqn 2.1) may be useful in – at least historically - benchmarking MP across time and /or across regions. In the next section it will be used to calculate notional cash rates for each State and Territory in Australia over a selected span of years. In what follows we explain how we calibrate the parameters and compute the variables of Eqn 2.1 for our purpose of evaluating and comparing the regional appropriateness of Australia's national MP.

3.1 Inflation Objective

The Statement on the Conduct of Monetary Policy (signed in 1996 by the Treasurer and the Governor of the RBA) explicitly states that the RBA should target an inflation band or zone of 2-3 percent (Macfarlane, 1999:http.//www.rba.gov.au/media). For our purposes, Australia's inflation target is therefore set at 2.5 percent.

Once an inflation target is determined, the next step is to select an inflation measure. We have selected the quarterly Consumer Price Index (CPI) for both Australia and individual states and territories as the relevant price level measure from which an annualised inflation measure was calculated as (data used were from December 1980 to September 2001):

$$p_{D81} = \left(\frac{D81}{D80} - 1 \right) * 100$$

3.3 The Output Gap

As mentioned in Section 2, there are difficulties in estimating the output gap. Differences in the output gap estimates are due to the different estimates of potential GDP. For the purposes of this paper, an output gap estimate would be needed for each Australian state and territory. Whilst output gap estimates for Australia at a national level are available, none are calculated at regional levels. Of course, it would have been possible to produce regional output gap estimates using any one of a number of available methods but all are highly problematical

and, to varying degrees, contentious. This would in turn have cast doubt on the ensuing notional cash rates for each region.

In place of using an estimate of regional output gaps, the unemployment rate nationally and in each region was used. In fact, there are other versions of "Taylor-type Rules" that utilise the unemployment rate and so this course is not too unusual (see, eg, Taylor, 1998, pp.37-38). In general, the substitution of GSP (or GDP) with the unemployment rate is a reasonable course given the inverse relationship that usually exits between output growth and the unemployment rate[5]. Of course the relationship between these two variables is not perfect since not only do changes in GDP growth affect the unemployment rate but so too do changes in labour force participation rates and changes to labour productivity. Notwithstanding this caveat, in using Eqn 2.1 with unemployment rate as the second variable, two approaches were considered.

The first method uses the national unemployment rate as the unemployment 'target' for individual Australian states and territories. Therefore we would have:

$$1.\quad (a)\qquad r_{State}^{notional} = p_{state} + 0.5(U_{National} - U_{State}) + 0.5(p_{State} - 2.5) + 2 \qquad (3.1)$$

where

$r_{State}^{notional}$ = quarterly notional cash rate for the state or territory
p_{state} = state inflation rate over the previous four quarters
$U_{National}$ = National unemployment rate for the quarter
U_{State} = State unemployment rate for the quarter

alternatively:

$$1.\quad (b)\qquad r_{State}^{notional} = p_{state} + 0.5\left(\frac{U_{National} - U_{State}}{U_{National}}\right) + 0.5(p_{State} - 2.5) + 2 \qquad (3.2)$$

where percent deviations from the target unemployment rate have been used as the relevant variable.[6]

The advantage of this approach is that the target unemployment rate for each Australian state and territory is explicit and identical for each quarter, therefore avoiding any potential controversy if the target unemployment rate differed for each state or territory. The only variables would be the states' actual unemployment and inflation rates for each quarter. On the other hand, one disadvantage is that it does not take into consideration differing regional characteristics of a state's or territory's full employment capacities. In other words, it could be argued that differing state and territory employment capacities should translate into different target unemployment rates.

[5] Briefly, the relationship between output growth and the unemployment rate is known as Okun's Law.

[6] The unemployment rate data that were utilised were seasonally adjusted for all Australian states and Territories and were obtained from the Australian Bureau of Statistics (ABS).

This method, at least conceptually, also makes the assumption that the national unemployment rate for a particular quarter is a desirable target value for each state. Thus, when implementing this method at a state level, the notional cash rates for any state would be estimated higher than the national cash rate unless the state unemployment rate happened to be higher than the national rate of unemployment. This seems counterintuitive. The second approach attempts to address this issue.

As with the first approach this second method results in a "target" unemployment rate which will be the same for all states and territories (although it will vary across time). This method will therefore possess the same drawback as the first approach in that it does not take into consideration potentially diverse state and territory full employment capacities. However, this second approach overcomes to some extent the second abovementioned consideration.

Consider equation 3.3 below.

2. (a) $$Austr = p + 0.5(X_a^* - U_{National}) + 0.5(p - 2.5) + 2 \quad (3.3)$$

where,

$Austr$	=	Actual national cash rate for the quarter
p	=	Actual national inflation rate for the previous four quarters
X_a^*	=	Quantity which solves Eqn 3.3 for given data on inflation, unemployment and cash rate for the quarter
$U_{National}$	=	Actual national unemployment rate for the quarter

Equation 3.3 may be re-arranged to solve for X_a^* for each quarter. This yields:

$$X_a^* = \frac{r - (p + 0.5(-U_{National}) + 0.5(p - 2.5) + 2)}{0.5} \quad (3.4)$$

X_a^* is then substituted into equation (3.5) below to calculate the notional cash rate for each state.

$$\text{State } r_{State}^n = p_{State} + 0.5(X_a^* - U_{State}) + 0.5(p_{State} - 2.5) + 2 \quad (3.5)$$

Alternatively, using percent deviations, we would have:

2(b) $$\text{Aust } r = p + 0.5\left(\frac{X_b^* - U_{National}}{X_b^*}\right) + 0.5(p - 2.5) + 2 \quad (3.6)$$

Re-arranging (3.6), we can calculate X_b^* as:

$$X_b^* = \frac{U_{National}}{-2(r - 2 - 1.5p + 0.5 * 2.5) + 1} \quad (3.7)$$

Then X_b^* may be substituted into equation (3.8) below to calculate a notional cash rate for each state.

$$r_{Sate}^{n} = p_{State} + 0.5\left(\frac{X_b^* - U_{State}}{X_b^*}\right) + 0.5(p_{State} - 2.5) + 2 \qquad (3.8)$$

It clear from equations (3.4) and (3.7) that an *X** is first calculated at a national level for each quarter. This quantity is simply the value which equates both sides of equations (3.3) and (3.6) in an ex-post sense. Thus, when substituted into equations (3.5) and (3.8) to calculate state and territory notional cash rates, the resulting notional state cash rate will be calculated using the same consistent ex-post X* as derived from the observed national unemployment rate, inflation rate and cash rate. In this way, an ex-post consistency between the calculated notional state cash rates and the observed national cash rate is maintained.

We prefer this second method to the first alternative. However, the approach should be viewed purely as a mathematical mechanical device which is simple to calculate and methodologically transparent. It is hoped that, by utilising this approach, the dilemma and controversy of estimating an output gap will be avoided. However, it is important to re-iterate that, utilising this second approach should not be construed as calculating some version of an output or unemployment gap. The X* calculated in Eqns (3.4) or (3.7) in no way relates to some sort of estimate of an implicit (or explicit) target unemployment rate of monetary policy.

Please note that the equilibrium real rate, the last term in equation (3.3), was left unchanged at 2 percent. A different value for the real rate will result in a level shift in all of the calculated notional cash rates but will not change their relativities to each other. However, for the purposes of comparing an individual State's notional cash rate with the national cash rate a level shift can alter the economic interpretation of any calculated differences.

In relation to this issue, quite recently the RBA Governor has gone on record as indicating that the RBA regards the long term real cash rate as being around 3 – 3.5% so that the Bank's view of a "neutral" nominal cash rate is around 5.5-6% (assuming the mid-point of its inflation target range of 2-3%). In any event, a simple level adjustment is all that is needed to achieve our purposes in this analysis.

After calculating the quarterly notional cash rates for the states and territories using method 2b described above (using 2% as the last term), a weighted average of all the resulting notional cash rates is calculated. The weights used were the relative population sizes of the states and territories and the resulting weighted average was then compared to the actual national cash rate. This approach of taking a weighted average is similar to the approach of Bjorksten and Syrjanen (2000) when estimating an optimal euro area cash rate. They first calculated a cash rate for each individual member of the EMU (European Monetary Union) and then calculated a Euro cash rate weighted by country size.

Any difference between the weighted average notional cash rate and the actual national cash rate for any period is eliminated by appropriately adjusting each regional notional cash rate by the difference. For example, the calculated notional cash rate for Queensland for the June 2001 quarter was 5.29 percent. The weighted average of all state and territory notional cash rates for that quarter based on relative population size was 5.95 and the actual national cash

rate for that quarter was 6.05 percent. Therefore, the difference for the quarter was 0.10 percent (6.05-5.95). This difference of 0.10 was added to each of the state and territory notional cash rates. The new adjusted notional cash rate for Queensland was then 5.39 percent. This adjustment nullifies possible level shift errors that may have been made in estimating a long run equilibrium real rate for inclusion in Eqn 2.1 and therefore makes it possible to make meaningful comparisons between the actual national cash rate and the various calculated notional state cash rates.

3.5. Validating the 0.5 Coefficients

Finally, as noted earlier, Taylor's original formula weights policy responses at 0.5 for both inflation and output/unemployment gaps. To test these weights a sensitivity test was conducted to determine what regional notional cash rate estimates would result from changing the relative sizes of the weights; in particular, to see if the relative rankings change, or whether the dispersion amongst the states and territories is significantly different.

4. Results and Discussion

Data used for the analysis were quarterly and spanned the period December 1980 – September 2001. After conversion of the CPI data to annual inflation data the sample period commenced in December 1981.

4.1 How closely does each of the regional adjusted notional cash rates track the actual national cash rate?

The actual national cash rates and the calculated notional regional cash rates using methods 2a and 2b are graphed for each state and territory in Charts 1 - 8. Assuming the value of the cash rate represents the stance of MP, if the notional cash rate for a particular state or territory is significantly lower than the actual national cash rate, this implies that the setting of the actual national cash rate is too tight for the economic conditions of that state or territory. Whilst the preferred method for calculating the notional cash rates is 2b (the percent deviation method) because it is more consistent with Taylor's rule, method 2a is also plotted in the graphs in order to compare the two methods.[7]

[7] nterestingly, the unadjusted weighted average of the regional notional cash rates – for either method – proved to be very close to the observed national cash rate for the vast majority of time periods. Over 90% of all quarters in the analysis had differences of less than 0.2%. This suggests the use of 2% for the equilibrium real rate works reasonably well. Despite this closeness, the notional regional cash rates were nevertheless adjusted as described in the text.

Chart 1, NSW Method 2

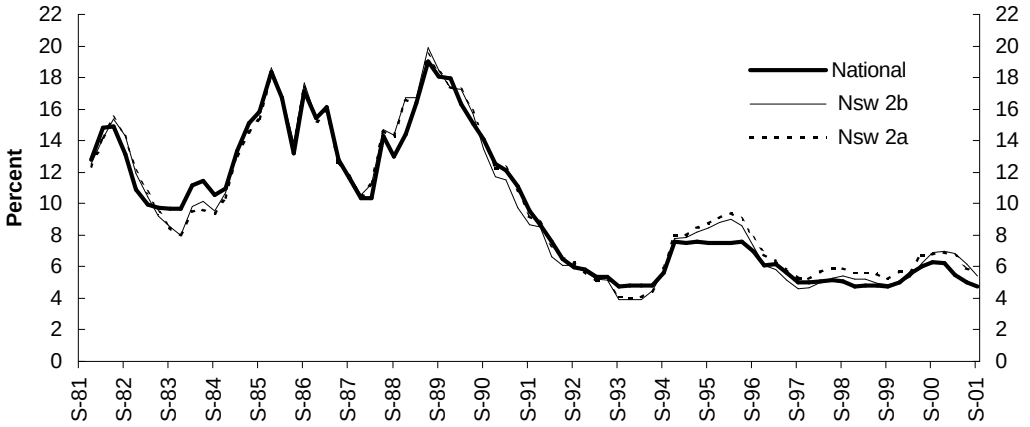


Chart 2, VIC Method 2

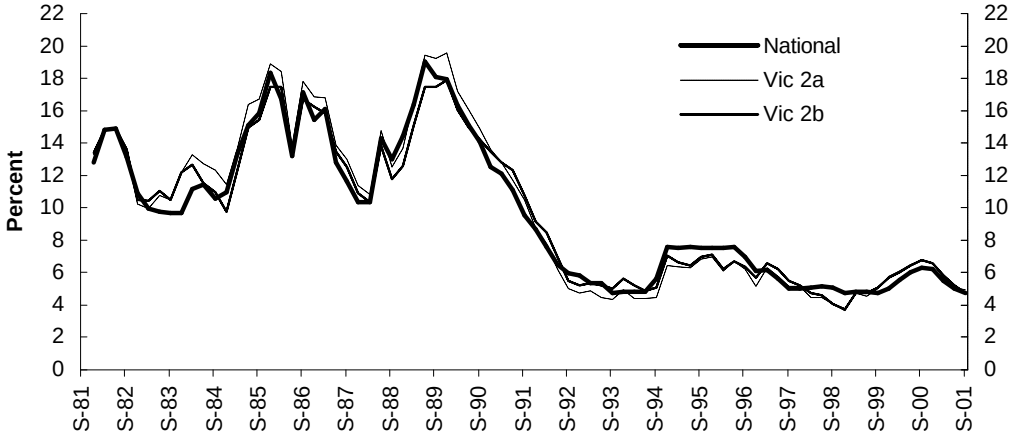
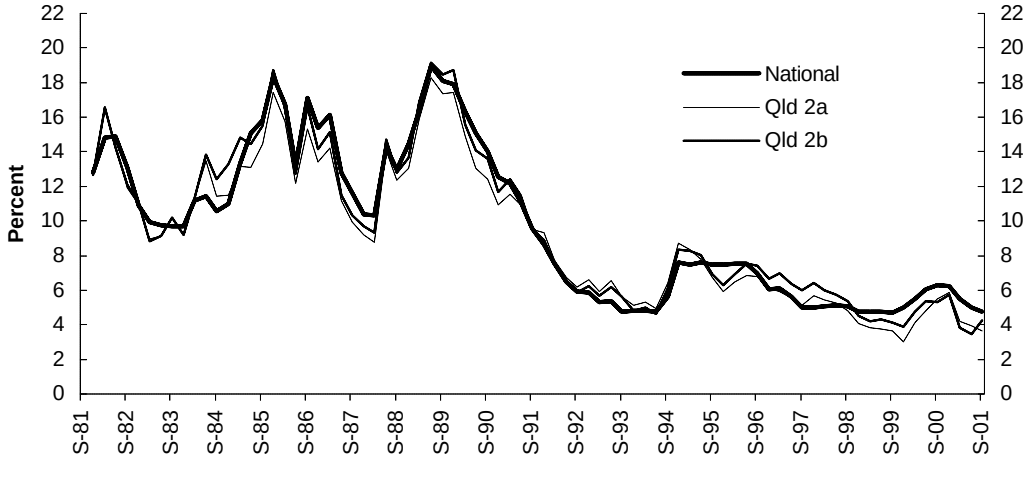


Chart 3, QLD Method 2



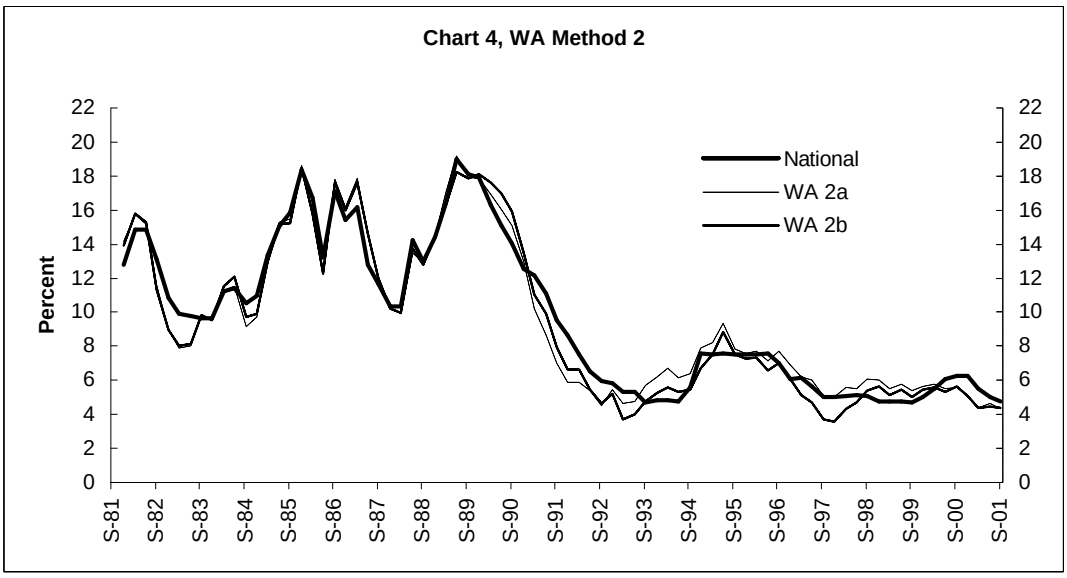


Chart 4, WA Method 2
Percent
National
WA 2a
WA 2b
0
2
4
6
8
10
12
14
16
18
20
22
S-81
S-82
S-83
S-84
S-85
S-86
S-87
S-88
S-89
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S-96
S-97
S-98
S-99
S-00
S-01

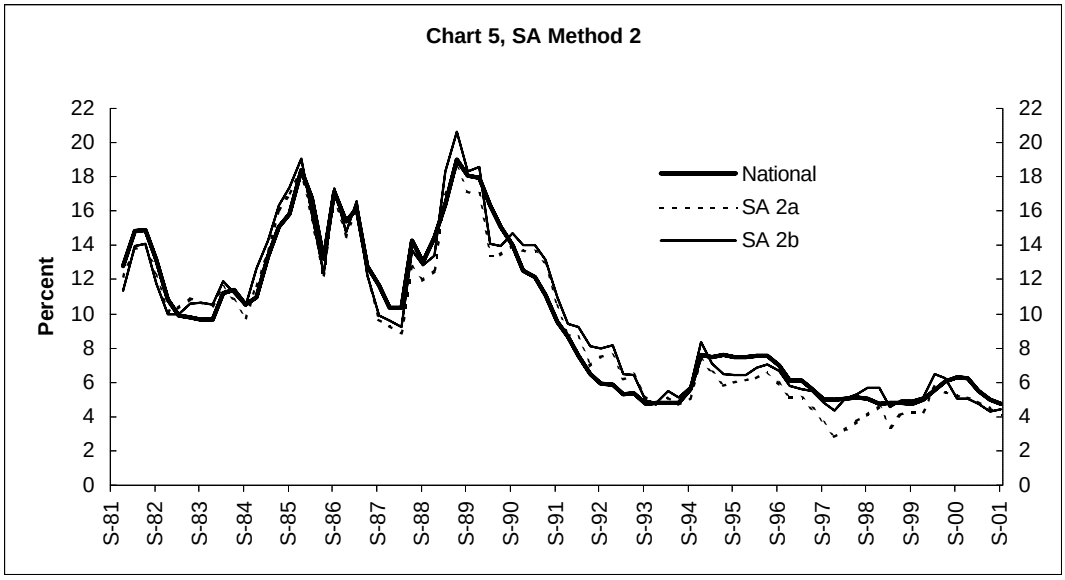
Chart 5, SA Method 2
Percent
National
SA 2a
SA 2b
0
2
4
6
8
10
12
14
16
18
20
22
S-81
S-82
S-83
S-84
S-85
S-86
S-87
S-88
S-89
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S-94
S-95
S-96
S-97
S-98
S-99
S-00
S-01

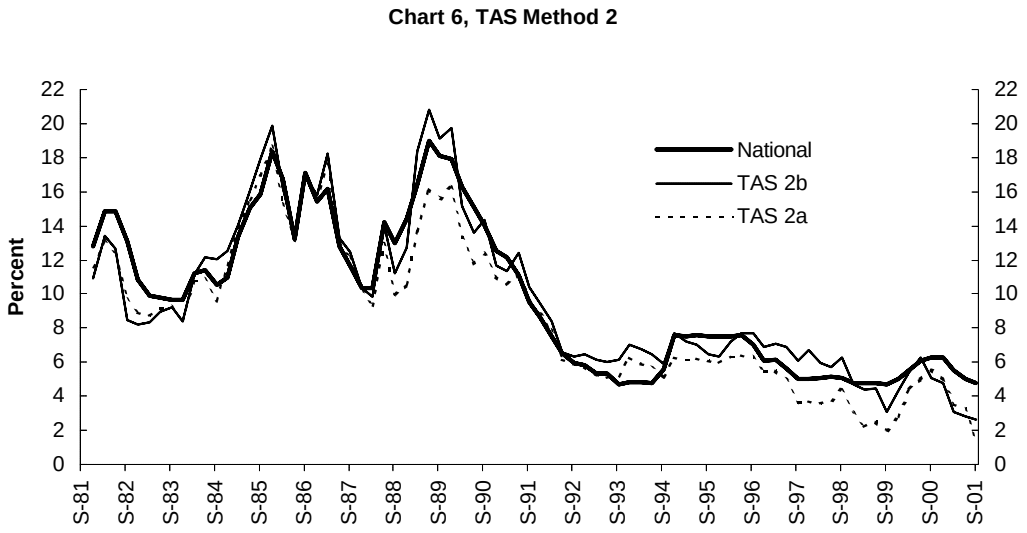
Chart 6, TAS Method 2
Percent
National
TAS 2b
TAS 2a
0
2
4
6
8
10
12
14
16
18
20
22
S-81
S-82
S-83
S-84
S-85
S-86
S-87
S-88
S-89
S-90
S-91
S-92
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S-96
S-97
S-98
S-99
S-00
S-01

Chart 7, ACT Method 2

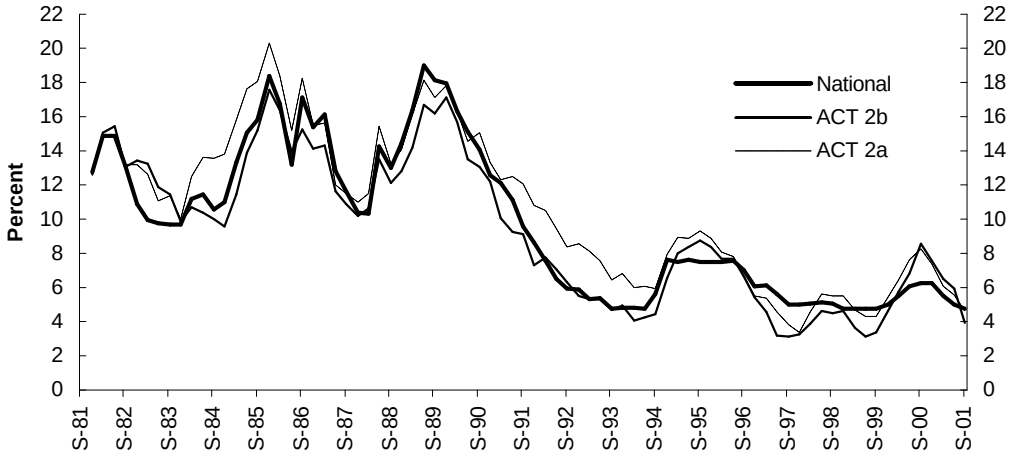
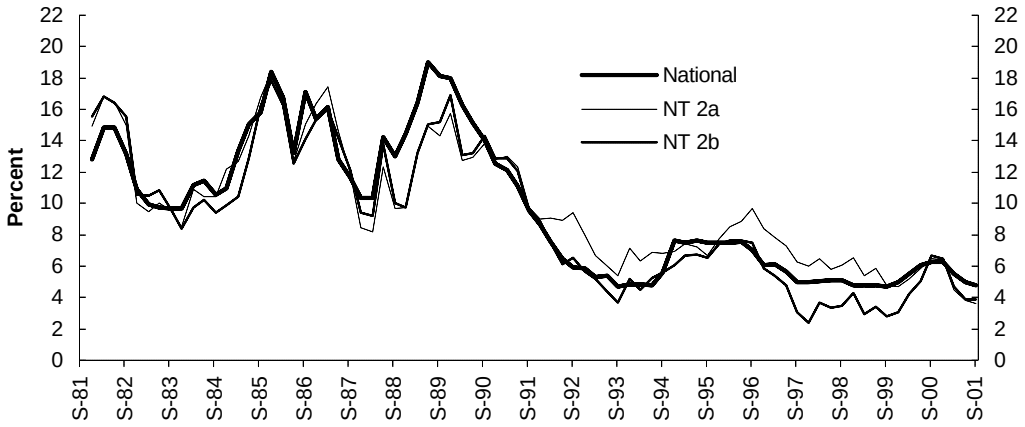


Chart 8, NT Method 2



Persual of these charts suggests that the differences between the notional cash rates for NSW and Victoria and the actual national cash rate are small and quite similar to each other. The differences for Queensland and Western Australia appear to be moderately small, while the other states and territories - and in particular the Northern Territory and the ACT - appear to be larger relative to the other regions. Instead of relying upon visual inspections of the graphs, the mean square deviation (MSD) of each region's notional cash rate from the national cash rate was calculated to provide an overall summary measure of the degree of difference.

Table 1 provides a summary of the MSDs for all the states and territories. As is again quite evident, over the entire sample period from December, 1981 – September 2001, NSW and Victoria are the states with the lowest MSDs (0.5532 and 0.5750) compared to the other states and territories. The differences between both states, however, are negligible (0.02). There is a considerable increase in the MSD for Queensland and Western Australia (about a

30 and 60 percent increase respectively relative to NSW and Victoria). For Tasmania and the Northern Territory their MSD is between three and four times that of NSW and Victoria![8]

Table 1, Mean square deviations Method 2b and 2b*

STATE/TERITORY	METHOD 2b	*METHOD 2b**
NSW	0.5532	0.5562
VIC	0.5750	0.5484
QLD	0.7259	0.7874
WA	0.8886	0.8916
SA	1.0291	1.0752
ACT	1.4958	1.4846
TAS	1.7580	1.8438
NT	2.3079	2.2788

Note: 2b* were calculated using the unadjusted notional cash rates of each region; ie prior to adding back in the differences between the actual national cash rate and the weighted average of the states' notional rates.

According to this modified version of Taylor's Rule, between the period of December 1981 through to September 2001, the notional regional cash rates that fit the actual national cash rates the closest were NSW and Victoria, followed by Queensland, Western Australia, South Australia, ACT, Tasmania and the Northern Territory in that order. The most likely explanation for the order of MSD rankings is that, when formulating national cash rates, the RBA now quite explicitly targets inflation as measured by the Australian consumer price index (CPI). The national CPI is a weighted average of all eight state and territory capital cities with weights based on their relative population sizes (refer to Australian Bureau of Statistics 6401.0). Therefore, because NSW and Victoria have the largest populations, their inflationary circumstances will significantly affect the national inflation rate and thereby more heavily influence the setting of national monetary policy.

4.2 Sensitivity testing - changing the inflation coefficient

A sensitivity test was conducted by increasing the coefficient for inflation from 0.5 to 2 while keeping the unemployment coefficient unchanged. This implies the weight given to inflation relative to unemployment varies from equality to being four times that of the unemployment variable. The modified state and territory notional cash rates were then compared to the earlier calculated notional cash rates.

Table 2 presents a comparison between the actual national cash rate and the weighted average of the state and territory notional cash rates for different values of the inflation coefficient. As can be seen, as the relative weight given to inflation increases, the various measures show an increasing divergence between the actual national cash rate and the constructed unadjusted "notional national" cash rate. These results provide some justification for selecting an inflation weight equal to that for unemployment. They further suggest that the inflation coefficient of 0.5 may be a reasonable approximation to the weight which might apply in the RBA's implicit national policy reaction function.

[8] Although not presented here, the MSDs for method 2a were also calculated. The rankings for both methods are virtually identical except that for method 2a, WA and Queensland switch ranks.

Table 2, Differences between Actual national cash rates and unadjusted weighted average notional cash rates using alternative inflation coefficients.

Coefficient	MSD	AVE DIFF	Highest	Lowest
0.5	0.0108	0.0065	0.4599	-0.1841
1.0	0.0194	0.0097	0.6175	-0.2524
1.5	0.0304	0.0129	0.7750	-0.3208
2.0	0.0439	0.0161	0.9326	-0.3892

Now, using the adjusted notional regional cash rates, Table 3 provides an indication of how the regional rankings change as inflation receives more weight. As might be expected given the results of Table 2, all the MSDs for the states and territories have increased. However, the results also indicate that increasing the inflation coefficient does not significantly alter the MSD ranking amongst the various regions. The only notable differences are that Queensland and WA switch rankings when the coefficient is increased beyond 1.0, and Tasmania and the NT also switch rankings when the inflation coefficient is increased from 1.5 to 2.[9]

Table 3, Comparison of MSDs after changing the inflation coefficient using the adjusted notional regional cash rates.

	Inflation Coefficient			
	0.5	**1.0**	**1.5**	**2.0**
NSW	0.5532	0.9644	1.5086	2.1868
VIC	0.5750	1.0148	1.7797	2.8794
QLD	0.7259	1.4945	2.6647	4.2355
WA	0.8886	1.5319	2.3867	3.4619
SA	1.0292	1.9626	3.3235	5.0834
ACT	1.4958	2.1529	3.4424	5.3642
TAS	1.7581	3.5805	6.6390	10.9045
NT	2.3079	4.3200	7.1218	10.7527

4.3 Comparing the State and Territory rankings under the different methods

Comparisons of the state and territory MSD rankings under the various methods are summarised in Table 4. The states and territories are listed in the first column of the table according to the size of their populations (in descending order). Note that Victoria and NSW consistently rank in the top 2, and Queensland, Western Australia and South Australia appear to consistently rank in the middle while the ACT, Tasmania and the Northern Territory fill the remaining ranks (6-8).

These findings are once again similar to the Bjorksten and Syrjanen (2000) paper in that they found that the European Central Bank (ECB) set the EMU MP in accordance with the economic conditions of the larger countries of Germany and France. One may therefore arrive at the perhaps unsurprising conclusion that, based on these findings, the RBA evidently sets national cash rates implicitly in accordance with economic conditions of the more

[9] The above results are similar to the Bjorksten and Syrjanen (2000) findings that increasing the inflation coefficient accentuates differences between the actual national cash rates and state and territory notional cash rates. Also, although not presented here, the exercise of increasing the inflation coefficient was also carried out using method 2a and produced similar results.

populus states. Whilst perhaps quite understandable, this nonetheless means that MP adjustments may, from time to time, be quite sub-optimal for other regions of Australia.

Table 4, Comparison of MSD rankings under various methods.

	Method 2a	Method 2b	Method 2a*	Method 2b*
NSW	1	1	1	2
VIC	2	2	2	1
Qld	4	3	4	3
WA	3	4	3	4
SA	5	5	5	5
ACT	6	6	6	6
TAS	7	7	7	7
NT	8	8	8	8

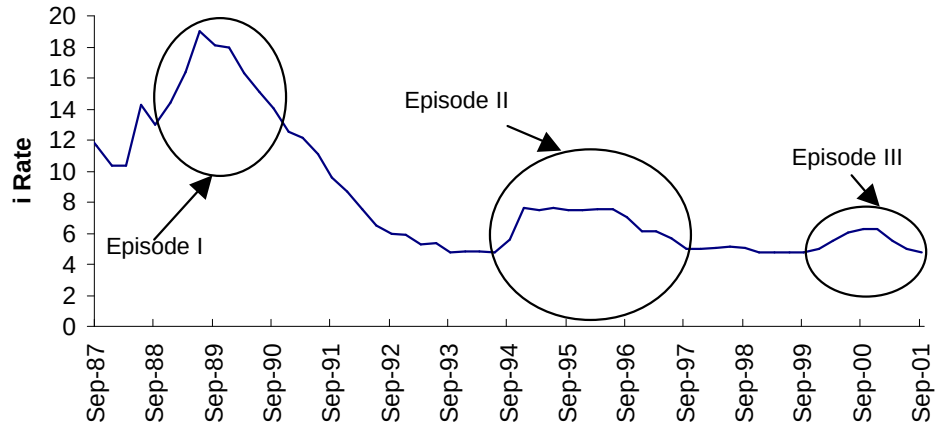
Note: 2a* and 2b* were calculated prior to adding the differences between the actual national cash rate and the weighted average of the notional regional cash rates.

In the next section three recent monetary policy (MP) episodes in Australia will be analysed.

5. Analysing three monetary policy episodes

This section focuses on providing an analysis of three monetary policy episodes in Australia. It is of interest to see whether focusing on shorter time periods will alter the MSD rankings or provide significantly different results from one episode to another.
As Figure 9 illustrates, Episode I relates to the 1988 – 1991 tightening phase, Episode II the 1994 – 1998 tightening phase, and Episode III the recent 1999 - 2001 tightening phase. Section 5.4 will then compare all three episodes.

Figure 9, Australia's National Cash Rate 1987 - 2001



5.1 Episode I, June 1988 to September 1991

The RBA commenced this tightening phase in the June 1988 quarter. In this tightening episode, the national overnight cash rate peaked at a thirty year high (19 percent) in the June 1989 quarter. The tightening phase ended in the September 1989, and the national cash rate eventually "eased" back to approximately its original level in the September 1991 quarter.

Table 5 Episode I, Differences between state/territory adjusted notional cash rates and Actual cash rates

Date	*Nsw 2b*	*Qld 2b*	*WA 2b*	*TAS 2b*	*ACT 2b*	*SA 2b*	*Vic 2b*	*NT 2b*
Jun-88	-0.460	-0.443	0.496	0.241	0.779	0.518	0.454	0.462
Sep-88	-1.370	0.188	0.189	1.784	0.845	0.134	1.254	2.992
Dec-88	-2.300	0.747	-0.030	1.710	1.624	1.060	1.808	4.697
Mar-89	-0.345	-0.485	0.134	-1.965	2.185	-1.936	1.329	3.185
Jun-89	-0.927	-0.162	0.749	-1.830	2.318	-1.653	1.535	3.918
Sep-89	-0.401	-0.379	0.263	-1.016	1.891	-0.218	0.649	2.881
Dec-89	0.614	-0.779	-0.189	-1.771	0.814	-0.606	0.054	1.056
Mar-90	-0.940	0.715	-1.331	1.140	0.637	2.242	0.257	3.210
Jun-90	-0.612	1.017	-1.898	1.474	1.601	1.110	0.155	1.866
Sep-90	0.564	0.440	-1.889	-0.282	0.966	-0.674	-0.153	-0.250
Dec-90	0.820	0.859	-0.944	0.898	0.359	-1.469	-0.927	-0.336
Mar-91	0.629	-0.281	1.102	0.832	2.091	-1.860	-0.626	-0.701
Jun-91	1.340	-0.365	1.203	-1.312	1.847	-2.067	-1.238	-0.942
Sep-91	0.854	0.037	1.562	-0.866	0.417	-1.418	-1.194	0.028
Standard Dev	1.023	0.582	1.105	1.387	0.692	1.347	1.004	1.895
Averages	-0.181	0.079	-0.042	-0.069	1.312	-0.488	0.240	1.576
MSD	1.0042	0.3209	1.1358	1.7904	2.1664	1.9226	0.9942	5.8206
MSD Rank	3	1	4	5	7	6	2	8

Note: The difference is the actual national cash rate minus the notional state or territory cash rate. A negative number suggests that the actual national cash rate is "loose" for economic conditions for that particular state/territory. A positive number suggests that the actual cash rate is "tight" for economic conditions for that particular state/territory.

Table 5 illustrates, for example, that the average of the differences between Victoria's notional cash rate and the actual national cash rate for the period June 1988 to September 1991 quarter was 0.240 percent. This suggests that the national cash rate was, on average, a marginal 24 basis points "too tight" for Victoria's economic conditions during this episode. The overall Victorian pattern would seem to be roughly the reverse of that for NSW. In fact, NSW generally seems to be somewhat out of step with other states during this episode.

Interestingly, although there were instances in which Queensland's quarterly notional cash rates were out of sync with the rest of Australia, Queensland's notional cash rates track the actual national cash rates closest during this Episode. Therefore Queensland's ranking is one (0.3209) for Episode 1 despite the fact that it's previous ranking was three for the longer sample period. Victoria and NSW again both had relatively low MSD rankings. In contrast, the Northern Territory (NT) had the highest average (1.576) and MSD (5.82). This implies that national cash rates were on average almost 1.6 percent "too tight" for NT's economic conditions during this tightening episode. Although the other states of Western Australia, Tasmania, South Australia had average differences close to zero their standard deviations were quite large. This higher volatility was captured in their MSD ranking of 4, 5, and 6 respectively.

5.2 Episode II, June 1994 to December 1998

After two years in which the national cash rate stood at or around 4.75percent, the RBA commenced a tightening phase in the September 1994 quarter. In this tightening episode the national cash rate peaked at around 7.50 percent and remained at that level for seven consecutive quarters (December 1994 – to June 1996). The national cash rate only returned to its original level (4.75 percent) in the December 1998 quarter after a period of over four years.

Table 6, Differences between state/territory adjusted notional cash rates and Actual cash rates

Date	*Nsw 2b*	*Qld 2b*	*WA 2b*	*TAS 2b*	*ACT 2b*	*SA 2b*	*Vic 2b*	*NT 2b*
Sep-94	-0.169	-0.503	0.135	-0.321	1.178	-0.111	0.526	0.016
Dec-94	-0.158	-0.739	0.875	-0.124	1.034	-0.729	0.543	1.529
Mar-95	-0.320	-0.773	-0.028	0.263	-0.529	0.392	0.836	0.804
Jun-95	-0.601	-0.443	-1.233	0.605	-0.763	1.102	1.183	0.873
Sep-95	-0.981	0.563	-0.013	1.072	-1.274	1.086	0.511	0.940
Dec-95	-1.327	1.220	0.210	1.150	-0.885	1.075	0.425	0.100
Mar-96	-1.484	0.611	0.199	0.302	-0.165	0.668	1.258	-0.151
Jun-96	-1.019	0.032	0.958	-0.165	-0.090	0.534	0.841	-0.057
Sep-96	-0.279	-0.419	0.009	-0.722	0.373	0.345	0.631	-0.492
Dec-96	-0.020	-0.598	-0.020	-0.806	0.662	0.257	0.415	0.193
Mar-97	0.331	-0.841	1.005	-0.927	1.583	0.505	-0.423	0.745
Jun-97	0.484	-0.728	0.919	-1.259	2.416	0.132	-0.580	0.871
Sep-97	0.407	-0.995	1.296	-1.049	1.890	0.208	-0.477	1.903
Dec-97	0.340	-1.452	1.426	-1.717	1.755	0.631	-0.191	2.627
Mar-98	0.050	-0.956	0.697	-0.885	1.178	0.025	0.314	1.391
Jun-98	-0.158	-0.612	0.421	-0.599	0.529	-0.194	0.521	1.764
Sep-98	-0.345	-0.278	-0.320	-1.198	0.563	-0.592	1.008	1.594
Dec-98	-0.461	0.235	-0.918	0.067	0.149	-0.894	1.059	0.492
Standard Dev	0.581	0.668	0.717	0.811	1.035	0.593	0.560	0.836
Averages	-0.317	-0.371	0.312	-0.351	0.534	0.247	0.467	0.841
MSD	0.4191	0.5589	0.5825	0.7438	1.2965	0.3926	0.5144	1.3675
MSD Rank	2	4	5	6	7	1	3	8

Table 6 illustrates that SA's notional cash rate tracked the national cash rate the closest, followed by NSW, Victoria and QLD. However, closer inspection reveals that QLD and NSW had quite similar patterns to each other as did SA and Victoria. Throughout most of this MP episode the national MP setting was "too loose" for NSW and QLD whilst for SA and Victoria it was "too tight".

5.3 Episode III, December 1999 to September 2001

The RBA commenced a tightening phase in the December 1999 quarter. In this brief tightening episode, the national overnight cash rate peaked at 6.25 percent a year later. The tightening phase ended in the December 2000 quarter.

Table 7, Differences between state/territory adjusted notional cash rates and Actual cash rates

	Nsw	*Qld*	*WA*	*TAS*	*ACT*	*SA*	*Vic*	*NT*
Dec-99	-0.0332	1.0923	-0.4277	0.6801	0.3621	-0.1197	-0.7121	1.9278
Mar-00	0.1711	0.7611	-0.0526	0.1165	-0.2308	-0.9562	-0.5105	1.2744
Jun-00	-0.2017	0.6499	0.7014	-0.2305	-0.7539	-0.1844	-0.3874	1.0107
Sep-00	-0.6163	0.9927	0.6482	1.2098	-2.2725	1.2373	-0.4997	-0.3935
Dec-00	-0.6949	0.4997	1.1660	1.4626	-1.3350	1.2178	-0.3190	-0.1983
Mar-01	-1.3508	1.6969	1.1130	2.4595	-0.9856	0.7698	-0.3149	0.8233
Jun-01	-1.1457	1.5646	0.5428	2.1709	-0.9657	0.6934	-0.2328	1.1234
Sep-01	-0.6490	0.4562	0.3408	2.1136	0.7845	0.3407	0.0114	0.8517
Standard Dev	0.5261	0.4673	0.5444	0.9932	0.9694	0.7599	0.2151	0.7625
averages	-0.5650	0.9642	0.5040	1.2478	-0.6746	0.3748	-0.3706	0.8024
MSD	0.5615	1.1207	0.5133	2.4202	1.2773	0.6457	0.1779	1.1527
MSD RANK	3	5	2	8	7	4	1	6

Interestingly, Table 7 illustrates that in this MP tightening episode the national cash rate was on average too tight for five out of the eight regions. In fact QLD stands out as being the only state or territory in which MP was "too tight" in every quarter during the entire period with

the average degree of over-tightness being of the order of 100 basis points. Only in NSW, Victoria and the ACT could MP be viewed as being insufficiently tight over this episode. This provides some support for some strongly held views at the time in states such as QLD that this MP tightening in particular was perhaps too closely geared to the economic conditions in NSW but was inappropriate for the economic conditions of other parts of regional Australia.

5.4 Comparing all three Episodes

This section compares all three episodes with respect to MSDs, averages, and standard deviations of the differences between the actual national cash rate and the state and territories' notional cash rates.

In Table 8 for each region the three episodes are ranked against each other according to the relative closeness with which the state or territory notional cash rate tracked the national cash rate. For example, for NSW the ranking was Episode II followed by Episode III and then Episode I.

Table 8: Mean Square Deviation Rankings by Episode

	Episode 1	Episode 2	Episode 3
Nsw	3	1	2
Qld	1	2	3
WA	3	2	1
TAS	2	1	3
ACT	3	2	1
SA	3	1	2
Vic	3	2	1
NT	3	2	1
Average	2.63	1.63	1.75

It appears that the actual national cash rates for Episode I tracked individual state and territory notional cash rates less well compared to the other episodes. Six out of the eight Australian states and territories ranked Episode I last, with Episode III coming second and Episode II ranking first. What this means is that, according to Table 8, the national cash rate in episode II was overall the closest to tracking individual state and territory notional cash rates.

Table 9 provides a summary of all three episodes.

Table 9: Comparing all three episodes

	Episode I, (June 1988 to Sep 1991)				Episode II, (Sep 1994 to Dec 1998)				Episode III, (Dec 1999 to Sep 2001)			
	STD DEV	Averages	MSD	MSD Rank	STD DEV	Averages	MSD	MSD Rank	STD DEV	Averages	MSD	MSD Rank
Nsw	1.0228	-0.1809	1.0042	3	0.5807	-0.3172	0.4191	2	0.5261	-0.5650	0.5615	3
Qld	0.5821	0.0792	0.3209	1	0.6679	-0.3709	0.5589	4	0.4673	0.9642	1.1207	5
WA	1.1051	-0.0415	1.1358	4	0.7166	0.3122	0.5825	5	0.5444	0.5040	0.5133	2
TAS	1.3867	-0.0687	1.7904	5	0.8107	-0.3508	0.7438	6	0.9932	1.2478	2.4202	8
ACT	0.6916	1.3123	2.1664	7	1.0351	0.5335	1.2965	7	0.9694	-0.6746	1.2773	7
SA	1.3468	-0.4883	1.9226	6	0.5926	0.2467	0.3926	1	0.7599	0.3748	0.6457	4
Vic	1.0044	0.2399	0.9942	2	0.5604	0.4667	0.5144	3	0.2151	-0.3706	0.1779	1
NT	1.8954	1.5762	5.8206	8	0.8358	0.8413	1.3675	8	0.7625	0.8024	1.1527	6

Again it is evident that NSW and Victoria consistently ranked in the top three over the three episodes analysed. For NSW, its averages over the three episodes were consistently negative meaning that the actual national cash rate was insufficiently "tight" for NSW's economic conditions over all three episodes analysed. The less populous regions such as NT, Tasmania, ACT consistently ranked towards the bottom in respect of their MSDs. The findings in this section are consistent with the previous in that one can conclude that the RBA evidently sets national cash rates implicitly in accordance with economic conditions of the two most populus states.

6. Conclusions

It is hoped that this paper has provided some groundwork for continuing research into the measurement of the degree of regional appropriateness of Australia's nationally-based monetary policy. Such measurement is a precursor to discussions of the policy ramifications of significantly large regional disparities in the appropriateness of specific monetary policy adjustments. A few final remarks follow.

First, some caveats of the analysis should be highlighted. We have used unemployment in our Taylor Rule formulation. A variety of alternative formulations would have been possible within the essential framework being suggested here. For example, it would be possible to perform a similar analysis using the differences between regional economic growth rates and the national economic growth rate (ie, essentially using the national economic growth rate as the notional "target" for each state and territory). Alternatively, it would be possible to use unemployment but to use the national unemployment measure as the regional "target" as was discussed in the paper. Other alternatives may no doubt also be possible. Such alternatives may certainly alter rankings somewhat, however, our feeling is that the overall substantive conclusions found here will nonetheless be sustained.

Whatever alternative is used, however, we strongly recommend using a weighted average adjustment procedure such as has been described in the paper before drawing any conclusions about the regional appropriateness of MP. Adjusting the notional regional cash rates – arrived at by whatever method - so that their weighted average accords with the observed national cash rate is, in our view, very necessary to allow proper relative comparisons across regions as well as to meaningfully compare the notional cash rate for each region with the national cash rate.

Second, one interesting, potentially important, example of regionally inappropriate national MP may arise as follows. Say one of the larger states was experiencing rapid growth, perhaps brought about in part by expansionary state fiscal policy, resulting in that state's inflation rate increasing. This will in turn "drive" the national inflation rate upward given the relatively large weight of that state's CPI in determining the national CPI. As a result, the setting of national monetary policy may be adjusted with the national cash rate being raised to combat the upward drift in inflation. This would then burden other states and territories with national cash rates which were sub-optimal for their particular economic circumstances. The scenario just described is sometimes referred to as "inflation bias" (Bjorksten and Syrjanen, 2000) in the European literature. It clearly means, for example, that the economic circumstances and state fiscal policy settings of the more populous states are of more than a passing interest to the other smaller states and territories in the commonwealth.

As a final point, whilst this paper quite clearly highlights the fact that it appears the RBA sets monetary policy implicitly in accordance with the economic conditions of the more populus states, it is not the intention to criticise the RBA for this. Just as it would be rather foolhardy for the European Central Bank to fix European cash rates in accordance with smaller EU member countries such as Luxemburg or Ireland, it would clearly be quite inappropriate for the RBA to set national cash rates in accordance with the economic conditions of the nation's smaller states or territories. However, it is nonetheless important for the RBA and other policymakers to have some measure of the extent to which nationally determined MP may be sub-optimal for the prevailing economic conditions in some of the smaller states and territories, and this paper has attempted to demonstrate how such a measure might be calculated.

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