Comments on Brischetto and Voss (1999): Forecasting Australian Economic Activity Using Leading Indicators

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The question addressed in Brischetto and Voss is whether leading indicators can make a useful contribution to our understanding of business cycles in ways other than as indicators of turning points in the cycle. They are at some pains to emphasise that they are not trying to put forward leading indicators as a once and for all explanator of activity whereby we can throw away all our other tools of analysis and need only concentrate on what is happening to the leading indicator as our forecasting tool. This is worth re-emphasising as it would be easy to read the paper in this way, however it is more of an exercise to see what information can be usefully extracted from the leading indicator series as a means of examining the characteristics of the business cycle.

The paper contains quite a number of different empirical variations examining the relationship between leading indicators and activity/employment. For the purposes of this discussion I will limit myself to examining their results for the relationship between the Westpac-Melbourne index and real GDP. Most of what follows could be similarly applied to the other combinations in the paper. The choice of the Westpac-Melbourne index and real GDP is simply justified in that the Westpac-Melbourne index seems to be the most successful of those Brischetto and Voss examine and GDP is arguably the activity variable of the most interest to practitioners.

Brischetto and Voss consider several two variable Vector Autoregression models of the relationship between the Westpac-Melbourne leading index and real GDP. Here I will examine these in the context of the VAR in differences results – akin to those presented in Figure 2 and Appendix C in their paper. One of the conclusions they draw from this work is that

"… for prediction, what really matters is the relationship between the activity variable of interest and its own history." (Brischetto and Voss p.15).

At least part of this conclusion is based on the forecast error variance decomposition results of the analysis. Consider a bivariate VAR with 8 lags as per the Brischetto and Voss analysis. In reduced form this can be expressed:

$$x_t = \sum_{j=1}^{8} A_j x_{t-j} + e_t$$

where x_t is the vector containing the variables ΔWestpac-Melbourne index and ΔGDP, A_j a matrix of parameters and e_t a vector of reduced form errors. This system can be rewritten as a moving average of the error terms and some initial conditions.

$$x_t = \textit{initial conditions} + \sum_{i=0}^{T} C_i e_{t-i}$$

$$\text{where} \quad \begin{cases} C_i = 0 \ \textit{for}\ i < 0 \\ C_0 = I_2 \\ C_1 = A_1 \\ C_i = \sum_{j=1}^{J} A_j C_{i-j} A_1 \quad \textit{for}\ i \geq 1 \end{cases}$$

The forecast error variance decomposition is based on this expression such that the conditional variance the variable x at k periods ahead is given by

$$\text{var}_t(x_{t+k}) = \sum_{i=0}^{k} C_i \Omega C_i'$$

where Ω is the variance of the reduced form errors. The forecast error variance can then be decomposed into components associated with each of the associated structural errors and this returns the decompositions used in Brischetto and Voss.

These forecast error variance decompositions give an overall picture of the average ability of the variables to contribute to explaining the variation in other components of the system. So for example, in Appendix C Brischetto and Voss show that changes in the Westpac-Melbourne index can account for only about 13% of variance in GDP changes at the 3 year horizon, and even less at smaller horizons. GDP itself accounts for the rest, prompting their conclusion about the importance of its own history in this structure.

It is also possible for us to look a little more closely at the within period performance of this analysis. The theme I want to develop more generally is that the forecasts we produce are going to be highly dependent on the period and model we use to generate them. In this context, we can examine the contribution of changes in the Westpac-Melbourne index to explaining changes in GDP observed during the estimation period. Because we are using the model as estimated, recall that this takes into account 8 lags of the index in estimation. The contribution of changes in the Westpac-Melbourne Index and GDP itself to changes in GDP over the cycle can be seen in Graphs 1 and 2, where the solid black line is the change in output series itself and the fine line the contribution made by the component series. The remnant is accounted for by the combination of the estimation error and the initial conditions.

Chart 1:

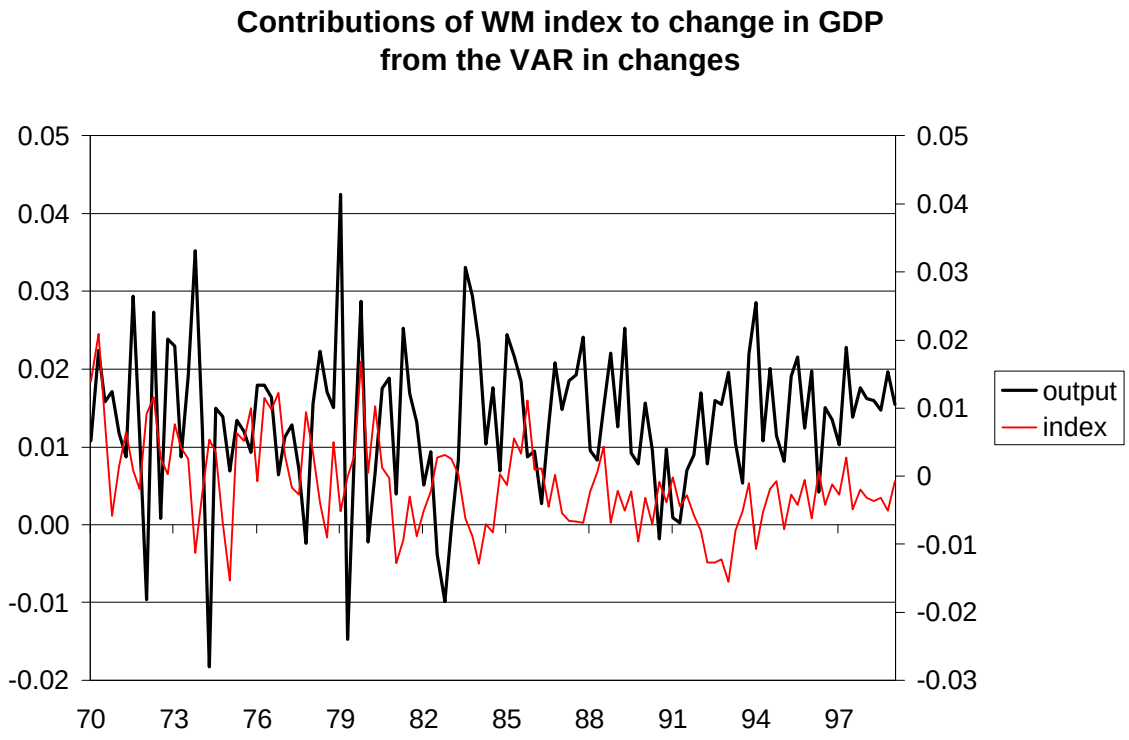


Chart 2:

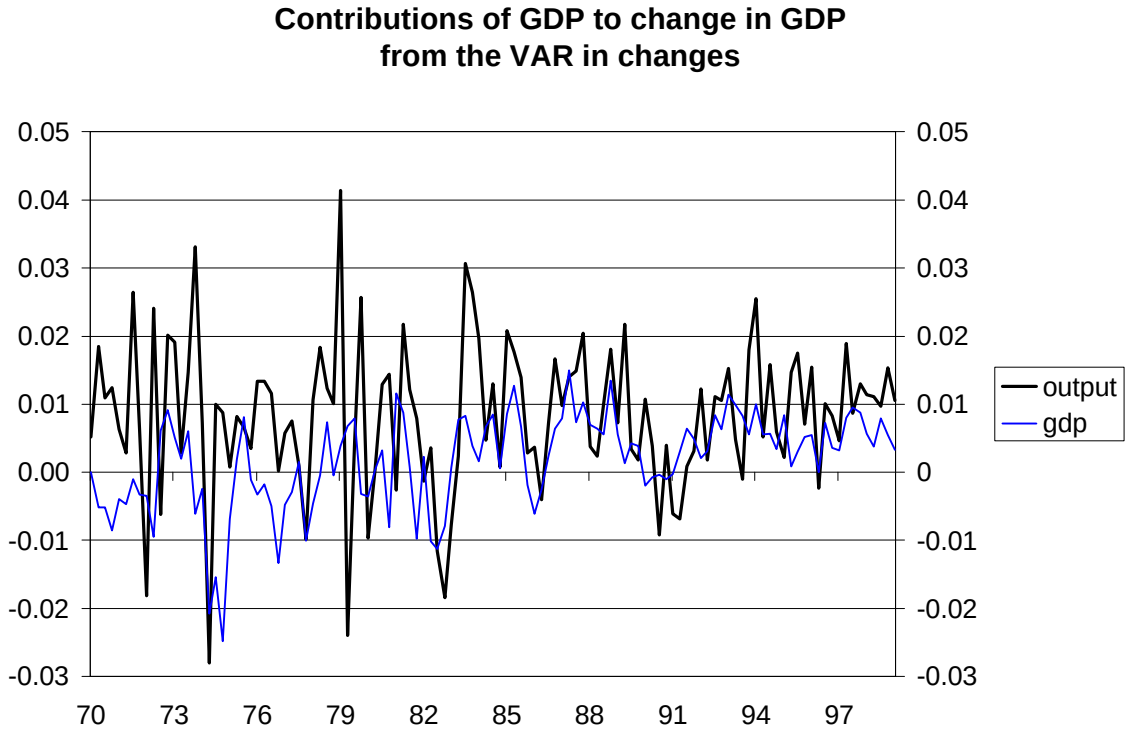
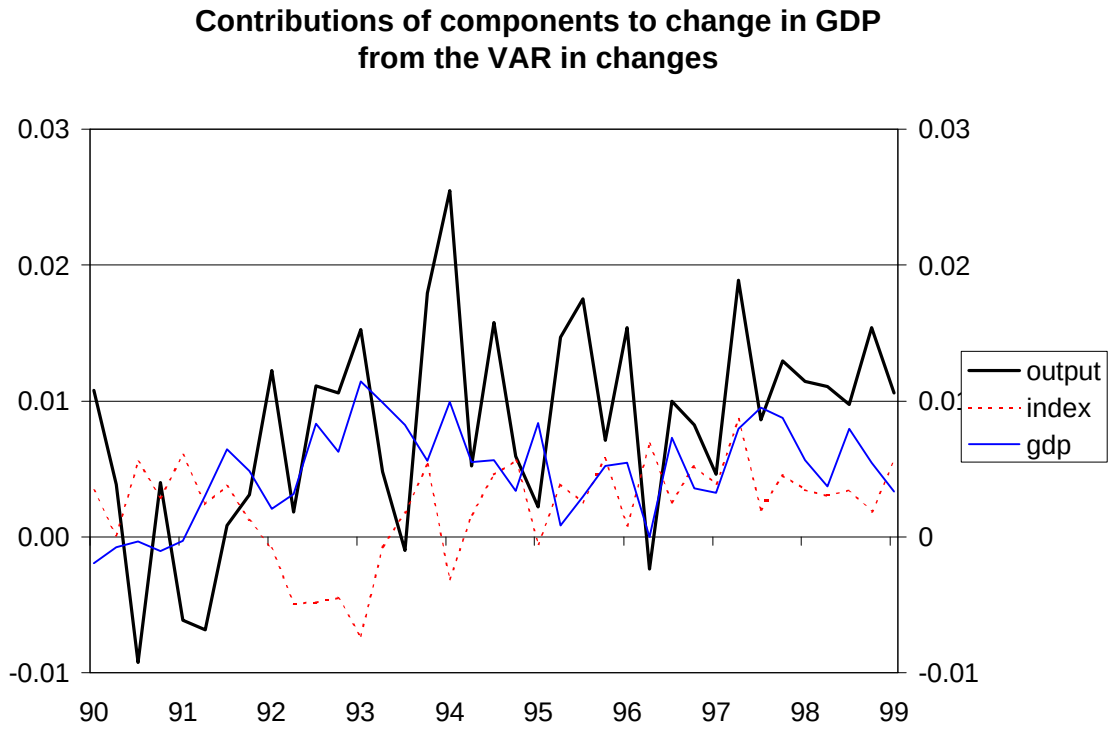


Chart 3.



These charts emphasise the results in Brischetto and Voss that the lagged changes in the GDP series itself is a more able explanator of the realised changes than changes in Westpac-Melbourne index. The charts would seem to illustrate that this is more pronounced in the 1990s than for the total sample period – this period is highlighted in Chart 3.

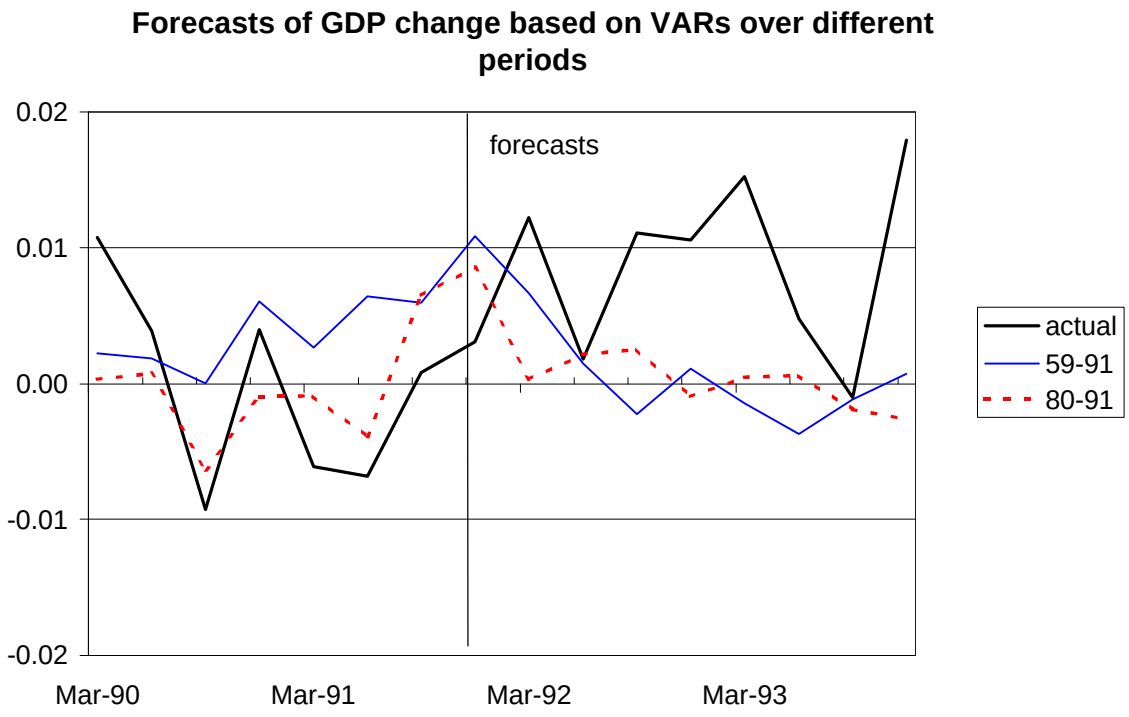
In comparing the different VAR models, Brischetto and Voss look at several aspects. One of these is their forecasting performance, based on historical estimations to 1991:4 and rolling forecasts forward for 8 periods – that is the forecasts are updated each period and an 8 period ahead forecast taken. I want to examine, for a moment, the implications of forecasting from an historical model taken over different time periods. Although we increasingly use sophisticated techniques to capture aspects of our data in forecasting, ultimately the historical scenario we use in setting up the model will have a large influence on the results. This aspect is important to bear in mind when we are trying to compare the forecasting performance of different models, particularly if those models have different information sets on which to draw. For example, usually we would wish to use as much information as possible in determining our forecasts, which would lead to the longest possible data periods. However, it could be the case that some form of structural change has occurred that we are unaware of, in which case a model with less data will have a better chance of forecasting well than the longer period model. I want to explore these issues a little further in the context of the forecasting comparisons Brischetto and Voss have presented in their paper. For the purposes of presentation I am going to concentrate on the historical fit of the models and the first 8 period forecast which ensues from those models.

Consider the experiment that is conducted in comparing the forecasting performance of the different models for GDP changes, whereby the models are estimated until 1991:4 and then an 8 period ahead forecast taken. Here I am going to concentrate again on the VAR in differences comprising the Westpac-Melbourne index and GDP, and contrast that with the estimates from the structural model of Gruen and Shuetrim (1994) as reported in Brischetto and Voss.

Brischetto and Voss construct forecasts from the Westpac-Melbourne Index/GDP system estimated over the whole data period from 1959-1991. These are then compared with

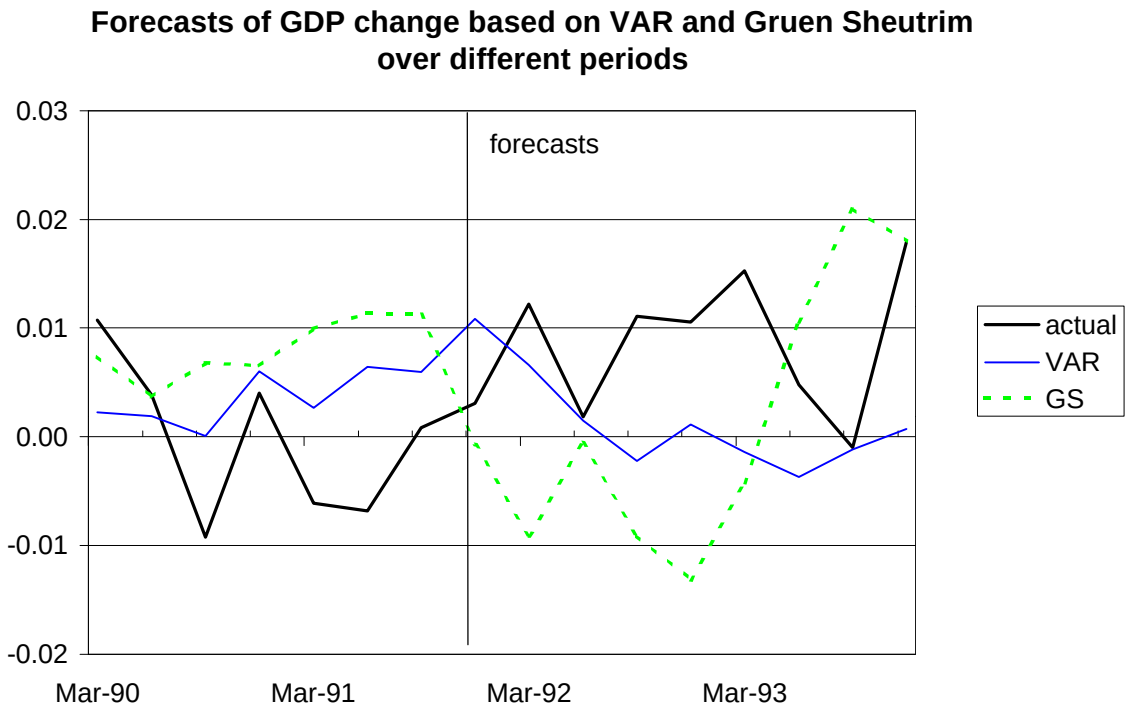
forecasting results from the Gruen and Shuetrim model which is estimated with data from 1980-1991. To clarify what is going on here, we can examine the first 8 period forecasts which result, shown in Chart 4.

Chart 4:



The solid black line represents the actual GDP changes outcome, the fine line gives the fitted values of the VAR prior to the end of the estimation period, and the forecasts thereafter. Similarly the broken line gives the fitted values and forecasts from the Gruen and Shuetrim estimation over this period (for the record the RMSE recorded for these two models for this first 8 period forecasts were 0.0134 and 1.3181 respectively). The performance of each of these forecasts individually is not my real concern here. What I want to examine is whether the information content of the data period chosen may be influencing the results. Consider comparing the forecasting results from these two methodologies estimated *over the same time period*, so that they both have equivalent chance of including structural changes in the economy for example. To do this I re-estimated the VAR in differences over the period 1980:1 to 1991:4 and as above constructed the 8 period ahead forecast. The comparison of the two VAR forecasts is shown in Chart 5.

Chart 5:



The chart shows that the behaviour of the forecasts differs over the two periods, and in this case the RMSE of the VAR estimated over the shorter data period is 0.0070, compared with the 0.0134 for the original. While the differences in the forecasts are unlikely to be statistically significantly different (the confidence intervals on VARs are notoriously wide) we can see that even the directional signals given by forecasts based on two different historical periods are quite different. To emphasise this further, consider some further results from the VAR estimated over the shorter time period. Table 1 shows the forecast error variance decompositions for the Westpac-Melbourne Index/GDP model based on firstly the full data period reported in Brischetto and Voss, and secondly based on the time period for which the Gruen and Shuetrim model was estimated, that is 1980:1 to 1993:4. The results clearly show the differences. If the second period had been chosen the results indicate that the Westpac-Melbourne leading index has an important role to play as a contributor to explaining variance in changes in GDP at relatively long horizons. This contrasts strongly with the results drawn based on the longer data period. In this case we would no longer be certain that the best explanator of activity is its own past lags.

Table 1:

Forecast error variance decompositions: VAR in differences, WM and GDP

innovation	forecast (quarters)	Proportion of forecast error variance based on 1959-99 GDP	based on 1980-93 GDP
WM	1	0.02	0.19
	2	0.02	0.37
	4	0.14	0.53
	8	0.13	0.52
	12	0.13	0.51
GDP	1	0.98	0.81
	2	0.98	0.63
	4	0.86	0.47
	8	0.87	0.48
	12	0.87	0.49

To emphasise this a little further, consider again the results in Chart 3, but now we will compare the results for the contribution of GDP and the Westpac-Melbourne index constructed from the shorter data period.

Chart 6:

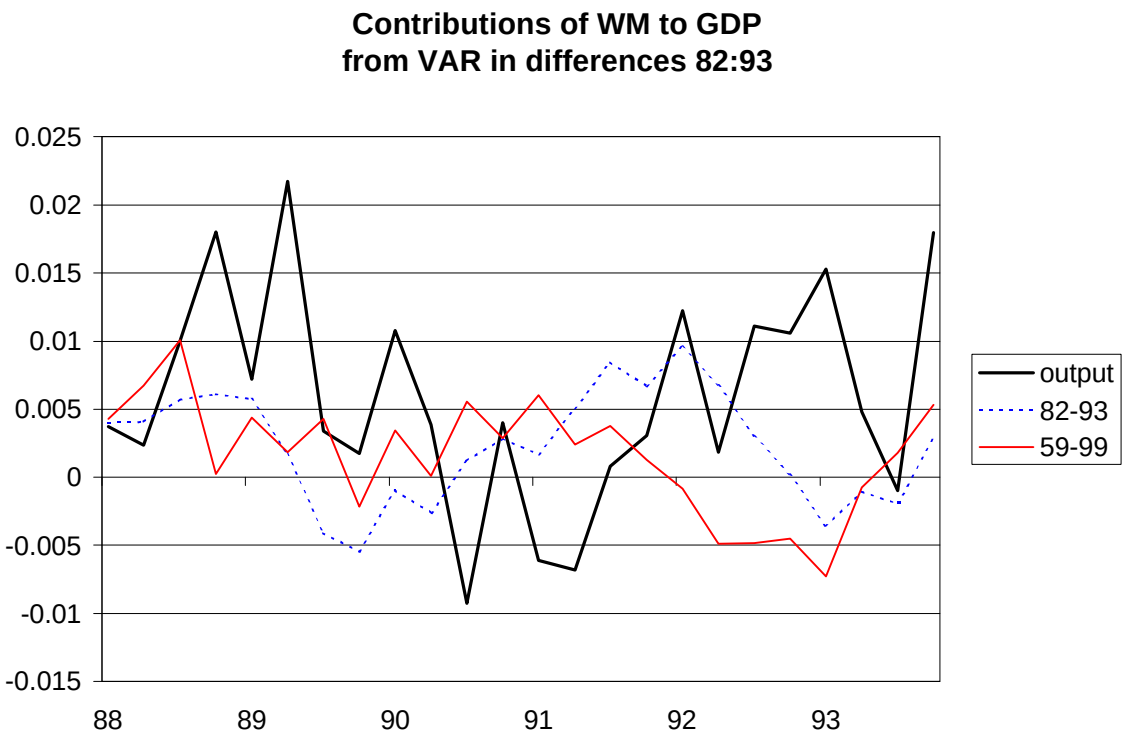


Chart 7:

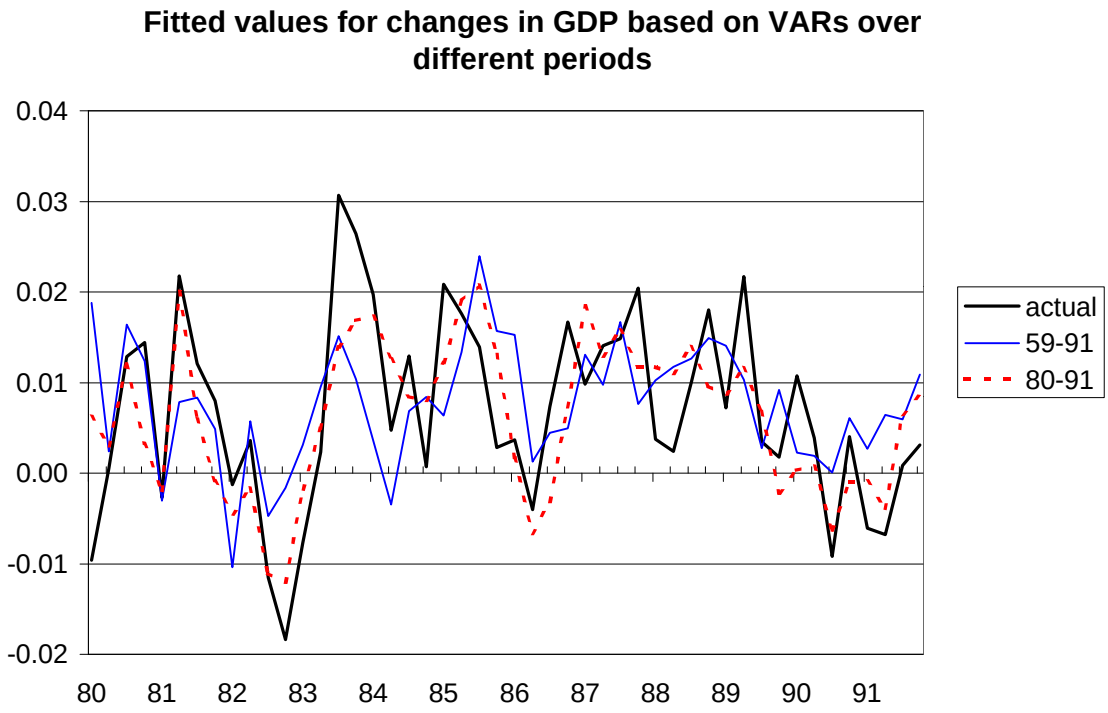
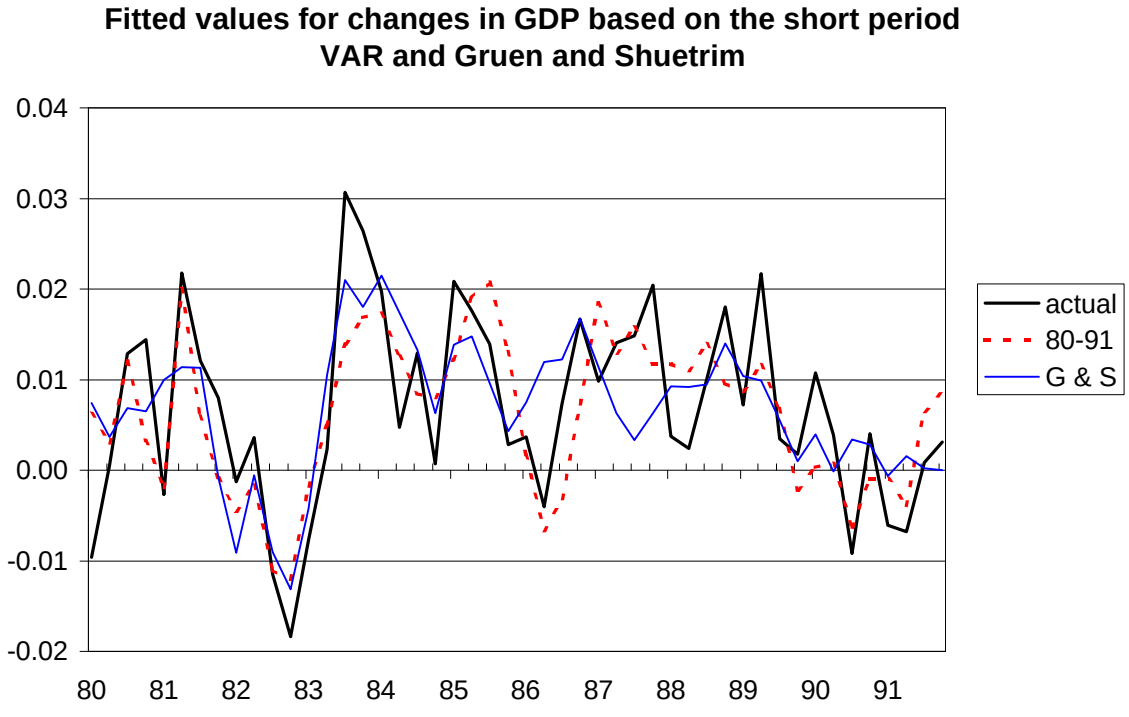


Chart 8:



As we can see from Chart 6 the contribution of the index to the changes in GDP is higher over the period than for the longer data period. We can also see from a comparison of the fitted values of Gruen and Shuetrim and the VAR that the fitted values from the smaller data sample seem to do much better than those from the VAR based on the whole period; Charts 7 and 8.

The results of all these comparisons then really are to make the following points:

1. The overall figures like the RMSE statistics and forecast error decompositions give us an 'average feel' for the analysis. By working a little further with these decompositions we can see more clearly how each of the components might be helpful over the course of the business cycle. In this case the results based on a VAR in differences of the Westpac-Melbourne leading index and GDP over 1959 to 1999 show that the index has relatively little to contribute, although in analysis of other VARs this has shown quite important detail missed by the overall figures.

2. The second aspect to emerge from this exploration is the difficulties inherent in constructing and comparing the performances of models. I have demonstrated that the results change quite markedly for different data periods. This really leaves us with a couple of questions; one of these is how should we compare the forecasting performance of different models, to which I would answer we need to take care that they have similar information sets in order to truly compare our results. However, this stance would not be without its dissenters – others may well argue that you wish to compare the performance of the models *as they are estimated* in your bank of models. The second, and most important question from other than an academic view is which of the models is better? Here I will fall back on Brischetto and Voss' viewpoint that this was not an exercise to actually forecast GDP, but rather to see in what way leading indices may be able to contribute to our understanding. From that point of view I think it is probably important here that the results be constructed over the same estimation periods. I would also point out that there is currently quite a deal of research, going on into the stability properties of VAR models, as many of them seem to encounter difficulties in producing consistent results over only marginally different data periods.

3. Finally, in conclusion, I believe there will always be a place for leading indices as a means of concisely summarising a lot of information in a simple form. Their use in regression analysis is less frequent than use of their components, which simply reflects that indices are a handy guide to our thinking, whereas when we wish to construct a rigorous model it is advantageous to free the parameters on the index components in our analysis.