LEADING INDICATORS OF EMPLOYMENT

IN SOUTH AFRICA

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Acronyms

BER	Bureau for Economic Research
GDP	Gross Domestic Product
LIE	Leading Indicator of Employment
LIESA	Leading Indicators of Employment in South Africa
SARB	South African Reserve Bank
Stats SA	Statistics South Africa

Executive summary

It would be useful for many purposes if there were an indicator that anticipated changes in employment before they occur. This study explores the possibility of constructing such a leading indicator.

It begins by examining the relationship between employment and GDP over the business cycle. Employment cycles are found to be coincident with the business cycle. This relationship is used to select leading indicators of the business cycle as potential candidates for leading indicators of employment. On the basis of these, two alternative Leading Indicators of Employment for South Africa (LIESA) are constructed.

The performance of both of these alternatives exposes a number of weaknesses. Possible reasons for this are poor employment data and the changing nature of the employment cycle after 1994. Despite this, the exploration does suggest there is a basis for taking the work further.

We recommend that should the work be continued, there is a need to create a standardised employment data series. There is also a need to develop an institutional basis for the construction of employment indicators.

1. Introduction

This study explores how an indicator might be constructed that can be used to predict where employment is going. To do this, we have explored the various series that are used to construct the South African Reserve Bank's (SARB's) leading, coincident and lagging indicators of the business cycle. For such an indicator to become useful, it should be produced on a systematic and regular basis over a number of years. To proceed with this, we recommend that a more rigorous and detailed investigation be undertaken, to place the indicator on a firmer foundation than we have been able to do within the confines of this project. Our work must therefore be seen as exploratory. We want to establish a prima facie case for institutionalising the regular production of an employment indicator series.

Business cycle analysts typically identify cycles in GDP and then examine series of other variables to find those whose turning points precede GDP turning points with some regularity (leading indicators), those where turning points coincide (coincident indicators) and those where the turning points occur after GDP (lagging indicators). Having identified leading series, a composite leading indicator is then constructed as a weighted aggregation of the leading series. The weights are typically determined by an econometric process to find the best-fitting composite. We attempt to do the same thing for employment (rather than GDP) cycles.

2. Business cycle analysis at the South African Reserve Bank

Before proceeding with the employment cycles, it is useful to review the long tradition of work on the South African business cycle within the SARB (see Smit & Van der Walt 1970, 1973, 1982; Van der Walt 1983, 1989; Van der Walt & Pretorius 1994, 1995; Pretorius, Venter & Weideman 1999; Venter 2004; Venter & Pretorius 2004). This work has entailed identifying the turning points of cycles since 1945 and constructing composite leading, coincident and lagging indicators. There has also been regular revision of the indicators.

This work has developed a number of indices:

- The *composite lagging indicator:* a weighted average of selected individual economic indicators which have historically preceded changes in general economic activity.
- The *composite leading indicator:* a weighted average of a selected number of individual economic indicators which have historically preceded changes in general economic activity.
- The *coincident indicator*: a weighted average of selected economic indicators which have historically coincided with the business cycle.
- The *current diffusion index*: a composite of month-to-month percentage changes in 251 seasonally adjusted time series of production, demand, employment and income in different sectors, weighted by contribution to aggregate value-added.
- The *historical diffusion index*: "the number of series which increase during any particular period as a percentage of the total number of series under consideration".

A central step in constructing these indices is the identification of reference turning points in the business cycle. This involves working out deviations from trend for a large number (251) of de-seasonalised series. These are then used to construct the historical diffusion index. Turning points occur when this index moves below or above 50%. In other words, a downturn occurs when fewer than 50% of the series are rising. The various series and indicators have been reviewed and modified regularly (1983, 1994, 2004, 2008).

Table 1 shows the thirteen labour-related series that have been used over time. Ten of these are employment-related and three are productivity- or cost-related. The employment-related series seem to have been changed regularly, mainly because the relationship between the series cycle and the reference turning points is inconsistent.

Table 1 – Labour-related series included in SARB business cycle indicators

	Series	*Type*	Used in revisions in:		
			1983	1994	2004
1	Registered unemployed whites, coloureds and Asians	Coincident	1		
2	Total employment in the mining sector	Leading	1		
3	Number of appointments per 100 production workers in manufacturing	Lagging	1		
4	Employment in the manufacturing, mining and construction sectors	Coincident	1	1	
5	Total number of hours worked by production workers in the construction sector	Lagging	1	1	
6	Employment in non-agricultural sectors	Lagging	1	1	
7	Labour costs per unit of physical volume of manufacturing production	Lagging	1	1	
8	Overtime hours as percentage of ordinary hours worked in manufacturing	Leading		1	
9	Total formal non-agricultural employment	Lagging	1	1	
		Coincident			1
10	Job advertisements in the *Sunday Times* newspaper: six-month smoothed growth rate	Leading			1
11	Opinion survey of the average hours worked per factory worker in the manufacturing sector	Leading			1
12	Labour productivity in manufacturing: six-month smoothed growth rate	Leading			1
13	Nominal labour cost per unit of production in the manufacturing sector (percentage change over four quarters)	Lagging			1

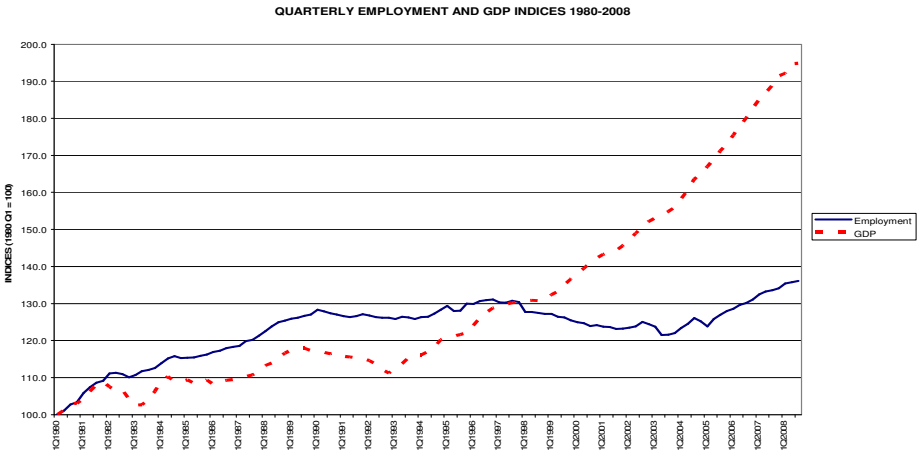
Sources: Pretorius et al. 1999; Van der Walt & Pretorius 1994; Venter 2004; Venter & Pretorius 2004

The work done at SARB over the years suggests that cycle analysis requires consistent work sustained over a number of years collecting consistent high-frequency series of data.

3. Employment and GDP in South Africa

Since employment essentially derives from the demand for labour in producing output, we might expect cycles in employment to follow cycles in GDP. Figure 1 shows that although there was a rough similarity between the trends in GDP and employment between 1980 and 1998, there was a growing divergence from then on. This divergence has been noted, and disputed, by many analysts. It may well be a reflection of the poor employment data rather than of a real trend. However, while the accuracy of the statistics is important for identifying trends and cycles, for the purposes of this study we have to work with what is available and therefore take the divergence as real.

Figure 1 – Employment and GDP in South Africa, 1980–2008



Source: SARB

Figure 1 shows the relationship between the level of GDP and the level of employment. From this perspective, although there are some fluctuations, neither series displays strong cyclical behaviour. This raises the problem of definition of cyclicity in a variable. Although it is possible to define cycles as movements in the level of a variable, a more common definition is in terms of deviations from a trend. Traditional business cycle theory decomposes the movement of a variable over time into its trend, cycle, seasonal and residual components. We can extract the cyclical component by removing the other three through some smoothing process.

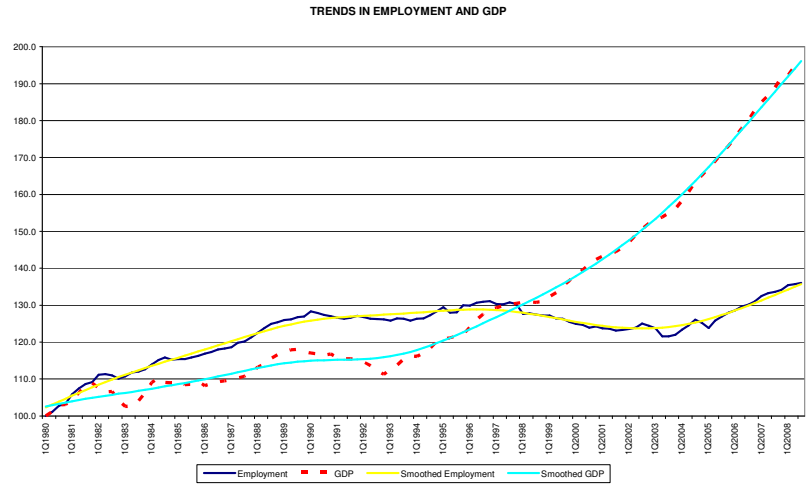
There are a variety of procedures for smoothing. We work with series that have had the seasonal component removed at source. To examine the cyclical component we need to estimate the trend. We do this using a method known as the Hodrick-Prescott filter (see Appendix).

Figure 2 shows the trends in quarterly employment and GDP since 1980. Although we could have fitted linear trends to both series, we have chosen not to smooth so excessively, but to retain some of the obvious non-linearity in the trend.1 We can see that

[1] Technically, we have selected a smoothing factor of 1600 in the HP filter. This is a commonly used value.

there appears to be a long cycle in the employment trend, with a peak in the second quarter of 1996 and a trough in the third quarter of 2002. With this degree of smoothing there is no long cycle in GDP.

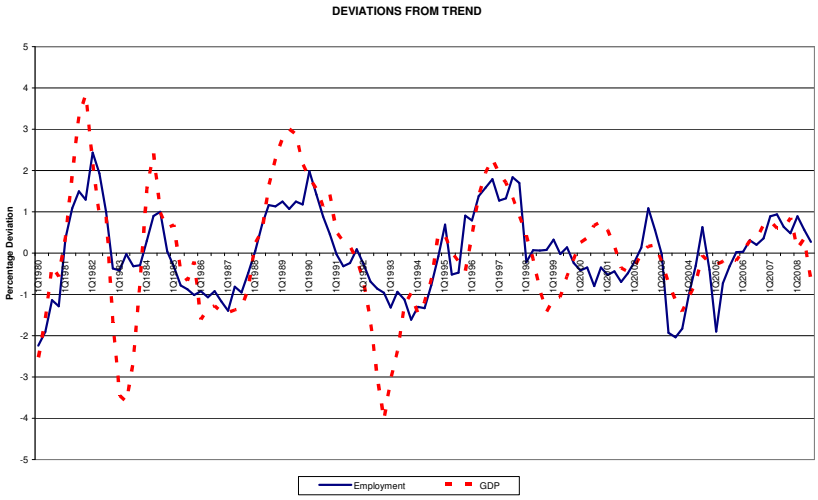
Figure 2 – Employment and GDP 1980–2008 – smoothed trends



Source: Author

Figure 3 shows the deviations of actual employment and GDP from their trends (shown in Figure 2). The visual impression is not only that there are fairly regular cycles in both these series, but also that they tend to move together. This impression can be examined further by means of smoothing of the deviations themselves. This is intended to remove residual variations that do not have any particular time profile.

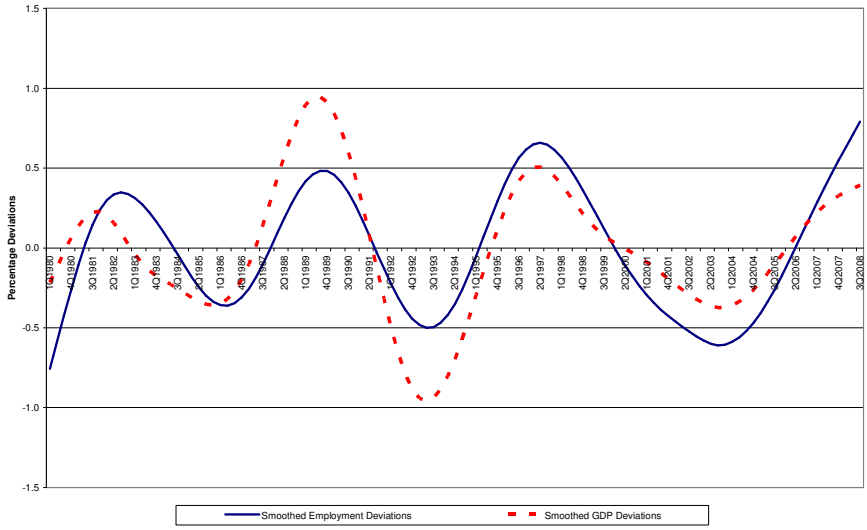
Figure 3 – Employment and GDP 1980–2008 – deviations from smoothed trends



Source: Author

Since the degree of smoothing affects the precise nature of the cycles, we have tested a number of different smoothing factors, and the cycles shown in Figure 4 are representative. The main observation to make on these cycles is that, while GDP initially tends to lead employment, by about 1990 the two are coincident.[2]

Figure 4 – Employment and GDP, 1980–2008 - Smoothed deviations from trend



Source: Author

This overview suggests that we can use the deviation of GDP from its trend in a particular quarter as an indicator of deviations of employment from its trend **in the same quarter**. However, since the trends diverge so markedly, this would not help us much: the cyclical component of employment is only a small part of explaining its overall movement.

Furthermore, the fact that the cycles coincide means that GDP cycles are not useful for anticipating cyclical employment movements. We would like to identify a **leading** indicator rather than a coincident one. We now turn to consider this

4. Towards a Leading Indicator of Employment in South Africa

To begin with, we need to establish the basic employment series whose cycles we wish to anticipate. Employment data in South Africa are notoriously inconsistent and incomplete. There are two main decisions we need to make:

- What employment are we looking at? We could look at total employment, but there are good grounds for excluding government employment. Not only is the government decision to employ not driven by the factors that drive cycles, but it

[2] This is in accordance with the SARB business cycle analysis, which changed employment from being a lagging indicator of GDP to a coincident one in 2004 (see Table 1).

could be deliberately counter-cyclical. We therefore focus on private employment. Within this, should we exclude certain sectors? For example, should we exclude agriculture and mining? In a more elaborate project we could examine each sector individually, since we might expect different cycles in different sectors. Here we do not.

- Which sources of employment data should be used? Over the years, employment data have been collected through a number of different surveys.[3] We need a 'high frequency' data series (i.e. monthly or quarterly) that runs long enough to permit robust analysis to be undertaken. Quarterly data are not available in sufficiently long series, so we have to chain them with other series and, for years in which data are available only semi-annually, we have to interpolate.

For the purposes of this preliminary investigation, we use a quarterly index of employment published in the SARB *Bulletin*, "Private Sector Employment in Non-Agricultural Sectors (7008Q)".[4] This series draws on the StatsSA *Quarterly Employment Statistics*, which have been statistically linked to compensate for structural breaks in the series. We select this data series largely for reasons of convenience (it is easily available and covers a number of years at the required frequency). However, we recommend that, should this exercise be taken further, resources and effort be devoted to creating a standardised employment series.

Leading indicators are aggregations of a number of different series into a single overall composite index. For our purposes we aim to construct a composite series that historically will be shown to lead cyclical employment. Leading indicators of employment series are designed to give advance warning of turning points in the employment cycle.

The analysis in the previous section and our analysis of the SARB data' suggested that, since 1990 at least, GDP and employment cycles have been coincident. This means that leading indicators of the (GDP) business cycle will also be leading indicators of employment cycles. We therefore adopt the simple principle that leading indicators of the business cycle in South Africa provide the candidates for leading indicators of the employment cycle in South Africa. Without rigorous time series analysis (for reasons of convenience), we select the following series for consideration:

1.	Continuous Commodity Price Index:	Total – Mar80=100 (commind, www.crbtrader.com)
2.	Trade:	Retail sales – 2000=100, SA (Period) [7086T;M] (retailtrd)
3.	Manufacturing Total:	Number of factory workers (net balance, available from the BER) (factwork)

[3] Some of the publications that Statistics South Africa has published (and often discontinued) since 1994 include the Labour Force Survey (P0210: September 2000–September 2007), the Quarterly Labour Force Survey (P0211: March 2008 ongoing), the Survey of Employment and Earnings (P0271: September 2000–December 2002; and P0275 March 2003–March 2005), and the Quarterly Employment Statistics (P0277.1 and P0277: December 2004 ongoing).

[4] Series 7008Q is expressed in terms of quarter-on-quarter percentage change which we convert to an indexed series with 1980 = 100.

4.	Trading-partner countries:	Leading indicator – Total – 2000=100, SA (Period) [7095N;M] (tradpartn)

Monthly series are reduced where necessary to quarterly series by taking three-month moving averages. Our series are all in index form or contain zero or negative values. Following Claus & Claus (2002), we take quarter-on-quarter differences between these values to transform each potential component of the Leading Indicator of Employment (LIE):

$$Y_t^j = \left(X_t^j - X_{t-1}^j \right)$$

where X_t^j is the value of component *j* at time *t*.

The transformed series are subsequently standardised by dividing Y_t^j by its historical average:

$$S_t^j = \frac{Y_t^j}{\frac{1}{T-1}\sum_{t=1}^{T}\left|Y_t^j\right|}$$

Using weights for each component we can combine the standardized series S_t^j into a composite variable:

$$I_t = \sum_{j=1}^{J} w^j S_t^j$$

where the weights w^j are determined by the concordance of each series with the reference series. The concordance is established by taking the maximum number of quarters over four lags during which the component moves in the same direction as the reference series.

The raw composite values of I_t are standardised so that the series has the same historical average as the reference series:

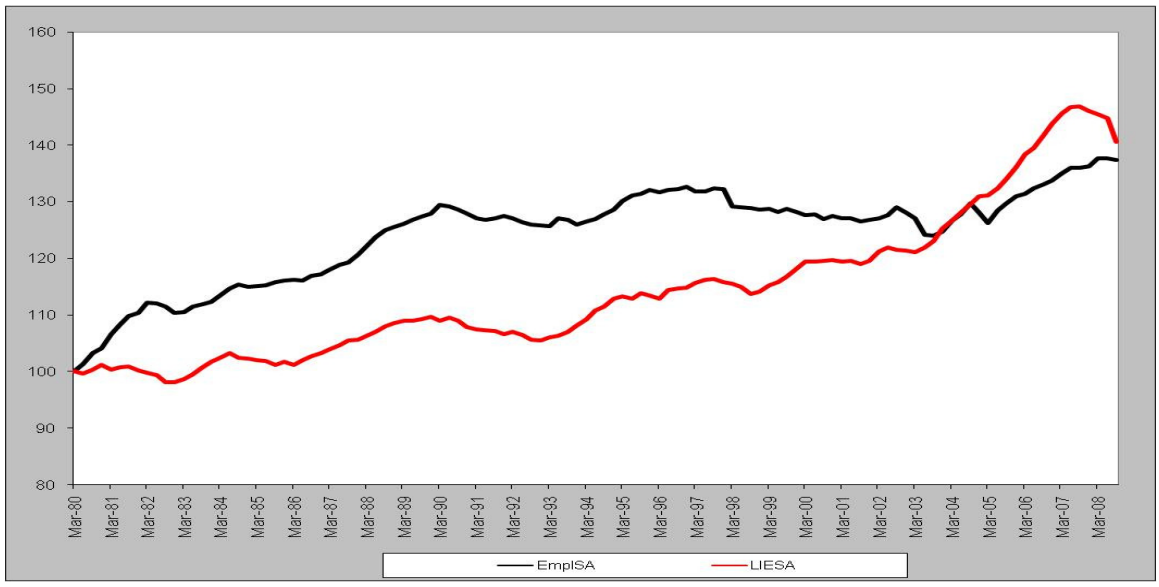
$$I_t^s = \frac{I_t}{\sum_{t=1}^{T} I_t \Big/ \sum_{t=1}^{T} E_t}$$

where E_t is the quarter-on-quarter change in the index value of the employment series.

Since the standardised composite value I_t^s represents a quarter-on-quarter change, the index of a LIE follows by setting the first element of the series to 100 and adding

I_1^s (for t = 1) to arrive at the second element of the series, and adding I_2^s for the third element, and so on. Results are summarised in the graph in Figure 5.

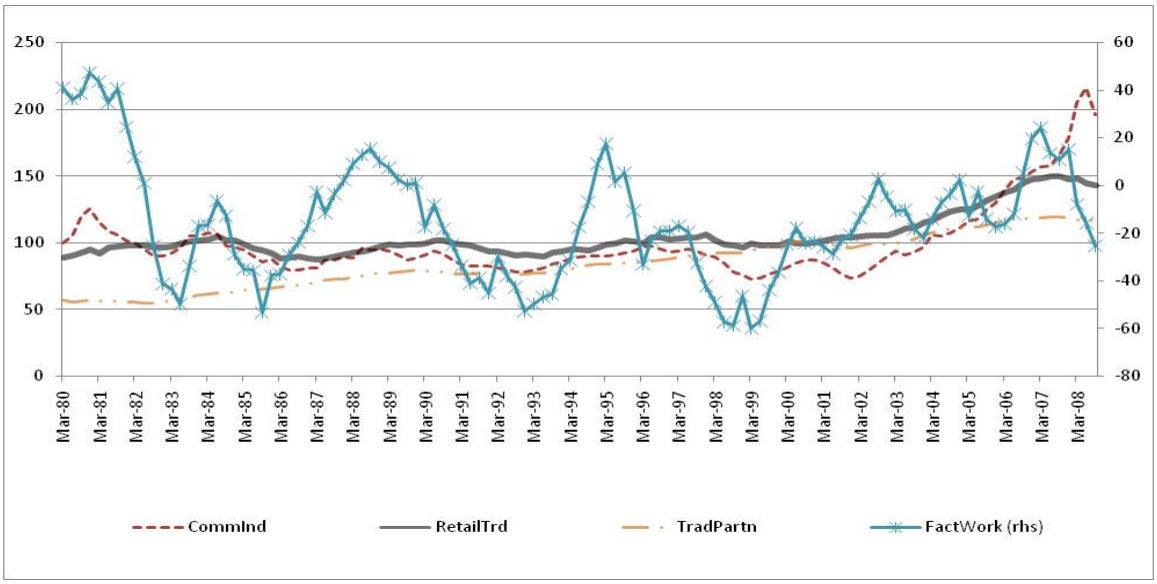
Figure 5 – A preliminary Leading Indicator of Employment in South Africa



Source: Authors

A cursory glance suggests that this preliminary Leading Indicator of Employment in South Africa (LIESA) has correctly given advance warning of an employment downturn on a number of occasions, in particular in the early 1980s and early 2000s, but also in the second part of the downturn in the early 1990s (although it lagged the first part of the downturn during that time). Incorrect warnings were given in the mid-1990s, while the long slump in the late 1990s was missed. The long downturn in employment during the late 1990s can probably be interpreted as structural change associated with a combination of trade and other liberalisation, as well as structural reform in fiscal and monetary policy, and as such defies cyclical behaviour. The downturn in the preliminary LIE at the end of the period of observation suggests that considerable weakness in employment can be expected in the near term. The individual components are shown in the graph in Figure 6.

Figure 6 – Individual components of a preliminary Leading Indicator of Employment



Source: Authors

Table 2 shows the weights calculated for each of the components. It can be seen from this table that, based on concordance with the reference series, the Leading Indicator of South Africa's Trading Partners yields the highest weights, while the net number of factory workers series, collected by the Bureau for Economic Research (BER), has the lowest weight.

Table 2 – Weights of components in a preliminary Leading Indicator of Employment in South Africa

Series	Weight
Continuous Comm. Price Index: Total – Mar80=100	24.1%
Trade: Retail sales – 2000=100, SA (Period) [7086T;M]	25.2%
Manufacturing Total: Number of factory workers (net balance)	23.4%
Trading-partner countries: Leading indicator – Total – 2000=100, SA (Period) [7095N;M]	27.4%

Alternative specification with motor vehicle sales did not improve on the ability to give advance warning of employment cycles, nor did building plans completed (which also forced us to use a shorter period). An interesting series that can be considered is the job advertising space in the *Sunday Times*, as an indicator of tightness in the labour market (as it can depend on demand as well as supply factors). The series is unpublished but available from the SARB.[5] It measures advertising space in square centimetres, with the obvious drawback that a single advertisement of modest size can

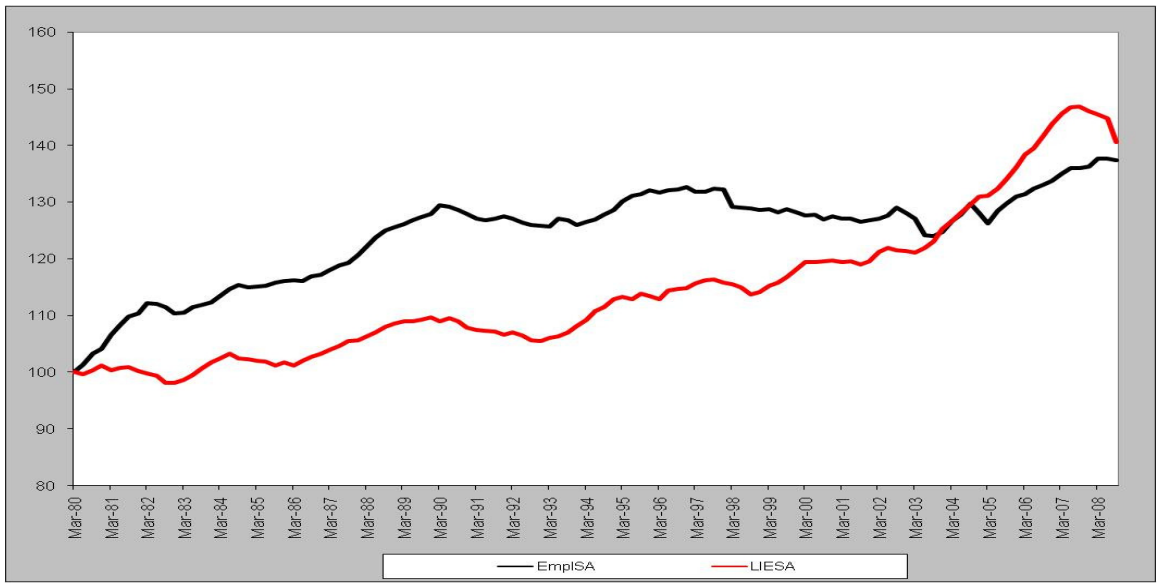
[5] The series is standardised by the SARB for the number of Sundays per month, and also seasonally adjusted.

represent several job vacancies, while a full-page advertisement may only seek applicants for a single highly skilled position.[6] An added disadvantage of this series is that it starts in 1997 and therefore misses the start of the long downturn at that time. Nevertheless, we present an alternative specification of a preliminary leading indicator of employment that is based on this series in combination with the following:

1.	Trade:	Retail sales – 2000=100, SA (Period) [7086T;M] (retailtrd)
2.	Manufacturing Total:	Number of factory workers (net balance, available from the BER) (factwork)
3.	Trading-partner countries:	Leading indicator – Total – 2000=100, SA (Period) [7095N;M] (tradpartn)

The results are presented in the graph in Figure 7 and it can be seen that this indicator shows the same advance warning of a short downturn in employment during the early 2000s. Although the long-term downturn in employment during the later 1990s was given advance warning by this specification, the subsequent upturn did not materialise in terms of positive employment growth until much later (three years).

Figure 7 – Alternative specification of a preliminary Leading Indicator of Employment in South Africa

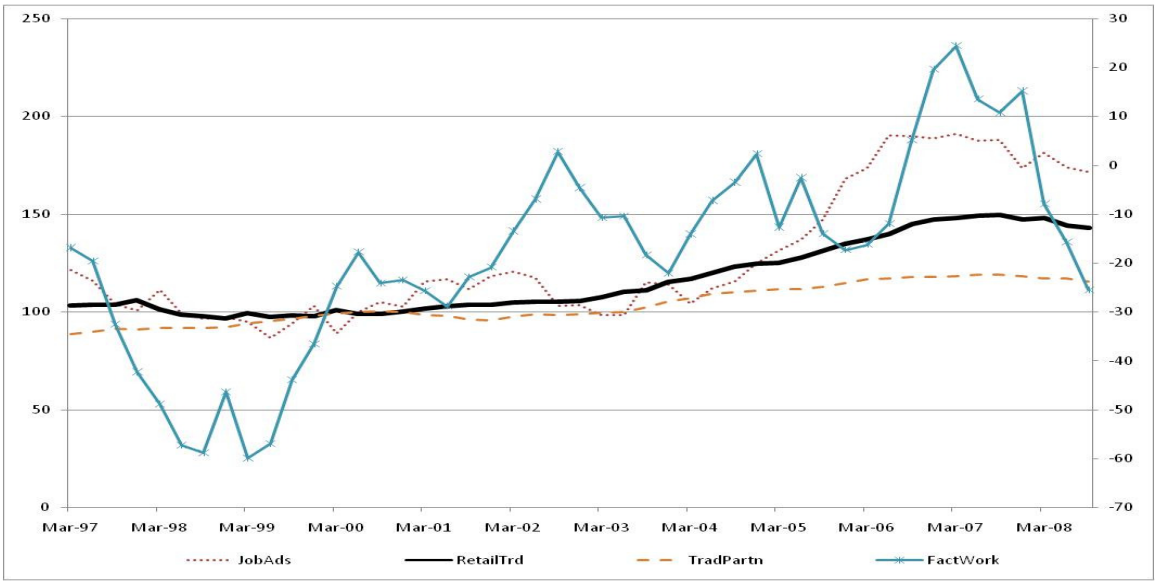


Source: Authors

The individual components of this series are shown in Figure 8.

[6] Ho

Figure 8 – Individual components of an alternative preliminary Leading Indicator of Employment in South Africa



Source: Authors

The weights of the components in the alternative specification are shown in Table 3. Job advertisement space and the BER series of net balance of factory workers employed are both slightly ahead of the others.

Table 3 – Weights of components in an alternative preliminary Leading Indicator of Employment in South Africa

Series	Weight
Job advertisement space in the *Sunday Times*	25.47%
Trade: Retail sales – 2000=100, SA (Period) [7086T;M]	24.53%
Manufacturing Total: Number of factory workers (net balance)	25.47%
Trading-partner countries: Leading indicator – Total – 2000=100, SA (Period) [7095N;M]	24.53%

Source: Authors' calculations

Further work is required to select more appropriate components for a final LIESA. Selection of series is a drawn-out process in which economic theory needs to be combined with statistical significance, forecasting performance and timelines of the series relative to the reference series. A number of alternative methods to determine the weights of the selected components can also be considered (see Claus & Claus 2007).

5. Conclusion

While the performance of both the LIESAs constructed still needs more work, there is sufficient indication that it would be possible to devise such an indicator. Any further work needs to address a number of issues.

The primary concern is the reliability of the employment series we are trying to predict. We have used the series that is constructed by the SARB and used in its own work on the business cycle. Apart from the convenience of using this series, it also has the merit that it is the data series that informs the SARB in its policy formulations (following the precept that if policymakers feel something is important, it is important).

Nonetheless the flaws in the data are well known and the construction of a standardised series would be useful, not only for this purpose.

Further work on employment cycles should also examine cycles within sectors, since it is likely that they are influenced in different ways by various factors. However, the data problems for aggregate employment are often compounded for more disaggregated data. Such work therefore also requires work on the standardised employment series.

Finally, we recommend that work on employment cycles be located in an institutional setting in which it can be undertaken systematically and continuously. Work on business cycles at the SARB has been undertaken continuously since 1960. This continuity has enabled them to build up the requisite high-frequency data over a long period. For employment cycles to be placed on a sound footing, similar focus and continuity are needed.

Appendix: The Hodrick-Prescott Filter

The Hodrick-Prescott filter is commonly used to smooth the data. This writes any time series, y_t, as a combination of a trend or growth component, g_t, and a cyclical component, c_t. Thus

$$y_t = g_t + c_t$$

Since the growth component should be relatively smooth (so that the change in the growth rate from one period to the next should not be large), the procedure minimises

$$Z = \sum_t c_t^2 + \lambda \sum_t \left[\left(g_t - g_{t-1} \right) - \left(g_{t-1} - g_{t-2} \right) \right]^2$$

where c_t is the cyclical component at time t, g_t, g_{t-1} and g_{t-2} are the growth or trend components at the indicated times and λ is a parameter whose value we choose to determine the relative influence of the two components.

If λ is zero, the growth (trend) component has no influence, so the smoothed and actual series will be the same. As we increase λ so the smoothing increases: at very high levels it would produce a linear trend line.

The method has been criticised, since the choice of λ is arbitrary and subjective as is the function Z that we choose to minimise. There are more sophisticated procedures available. However, there is evidence that the H-P performs just as well as many of these procedures and it has the merit of simplicity.

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