The Link Between Disability Experience and Economic Conditions in South Africa

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Abstract

The purpose of this paper is to discuss whether there is a meaningful and measurable link between the claims incidence of South African disability business (group and individual, lump-sum and income) and the state of the economy.

The experience of most South African disability business in the past decade has been good. As a result of this benefits have increased, risk management tools have been weakened, and risk and office rates have been reduced. However, it is not clear how much of this experience is due to the strong and sustained economic growth. Consequently, insurers are not in a good position to quantify when, and by how much, they should change their risk rates and reserving bases should the economic conditions weaken.

This paper begins by looking at the theoretical link between disability experience and economic growth. It then presents the results of the analysis of South Africa disability experience over the past 15 years and attempts to quantify by how much disability experience will worsen should the economy suffer a major slowdown.

Keywords

South African disability business, economic growth, experience of disability business.

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1 Overview

1.1 Introduction

As a subject of casual discourse, many South African life insurance actuaries would agree that there is an intuitive relationship between disability experience and economic conditions. The generally voiced opinion is that claiming for disability becomes more attractive during times of economic hardship – either because there are fewer financial incentives for the individual to continue working, or because the employer encourages this as an alternative to retrenchment.

There are also other factors. Maintaining safety standards costs money. So does maintaining the technical skills that could avoid workplace related accidents. Psychological effects such as stress and work pressure are also economically linked. Less obviously, the state of the economy affects how strictly insurers apply claims management.

While a casual consensus seems to exist, there is very little factual evidence in South Africa from which to draw any definitive conclusions. This is partly due to the fact that for the past 20 years South Africa has sustained a strong rate of economic growth and there has therefore been little reason to conduct such a study in the past. However, in 2008/2009 South Africa (along with the global economy) suffered a major economic slowdown, leaving insurers with no way of estimating the subsequent effect on claims incidence and required reserves.

This paper therefore attempts firstly to prove that there is in fact a strong correlation between disability rates and economic conditions; secondly to quantify and model this relationship; and thirdly to provide practical and useable predictions for disability rates based on different economic scenarios.

The collaboration of a number of South African life offices was needed to conduct this study, and the authors of this paper are greatly indebted to all the people involved in extracting and preparing the disability data used in this study. The sourced data include lump sum and income replacement policies, group and individual business, and various waiting periods and disability definitions. Where possible these have been split into appropriate homogeneous rating cells.

All of the economic indices used in this study are publicly available and regularly published and are included in the appendix.

1.2 Scope of the Paper

This paper's results are derived from quarterly statistics on disability rates and economic indicators over the period 1995 Q1 to 2008 Q4.

A number of different economic factors may influence claims incidence, each of which may elicit a number of different responses from individual claimants. For example, when the economy starts to struggle a wealthy person who finds his or her job decidedly unsatisfactory becomes more likely to claim. On the other hand, a person who is struggling financially may become less likely to claim on an income policy that pays out only 75% of his or her salary, although they may claim on a lump-sum policy that pays a multiple of their salary (even though this may not be enough to sustain them till normal retirement age).

Bearing the above in mind, this paper attempts to isolate and model only the most important factors so as to achieve a model that is sufficiently workable.

The modelling done relies entirely on historical economic data, and no attempt is made to predict future economic conditions, or to use economists' predictions to estimate the future incidence of disability claims.

The effect on terminations of income replacement type policies is not considered in this paper as there is insufficient data available to do such a study properly. Many of the theories discussed in this paper would be applicable to termination rates though, and a future study of that sort may yield some interesting results.

1.3 The Disability Market in South Africa

Although it is not crucial to understanding the results of this paper, it is useful for the reader to have some insight into the South African disability insurance market to appreciate the subtle (and sometimes not so subtle) differences to other insurance markets.

South African insurers offer income and lump sum disability benefits through both individual and group arrangements. There are relatively few insurance markets that offer lump sum disability benefits but they have sold extremely well in South Africa, both through individual and group insurance arrangements. There are several reasons why lump sum disability insurance is popular, including: it is easier to understand and hence to sell, it suits the purpose of paying off lump sum debt, it is easier and cheaper to administer, it does not require ongoing claims management, it does not require ongoing payment into and collection from a bank (a point that should not be underestimated in South Africa where many employees retire to rural areas), and may appear less expensive to the policyholder than income disability insurance.

1.3.1 Group disability insurance

The successful growth of group insurance in South Africa can largely be attributed to the fact that South Africa has relatively under-developed state sponsored social security benefits. Post retirement funding and in-service risk benefits for formally employed South Africans are offered through employer sponsored pension funds and risk benefit arrangements. Typical death benefits would be a multiple of salary, say two to four times, occasionally with spouses' and orphans' annuities. Disability benefits are either a lump sum, usually the same multiple of salary as the death benefit, or income related. Income disability in South Africa is usually referred to as permanent health insurance (PHI). A standard income benefit would be 75% of the employee's salary, plus an allowance for an "employer waiver" (which is the employer's continuing contribution to retirement funding whilst the employee is on disability insurance) of up to 20% of salary.

The definitions for disability are as follows:

Lump sum

– Totally and permanently unable to perform your own occupation or any alternative occupation for which you are or could be reasonably expected to become qualified or suited, taking into account the degree of disability and your knowledge, training, education, ability, experience and age.

Income

– If injury or disease renders you totally incapable of engaging in your regular job with your employer or any other suitable job that your employer could offer you during the first 24 months after the date of disability.

– Thereafter, the insurer may reassess your disability on the basis of your capacity to perform any occupation with any employer for which you are or could reasonably be expected to become qualified or suited taking into account your degree of disability and your knowledge, training, education, ability, experience and age. This need not be with the existing employer and includes self-employment and does not have regard to the availability of work opportunities.

Traditionally, white collar schemes offered PHI benefits whilst blue collar schemes had lump sum benefits, but this differentiation is now changing with some blue collar schemes offering PHI, and some white collar schemes offering lump sum disability.

Although there are no official statistics, approximately 3.5m people are covered by employer sponsored group schemes.

A point that is relevant to the observed improvement of incidence rates in group business (see section 3.1) is the change in claims management protocols over the last 15 years. In the mid 1990s South African insurance companies made significant losses on their group disability portfolios. One way in which this was rectified was by increasing the price (group business is annually renewable, with

guarantees of longer than 12 months being extremely rare). However, the more important reaction in terms of the long term sustainability of the industry was a significant focus on claims management.

Prior to these losses claims management was often seen as more of an administrative function and was performed by individuals who were not necessarily trained to assess an individual's ability to work. Hence the industry began to employ occupational therapists who would have been specifically trained to assess whether people are able to perform their own or a reasonable alternative occupation. As a consequence, group insurers developed an ethos where disability claimants were actively managed, and those who could be rehabilitated were returned to meaningful employment. This can be contrasted with the individual life market where claims assessment is often done by individuals with less occupational and rehabilitation skills, and where there is less focus on ongoing reassessment to attempt to get people back to work.

For more details on group disability insurance in South Africa, please refer to the paper "Current issues in South African Group Life insurance" Lewis, Cooper-Williams, Rossouw, South African Actuarial Convention 2005.

1.3.2 Individual disability insurance

As a result of the success of compulsory group insurance arrangements, individual disability insurance has primarily been sold to self-employed individuals. Both lump sum and income disability insurance are sold, with lump sum probably the more popular. However, in the last couple of years insurers have revamped their income products, with some success.

Individual disability benefits also include temporary income benefits and business expenses cover. Temporary income benefits usually have a shorter waiting period, 7 days to 1 month rather than 3 to 6 months, and pay for 12 to 24 months. A lump sum disability or a PHI with a suitable 12 or 24 month waiting period would usually be sold along with this.

A feature of the individual insurance market has been the significant increase in benefits that are being requested by individuals. Whereas ten years ago maximum benefits were around R4m, currently disability benefits of R20m and more are not uncommon. The reason for the cover is usually business cover, that is buy-and-sell or contingent liability cover, not personal income replacement. On the income disability side maximum benefits have increased from around R75,000 to R200,000 per month, and even to R350,000 per month for temporary income and business income products. This increase in benefits has been partially mirrored on the group insurance side, but in that market there is a natural capping of benefits in that there is a link to salary.

The definition of disability for individual life products is not too dissimilar from group products and ranges from "the inability to perform any occupation" to "the inability to perform your own occupation or an alternative occupation which you could be reasonably expected to perform given your education and training", through to "the inability to perform your own occupation". The last definition is clearly the most generous to the claimant and has gained more prominence in the last several years. When this definition was first introduced it was targeted only at professionals but it is now being offered to more

and more occupations, often without an increase in the premium. This is one example of either a weakening of risk management tools or benefit improvements that have occurred in the last decade.

1.4 The Economy in South Africa

Over the period 1995 to the end of 2007 South Africa's economy has been characterised by the following:

- Consistent economic growth, at an average annual growth of 3.5% in real GDP (or 51% over the 12 year period).
- High, albeit relatively stable levels of unemployment, averaging at around 25% of active job seekers.
- Medium inflation, averaging at around 6%.
- High and generally volatile interest rates (fluctuating between roughly 7% and 12%). South Africa's Reserve Bank has continuously adopted the strategy of altering interest rates in an attempt to keep inflation within a target range of 3% to 6%.

During this period there have been no dramatic economic changes to speak of, which makes it particularly difficult to identify how and when disability rates react to fluctuations in the economy.

The first major downturn occurred during 2008/2009 in the wake of the global sub-prime crisis. To a certain extent South Africa was initially insulated against the worst of the fallout because its banks and investors had very little direct exposure to any of the sub-prime debt. South Africa is nevertheless very much part of the global economy and its markets did eventually recede into the same spectacular slump that was already being experienced by many developed countries.

For a study of this sort the period 2008/2009 is of particular interest, and the subsequent effect (or lack thereof) on disability rates that we would be able to observe would be the ideal acid test for the findings of this study. Since this study does not fully include this period, readers should be aware that any results derived from this study would have to be re-evaluated as new information becomes available.

2 Earlier studies

Globally, a number of studies of a similar sort have been done at various intervals over the past 35 years. Most of these were able to establish that there is in fact a link between economic conditions and the rate of disability claims. Only a few, however, have been able to statistically quantify this relationship and produce useful prediction models. No studies seem to have been done in South Africa yet.

It is interesting to note that not all studies agree on the direction of the economy's influence. "Anti-cyclical" theories argue that disability experience worsens as the economy struggles. "Pro-cyclical" theories argue the reverse. The direction of the relationship appears to be largely dependent either on the level of social and economic development in the country being studied, or on whether one is looking at a social / government sponsored not for profit disability scheme or a for profit insurance company arrangement. This is discussed further in sections 2.2 and 2.3.

The USA is an example of a developed country that has previously shown a strong anti-cyclical relationship in the private insurance sector (see section 2.4.1). Given that the USA was one of the countries hardest hit by the recent global financial crisis, one would have expected a sharp increase in disability rates in the last 12 months. However, anecdotal evidence from industry experts indicates that this has not been the case and that disability rates have been fairly stable. Two possible reasons for this are, firstly, that many Americans are facing such significant household debt that they simply cannot afford to take a disability benefit of 60% of their salary, which is the most common benefit (lump-sum disability benefits are not sold in the USA so these cannot be used to pay off household debt); and secondly, many of the retrenchments in the USA happened so quickly that individuals were not able to put in a disability claim before they lost their job, and were subsequently not able to claim as they were not "actively at work" at time of claim. It will be interesting to see the impact of the crisis over the next few years.

South Africa's profile also suggests an anti-cyclical relationship and the focus of this study has therefore been on determining the extent of the negative impact on disability rates during periods of recession.

The theoretical reasons for the change in disability rates due to economic movements are set out in the sections below. We provide a condensed discussion of the theories echoed in a number of different studies; readers are directed to the bibliography for a listing of all publications that were consulted.

2.1 A matter of choice

Every economy-disability theory hinges on the fact that a disability claim is not always something that simply *is.* There is a strong element of choice in the matter, and what people choose to do is largely influenced by what the economy looks like. We can describe this phenomena using utility theory:

1. Individuals will claim only when the utility they derive from disability benefits exceeds that of working.

2. Employers will encourage employees to file for disability as an alternative to retrenchment.

3. Insurance companies will accept more borderline disability claims when the reputational cost of doing otherwise exceeds the cost of paying such claims.

4. Similar to point 3, governing parties will be worried about re-election and are likely to relax claims management on government sponsored disability schemes when it is affordable to do so.

All of the above reactions are directly influenced by the economy. Points 3 and 4 relate to the rate of claim acceptance, and are of lesser importance to this study since claims management can largely be controlled by insurers. Points 1 and 2 however relate to the incidence of claim notification and insurers may well see a spike in notification rates during periods of dramatic economic change.

2.2 Anti-cyclical effects

Anti-cyclical effects cause disability rates to go up when the economy recedes. The sections below set out some of the intuitive reasons for this.

2.2.1 The "hidden disabled"

The "hidden disabled" are actively working lives that technically qualify for disability benefits, but who choose to continue working. The theory is that these lives will become disability claims the moment the utility derived from receiving disability benefits exceeds that of working. Such a situation is more likely during an economic downturn when job availability, salary increases and bonuses decline.

2.2.2 More frequent claims for minor causes

Tying in with the utility theory argument above, more policyholders may enter disability claims for minor causes. While this may lead to increased claim notifications it should naturally also lead to an increase in declined claims.

2.2.3 Employer cost control

Instead of retrenching staff an employer may (fraudulently or otherwise) encourage staff to claim for disability.

Prolonged cost cutting by way of reduced safety standard and less expenditure on staff training may, in certain industries, lead to a greater prevalence of occupational injuries. This is a longer term effect and is not expected to be influenced by short-term economic movements.

2.3 Pro-cyclical effects

Pro-cyclical effects are factors that cause disability rates to go up when the economy booms. To a large extent these points are valid only in a very well developed market, because the theory hinges on a high percentage of participation in the available workforce. The Netherlands is a good example of such a market where a strong pro-cyclical correlation can be observed (see section 2.4.2).

2.3.1 The "marginal worker" effect

When the economy is strong the demand for labour improves and more people in poor health are pulled into the active workforce, leading to a more disability prone group of working lives.

Similarly, as the economy prospers a wider pool of people gain access to social security type benefit schemes. This may well lead to an increase in incidence rates.

2.3.2 Increased work pressure

When the economy booms corporate activity increases and workers are expected to work harder, causing physical and mental stress, both of which could lead to disability.

2.3.3 Labour market churn

When the economy struggles, workers are laid off. When it picks up again, new (often inexperienced) workers are hired. In industrial areas of the market this may lead to a greater prevalence in occupational injuries.

2.3.4 Claims management

Claims management is relaxed during favourable economic circumstances, and tightened up during a recession. This theory is mostly applicable to government sponsored type disability schemes, where politicians may have some influence on relaxing claims management strictness with the view of keeping a seat in office. This phenomenon is discussed in more detail in section 2.4.2.

It does also bear some relevance to corporate disability policies, where insurance companies will weigh up the reputational consequences of strict claims management against the cost of paying out more benefits. During favourable economic conditions the reputational consequences are more likely to take precedence.

This effect is directly within the insurer's control though, and will have only a secondary impact on the rate of claims notification. (After a prolonged period of slackened claims management policyholders are likely to start catching up on the fact that claim strictness has declined.)

2.4 A summary of two studies with opposing views

This section deals briefly with the key findings of two previous studies with opposing views.

2.4.1 Anti-cyclical: Donald J. Doudna (1977), USA

Donald J. Doudna (1977) formulated a statistical model for predicting quarterly movements in disability rates. A linear model (LM) was fitted to disability data with the following variables:

- Unemployment rate
- Corporate profits
- Consumer sentiment

In addition, Doudna fitted dummy variables to remove the effect of seasonal (quarterly) variation which can not be ascribed to economic changes. The exercise resulted in a regression coefficient of 74%; that is 74% of the variation in disability rates from one quarter to the next could be explained by a combination of unemployment, corporate profits, consumer sentiment and seasonality. Doudna also tested the significance of each individual variable, and found that unemployment was the most significant contributing factor.

The model assumes a time lag of one quarter between a change in the economy and a subsequent change in disability rates. Assuming that economic data is published every quarter this would allow a life office to predict the change in disability rates or reserving requirements one quarter in advance.

Doudna also set out some of the intuitive reasons why one would expect the variables above to impact on disability rates – similar sentiments are expressed in a number of other papers as well. These have already been discussed in the preceding sections.

2.4.2 *Pro-cyclical: Bernard Wolters (2008), Netherlands*

Bernard Wolters (2008) analysed the disability rates experienced in the Netherlands by way of a game theory model. While the aim of the study was not to identify the relationship with the economy per se, it does make a number observations that is directly applicable to an economy-disability study. This study is also of particular interest in that it demonstrates the existence a strong pro-cyclical relationship in the Netherlands.

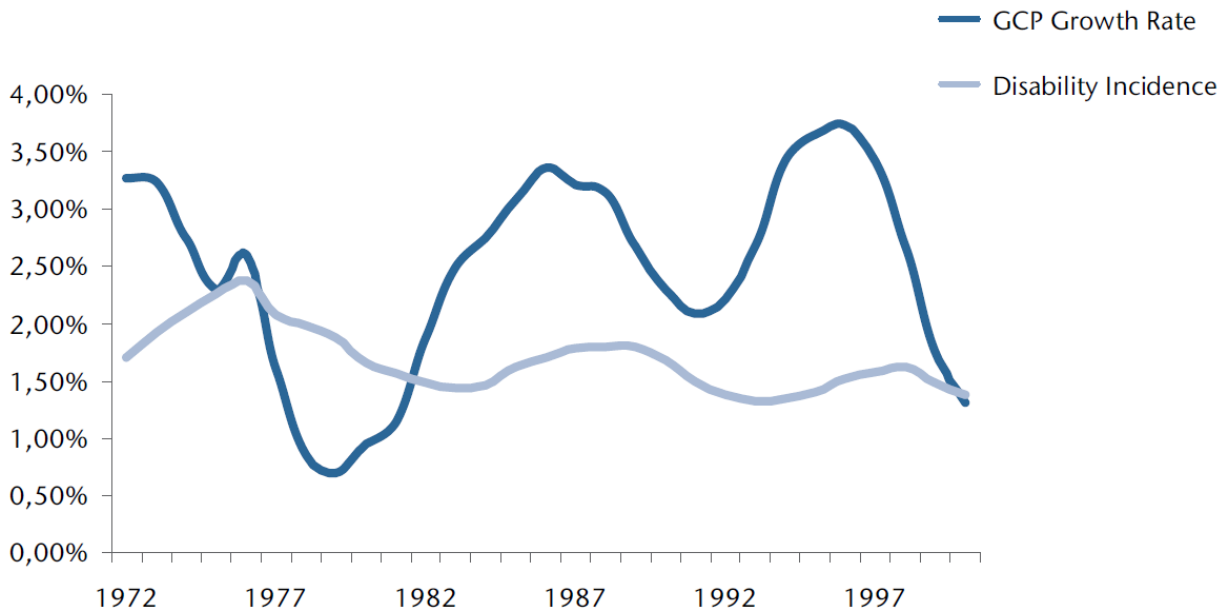
The study was based on experience under public disability regimes. The dynamics of the system is therefore entirely different from that of the corporate disability market in South Africa. (Under a public disability regime one would expect greater coverage of substandard risks and less focus on making a profit).

Wolters suggests a game theory model with two players: the employee and the government. The aim of the employee is to maximise his or her utility, and as such he or she will continue working only while the utility gained from working exceeds that of claiming for disability. The aim of the government is re-election, and it will alter claims management strictness under public disability regimes to help achieve this.

As an economic recession begins, government will be forced to tighten its claims management (since leading the country into financial trouble is not a good way to be re-elected). This will cause employees to revise their expectation of a successful claim, in time leading to reduced claim notifications. On the other hand, when the economy booms government will loosen its claims management, setting the reverse situation in action.

This situation can be observed in the illustration below, where the disability rate appears to follow the change in the rate of economic growth with a lag of a few periods.

Figure 1: Dutch GDP growth and Disability (Five-year moving averages)



3 Results

3.1 Group and Individual

A further discussion on the nature of group and individual disability business is required at this time. In any experience analysis, group and individual experience should be dealt with separately. There are numerous reasons why this is the case (including, but not limited to: differences in levels of underwriting, target markets, policy conditions, and mix of lives) but there is also an interesting economy-disability argument that produces some useful insights when these two are analysed separately.

Over the past 15 years in South Africa there has been a reduction in the number of employees in the mining and agricultural industries, while employment in white collar industries has expanded rapidly.[1] The implication of this is that the proportion of white collar workers in South Africa's employed workforce is growing – a fact that we can expect to see reflected in the demographic mix of lives in insurers' group disability business. White collar workers are generally less disability prone, and we could then expect a long term declining trend in disability rates under group business. Group business can therefore be expected to show a strong correlation with long-term, systematic changes to the economy.

Generally the same cannot be said for individual disability business, which exhibits a much more stable mix of lives. The long-term mean disability rate is expected to remain unaffected by structural changes in the economy. These lives would also be largely self-employed, which would arguably make it easier for them enter a claim for disability as and when it suits them. (A self-employed person would have less company bureaucracy – such as dealing with the human resource department or first using up sick leave – to deal with before filing a claim). It could also be argued that economic conditions could impact more quickly and more dramatically on a self-employed person, who may loose his or her entire income in an instant, while the salary of a formally employed person will to some extent be protected by labour laws. These factors may lead to greater sensitivity to short-term economic fluctuations.

There are therefore two issues at stake here:

1. The actual portfolio of lives exposed is affected by the long-term evolution in the economy. In other words, the likelihood of claims occurring changes due to demographic changes in the underlying risk pool, rather than due to a change in policyholder behaviour as a result of economic fluctuations. In the case of group business this change in the risk pool is nevertheless driven by structural changes in the economy.

2. Short-term fluctuations in economic conditions cause changes in policyholder behaviour, which leads to spikes and troughs in observed disability rates.

[1] According to StatsSA between 1995 and 2009 the absolute number of people employed in agriculture has declined from 1.3m to 0.8m and in mining from 0.45m to 0.35m. At the same time employment in financial services has expanded from 0.65m to 1.7m and in retail and wholesale from 1.75m to 3m.

Source: *October Household Survey (P0317), 1995* and *Quarterly Labour Force Survey (P0211), 2009 Q2.*

Figure 2: Individual business: quarterly disability rates

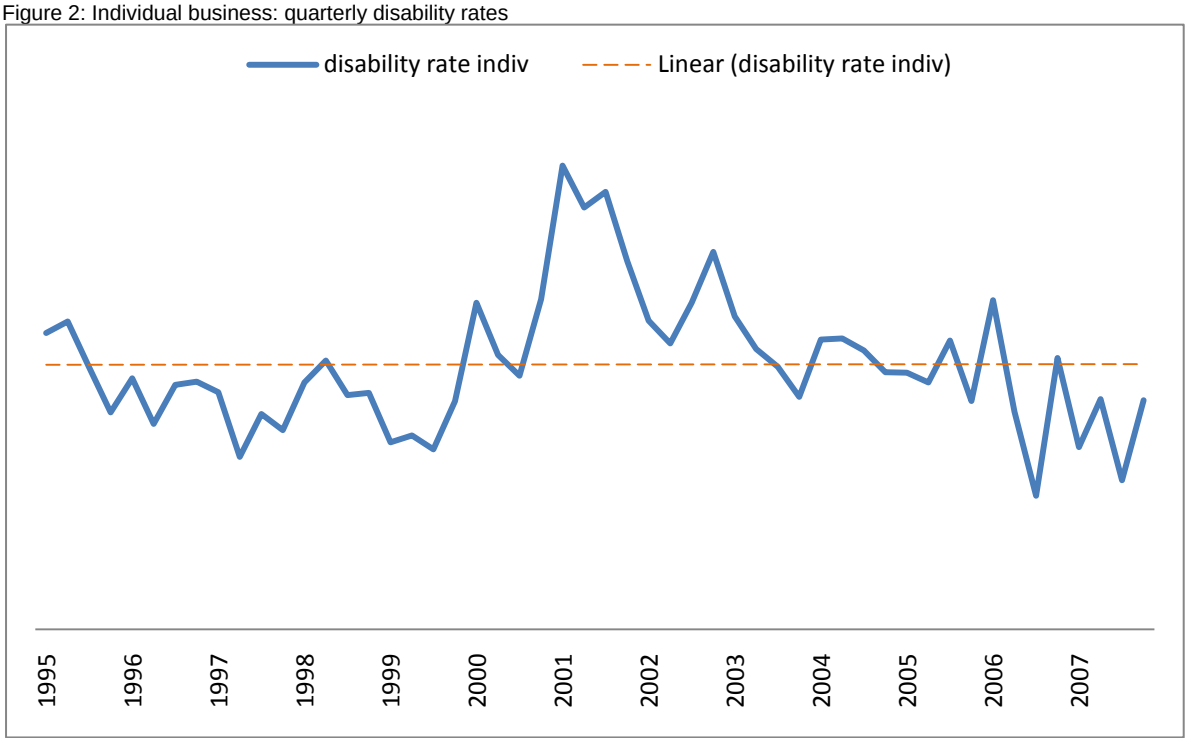
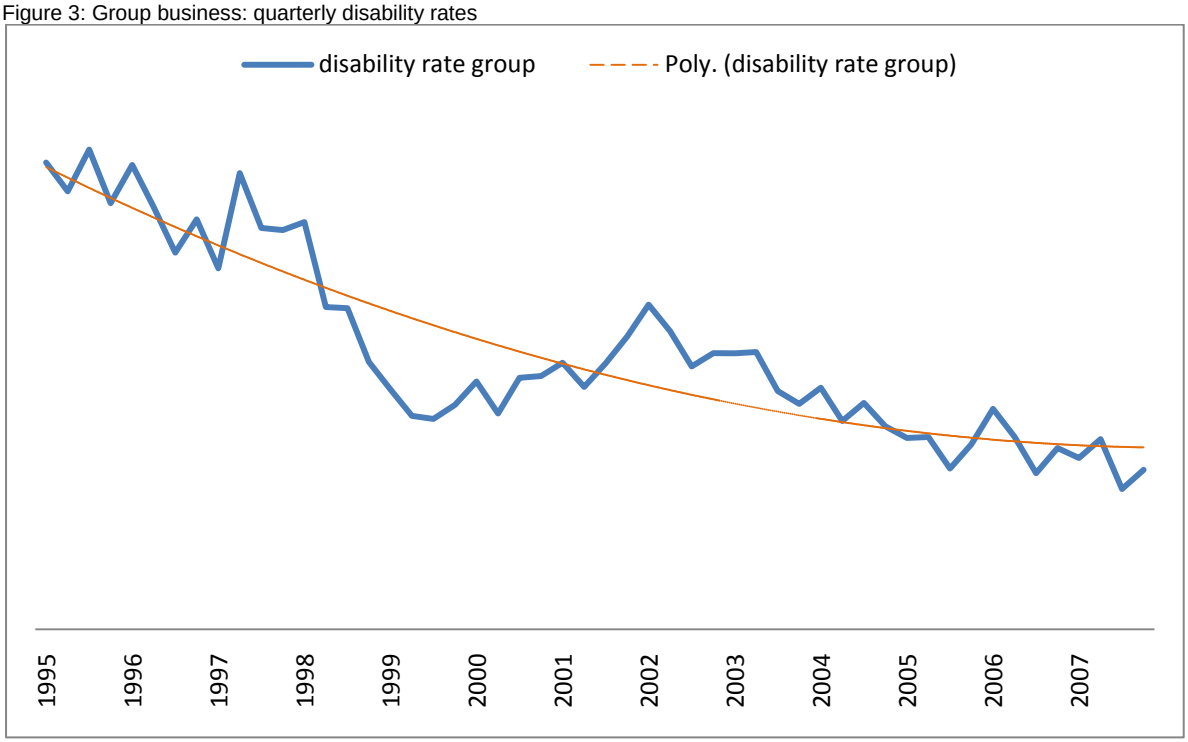


Figure 3: Group business: quarterly disability rates



The graphs above clearly indicate the expected long-term downward trend in group business, and the stable long-term mean in the individual business. A spike appears to occur in the individual disability rates during 2001 (a period that happens to coincide with generally below average economic conditions).

The group disability rates also show some short term variation, but we should resist ascribing too much of this to short term economic fluctuations. There are a number of problems with modelling the short term responsiveness of group disability rates. For one thing, since schemes are renewed annually an insurer could easily win and/or loose large amounts of business in a given year, altering the underlying risk pool. These movements can be very large and can have a significant impact on the experience observed in the period that follows. Consider for instance how much heavier one would expect the experience to be in the period directly after taking a mining scheme of 50,000 lives onto the books. It is unfortunate that industry information is not always captured when group business is written, and that it is consequently impossible to remove the effect that these changes have on the mix of business. The authors may consider another exercise where the disability rates of specific schemes (rather than insurers) are monitored over time.

Another problem with group data is that the exposures are typically captured only as annual census points. In order to investigate quarterly variations in experience it is therefore necessary to interpolate the exposures between these annual points; since schemes renew at various different times during the year the accuracy of exposures calculated in this way is somewhat dubious.

The improved management of claims that started in the mid 1990's (see section 1.3.1) would also have contributed to large changes in the observed disability rates. This could in part explain the sharp decline in disability rates that can be observed over the period 1997 to 1999.

Finally, from the point of view of producing a model that is statistically sound, the downward trend in the group disability rates presents significant problems. In order to produce a linear model one of the fundamental assumptions is that the time series should be stationary (that is, the mean and variance should be independent of time). Modelling a result based on the group data would therefore require much more complex techniques.

In order to at least roughly gauge the effect of long-term economic changes on group disability rates, consider the following tables of approximate values derived from the group data:

(We are assuming that claims management efficiency remained stable from 2000 onwards, and have therefore excluded periods prior to this.)

Figure 4: Progression of group disability profile

	Average Age	% Male	Average Real Salary *
2000	39.70	62.95%	86,123
2001	40.10	63.12%	91,941
2002	40.13	62.64%	90,530
2003	40.27	65.67%	87,820
2004	39.79	68.49%	94,345
2005	40.40	67.48%	102,876
2006	40.86	68.11%	107,945
2007	41.08	67.82%	111,678
2008	41.06	66.26%	112,073

** Adjusted for CPI*

The average age and the percentage of male lives have remained fairly stable. There was however a significant (and consistent) growth in the average real salary over this period, which could partly reflect the movement towards financial services industries.

Figure 5: Comparison of actual and expected progression of group disability rates between 2000 and 2008

	Blue collar : White collar	Average Real Salary	Rate per mille	Expected rate per mille
2000	60 : 40	86,123	3.1	3.3
2008	40 : 60	112,073	2.2	2.3
%change		*30%*	*-29%*	*-26%*

If we assume that the ratio of blue collar to white collar employees changed from 60:40 to 40:60 over this period, while also considering the 30% increase in average real salary, then on a rough calculation (based on theoretical office rates) one would expect to see a 26% decline in disability rates. This seems to be consistent with the 29% decline that has been observed.

The consequence of this is that it is impossible, at this stage, to determine how much of the improvement in disability incidence rates is due to (a) the improving economic conditions (b) the change in the profile of lives being insured and (c) potential ongoing changes in claims management practices. The authors are extremely disappointed that we are unable attempt to fit a model to the group data. However, we feel that this would be a pointless exercise until we are able to get a better understanding of the profile of the underlying data. We will be contacting the relevant insurance companies to try to resolve this.

3.2 Model

For the modelling exercise only the individual business was considered. The data available for individual business is of a high standard and generally does not suffer from any of the limitations encountered in trying to analyse the group business.

Only lump-sum business was considered; we believe that this lends particular relevance to a study which is confined to incidence rates. South African insurers have been writing large volumes of lump sum disability for decades, making it a particularly good product to base a time series analysis on. The available volume of individual life income disability study data was insufficient to perform a credible modelling exercise.

Our intuitive feeling is that if the model shows a link between lump-sum incidence rates and the economy, the same should apply to income disability, possibly with an even stronger correlation. The reason for this is that to claim for income disability you only have to be temporarily disabled, whereas to claim for lump-sum disability you have to be permanently disabled. Hence it is easier to manipulate an income disability claim, and in addition, the income payments may more accurately solve your predicament, which is to replace a lost income until your business recovers.

The following economic indicators were considered (these indices are published in the appendix):
U : Unemployment
CCI : Consumer Confidence (Index)
BCI : Business Confidence (Index)
GDP : Gross Domestic Product

All of these indicators are publicly available and are published on a regular basis (at least quarterly). They are also similar to the indicators that were considered by Donald Doudna in his study done in the USA in 1977.

The period 1997 Q3 to 2008 Q4 was considered in the modelling exercise.

3.2.1 Univariate Regression

The linear regressions outlined in this section test the significance of the relationship between disability rates and individual economic time series. This was done firstly in order to determine which economic indicators independently show the strongest correlation with disability rates, and secondly to identify the appropriate lag between a change in an individual indicator and a subsequent change in disability rates.

The univariate regressions were performed primarily to prepare appropriate assumptions for a more complex multivariate modelling exercise.

The tables below outline only the main results; further details on the regressions are provided in the appendix.

Strength of correlation

Figure 6: Univariate Modelling Results

	Statistic			
Test	**U**	**CCI**	**BCI**	**GDP**
Quarters lag used	1	4	2	1
F-statistic	15.00	16.65	0.01	2.97
p-value (F-statistic)	0.0004	0.0002	0.9389	0.0919
Durbin-Watson	0.91	1.12	0.65	0.70
R-square	25.42%	27.45%	0.01%	6.32%

The F-statistic tests the hypothesis that no correlation exists between disability rates and the independent economic variable in question.

The R^2 value indicates how much of the variation in the disability rate can be explained by considering the relationship with the economic variable in question.

The low F-statistic and R^2 for BCI and GDP indicate that there is very little correlation between disability rates and either of these economic indicators.

The high F-statistic and R^2 for both U and CCI indicate the existence of strong correlations. The relationship with CCI is particularly strong.

Appropriate lag

It makes sense that policyholder behaviour would only change after they have had time to reassess their utility based decisions, and this is unlikely to happen immediately after an economic change occurs.

In order to determine an appropriate lag for each economic variable univariate models with lags of 0, 1, 2, 3 and 4 quarters of a year were considered. A blended method was then applied to choose the most appropriate lag. For variables that exhibit a strong correlation with disability rates (that is CCI and U) the lag was chosen that produced the strongest R^2 statistic. For BCI and GDP a reasoned judgement was made.

Figure 7: R^2 statistics for univariate modelling at different lags

	R^2			
Quarters Lag	**CCI**	**U**	**BCI**	**GDP**
0	11.51%	22.36%	2.15%	6.03%
1	12.08%	***25.42%***	0.21%	6.32%
2	13.85%	23.93%	0.01%	6.39%
3	21.20%	18.82%	0.53%	6.50%
4	***27.45%***	15.30%	2.14%	6.67%

From the results above we can deduce that CCI is the first indicator to move when something changes in the economy. Unemployment would typically take longer to change, and would require a more sustained impact on the economy to register any significant shifts. The lags of 4 quarters for CCI, and 1 quarter for Unemployment therefore seem to be reasonable assumptions.

It could be argued that businesses will only start to experience the impact of a negative economic shock some time after consumers have reduced their spending, and similarly that Unemployment would only start worsening some time after businesses start registering losses. We would therefore expect the BCI index to react only after CCI, but before Unemployment, and have used a lag of 2 quarters.

Similarly to Unemployment, the GDP index would only show a change in economic conditions some time after earlier indicators such as CCI and BCI have already done so, but may nevertheless be reasonably expected to show a change before disability rates react. It should be noted though that the GDP lag assumption has a very small effect on the final modelled result. Partly for simplicity's sake we have therefore chosen a lag of 1 quarter.

Durbin-Watson test statistic

In each case the Durbin-Watson test statistic is significantly different from 2.00, which indicates the presence of autocorrelation in the error terms (that is, the disability rates in successive periods are not independent). To an extent this invalidates the result achieved by the regression exercise, but it was not dealt with here since the results are purely illustrative. A more accurate model, for which the autocorrelation has been corrected, is outlined in the section that follows. The issue of autocorrelation is also explained in detail the following section.

3.2.2 Multivariate Regression

The multivariate linear regression described in this section attempts to explain the relationship between disability rates and the combined effect of various economic indicators. Three different multivariate regressions were considered and only the one that appears to be the most accurate is discussed here. Complete details on all the other regressions can be found in the appendix.

The lags identified in the univariate regression exercises were used here.

In order to determine which economic indicators to include in the model a manual stepwise regression by way of backwards selection was implemented. The stepwise process started by producing a model based on all four economic variables (see section 7.2.1) but without correcting for autocorrelation in the error terms. The resulting statistics indicated that only GDP does not contribute significant information to the model (we can see this from the high p-value for the t-statistic), and by removing GDP (see section 7.2.2) the model does not suffer a serious reduction in its R^2, reducing from 42.14% to 41.15%.

All the variables in the subsequent model are statistically significant at the 95% confidence level. If we next remove BCI from the model (a course of action that seems reasonable since the univariate modelling exercise indicates that BCI on its own shows very little correlation with disability rates) the R^2 value drops from 41.15% to 32.60% (see section 7.2.3). Since this is an unacceptably large loss of explanatory power it was decided to keep BCI as part of the model.

The final model was therefore based on Unemployment, Consumer Confidence and Business Confidence. The model formula can be written as:

$$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4} + c_3 BCI_{t-2} + r_t$$

where $r_t = \rho r_{t-1} + \epsilon_t$

where the variables are defined as:

t : Time unit in quarters of a year
dx_t : The disability rate (per mille)
U_t : Unemployment
CCI_t : Consumer Confidence index
BCI_t : Business Confidence index
c_0 : Intercept
c_n : Coefficient for the economic variable in question
r_t : Estimated error term at time *t*
r_{t-1} : Actual error term at time *t – 1*
ρ : Coefficient for the error correction term (number between -1 and 1)
ϵ_t : A white noise term

The r_t term is what is known as an “autoregressive error correction term” of order 1, or simply an AR(1) error term. It is “autoregressive” because it implies that the disability rate at time *t* will be affected by the disability rate at time *t – 1*. It performs this by way of “error correction”, which means that it adjusts its estimate of the disability rate at time *t* by factoring in how far off the mark it was with its estimate at

time *t – 1*. This also means that (for example) Consumer Confidence at time *t – 4* will affect not only the disability rate at time *t,* but also at time *t + 1, t + 2* etc. with the effect diminishing by the factor ρ at each next time period.

We could therefore summarise the model as one that sets out to determine the disability rate at time *t* by looking at a combination of economic indicators at appropriate lags, as well as considering what disability rates looked at time *t – 1* compared with what was expected.

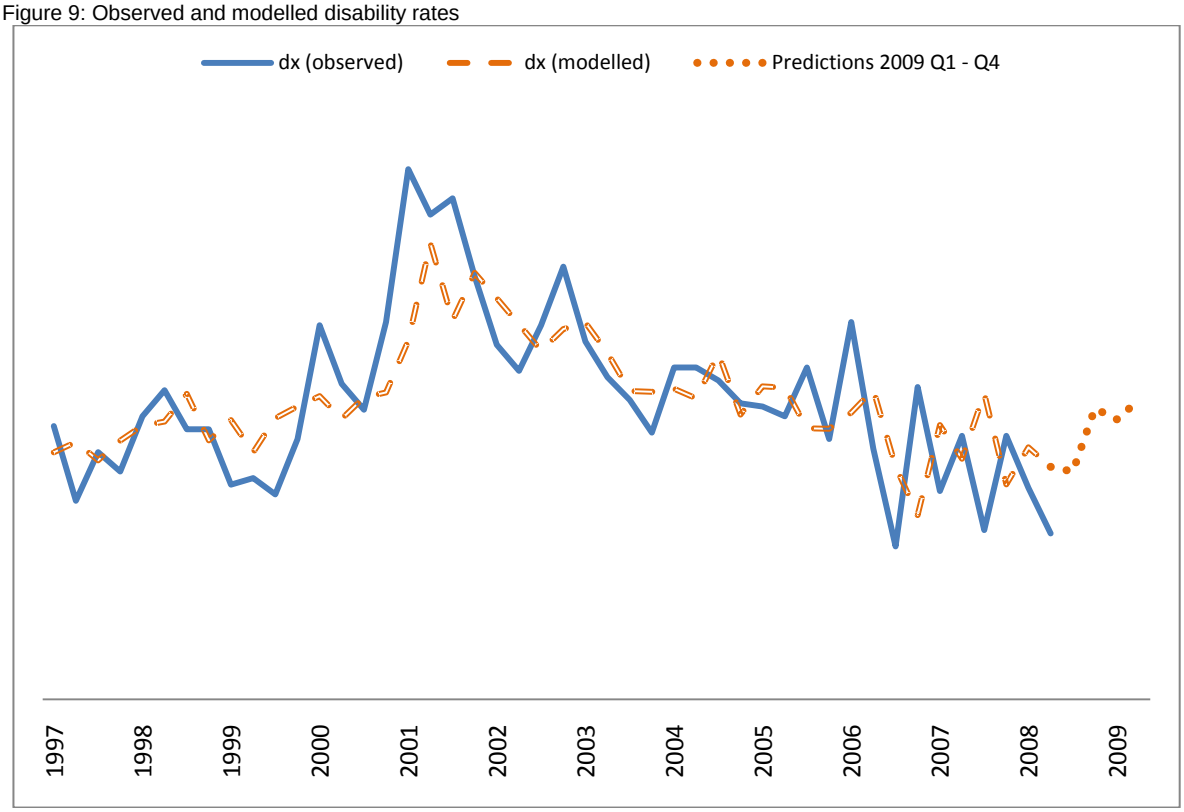
Figure 8: Model Estimates

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	-0.3513	0.6222	-0.5646	0.5755
U	0.0482	0.0243	1.9849	0.0540
CCI	-0.0058	0.0039	-1.4833	0.1458
BCI	0.0027	0.0023	1.1886	0.2416
AR(1)*	0.4510	0.1498	3.0114	0.0045

Test	Statistic
F-statistic	9.96
p-value (F-statistic)	0.00001
Durbin-Watson	2.069
R^2	49.89%

** Autoregressive error term of lag order 1*

Figure 9: Observed and modelled disability rates



Durban-Watson Test Statistic and the AR(1) term

One of the critical assumptions of a linear model is that the model's error terms are uncorrelated (in other words the disability rate in successive periods must be independent). We have already discussed how this is not the case and have therefore made explicit allowance for the fact by adding an AR(1) error correction term. The Durbin-Watson test indicates whether or not this course of action has been sufficient to eliminate the model's autocorrelation. A Durbin-Watson test statistic that differs significantly from 2.00 would indicate that autocorrelation is still present. Since the test statistic of 2.069 does not differ significantly from 2.00 we can surmise that the autocorrelation has been sufficiently dealt with.

The AR(1) coefficient of 0.45 indicates the strength of the correlation of errors between successive disability rates. An AR(1) coefficient of 1 would indicate perfect positive autocorrelation (in other words we would expect the error at time t to exacts equal the error at time $t - 1$), while a coefficient of 0 would indicate complete absence of autocorrelation. There are a number of reasons why this autocorrelation might exist, one of which is the fact that a shock to the system (for example a sudden increase in Unemployment) might have effects that ripple down through a number of periods after the shock. This is therefore not an unexpected result.

R^2 Statistic

The R^2 test statistic indicates that 49.89% of the variation in the observed disability rates can be explained by the model. Reasons for the unexplained variation may include seasonality, changes in claims management practices, or simply random variation in the level of disability incidence.

t-statistics / p-values

The t-statistic tests the hypothesis that an individual variable contributes no useful information to the model.

When we consider the model without an AR(1) term (see section 7.2.2) at a 95% significance level all the variables are significant. (This can be seen from the p-values provided.) In other words, the likelihood that any given variable does not impact on the disability rate is less than 5%.

Based on these results there is a very small statistical likelihood that disability claims are not affected by the economic indicators used in the model.

When we include the AR(1) term the significance level for each of these variables decreases. This is not necessarily a problem, and merely indicates the explanatory power of the AR(1) term and the way it incorporates the effect of changes in economic indicators in previous periods (see above where r_t term is explained).

F-statistic

The F-statistic tests the hypothesis that there is no relationship between any of the independent variables and disability claims. The resultant F-statistic of 9.96 is very significant and there is therefore clearly a correlation between the disability rate and at least one of the economic indicators.

3.2.3 Model conclusions

Based on the various univariate and multivariate regressions considered in the sections above, ***we can conclude that there is in fact an anti-cyclical relationship between disability rates and economic conditions in South Africa***.

The univariate regression exercise suggests that Unemployment and Consumer Confidence are the two factors with the strongest influence. It also suggests that disability rates react only a year after a change occurs in Consumer Confidence, and three months after a change in Unemployment.

The multivariate modelling exercise suggests that the most appropriate model includes variables for Consumer Confidence, Unemployment and Business Confidence as well an autoregressive error correction term. This model produces a relatively accurate fit, with a high R^2 value and F-statistic.

3.3 Sensitivities and Predictions

The following table presents a rough summary of the expected sensitivities to changes in economic indicators.

Figure 10: Model sensitivities

Economic change	Effect on disability rates
1% increase in Unemployment	6% increase
1 point increase in CCI	1% decrease
3 point increase in BCI	1% increase

The fact that the model predicts an increase in disability rates when Business Confidence improves is somewhat counter-intuitive, and may indicate that a longer period of investigation is required to fully gauge this effect.

The following table summarises the progression of annual observed mortality rates as well as the corresponding modelled disability rate.

Figure 11: Average annual disability rate per mille

	Observed disability rate	Modelled disability rate
2002	1.24	1.22
2003	1.14	1.11
2004	0.95	0.94
2005	0.92	0.97
2006	0.94	0.87
2007	0.72	0.72
2008	0.62	0.77
2009 Q1 – Q4	?	0.84

If we look at the period 2002 to 2008 in isolation then the disability rate is clearly trending downwards. This is not unexpected as during this period Unemployment has steadily reduced (from a high of 27% in 2003 Q1 to a low of 19% in 2007 Q1), Consumer Confidence has been high and the economy in general has been doing well.

The modelled disability rates confirm this expectation of declining incidence. However, compared to 2007 the model predicts a 7% increase in disability rates in 2008 and a further increase of 11% in 2009. The observed disability rate has nevertheless declined in 2008; we can examine this in more detail by considering the following table:

Figure 12: 2008/2009 observed and modelled disability rates per mille

Period	U_{t-1}	CCI_{t-4}	BCI_{t-2}	dx_t observed	dx_t modelled
2008					
Q1	25.2	23.0	72.0	0.52	0.941
Q2	23.5	21.0	67.0	0.81	0.661
Q3	23.1	18.0	48.0	0.65	0.775
Q4	23.5	22.0	45.0	0.51	0.715
2009					
Q1	21.9	12.0	34.0	-	0.700*
Q2	23.5	-6.0	33.0	-	0.894
Q3	23.6	-1.0	27.0	-	0.861
Q4	24.5	-4.0	26.0	-	0.922

** 0.777 per mille if unemployment assumed to be 23.5%*

Observed disability rates in 2008 have been generally low (although somewhat volatile). This may indicate the presence of some unreported claims (although the data was extracted more than 10 months after the end of 2008 Q4) or it may be the first sign that the expected increase in disability claims due to the recent recession may not actually occur.

Further increases are predicted for 2009, with the exception of 2009 Q1 which predicts a low disability rate largely due to the somewhat anomalous unemployment statistic of 21.9%. It is quite possible that this statistic is wrong; it does not make sense for Unemployment to reduce from 23.5% to 21.9% (particularly as this was at the height of the financial crisis) and then increase back up to 23.5% in 3 months. This is the equivalent of 200,000 people being given jobs and then the same number of people becoming unemployed 3 months later. Given that StatSA have previously corrected historical data it is possible that Unemployment may actually have remained stable at 23.5%, in which case the model would predict a rate per mille of 0.777 in 2009 Q1.

We will shortly know whether or not disability rates have actually increased in 2009 and the model presented here will therefore have to be re-evaluated in 2010 or 2011 when the full effect of the economic downturn can more accurately be gauged.

4 Conclusion and Next Steps

The purpose of this paper was to test the assumption that there is a link in South Africa between the state of the economy and disability incidence rates. Most South African disability experts would probably have agreed that there was an (anti-cyclical) link, but to date there have been no statistical studies to prove or disprove this.

Thanks to the support of the insurance industry we were able to obtain a significant amount of both individual and group life disability data. One of the key new understandings for the authors was the extent to which group disability incidence rates had declined over the analysis period, far exceeding what we were expecting. While trying to understand why this might have been the case we discovered that there has been a significant shift in the economy from blue collar to white collar workers. This is reflected in the average salary of the group lives insured, which increased in real terms by 30% from 2000 to 2008. While this in itself is fascinating, it did unfortunately mean that we were unable determine how much of the improvement was due to the economy and how much was due to a change on the demographics of the insured population. One of the key follow-ups of this paper will be to attempt to rectify this by looking a particular group of schemes' experience, rather than at insurers' experience.

The individual incidence rates were more stable and we were able to fit a multi-variate model which, we believe, proves that there is an anti-cyclical link between the economy and disability rates, and which will enable insurance companies to estimate how much their rates and reserves could change when the economy changes. A univariate modelling exercise indicates that the strongest correlation is with Unemployment and Consumer Confidence. The model predicts that compared to 2007, disability rates would have increased by 7% in 2008 and by a further 11% in 2009.

While the model completes the picture for lump sum disability business, for income disability business it is crucial to understand the impact of the economy on termination rates. The authors were not able to cover this aspect in this paper, but we can gain access to termination rates data and we will investigate the link between termination rates and the economy.

The latest fully run off disability data available for this study was for calendar year 2008. Seeing that South Africa experienced a sustained period of economic growth for 15 years, followed by a significant economic downturn during 2008/2009, any conclusions drawn from this study would have to be re-evaluated during 2010 and 2011 to incorporate the effect of this shock.

Once again the authors would like to thank all those people who were involved in collecting the data, answering data queries, and reviewing the paper. Special thanks should also go to Professor Martin Kidd at the University of Stellenbosch for his guidance on some of the technicalities surrounding the modelling exercise.

Appendix

5 Disability data

5.1 Sources of data

Data on the incidence of disability claims over the past 5 to 20 years were sourced from 5 different insurers. This includes experience from both individual and group business, and lump sum and income replacement benefits.

5.2 Data Summary

The tables bellow summarise the total data that was available for this study. In order to achieve consistent results some of the data listed here was left out when the results were derived.

Figure 13: Summary of disability data

	Period	Life Years	Claims
Individual	1990 - 2008	12,327,727	11,253
Group	1995 - 2008	11,550,626	38,259

Figure 14: Lives by year, individual business

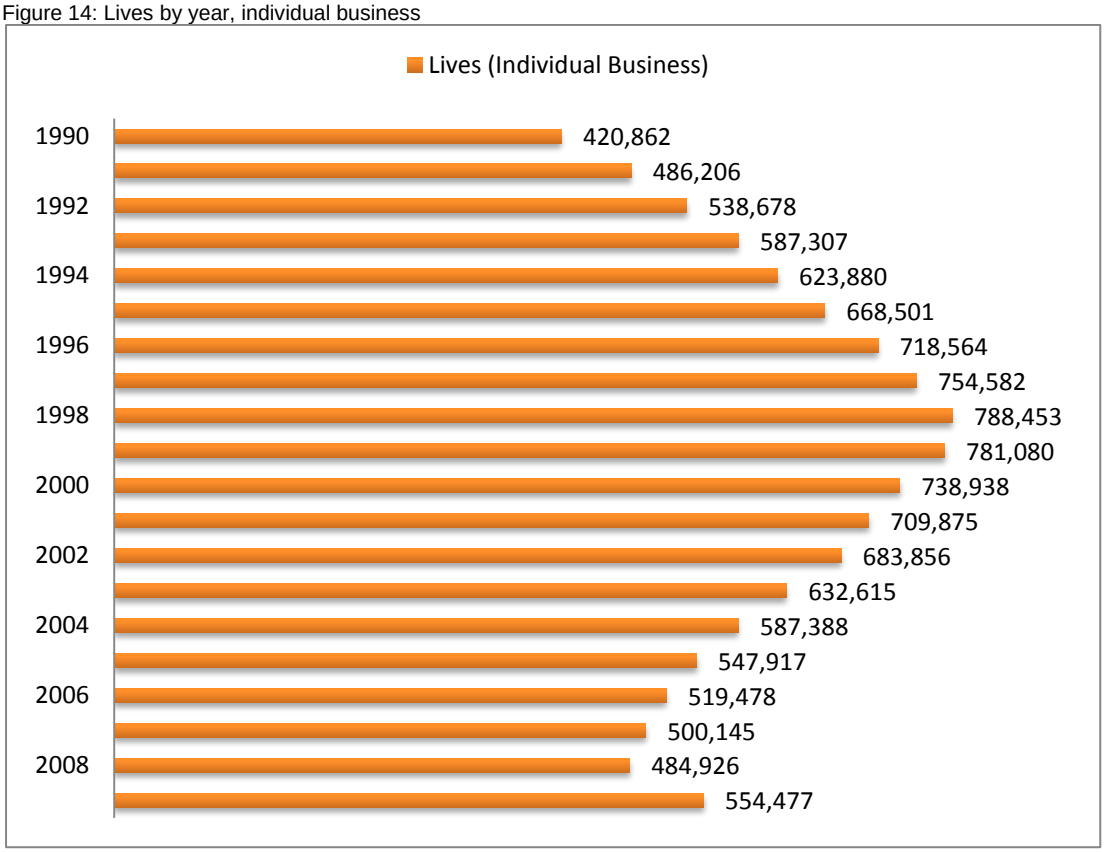
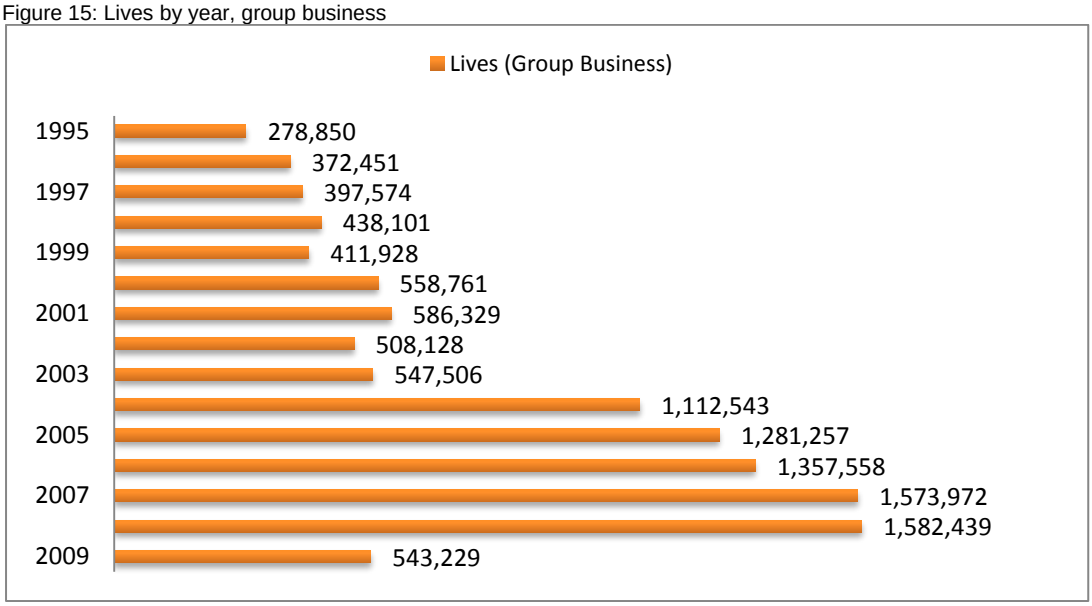


Figure 15: Lives by year, group business



6 Economic data

Year	Quarter	U *	CCI	BCI	CPI	GDP **
1995	Q3	16.5	14	53	45.7	80.63
1995	Q4		16	64	46.3	80.9
1996	Q1		12	51	47.3	82.4
1996	Q2		7	42	48.4	83.38
1996	Q3	20.3	9	34	49.5	84.38
1996	Q4		10	42	50.6	85.17
1997	Q1		6	45	51.9	85.6
1997	Q2		9	38	52.6	86.14
1997	Q3	21.98	2	32	53.5	86.23
1997	Q4		8	29	53.8	86.24
1998	Q1		-4	29	54.7	86.48
1998	Q2		4	17	55.4	86.6
1998	Q3	25.2	-5	13	58.3	86.41
1998	Q4		-6	12	58.6	86.49
1999	Q1		-3	12	59	87.29
1999	Q2		-1	15	59.4	87.99
1999	Q3	23.3	-1	25	59.4	88.95
1999	Q4		10	36	59.9	89.92
2000	Q1	26.7	6	44	61	90.94
2000	Q2		-10	36	62.4	91.77
2000	Q3	23.3	-9	39	63.6	92.68
2000	Q4		-17	30	64.1	93.47
2001	Q1	23.64	3	33	65.5	94.08
2001	Q2		-7	39	66.4	94.55
2001	Q3	26.2	-9	38	66.4	94.8
2001	Q4		-9	47	67	95.53
2002	Q1	25.88	-2	57	69.6	96.53
2002	Q2		1	68	71.7	97.76
2002	Q3	26.6	-1	68	73.8	98.87
2002	Q4		-12	64	75.3	99.69
2003	Q1	27.32	0	59	76.7	100.37
2003	Q2		1	50	76.5	100.93
2003	Q3	24.8	-9	54	76.6	101.54
2003	Q4		4	61	75.6	102.26
2004	Q1	24.07	-7	68	77	103.79
2004	Q2		20	70	77.4	105.45
2004	Q3	23	6	79	77.6	107.31
2004	Q4		4	87	78.1	108.26
2005	Q1	23.29	19	78	79.3	109.4
2005	Q2		17	82	79.6	110.9

2005	Q3	23.5	17	86	80.9	112.25
2005	Q4		20	84	80.9	113.35
2006	Q1	20.54	21	85	82	114.99
2006	Q2		20	81	83.5	116.72
2006	Q3	22.1	17	85	85.2	118.04
2006	Q4		18	83	85.6	119.87
2007	Q1	19.23	23	80	87	121.49
2007	Q2		21	80	89.4	122.58
2007	Q3	21	18	72	91.3	123.93
2007	Q4		22	67	93.3	125.57
2008	Q1	23.5	12	48	96.2	126.12
2008	Q2	23.1	-6	45	100.3	127.68
2008	Q3	23.5	-1	34	103.3	127.74
2008	Q4	21.9	-4	33	102.2	127.15
2009	Q1	23.5	1	27	105.4	125.05
2009	Q2	23.6	4	26	107.2	124.43
2009	Q3	24.5	1	23	109.6	124.97

** Unemployment statistics were interpolated between points to achieve quarterly results where necessary*

** GDP amounts are per 100,000 million at constant 2000 prices*

** The official StatsSA statistics for GDP and CPI in 2009 Q2 and Q3 have been rebased here to be consistent with earlier time periods*

7 Further Modelling Results

The variables used in this section are defined as follows:

t : Time unit in quarters of a year
dx_t : The disability rate (per mille)
U_t : Unemployment
CCI_t : FNB/BER Consumer Confidence index
BCI_t : RMB/BER Business Confidence index
GDP_t : Gross domestic product index
c_0 : Intercept
c_n : Coefficient for the economic variable in question
r_t : Estimated error term at time *t*
r_{t-1} : Actual error term at time *t – 1*
ρ : Coefficient for the error correction term
ϵ_t : A white noise term

7.1 Detailed Univariate Modelling Results

This presents detailed results on the univariate regressions discussed in section 3.2.1.

7.1.1 Unemployment

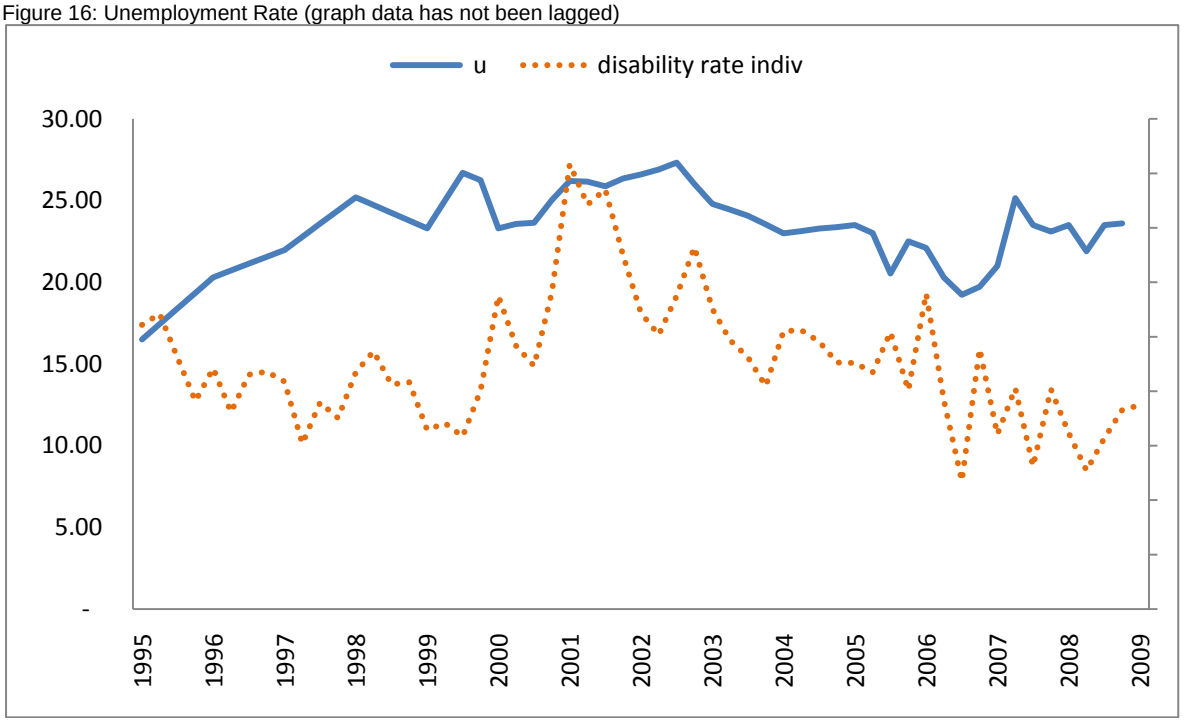
Model Formula:

$dx_t = c_0 + c_1 U_{t-1}$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	-0.6983	0.4203	-1.6610	0.1038
U	0.0680	0.0176	3.8730	0.0004

Test	Statistic	
F-statistic	15.00	***Significant***
p-value (F-statistic)	0.0004	
Durbin-Watson	0.91	
R^2	25.42%	

Figure 16: Unemployment Rate (graph data has not been lagged)



7.1.2 Consumer Confidence

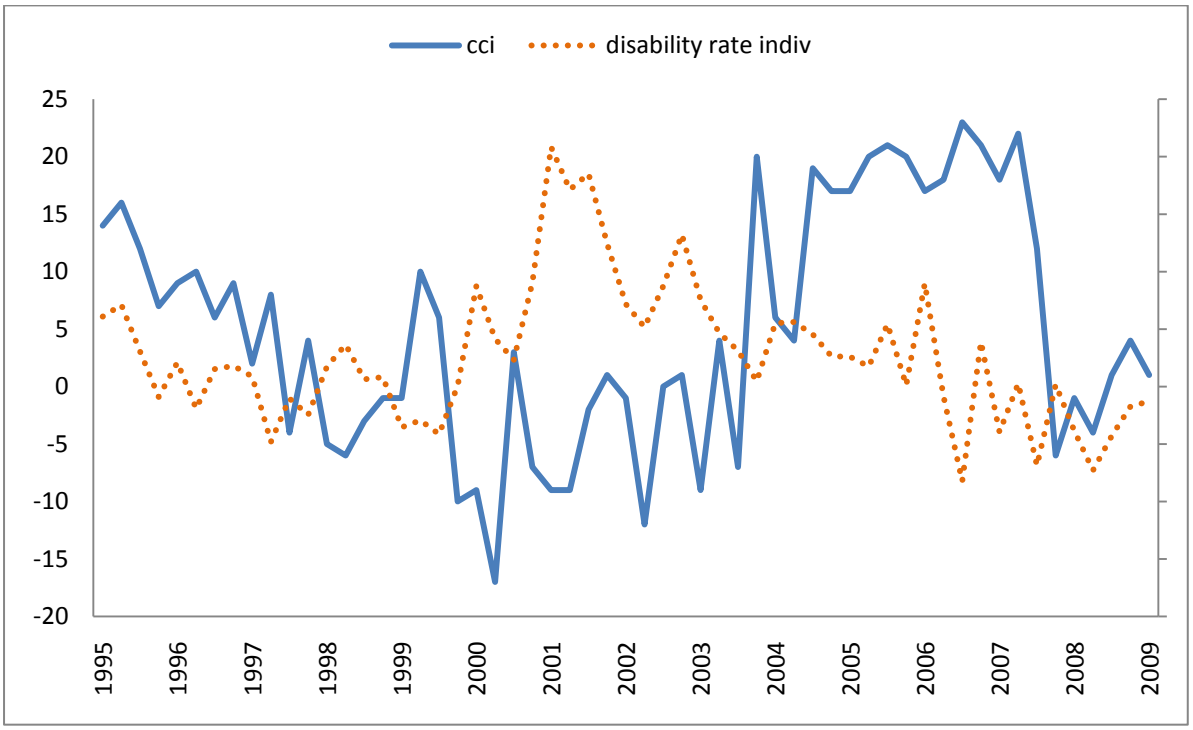
Model Formula:

$dx_t = c_0 + c_1 CCI_{t-4}$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	0.9841	0.0361	27.2700	0.0000
CCI	-0.0123	0.0030	-4.0800	0.0002

Test	Statistic	
F-statistic	16.65	***Significant***
p-value (F-statistic)	0.0002	
Durbin-Watson	1.12	
R^2	27.45%	

Figure 17: Consumer Confidence (graph data has not been lagged)



7.1.3 Business Confidence

Model Formula:

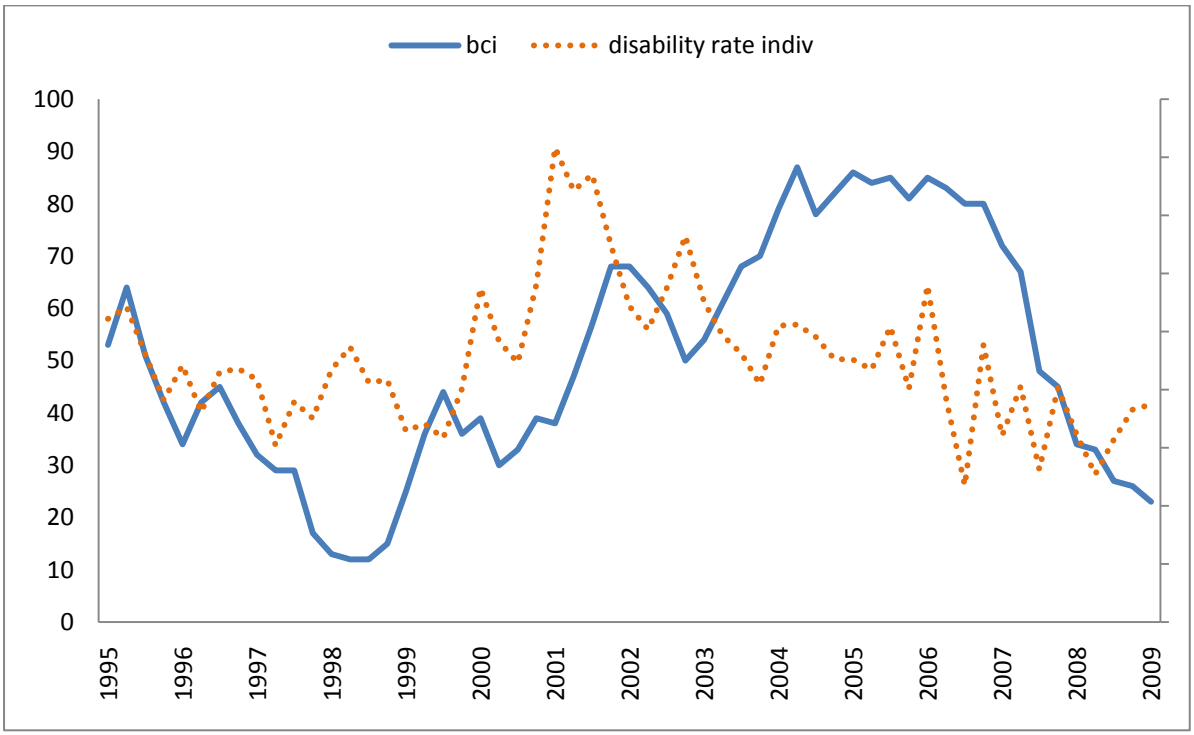
$dx_t = c_0 + c_1 BCI_{t-2}$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	0.9312	0.0966	9.6430	0.0000
BCI	-0.0001	0.0017	-0.0770	0.9390

Test	Statistic
F-statistic	0.01
p-value (F-statistic)	0.9389
Durbin-Watson	0.65
R^2	0.01%

Not Significant

Figure 18: Business Confidence (graph data has not been lagged)



Gross Domestic Product

Model Formula:

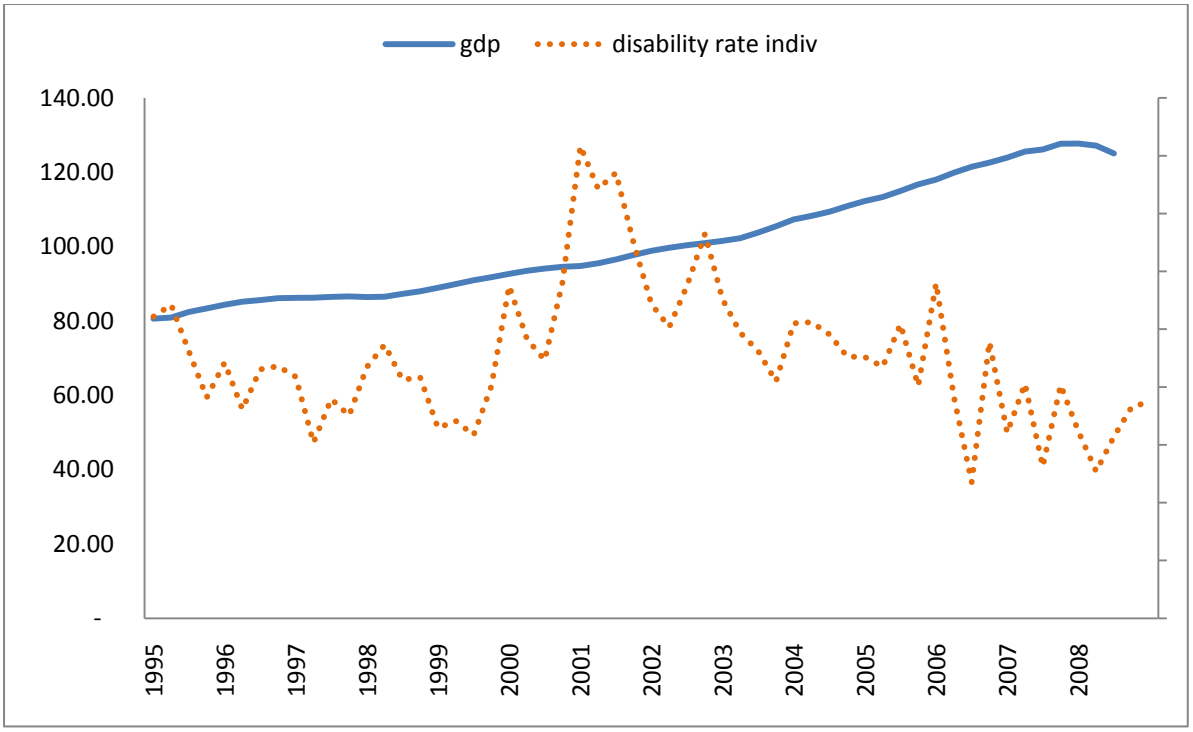
$dx_t = c_0 + c_1 GDP_{t-1}$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	1.4193	0.2897	4.8990	0.0000
GDP	-0.0048	0.0028	-1.7230	0.0919

Test	Statistic
F-statistic	2.97
p-value (F-statistic)	0.0919
Durbin-Watson	0.70
R^2	6.32%

Not Significant

Figure 19: Gross Domestic Product



7.2 Detailed Multivariate Modelling Results

7.2.1 Model including all four economic indicators

Without Error Correction

Model Formula:

$$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4} + c_3 BCI_{t-2} + c_4 GDP_{t-1}$$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	-0.0203	0.6205	-0.0330	0.9740
U	0.0458	0.0207	2.2170	0.0322
CCI	-0.0093	0.0042	-2.2100	0.0327
BCI	0.0049	0.0021	2.3360	0.0245
GDP	-0.0035	0.0042	-0.8370	0.4076

Test	Statistic
F-statistic	7.47
p-value (F-statistic)	0.00013
Durbin-Watson	1.26880
R^2	42.14%

With Error Correction

Model Formula:

$$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4} + c_3 BCI_{t-2} + c_4 GDP_t + r_t$$

Where $r_t = \rho r_{t-1} + \epsilon_t$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	0.4859	0.9571	0.5077	0.6145
U	0.0402	0.0253	1.5865	0.1207
CCI	-0.0039	0.0041	-0.9361	0.3550
BCI	0.0050	0.0030	1.6342	0.1103
GDP	-0.0075	0.0065	-1.1554	0.2549
AR(1)	0.4675	0.1478	3.1635	0.0030

Test	Statistic
F-statistic	8.31
p-value (F-statistic)	0.00002
Durbin-Watson	2.07439
R^2	51.59%

7.2.2 Model excluding GDP

Without Error Correction

Model Formula:

$$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4} + c_3 BCI_{t-2}$$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	-0.3047	0.5172	-0.5890	0.5590
U	0.0456	0.0206	2.2130	0.0324
CCI	-0.0110	0.0037	-2.9290	0.0055
BCI	0.0037	0.0015	2.4700	0.0177

Test	Statistic
F-statistic	9.79
p-value (F-statistic)	0.00005
Durbin-Watson	1.30360
R^2	41.15%

With Error Correction

Model Formula:

$$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4} + c_3 BCI_{t-2} + r_t$$

Where $r_t = \rho r_{t-1} + \epsilon_t$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	-0.3513	0.6222	-0.5646	0.5755
U	0.0482	0.0243	1.9849	0.0540
CCI	-0.0058	0.0039	-1.4833	0.1458
BCI	0.0027	0.0023	1.1886	0.2416
AR(1)	0.4510	0.1498	3.0114	0.0045

Test	Statistic
F-statistic	9.96
p-value (F-statistic)	0.00001
Durbin-Watson	2.06890
R^2	49.89%

7.2.3 Model excluding GDP and BCI

Without Error Correction

Model Formula:

$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4}$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	0.0290	0.5281	0.0550	0.9564
U	0.0392	0.0216	1.8130	0.0769
CCI	-0.0080	0.0038	-2.1400	0.0381

Test	Statistic
F-statistic	10.40
p-value (F-statistic)	0.00021
Durbin-Watson	1.05590
R^2	32.60%

With Error Correction

Model Formula:

$dx_t = c_0 + c_1 U_{t-1} + c_2 CCI_{t-4} + r_t$

Where $r_t = \rho r_{t-1} + \epsilon_t$

Variable	Coefficient	Std. Error	t-statistic	p-value
(Intercept)	-0.0500	0.5991	-0.0834	0.9339
U	0.0412	0.0247	1.6710	0.1023
CCI	-0.0038	0.0037	-1.0222	0.3127
AR(1)	0.5333	0.1386	3.8481	0.0004

Test	Statistic
F-statistic	12.86
p-value (F-statistic)	0.00001
Durbin-Watson	2.11392
R^2	48.47%

8 Assumptions and Potential Pitfalls

1. Disability data

The following factors may cause variations in the disability trends and invalidate the proposed correlations with economic indicators:

- Group exposure was provided as annual census points. In order to obtain a quarterly exposure a linear progression of lives between each census point was assumed. Individual exposure was generally provided as movement files, allowing for an exact exposure to be calculated.

- A long-term trend of reducing claims experience may be a function of insurers tightening up their claims management, longer waiting periods and stricter disability definitions.

- The volume and quality of data is not sufficient to split the analysis by all the relevant rating factors. As such the effect of a change in the mix of business has not been entirely eliminated. This is of particular importance for group business. For example, if an insurer loses a 50,000 man scheme that has particularly heavy experience then there may be a large reduction in incidence rates from one year to the next.

- Different insurers have different practices and target markets. This becomes a problem where the relative volume of data attributable to each insurer differs by period.

- Even after performing detailed checks it is still possible that there may be some errors in the available data.

2. Economic data

- In the past Unemployment data were adjusted a number of years down the line (for example, in 2007 the Unemployment statistics for 2000 to 2007 were significantly changed to reflect what StatsSA claim to be more accurate estimates). It begs the question then if the most recent Unemployment data will always be the most accurate (and in fact the 2009 Q1 Unemployment rate looks too low).

- There will always be some correlation between different economic factors. This presents a problem when attempting to construct a model based on a number of uncorrelated economic inputs.

- Some interpolation had to be done to produce quarterly Unemployment statistics.

- It is not easy to estimate the lag between economic changes and subsequent changes in disability rates. In this paper we have used the R^2 value obtained from univariate regressions to determine the most appropriate lag (see section 3.2.1), as well as relying on reasoned judgement.

- A number of economic indicators that may have been useful in this study are not publicly available, or do not exist at all (for example an index of corporate profits).

3. Model

- The model makes no allowance for seasonal variation, mainly because it was not evident in the data. It is possible that disability rates may also fluctuate by season – just like more people die during winter it may also be that more people become disabled.

- We must bear in mind that the time series data considered here represents only a limited sample of the complete picture. We must accept that whatever relationship we observe in our 15 years of data today may well be disproved if we were to look at 30 or 100 years of data.

- A linear model is susceptible to what is called “spurious regression”, which happens when the relationship between two sets of data is purely coincidental and does not actually indicate a fundamental correlation. (It might, for example, be possible to obtain an apparent relationship between consumer spending patterns and the Amazon forest’s yearly rainfall index.) We have of course aimed to eliminate this by presenting intuitive arguments for why one might expect the modelled relationships to exist. But we must allow for the fact that these assumptions too might be proven false in the future.

- A model can only predict things in the future which have already happened in the past. It is entirely possible that something might happen in a few years from now which completely flies in the face of every assumptions we have made about the behaviour of the economy or the nature of disability business.

- As the eminent Professor of Statistics George E Cox once said “Essentially, all models are wrong, but some are useful”. We hope that our model is useful to someone.

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