Startups, Bustups and Other Windups:
An Econometric Model of
Company Creation and Destruction in Australia

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Abstract:
We present a quarterly structural econometric model of company creation and destruction in Australia, which has been developed for use in explaining, forecasting and performing policy and scenario analysis for Australian Government expenditure on the Fair Entitlements Guarantee. It is also potentially useful for other purposes, such as explaining the number of retrenchments. We estimate econometric equations for the Startup (new company registration), Bustup (company insolvencies that are considered to be most closely related to expenditure on the Fair Entitlements Guarantee), and Other Windup rates. The model explains a high proportion of the variation in company creation and destruction in Australia since the early 1990s, as well as the recent decline in the insolvency rate.

Note: This paper reflects the authors' views and does not necessarily represent those of the Department of Employment or the Australian Government. The authors would like to thank Dr Yongping Li and other staff in the Labour Economics Section and in the Employee Entitlements Branch of the Department of Employment for their assistance in the compilation of the data series and discussion of findings in this paper, while absolving them of any blame for the results. The lead author can be contacted at greg.connolly@employment.gov.au.

1. INTRODUCTION

A quarterly structural econometric model of company creation and destruction in Australia, which has been developed by the authors for use in explaining, forecasting and conducting policy and scenario analysis for Australian Government expenditure on the Fair Entitlements Guarantee, is presented in this paper. In this model, data from the Australian Securities and Investments Commission or ASIC, starting from the early 1990s, is used. Going back this far is important, because, as will be shown later in this paper, the recession of the early 1990s had a sizable effect on the insolvency rate.

The model is also potentially useful for other purposes, such as explaining the number of retrenchments or understanding other aspects of company structure, dynamics and finances in Australia and the flow-on effects of corporate insolvencies on the rest of the economy. Al Badhily (2011) states that "…corporate insolvencies can have a major effect on the economy at large, especially in the wider context of large-scale corporate collapses where thousands of employees may lose their employment and entitlements." For instance, it is relevant to the current Productivity Commission Inquiry into Business Set-up, Transfer and Closure (see PC 2014 for the Terms of Reference and issues involved in this Inquiry).

Under the Fair Entitlements Guarantee (FEG), payments are made to people owed outstanding employee entitlements following the insolvency or bankruptcy of employers if their employer went bankrupt or entered liquidation on or after 5 December 2012. The FEG replaced the General Employee Entitlements and Redundancy Scheme (GEERS), under which outstanding employee entitlements were paid to former employees if their employer went bankrupt or entered liquidation before 5 December 2012 (this Scheme started in applies to people whose employment was terminated after 12 September 2001, according to Al Badhily 2011). Al Badhily (2011) also describes several similar schemes, with less coverage than the GEERS scheme, and one-off actions for large insolvencies, that applied in the few years before the start of the GEERS scheme.

Over the four financial years up to 2013-14, the amount spent by the Australian Government on FEG/GEERS has varied between $150 million and $260 million, with expenditure varying substantially from year to year. Therefore, it is worthwhile to attempt to get better forecasts of this spending.

Since GEERS was, and FEG is, triggered by insolvency/bankruptcy, a logical starting point in forecasting FEG expenditures is to construct an economic model of insolvencies. We found that it was not sensible to forecast the level of insolvencies alone, because there were different influences on the insolvency rate (insolvencies as a percentage of the number of companies) and the number of companies. We also found that in order to explain econometrically the insolvency rate, we needed to explain econometrically the rate of new company registrations, otherwise known as the Startup Rate. This is because one of the significant explanatory variables for the insolvency rate is the share of companies aged less than one year, and our proxy for this variable is constructed from the Startup Rate (multiplied by the number of companies at the end of the previous quarter).

In this model, we explain econometrically the Startup Rate (new company registrations with the Australian Securities and Investments Commission or ASIC as a percentage of the total number of companies), the Bustup Rate (the three main types of company insolvencies that are considered to be most closely related to expenditure on the Fair Entitlements Guarantee as a percentage of the total number of companies) and the Other Windup Rate (Other Windups, including the types of insolvency excluded from the definition of Bustups, are determined as an identity in this model which is explained later in this paper, and the rate is expressed as a percentage of the total number of companies).

The company Startup and Bustup Rates and the number of companies are estimated econometrically as functions of three different types of explanatory variables:

1. Economic and financial variables, such as the growth rate of real GDP and the real interest rate;

2. Variables related to industry and company structure, such as the share of companies aged less than one year and variables related to key industries such as the Construction Industry; and

3. Variables relating to policy, definitional and data-processing changes and developments.

The Bustup Rate is estimated to depend on economic and financial variables (the growth rate of real GDP, the growth rate of the real exchange rate, the real interest rate, the real share price, the business debt/equity ratio and the Business External Funding Flow Rate), variables relating to volatile industries (Dwelling Approvals per person, relating to the Construction industry, and rainfall and flooding variables relating to the Agriculture, Forestry and Fishing industry), variables relating to taxation, legal and structural changes around the turn of the Millennium and a variable relating to the age structure of companies (the share of companies aged less than one year old).

The inclusion of the latter variable meant that it was necessary to include a set of equations to explain the Startup Rate of companies in order to construct this structural model. The Startup Rate is estimated to depend on economic and financial variables (the growth rate of real GDP, the real interest rate, and the debt/equity ratio) and dummy variables relating to structural and definitional changes around the turn of the Millennium.

The final set of estimated equations relates to the Other Windup Rate. This was estimated as a function of the relativity between company and individual tax rates and dummy variables relating to structural and definitional changes around the turn of the Millennium and ASIC company record-keeping procedures in the 1990s. In order to complete the structural model, a series of identities linked these estimated equations.

The paper is organised as follows. A review of past research, particularly in Australia, on company insolvencies and other relevant company developments is presented in Section 2. The data and data-transformation methods used in this study are described in Section 3. Section 4 presents the estimation method and results. Section 5 concludes. Appendices detail methods of construction for some of the more complicated explanatory variables and testing of the orders of stationarity and integration of the variables.

2. PAST RESEARCH

Much of the past literature on company creation and destruction appears to the authors to be focused on the latter, and this is the more relevant part of company dynamics for the main purpose of the current analysis. Accordingly, this literature review will be focused on past research into corporate insolvencies.

In relation to company creation, however, PC (2014) provided a brief overview of the issues involved in business set-up in Australia, mentioning that entry rates were higher for small businesses than for medium and large businesses, that entry rates depended upon the type of organisation (companies, trusts, sole traders, etc), and that barriers to business set-up included "regulatory arrangements and requirements (or 'red tape')", access to markets, access to finance, access to payments systems, foreign investment regulations and business structures.

The global literature on forecasting corporate insolvencies may be classified into three broad categories:

- the microeconomic approach;
- the neural-network approach; and
- the macroeconomic approach.

2.1 The microeconomic approach

The early approaches to assessing and predicting corporate insolvencies were microeconomic in perspective. They were primarily based on a financial view of the firm. The early research papers were predominantly developed in the US. They emphasised narrowly on the financial factors that determined corporate insolvencies – explanatory variables were concentrated on a set of financial ratios, determined from internal report data and organised into the five major classes of financial data (known as 'CAMEL' in short): Capital adequacy, Asset quality, Management efficiency, Earnings quality and Liquidity.

For example, Beaver (1966) presented a univariate discriminant analysis to test the usefulness of ratio analysis in predicting corporate insolvencies. He found that (out of the 30 ratios tested for 79 insolvent firms from 1954 to 1964) cash flow to total debt ratio was the most important factor in his microeconomic analysis of corporate insolvencies.

Altman (1968) built on Beaver's pioneering work, expanding the microeconomic approach into a multivariate analysis. He developed a linear model with five variables crucial for predicting corporate bankruptcy, an approach known as multivariate discriminant analysis. For a while, this became the standard approach to predicting corporate insolvencies. Important variants to this multivariate-discriminant-analysis approach were provided by Deakin (1972) and Blum (1974). Ohlson (1980) subsequently innovated with logit and probit models to predict the likelihood of corporate insolvency.

In general, the microeconomic models have achieved some measure of success (especially in the US and the UK) in identifying potential cases of insolvencies at the firm level, with the help of timely financial accounts. However, their usefulness was limited to the short-term time frame because the predictive capabilities of these microeconomic models generally deteriorated significantly beyond the one-year forecasting period.

Lincoln (1982) in his Ph D Thesis[1], provided a new dimension to predicting insolvencies in Australia—by using accounting ratios to predict corporate failure. While previous studies made use of the statistical technique of discriminant analysis to derive models for predicting whether a firm will or will not fail, Lincoln employed the same statistical technique with improved results. Three main differences set Lincoln's approach apart from others.

- First, the ratios used in the discriminant analysis were selected by a method which ensured that no arbitrary limit is placed on their number.
- Second, four industries were analysed separately—manufacturing, retail, property, and finance—rather than collectively in aggregate (because the significance of accounting ratios can vary from industry to industry).
- Third, the resulting statistical probabilities from the analysis were used to measure a firm's current level of insolvency risk.

Lincoln built on Altman's earlier work in the US, where he used both accounting and other market-based indicators to predict US corporate failures. Professor Ken Wright who supervised Lincoln's PhD thesis, stated that Lincoln's approach was more successful in predicting corporate failures than Altman's because he relied solely on fundamental accounting measures, whereas Altman had also made use of the noisier financial market indicators in his analysis[2].

[1] Mervyn Lincoln's Thesis is available at this website: https://minerva-access.unimelb.edu.au/bitstream/handle/11343/38867/66054_00000636_01_Lincoln.pdf?sequence=1
[2] Source: http://fbe.unimelb.edu.au/accounting/caip/aahof/ceremonies/ken_wright

2.2 The neural-network approach

The search for greater accuracy in the prediction of corporate insolvencies over the past two decades has resulted (in parallel with the growth of conventional macroeconomic models) in the development of neural-network models. Neural networks are essentially computer systems that simulated the existing known facts (known as the 'training set') about how the human brain[3] behaves in order to identify specific patterns that could lead to the likelihood of corporate insolvencies. These models mainly concentrate on microeconomic factors that affect corporate insolvencies. In recent years, they have led to a proliferation of software modelling, utilising complex algorithms with software houses charging very high fees for the use of the latest popular models.

Salchenberger *et al.* (1992) first pioneered a neural-network model that predicted the probability of corporate failures for savings and loan associations in the US. Using financial variables that signal an institution's deteriorating financial conditions, they showed that their neural-networks model performed as well as, if not better than, a logit model in predicting corporate insolvencies.

Despite the growing popularity of neural-network models in banks and other financial institutions, much of the work relating to the prediction of corporate insolvencies is concentrated on firm-specific cases. Very little has been done on neural networks in terms of forecasting corporate insolvencies with the macroeconomic variables. The high cost of software acquisition together with the highly-specialist nature of skills required for neural networks are factors that limited the use of neural networks beyond the profitable banks and corporate institutions with deep pockets.

The efficacy of neural networks (over conventional approaches) in the prediction of corporate insolvencies remains a moot point. Coats and Fant (1993) and Wilson and Sharda (1994) compared the prediction results from the microeconomic multivariate discriminant analysis with the neural network approach and found the latter to be superior. In contrast, Boritz, Kennedy and Albuquerque (1995), after comparing the results from two neural-network techniques with those from the multivariate discriminant analysis, the probit and logit, as well as the earlier results from Altman's and Ohlson's prediction models, found that the results from the two neural-network techniques were no better. Similar findings were also reported by Laitinen and Kankaanpaa (1999), who stated that "*…, neural networks, is in its present form as effective as discriminant analysis was as early as thirty years ago*"[4].

[3] A neural network is a mathematical model that is structured like a human brain, one whose complexities in decision making are modelled to identify the slightest of discernible patterns among a group of financial and economic variables, for the purposes of predicting corporate insolvencies. Neural networks replicate the human brain's decision-making capabilities through the development of artificial intelligence.

[4] Laitinen, T. and Kankaanpaa, M. (1999), *Comparative analysis of failure prediction methods: the Finnish case*, *The European Accounting Review*, Vol 8, p 69.

There are some positive claims of the efficacy of the use of neural networks in the more recent years, although it is difficult to validate them as they are shrouded in marketing hype and limited by the proprietary nature of the data involved. Neural networks are in general prone to 'overfit'[5] the data in the training set, which results in poor out-of-sample forecasts. However, this problem is inadequately discussed by the promoters of neural network models. The applications of neural networks to macroeconomics are still quite novel and they are still considered to be at the frontier of empirical economic methods at the leading institutions in Europe and North America.

2.3 The Macroeconomic approach

Interests in macroeconomic factors grew from around the late-1970s when microeconomic model builders were frustrated with the dismal results of microeconomic models in the prediction of corporate insolvencies beyond the one-year time frame. This shift in emphasis to the macroeconomic factors was also the result of the substantial globalisation of trade and investments, with floating exchange rates and financial market deregulation making the variability of macroeconomic factors (such as real GDP, inflation, the unemployment rate, interest rates and the exchange rate) becoming relatively more important considerations to the outlook for corporate insolvencies.

Desai and Montes (1982) built models that focussed on the monetary factors, because they considered corporate insolvency to be essentially a monetary phenomenon. Using annual data and a set of dynamic equations, they explored the effects of interest rates and money supply growth on failing companies in the UK from 1945 to 1980. Their findings showed that interest rates have had a positive effect on corporate failures, while the money supply has had a negative effect.

Rose *et al* (1982) analysed the relationships of macroeconomic factors with corporate insolvencies in the US. Using quarterly data for the period 1970-1980, their variable-selection-approach results (in a six-variable model) showed that macroeconomic conditions played an important part in affecting aggregate corporate insolvency rates. The lead-lag relationships evident in their study indicated that forecasts of corporate insolvency rates can be made one to four time periods (i.e., up to one year) ahead by determining a suitable index of economic indicators that lead corporate failure rates.

Wadhwani (1986), using UK quarterly data for the period 1962-1981, found significant positive effects from inflation, interest rates and the level of debt to rates of corporate insolvencies. Cornelius and Wright (1995) re-estimated Wadwhani's model for the period 1965-1994, using quarterly data and generated similar results after introducing a dummy variable to take into account the impact of the UK *1986 Insolvency Act*.

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[5] A major problem with neural-network training is 'over-fitting'. This occurs when the error on the training set is driven to a very small value, but when new data is presented to the network the error is large. However, the network has 'memorized' the training examples, but it has not learned to 'generalize' to new the data situation. See web page: http://web.engr.oregonstate.edu/~tgd/classes/534/slides/part10.pdf

Hudson (1987) undertook a detailed analysis of the structure of UK company liquidations. He studied 1,830 failed UK firms during the period from 1978 to 1981 and found that recessions were responsible for them entering into liquidation proceedings, with young firms being affected most.

Levy and Bar-Niv (1987), using US annual data from 1947 to 1982, showed that corporate insolvency rates were positively correlated with the variances of the GNP and the GNP deflator, and negatively correlated with the covariance of these variables.

Goudie and Meeks (1991) using a macro-micro model, tried to bridge the gap between their approach and that of the multivariate-discriminant-analysis practitioners. They forecast corporate insolvencies not only on the basis of financial accounts, but also on macroeconomic developments. They found that in concentrating on just one key macroeconomic variable, the exchange rate, they were able to identify specific companies at risk of insolvency under different macroeconomic conditions, rather than predicting just an aggregate failure rate.

Wickramanayake (1996), using annual data for the period 1973-1995 for Australia, examined the relationship between corporate insolvencies and certain economy-wide factors such as the bank advances-to-GDP ratio, unemployment, the price level and the Australian stock price index. His results, based on a cointegration approach, showed that corporate insolvencies were positively related to the bank advances-to-GDP ratio, the level of unemployment and the price level. Corporate insolvencies were negatively related with the stock price index.

The Productivity Commission (2000) undertook a major economic modelling exercise on insolvencies, as part of a broader study into the reasons for business failures in Australia. It sought to explain movements in the bankruptcy rate for Australia in macroeconomic terms, from a host of labour market, monetary and cyclical economic variables. The modelling results showed two main factors responsible for the rise in Australia's bankruptcy rate since WWII:

- Declining interest cover (i.e., the ratio of unincorporated income to interest payments by unincorporated interest payments) which was particularly important in explaining the rise from 1950-51 to 1970-71. The Productivity Commission states that "*this variable captures the combined effect of a generally increasing exposure of businesses to debt (with large increases in the ratio of the stock of debt to unincorporated income) and changing interest rates*"[6].

- The disappearance of capital gains associated with the effect of inflation on debt, combined with the effects of the deep recession in the early 1990s, which was particularly important in explaining the increase in bankruptcies from the late 1980s.

[6] Productivity Commission (2000), *Business Failure and Change: An Australian Perspective*, December, p. 183.

Vlieghe (2001), using UK quarterly data from 1975 to 1999, explored the ability of a time series model to track the behaviour of corporate liquidations over time and concluded that, over that period, macroeconomic variables had greater explanatory power than microeconomic and financial accounting ones.

Archambault and Laverdière (2005) adopted the macroeconomic approach in systematically tracking corporate insolvencies in Canada, with the purpose of predicting how this might change in the future. They developed a model for consumer insolvency and another model for business insolvency. Their findings showed that for consumer insolvency (which rose in the period from 1987 to 2003) rising debt-to-income ratio was the most important explanatory factor. In contrast, the fall in interest rates was the main reason for the fall in business insolvency in the period between 1996 and 2003.

In a feasibility analysis conducted for the Department of Employment and Workplace Relations, Econtech (2006) wrote that on the basis of its own short literature review and previous economic modelling work that it had done on the determinants of credit risk:

- It considered that interest rates would be one of the main drivers of the business insolvencies and suggested that the interest rate on 90-day bank bills would be a suitable interest rate series to use;
- It viewed business gearing rates as a potential driver of business insolvencies;
- It regarded the level and composition of real GDP as another key driver of business insolvencies. Regarding composition of GDP, it stated that this could be disaggregated either from an expenditure perspective (consumption, investment, net exports, etc) or from a production perspective (the contribution of various industries to output); and
- It also considered that factors driving demand for goods and services, such as the exchange rate, may also influence business insolvencies.

Orzechowska-Fischer and Taplin (2010), following on the macroeconomic modelling approach by Archambault and Laverdière (2005), developed a model for forecasting the corporate insolvency rate in Australia. The findings showed that GDP at market prices was the most important factor. Other significant factors included business profits and the unemployment rate.

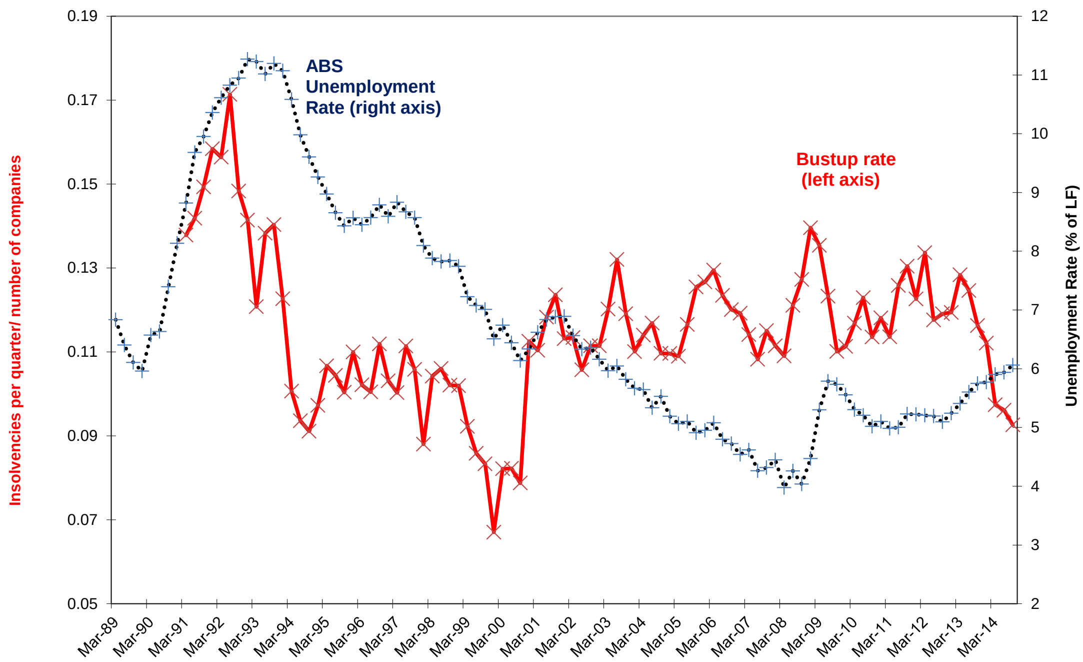
However, their long-term results for the unemployment rate are counter-intuitive. The relevant parts of their estimated equation from their quarterly model are shown in equation 1.

$$\text{Ln(Insolvency Rate)}_t = \ldots + 0.446 * \text{Ln(Unemployment Rate)}_t - 0.749 * \text{Ln(Unemployment Rate)}_{t-1} + \ldots \qquad (1)$$

The long-term effect is the sum of these two coefficients, namely -0.302. This implies that a higher unemployment rate is followed, with a lag of one quarter, by a <u>lower</u> insolvency rate. This finding is clearly counterintuitive.

There are two probable explanations for this counterintuitive finding. The first is that Orzechowska-Fischer and Taplin (2010), in following the lead of Archambault and Laverdière (2005), mistakenly included the unemployment rate in their equation for the business insolvency rate. In Archambault and Laverdière (2005) the unemployment rate was tested for inclusion in their equation for consumer insolvencies, but was not considered relevant to be tested for inclusion in their equation for business insolvencies. The other reason is that the unemployment rate is actually a lagging indicator, not a leading indicator, of the business insolvency rate, as would be implied in the equation above from Orzechowska-Fischer and Taplin (2010). This can be clearly seen in Figure 1 below.

Figure 1: The **Bustup Rate and the Unemployment Rate**



Source: Bustup Rate: ASIC data in original terms was seasonally adjusted in the Department of Employment, using the Census X-13 routine in the EViews8 computer programme. Unemployment Rate: seasonally adjusted data from ABS (2015), *Labour Force, Australia, Detailed, January 2015*, Cat. No. 6291.0.55.001, adjusted for ABS Labour Force Survey redefinitions as explained in Connolly (2008). Unemployment rate data are for the middle month of each quarter (i.e., February, May, August and November), while the insolvency rate is for the whole of the quarter .

A recent example of the lagging nature of developments in the unemployment rate, relative to developments in the business insolvency rate, can be seen around the time of the Global Financial Crisis in 2008 and 2009, when the business insolvency rate peaked in the December quarter of 2008, but the unemployment rate did not peak until the June quarter of 2009.

2.4 Assessment of past research

All of the three approaches: microeconomic; neural network; and macroeconomic; have their advantages and disadvantages; but for the purposes of this analysis, the macroeconomic is clearly the most applicable. This is largely driven by the nature of our task: to estimate an Australia-wide model of company creation and destruction to be used in developing a forecasting model for expenditures on the Fair Entitlements Guarantee.

In many ways, the economic model for the insolvency rate that will be presented later in the current paper is similar to that in Orzechowska-Fischer and Taplin (2010), but the unemployment rate will not be used as an explanatory variable of the business insolvency rate in the current analysis, unlike in Orzechowska-Fischer and Taplin (2010).

3. METHODS and DATA

The dependent variables for the three sets of equations (on the Startup Rate, the Bustup Rate and the Other Windup Rate) were constructed by the authors and other members of the Economics Branch and the Employee Entitlements Branch of the Department of Employment (and the predecessors of these Branches and this Department), from ASIC corporate data. These data (in original terms) are freely available on ASIC's website (www.asic.gov.au) for the period from January 1999; for the period before then the data were obtained (at least some of the data were purchased) by the Department of Employment (or its predecessors) from ASIC. These data were then converted to seasonally adjusted terms by the authors using the Census X-13 routine in the EViews8 computer programme.

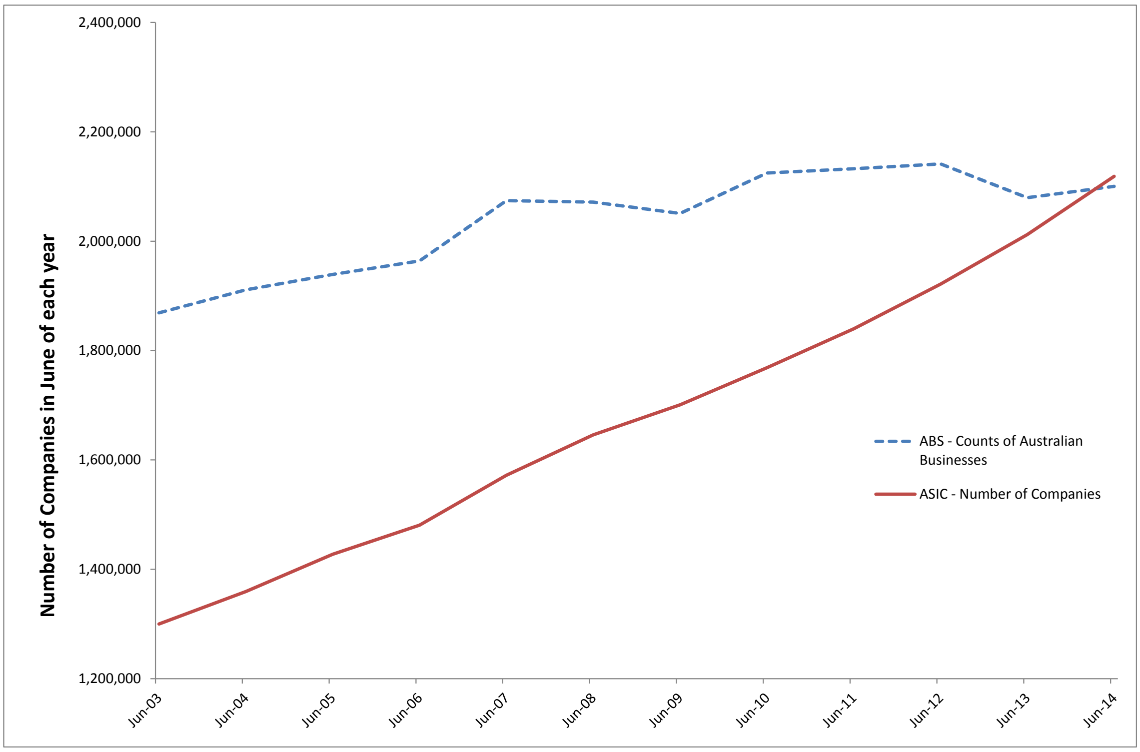
The explanatory variables were constructed by the authors from various sources, as explained further in this Section.

3.1 Data on Companies and Businesses

The number of companies, for the purposes of this analysis, is the number of corporations registered with ASIC, using ASIC data. These data (in original terms) are freely available on ASIC's website (www.asic.gov.au) for the period from January 1999; for the period before then the data were purchased by the Department of Employment from ASIC.

Using ASIC data on the number of companies is the logical choice for this research project, because the data on Startups and Bustups also comes from ASIC data. However, there is another, shorter, annual series on the number of businesses from the ABS *Counts of Australian Businesses* (ABS Cat. No. 8165.0) publication. This is based on quite a different definition of companies/businesses and not surprisingly, both series evolve differently over time, as shown in Figure 2.

Figure 2: **Comparison of ASIC and ABS Data on the Number of Companies/Businesses**



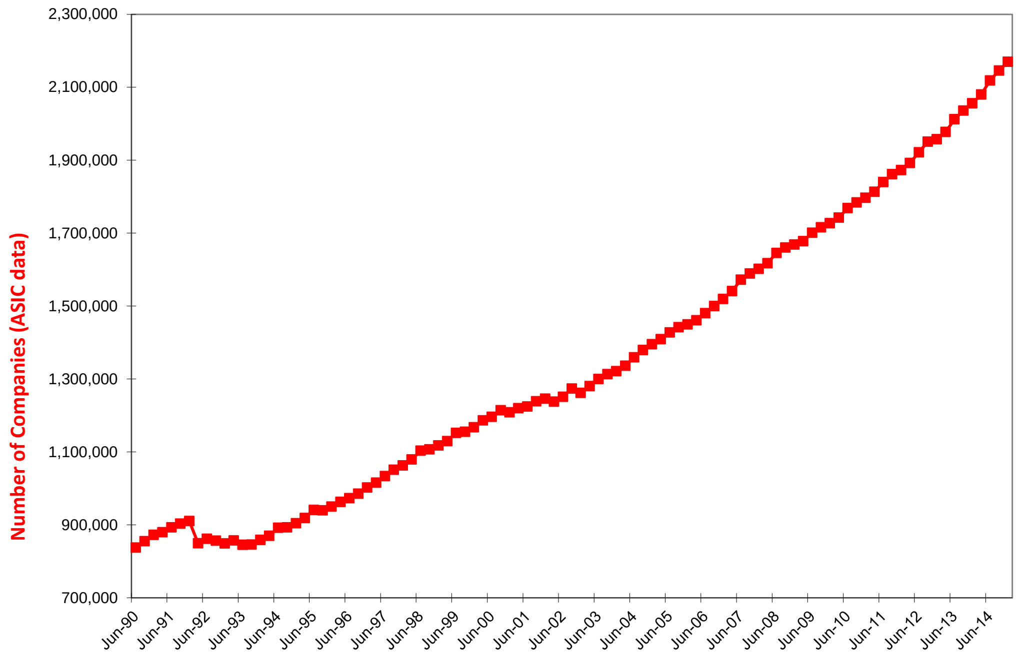
Sources: ASIC data on number of registered companies in original terms for June of each year were obtained from www.asic.gov.au, while ABS data on the number of businesses (also in original terms for June of each year) were obtained from ABS (2015), *Counts of Australian Businesses, including Entries and Exits, Jun 2010 to Jun 2014*, ABS Cat. No. 8165.0 (and previous issues). Note that it is only possible to conduct this comparison from June 2003 through June 2014, because this is the span of the ABS data on the number of businesses from this publication.

The ASIC data are on the total number of corporations registered with this organisation, whether they are actively trading or not. The ABS data are on the number of actively trading businesses on the ABS Business Register, which in turn is based on the number of businesses with an Australian Business Number, which is a requirement for filling out Business Activity Statements under A New Tax System and remitting Goods and Services Tax to the Australian Taxation Office. The ABS counts not only corporations, but also other business structures such as partnerships and sole traders. Given these different definitions, it is unsurprising that the two series shown in Figure 6 do not have a perfect correlation with each other (although, coincidentally, they are at very similar levels in June 2014).

Over the period from June 2003, the growth in the number of companies registered with ASIC has grown more quickly and smoothly than the ABS count of businesses. A partial explanation is that the ASIC number includes superannuation companies, which have been growing at a fast and steady rate, but many of these companies would be excluded from the ABS count because they are not actively trading.

A longer time series of the ASIC data on the number of registered corporations is shown in Figure 3.

Figure 3: **Quarterly ASIC Data on the Number of Companies**



Sources: ASIC data on number of registered companies in original terms were obtained from www.asic.gov.au back to January 1999 and purchased by the Department of Employment from ASIC before then.

As can be seen from Figure 3, there is no visually apparent seasonal pattern in the data. A noticeable feature of the data is the large buildup in the number of registered companies in the six quarters from June quarter 1990 through December quarter 1991, followed by a sudden fall in March quarter 1992. One of the authors contacted the data experts in ASIC, who informed him that this was due largely to the record-keeping practices at ASIC at the time, where there were substantial deregistrations for compliance reasons in March quarter 1992 and then again in June quarter 1993. For the econometric analysis, two dummy variables, $D1992Q1_t$ and $D1993Q2_t$, respectively, were created. These were set equal to one in the quarters when the substantial deregistrations for compliance reasons were conducted by ASIC and set equal to zero in other quarters. As can be seen from Figure 7, the second set of one-off deregistrations was much smaller than the first set. Subsequent to that, there did not appear to be similar episodes of large, one-off episodes of company deregistrations.

Although there wasn't a seasonal pattern in the level of the number of companies, there was in the monthly change in the number of companies. Seasonal adjustment on the monthly change in the number of companies was conducted using a regression-based approach in the TSP 5.1 computer programme (Hall and Cummins 2009), which enabled adjustments to be made for the outliers mentioned above. A seasonally adjusted series for the level of the number of companies was then generated from the seasonally adjusted monthly changes. Details are available from the authors.

The large-scale deregistration of companies by ASIC for compliance reasons in March quarter 1992 implies that there must have been a buildup of non-compliant companies in the period before this quarter. This was assumed to occur in the six quarters from June quarter 1990 through December quarter 1991 and was captured econometrically through the construction of a dummy variable, $RAMP92Q1_t$, that was set equal to zero before September quarter 1990 and from March quarter 1992 onwards, but ramped up by one sixth from the September quarter 1990 to the December quarter 1991, when it reached a value of one.

3.2 Definition of 'Bustups'

The following three types of company insolvency are included in the definition of "bustups":

1. Court wind-up;

2. Creditors' wind-up; and

3. Voluntary Administration.

In most months over the last decade or two, these three types of insolvencies are the most numerous. They are also judged to be the most likely to result in FEG/GEERS cases, because they are generally more likely than the other types of insolvencies to result in the company actually being wound up and a FEG/GEERS payment being made (rather than the company being managed externally to trade out of their financial difficulties). The other reason for using these three types of insolvency only is that we were able to obtain a largely consistent monthly time series from ASIC for this definition going back all the way to January 1991, but we were only able to obtain a consistent time series for the currently defined total going back to January 1994. The additional three years of consistent time-series data for the "bust-ups" definition is highly important because it includes the economic recession of the early 1990s and its immediate aftermath. As will be shown later in this paper, variables which are affected by this recession such as the growth rate of real GDP and the debt/equity ratio, are important determinants of the insolvency rate.

The other types of company insolvencies which were not included in the "bustups" measure, but are included in the Other Windups measure, are:

4. Provisional wind-up;

5. Receiver appointed;

6. Controller (except receiver or managing controller);

7. Managing controller (except receiver & manager);

8. Receiver manager appointed;

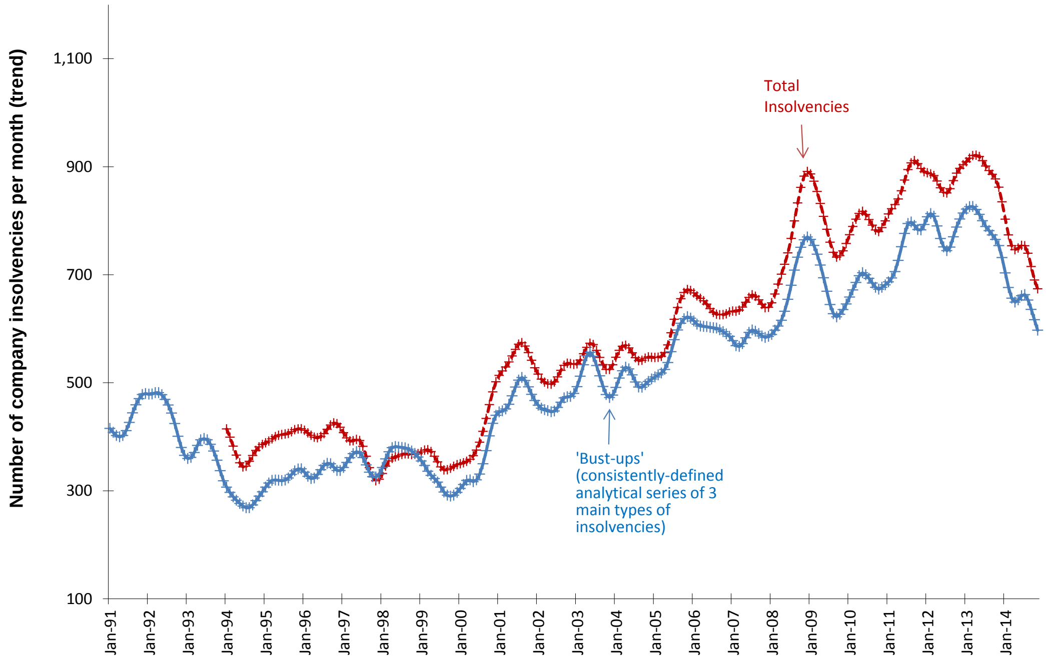
9. Scheme administrator appointed; and

10. Foreign/Registrable Australian Body wind-up.

As can be seen from these descriptions, some of these, such as the appointment of a Managing controller (except receiver & manager), could be less likely to lead to a FEG payout because the managing controller may attempt to get the company to trade out of its financial difficulties.

Despite the exclusion of seven types of insolvencies from the analytical ‘bust-ups’ series, Figure 4 shows that the ‘bust-ups’ series covers a high proportion of total insolvencies and that there is a very close relationship between the two series for the period from January 1994 when both series are available.

Figure 4: **‘Bust-ups’ and Total Company Insolvencies**

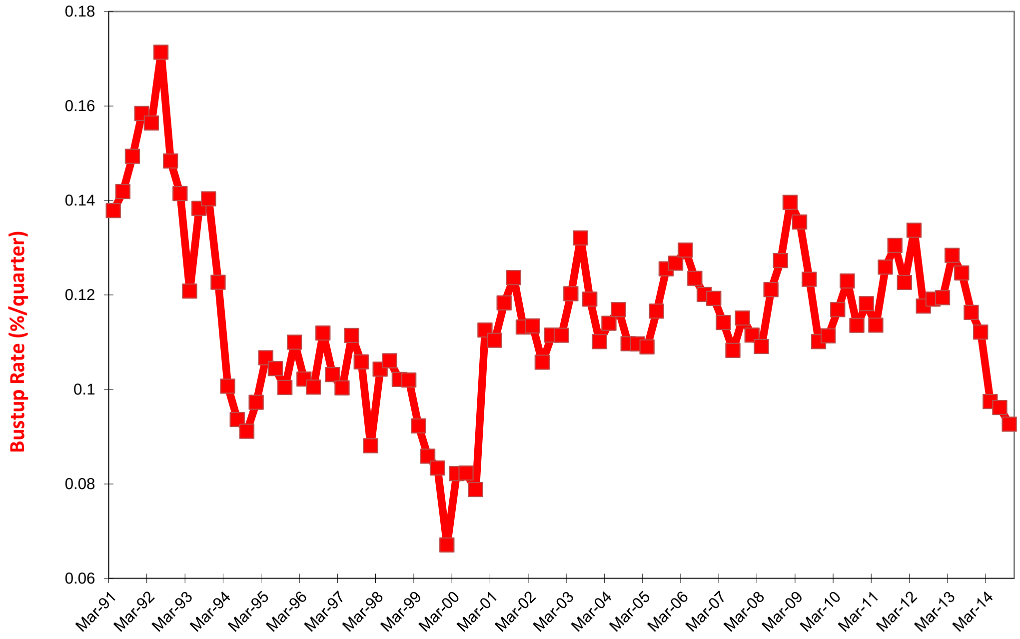


Source: ASIC data in original terms, seasonally adjusted and trended in the Department of Employment, using the Census X-13 routine in the EViews8 computer programme.

3.3 Bustup Rate

The Bustup Rate is calculated as the quarterly total number of Bustups, expressed as a percentage of the number of companies at the end of the previous quarter (with both numerator and denominator being in seasonally adjusted terms). This rate is shown in Figure 5.

Figure 5: **The Bustup Rate**



Source: ASIC data in original terms, seasonally adjusted in the Department of Employment, using the Census X-13 routine in the EViews8 computer programme.

Two important things to note about the Bustup Rate are that:

- it is very low; each quarter only around 0.1 per cent of companies become insolvent; and

- partly as a result of it being so low, it can move around a lot from quarter to quarter.

As can be seen from Figure 5, the Bustup Rate was relatively high during and in the aftermath of the recession of the early 1990s. It then recovered, along with the recovery in the economy and the general fall in real interest rates, in the middle and late 1990s. It then rose fairly suddenly at the start of the 2000s and remained relatively high for the rest of the 2000s, before falling again in early 2014.

A likely cause of the fairly sudden rise in the Bustup Rate and its persistently high level since then in spite of the good economic conditions in the mid-2000s is that there were a number of structural and definitional changes around the year 2000 that are likely to have led to a permanently, or at least persistently, higher Bustup Rate. These will be explained in the next sub-section.

3.4 Structural and Definitional Changes around the Year 2000

There were several structural, legal and definitional changes, both to ASIC data on insolvencies and to the operation of companies themselves, around the Year 2000. Most of these are likely to have led to a permanent, or at least a highly persistent, increase in the Bustup Rate, and so, two alternative variables (one on the assumption of permanent effects and the other on the assumption of highly persistent effects) have been constructed by the authors to enable these effects to be modelled.

The first of these changes is a change in definition and measurement of insolvencies by ASIC from January 1999 onwards. This effect is considered to be minimal on the analytical series, 'bustups', which was constructed to be as consistent as feasible through time. There is no visually apparent structural break in the Bustup Rate around the start of 1999 and so no adjustment was made, nor explanatory variable defined, to cover this definitional change.

The next set of changes was the introduction of a number of employee entitlements schemes, paid for by the Australian and at least one State Government, between the start of 2000 and the end of 2001. These could arguably have increased the Bustup Rate through the mechanism of 'moral hazard'; that is, as companies learned that the Government would step in and cover their employees' unpaid entitlements if they become insolvent without setting aside enough funds to cover their employees' entitlements, they could have take more financial risks, which in turn could increase their chances of becoming insolvent.

The history of the introduction of these schemes over these two years is explained well in Al Badhily (2011). His description can be summarised as follows.

When the National Textiles Company went into voluntary administration in January 2000, the Government provided $7 million to cover employee entitlements. On 8 February 2000, the Employee Entitlements Support Scheme (EESS) was introduced, to protect all employees whose employment was terminated due to insolvency from 1 January 2000. However, this scheme only provided a limited amount of coverage (e.g. only four weeks' unpaid wages, annual leave or redundancy pay, for employees earning up to $40,000). Although it was conceived as an equal partnership between federal and state governments, only South Australia joined the scheme, so that only half the prescribed amount was paid out in most cases.

When Ansett Airlines entered administration in September 2001, the Special Employee Entitlements Scheme for Ansett Group Employees (SEESA) was created, which had a much wider coverage than regular EESS. Finally, the General Employee Entitlements and Redundancy Scheme (GEERS) was set up to cover employees whose employment was terminated after 12 September 2001. It was also much more generous than EESS.

As can be seen from this description, the coverage and generosity of these schemes increased progressively over the period from the start of 2000 to the end of 2001.

The third structural change during this period was the introduction of A New Tax System (ANTS) in July 2000. The net effect of the introduction of this System is likely to have been a persistent increase in the Bustup Rate, because this System involved additional reporting (Business Activity Statements) and tax (Goods and Services Tax) collection and remitting responsibilities for companies. Some companies may not have the capacity to handle these additional responsibilities and so may have become insolvent. Another aspect of the introduction of A New Tax System is that it led to structural changes in the economy, with some industries growing at the expense of others, and this may also have led to some companies in declining industries becoming insolvent. A third, shorter term, outcome of the introduction of A New Tax System is that there was an initial decline in the housing industry, but this was ameliorated through the introduction of an additional First Home Owners Grant (to foreshadow the results later in the paper, the estimated coefficient in the Bustup Rate equation for the variable that is created in this sub-section to capture the longer-term effects of structural, definitional and legal changes around the turn of the Millennium is unlikely to be confounded by this shorter-term response, because there is a separate explanatory variable (dwelling approvals per person) in this equation that would capture this short-term response).

The fourth structural change during this period was the *Corporations Act 2001*, for which Assent was granted on 28 June 2001[7], with a date of effect of 15 July 2001[8]. Under this *Act*, it was illegal to trade while insolvent. This is also likely to have led to a permanent or highly persistent increase in the Bustup Rate, as company directors would be more likely after the introduction of this *Act* to put their companies into voluntary administration if they were close to insolvency, to avoid being charged with trading while insolvent.

The explanation of the construction of the two alternative explanatory variables for these changes is provided in Appendix A.

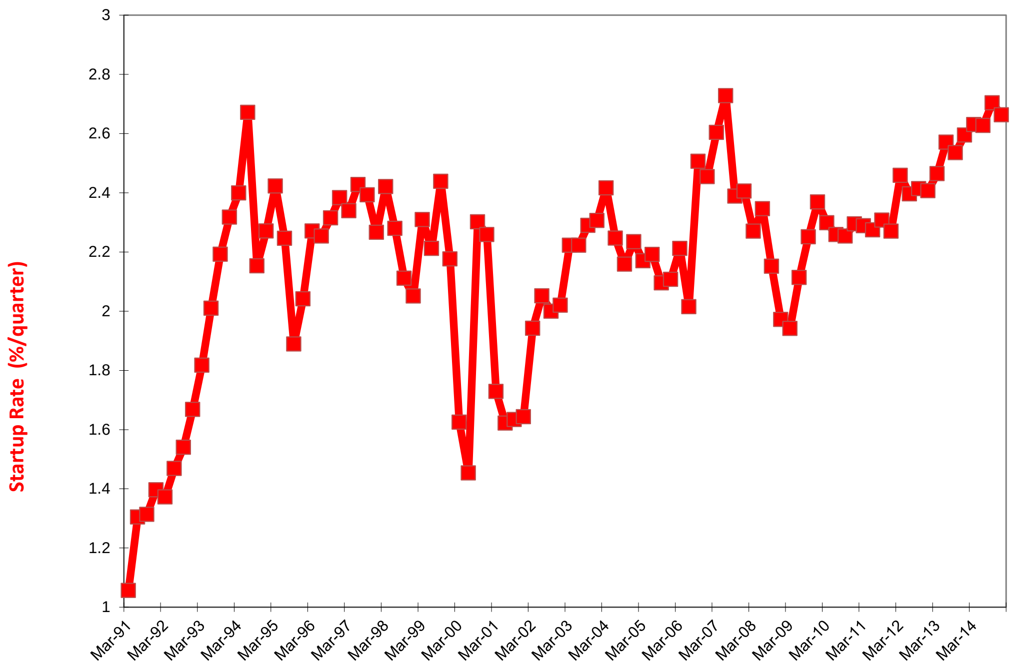
3.5 The Startup Rate

Unlike Bustups, which is a consistently defined subset of total company insolvencies, Startups are the total new company registrations with ASIC. These data (in original terms) are freely available on ASIC's website (www.asic.gov.au) for the period from January 1999; for the period before then the data were purchased by the Department of Employment from ASIC. These data were then converted to seasonally adjusted terms by the authors using the Census X-13 routine in the EViews8 computer programme.

The Startup Rate is calculated as the quarterly total number of Startups (in seasonally adjusted terms), expressed as a percentage of the number of companies at the end of the previous quarter (with both variables being in seasonally adjusted terms). This rate is shown in Figure 7.

[7] Source: http://www.comlaw.gov.au/Series/C2004A00818.
[8] Source: http://www.comlaw.gov.au/Details/C2004L06605.

Figure 7: **The Startup Rate**



Source: ASIC data in original terms, seasonally adjusted in the Department of Employment, using the Census X-13 routine in the EViews8 computer programme.

There are a number of important things to note about the Startup Rate. The first is that it is substantially higher than the Bustup Rate and averages around 2 per cent per quarter. While this partly reflects growth in the number of companies, it also reflects the fact that there are Other Windups; i.e., companies that close down for reasons other than Bustups such as takeovers by other companies.

The second thing to note is that the Startup Rate appears to be responsive to economic and financial conditions, rising strongly in the early 1990s with the recovery from the recession of those times, falling around the time of the Global Financial Crisis and recovering since then.

The third thing to note is that the company Startup Rate also appears to be affected by the structural, legal and definitional changes that occurred around the turn of the Millennium, but in a different way from the Bustup Rate.

In particular, there was a hiatus in company Startups in the half a year before the introduction of A New Tax System in July 2000, followed by a temporarily higher rate in the half a year after the introduction of this System. This is likely to be due to would-be entrepreneurs holding off from starting their companies soon before the new tax system and then starting them up in the half year afterwards, to avoid having to begin working and setting up accounting systems under one tax system, but then soon change over to a different regime. To capture this effect, a dummy variable, $ANTSWAIT_t$, was defined to be equal to -1 in the two quarters before the introduction of A New Tax System, +1 in the quarter that A New Tax System was introduced and the following quarter, and zero at other times. This was used as an explanatory variable in the set of equations for the Startup Rate.

The Startup Rate also appears to have been reduced by the structural and legal changes to companies occurring in 2000 and 2001, but the effect does not appear to have been permanent or as highly persistent as the effect on the Bustup Rate (this is probably due to the fact that it is a different group of entrepreneurs starting up companies from the entrepreneurs running existing companies which become insolvent). To capture the lower persistence of these effects on the Startup Rate, a separate couple of dummy variables was defined as follows:

- $DUMNTSYH_t$ was set equal to one in the year and a half after the introduction of A New Tax System (i.e., from September quarter 2000 through December quarter 2001) and zero at other times; and

- $DUMNTS1Y_t$ was set equal to one in the year after the introduction of A New Tax System (i.e., from September quarter 2000 through June quarter 2001) and zero at other times. In the long-term equation for the Startup Rate, this variable was lagged by six quarters, so that it took effect after the values of the variable, $DUMNTSYH_t$ had declined to zero. In this way, it allowed for a different medium term effect than the short-term effect captured by $DUMNTSYH_t$.

3.6 Other Windups and the Other Windup Rate

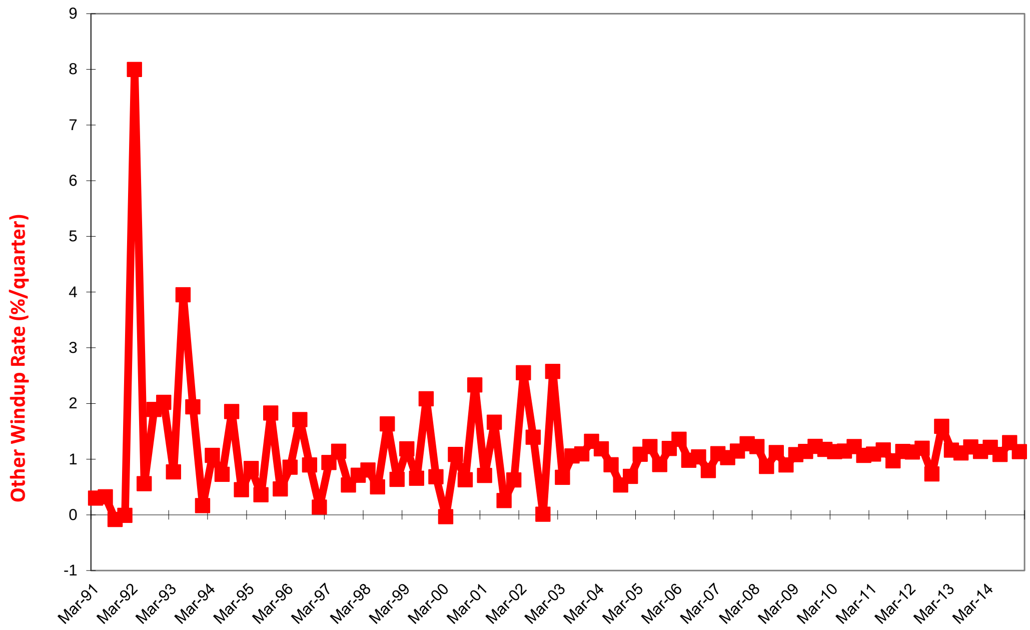
In the model developed in this paper, Other Windups can be determined as a residual using the following identity:

$$\text{Other Windups}_t = \text{Companies}_{t-1} - \text{Companies}_t + \text{Startups}_t - \text{Bustups}_t \qquad (2)$$

Where:
Other Windups_t is the number of company closures in quarter 't' for reasons other than the three main reasons for insolvencies;
Companies_t is the number of companies registered with ASIC in quarter 't';
Bustups_t is the number of company closures in quarter 't' for reasons other than the three main reasons for insolvencies; and
Startups_t is the number of new companies registering with ASIC during quarter 't'.

The Other Windup Rate is calculated as the quarterly total number of Other Windups (in seasonally adjusted terms), expressed as a percentage of the number of companies at the end of the previous quarter (with both variables being in seasonally adjusted terms). This rate is shown in Figure 8.

Figure 8: **The Other Windup Rate**



Source: Calculated by the authors using the formula shown above, from ASIC data in original terms, seasonally adjusted in the Department of Employment.

Important things to note about the Other Windup Rate are that:

- It is substantially higher than the Bustup Rate, averaging 1.2 per cent per quarter during the period from the start of 1992 to the end of 2014.

- Some of the calculated values are negative. Although the values are non-negative in original terms, they are zero in original terms in some quarters. Because separate seasonal adjustment is conducted on Startups, Bustups and the monthly change in the number of companies, the seasonally adjusted Other Windup Rate is just below zero in three quarters during the sample period. This means that if an attempt is made to take logarithms of the Other Windup Rate, missing values would be generated for these quarters.

- It is unusually low in the first few quarters of the sample period. This is considered to be due to an increase in the number of non-compliant companies before the large one-off deregistration of companies by ASIC in the March quarter 1993. This will be covered in the econometric work which follows by including the variable, RAMP92Q1t, as an explanatory variable. A negative coefficient is expected in the regression analysis, because the increase in the number of non-compliant companies implies that Other Windups for compliance reasons were lower than usual.

- The large one-off deregistrations for compliance reasons by ASIC in the early 1990s substantially raised the Other Windup Rate in the quarters that they occurred. These will be covered in the econometric analysis by including the explanatory variables, $D1992Q1_t$ and $D1993Q2_t$.

- Unlike the Startup and Bustup Rates, it does not appear to be particularly responsive to the economic cycle.

- It is more variable in the period up until early 2003 than afterwards.

3.7 Age Structure of Companies

The age structure of companies is expected to affect the Bustup Rate. Specifically, a higher share of companies aged less than one year old is expected to raise the Bustup Rate. The main reason for this is that companies less than one year old are considered to be more likely to become insolvent for various reasons, including:

- The staff of younger companies would generally have less business experience than the staff of older companies and so may be more likely to make business mistakes leading to insolvency;

- Younger companies are generally smaller and starting up in niche or more difficult business areas (such as mineral exploration); and

- Younger companies have had less time to build up stocks of financial capital to tide them though difficult circumstances.

A subsidiary reason is that some young companies are aggressive competitors and/or may be starting up with new and better technology and so may displace some older companies into insolvency.

The authors weren't able to find a readily available long and consistent time series on the age structure of companies and so constructed a proxy for the share of companies, in percentage terms, that are aged less than one year using equation (3).

$$SCOY1YO_t = (Startups_t + Startups_{t-1} + Startups_{t-2} + Startups_{t-3})/Companies_{t-4} * 100 \quad (3)$$

Where:
$SCOY1YO_t$ is the proxy for the share (percentage) of companies that are less than one year old in quarter 't'; and
$Startups_t$ and $Companies_t$ are as previously defined.

3.8 Economic Activity

Consistent with the findings in the macroeconomic section of the literature, economic activity is expected to have a significant influence on all three aspects of company creation and destruction in Australia (i.e., the Bustup Rate, the Startup Rate and the Other Windup Rate). Real GDP, from the ABS quarterly *National Accounts* (ABS Cat. No. 5206.0) is used as the measure of economic activity, as it is the standard or headline measure and it was used by Orzechowsksa-Fischer and Taplin (2010) in their analysis of the corporate insolvency rate in Australia.

In the initial specifications of these equations, the level of real GDP[9] will be used as the explanatory variable, since this was the form used by Orzechowsksa-Fischer and Taplin (2010). If this yields unsatisfactory results, the four-quarterly growth rate in real GDP will be used instead.

Opposite signs on the economic activity variable are expected in the equations for the Bustup Rate and the Startup Rate. A higher level or growth rate of real GDP is expected to reduce the Bustup Rate but increase the Startup Rate. In addition to a concurrent effect, a lagged effect of the level or growth rate of real GDP on the Startup and Bustup Rates is expected, because it can take time for strong or weak economic growth to affect company creation and destruction through lags due to timing of contracts, accounting lags, the time taken to run down company finances in periods of weak economic growth (in the case of the Bustup Rate), time taken to organise to set up a new company in periods of strong economic growth (in the case of the Startup Rate) and other reasons.

Some components or shares of GDP were also thought to have a possible effect on company creation and/or destruction in Australia. The share of Gross Operating Surplus of Private Non-financial[10] Corporations in GDP was expected to be negatively related to the Bustup Rate and possibly positively related to the Startup Rate.

The detrended stocks to sales ratio was expected to be positively related to the Bustup Rate. This is because a buildup in inventories above the trend level is likely to impose additional stockholding costs on companies that increases the probability that they may become insolvent. Additionally, such a buildup could be a signal that companies have over-forecast or over-anticipated the amount of demand for their products and have incurred the costs of producing goods, but been unable to sell them. This also signals financial vulnerability to insolvency. Staff of what is now the Labour Economics Section in the Department of Employment conducted unpublished internal research in the mid-2000s indicating that this link was statistically significant, and so it will be tested again in the analysis for this paper, with a longer sample period that includes the Global Financial Crisis and 6½ years since then.

3.9 Real Interest Rates

Interest rates were one of the explanatory variables considered by Orzechowsksa-Fischer and Taplin (2010) in their analysis of the corporate insolvency rate in Australia. They used the nominal interest rate on a standard variable housing loan, but it did not make it into their preferred equation.

Following the suggestion from Econtech (2006) that interest rates would be one of the main drivers of the business insolvencies and that the interest rate on 90-day bank bills would be a suitable interest rate series to use, this particular interest rate series is used in the current analysis, using RBA Statistics from www.rba.gov.au, in preference to the housing interest rate.

[9] As will be shown later in this Section, for functional form considerations, the natural logarithm of the level of real GDP will be used instead of the level itself.

[10] Non-financial companies is used in the sense of companies that are not financial institutions, not in the sense of companies that have no finances left.

Unlike these two previous studies where the nominal interest rate was either used or suggested, the real interest rate is used in the current analysis, because real interest rates are considered to be more relevant to businesses, especially over the longer sample period used for the current analysis (compared with the research by Orzechowsksa-Fischer and Taplin (2010), which was completed around five years ago.

The deflator that is used to construct the real interest rate is the four-quarterly percentage change in the headline CPI (from the ABS *Consumer Price Index* release - ABS Cat. No. 6401.0), adjusted for the effects of the introduction of A New Tax System in September quarter 2000 (which is estimated to have boosted the CPI by 2.95 per cent).

Real Interest Rates are expected to have the opposite effect to the growth rate of real GDP on company creation and destruction. That is, higher real interest rates are expected to lead to a higher Bustup Rate and a lower Startup Rate. Once again, a lag between real interest rates and the Bustup and Startup Rates is expected.

3.10 Debt/Equity Ratio and other Financial Variables

As shown in the literature review, financial ratios and other financial variables are likely to be important determinants of company creation and destruction. For example, Orzechowksa-Fischer and Taplin (2010) considered a financial ratio (the ratio of credit approvals to the total credit outstanding) in their analysis of the corporate insolvency rate in Australia. In like manner, several financial variables were considered in the present analysis.

The first was the debt/equity ratio. This was calculated as the ratio of business debt (both business credit and non-intermediated business debt in the form of corporate bonds, asset-backed securities and similar forms of debt) to the market value of the enterprise capital stock (see Appendix B for further details of the construction of this variable).

A different way of looking at the effect of business debt on the Bustup Rate is to use the Business Interest Repayment Burden, which is the ratio of business interest payments to a proxy for business profitability (Gross Operating Surplus, adjusted for tax rates). This is a flow concept of the effects of business debt, whereas the Debt/Equity ratio is a stock concept. The direction of effect is expected to be the same, however, with a higher Business Interest Repayment Burden being followed by a higher Bustup Rate.

The next was Net Equity Raisings (on the Australian Securities Exchange, using data from this source, as a proportion of current-price GDP, using data from the ABS quarterly *National Accounts*, ABS Cat. No. 5206.0). Higher Net Equity Raisings, relative to GDP, are expected to reduce the Bustup Rate and increase the Startup Rate. The former effect is expected because some of the additional equity raisings would be raising of secondary financial capital, which would assist some struggling companies to remain solvent. The latter effect is because some of the additional net equity raisings would be Initial Public Offers or sharemarket floats, which would give the initial capital to some companies to form (or at least would encourage other companies to form so that they can list on the Australian Securities Exchange and obtain equity capital to grow).

The next was Real Share Prices (on the Australian Securities Exchange, using data from this source, and deflated by the implicit price deflator for GDP, using data from the ABS quarterly *National Accounts*, ABS Cat. No. 5206.0). Higher real share prices are expected to reduce the Bustup Rate, and may also boost the Startup Rate, for the same reason as the variable for net equity raisings as a proportion of GDP. That is, higher real share prices would make it easier to raise equity capital on the share market, other things being equal. Real share prices could also act as a proxy for other effects. Share prices tend to respond to company profitability, and so could be acting as a proxy for this. They may also be a proxy for the confidence of businesses and financial investors.

Another financial variable included in the set of possible explanatory variables is the rate of corporate cash flow (relative to the enterprise capital stock). This variable is the same as used (and an explanation of its construction is given) in Connolly, Trott and Li (2012) in their analysis of the determinants of aggregate labour productivity in Australia. The rate of corporate cash flow reflects the amount of internal financing or retained earnings that companies have left after the costs of production, taxation, interest and dividend payments, that is available to be used for purposes such as working capital and to assist a company to remain solvent if it falls on troubled times. Accordingly, a higher rate of corporate cash flow is expected to be followed by a lower Bustup Rate.

A related financial variable included in the set of possible explanatory variables is the Business External Funding Flow Rate. This is the counterpart to the variable mentioned immediately above, which relates to internal financing of businesses. As with the former variable, this is also calculated relative to the enterprise capital stock. The business external funding flow is defined as the quarterly change in the inputs of business finance which are external to the firm. It includes lending from financial intermediaries such as banks, debt finance raised directly by businesses (corporate bonds and asset-backed securities), new equity raisings on the Australian Securities Exchange (ASX) and foreign investment in Australia. This variable is the same as used (and an explanation of its construction is given) in Connolly, Trott and Li (2012) in their analysis of the determinants of aggregate labour productivity in Australia. A higher business external funding flow rate is expected to be associated with a lower Bustup Rate (and possibly a lower Other Windup Rate), either contemporaneously or with a short lag of around a quarter or so, because provision of external funds would help vulnerable companies stave off insolvency in the short term.

Another aspect of the financial and economic performance of companies and their ability to survive is their international cost-competitiveness. The four-quarterly growth rate of the real exchange rate was the variable used to represent this. This was formed using the RBA's Trade-weighted Exchange Rate, multiplied by the Australian GDP price deflator and divided by the weighted average GDP price deflator in Australia's main trading partners.

A different set of financial variables that were included were company and individual tax rates. The Startup Rate is expected to respond negatively to a higher company tax rate, compared with the individual tax rate. This is because entrepreneurs can start firms under different structures (companies, partnerships, trusts and individual proprietorships) with different tax rates and there would be a financial incentive to choose a business structure which optimises the tax rates (subject to other considerations such as the cost of starting and maintaining different business structures). The Bustup and Other Windup Rates may respond positively to a higher company tax rate, compared with the individual tax rate, because a higher company tax rate may make it difficult for existing companies to continue. The Other Windup Rate is also expected to respond positively, because a larger gap between these two tax rates would create financial incentives for firms structured as companies to restructure themselves in another form (trust, partnership or sole proprietorship).

3.11 Real Household Wealth

Higher real household wealth (per adult) is expected to lead to a higher Startup Rate and a higher number of companies. The main effect here is thought to be that higher wealth would mean that more people reach wealth levels where it is financially advantageous to set up small companies for superannuation purposes. As companies set up for superannuation purposes rarely go insolvent, the opposite effect is not expected on the Bustup Rate.

The variable for household wealth is obtained from the FoCUS macroeconomic model (see Connolly 2011 for an overview of this model). It is constructed in a similar way to the variable for private wealth in the TRYM model (Taplin, Jilek, Antioch, Johnson, Parameswaran and Louis 1993). To convert this variable from current-price to real terms, it is divided by the implicit price deflator for private household consumption from the ABS quarterly *National Accounts* (ABS Cat. No. 5206.0). Finally, to convert it to per-adult terms, it is divided by the civilian adult population from the ABS Labour Force Survey (ABS Cat. No. 6291.0.55.001).

3.12 Industry Variables

Several variables, relating to the structure of industries, or developments in key industries, were considered in the model. This is because numbers of companies (Startups, Bustups and the total number of companies) are not spread evenly among all industries, but are concentrated in a small number of industries that tend to be dominated by the private sector, volatile and responsive to economic activity. These key industries include: Agriculture, Forestry and Fishing; Manufacturing; and Construction.

The logical starting point was to include a structural change index among industries. This index was calculated for the four-quarterly change in each employing industry's[11] share of real Gross Value Added in these 19 employing industries, using the structural change index defined in Appendix A of PC (1988).

[11] That is, for the 19 employing industries at the Division, or 1-digit ANZSIC 2006 level, in the ABS quarterly *National Accounts* (ABS Cat. No. 5206.0).

The next set of variables related to the Construction industry, which is a volatile industry, responsive to economic activity and has a large number of small private companies. Correspondingly, it has large rates of both Startups and Bustups, compared with the average industry. In terms of insolvencies, 18 per cent of the insolvencies recorded by ASIC in 2013-14 were for the Construction industry[12]. In comparison, the Construction industry's share of real GDP in 2013-14 was substantially lower at 8 per cent[13]. The first variable that was defined was the number of dwelling approvals per adult civilian (using ABS *Building Approvals* data, from ABS Cat. No. 8731.0, as the numerator, and statistics on the civilian adult population from the ABS Labour Force Survey (ABS Cat. No. 6291.0.55.001) as the denominator). This is a leading indicator of activity in the housing sub-industry within the Construction industry and so, a higher number of dwelling approvals per adult civilian is expected to be followed by a lower Bustup Rate.

The second two are co-incident indicators rather than leading indicators of activity: the shares of private dwelling investment and private non-dwelling construction investment in GDP (in real terms, and using data for all variables from the ABS quarterly *National Accounts*, ABS Cat. No. 5206.0). Higher shares for these two variables are also expected to be followed by a lower Bustup Rate.

The next couple of variables relate to the Agriculture, Forestry and Fishing industry and parts of other industries related to it, such as input supply to farming and transport, processing and distribution of farm products. These were a rainfall index in 10 Agricultural regions of Australia that are highly dependent on rainfall, and a flood index derived from this index. The construction of these variables is explained in Connolly, Trott and Li (2012). Agricultural and forestry industries, and firms reliant on them, are considered to be more likely to become insolvent (i.e., to have a higher Bustup Rate) during times of drought (low values of the rainfall index) and flood (high values of the flood indicator). While the flood indicator is for 10 Agricultural regions, the two recent floods (in the middle of the 2010-11 financial year and in March quarter 2012) were widespread and covered non-agricultural regions, especially in Queensland and the first was also accompanied by Cyclone Yasi. Therefore, the flood indicator could also be reflecting associated weather phenomena which is likely to have an additional adverse impact on the Bustup Rate.

3.13 Functional Form Considerations

Since this model is designed to be used for forecasting and policy analysis involving dynamically simulated values of the variables, two of the three dependent variables (the Startup Rate and the Bustup Rate) were converted to proportional terms by taking the natural logarithms of the initial variables. This ensures that predicted values of the initial variables cannot fall below zero. As previously mentioned, this was not feasible with the Other Windup Rate, because some observed values of this seasonally adjusted rate were below zero.

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[12] This percentage was calculated from statistics on insolvencies by industry (series 1A) downloaded from www.asic.gov.au.

[13] This percentage was calculated by one of the authors from seasonally adjusted statistics on chain-volume GDP from Table 6 (spreadsheet 5206006.xls) from the ABS quarterly *National Accounts* (ABS Cat. No. 5206.0).

Where it was sensible, the explanatory variables were also expressed in logarithmic terms (as an example, natural logarithms were taken of real GDP). A subsidiary benefit of this is that the estimated coefficients are also elasticities. Of course, it did not make sense to take logarithms of explanatory variables in many cases. For example, this could not be done for real interest rates, since they can be negative.

3.14 Orders of Integration and Stationarity

Now that the dependent and explanatory variables are defined, the next consideration before the econometric estimation is the orders of Integration and stationarity for the variables, and preliminary testing for co-integration (unless all of the variables are found to be stationary). These tests were conducted under both null hypotheses of stationarity (the KPSS test, from Kwiatkowski, Phillips, Schmidt and Shin 1992) and integration (Augmented Dickey Fuller and Weighted Symmetric Tau tests). Results, shown in Appendix C, showed that the dependent variables and most of the explanatory variables were integrated of the first order or I(1), but not the second order, I(2). This didn't apply to the Other Windup Rate, which was estimated to be stationary.

The testing also showed that both of these dependent variables are likely to be cointegrated with their explanatory variables. Under these circumstances, the Engle-Granger two-step error-correction estimation procedure is an appropriate econometric method to use[14] for the Bustup and Startup Rates, while the Other Windup Rate will be estimated as a single equation using Least Squares regression.

4. RESULTS AND DISCUSSION

Since the logarithms of the Bustup Rate and the Startup Rate showed signs from the testing of integration and stationarity that they could have been integrated of the first order, an Engle-Granger two-step error-correction estimation procedure was used for these two variables. However, since the Other Windup Rate was estimated to be stationary, a single equation was estimated for this variable.

With the Engle-Granger two-step error-correction estimation procedure, the first step is to estimate the regression in levels of the logarithms to determine the long-term relationship. The second step is to re-estimate the equation in quarterly changes, and include the lagged estimated error term from the first step as one of the explanatory variables. All equations were estimated using Ordinary Least Squares regression analysis in the TSP Version 5.1 computer programme (Hall and Cummins 2009).

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[14] Some consideration was given to using Johansen-Juselius matrix cointegration methods to estimate these relationships, but it was decided against this approach on a number of grounds. These methods are highly dependent on inclusion of lagged dependent variables, which in turn are likely to result in bias in the estimates of the coefficients of these and other explanatory variables (this is known as the Achen critique after Achen 2000). They also often don't work satisfactorily when there is a large number of variables, such as in the present situation. Finally, many of the explanatory variables are either genuinely exogenous, such as the dummy variables for structural, legal and definitional changes affecting companies in 2000 and 2001, or are entered with a substantial lag, such as real interest rates.

4.1 Bustup Rate

The first stage of the Engle-Granger error correction model consisted of estimating an equation for the level of the logarithm of the Bustup Rate. This is also known as the long-run equation.

Several of the initially specified variables were found to be statistically insignificant and were not included in the preferred equation. This is especially the case where there were a number of alternative specifications for the explanatory variables. The ratio of Net Equity Raisings to GDP was found to be statistically insignificant and was dropped, but Real ASX200 Share Prices, representing similar effects to the net equity raisings ratio, was found to be statistically significant with the expected negative sign (i.e., a higher real share price is followed by a lower Bustup Rate) and was included. Similarly, dwelling approvals per adult were found to be statistically significant and included, but the two alternative explanatory variables for the Construction industry (the shares of dwelling and non-dwelling construction investment in GDP) were found to be insignificant and not included in the preferred specification. Other shares and components of GDP (the share of Corporate Gross Operating Surplus in GDP and the detrended stocks to sales ratio) were also found to be statistically insignificant and weren't included in the preferred equation.

Several of the financial variables and ratios were likewise found to be statistically insignificant and wasn't included in the preferred equation. These were Rate of Corporate Cash Flow and the Business Interest Repayment Burden.

Another noteworthy variable that was found to be statistically insignificant and not included from the preferred equation is the structural change index across industries.

Details of the non-preferred equations are available from the authors.

The preferred first-stage regression was estimated to be:

$$\ln(\text{Bustup Rate})_t = \underset{(0.82)}{0.366} + \underset{(8.38)}{0.0709}*RIR_{t-4} +$$

$$- \underset{(-2.64)}{2.44}*\Delta_4 \ln(RGDP)_t - \underset{(-2.03)}{1.74}*\Delta_4 \ln(RGDP)_{t-4}$$

$$- \underset{(-4.65)}{0.108}*DWELLAPP_{t-1} - \underset{(-3.19)}{0.0768}*DWELLAPP_{t-4}$$

$$- \underset{(-2.83)}{0.000305}*RAIN_{t-2} + \underset{(1.69)}{0.0637}*FLOOD_{t-2}$$

$$+ \underset{(6.73)}{0.837}*DEBTEQU_{t-10} - \underset{(-1.61)}{2.79}*BUSEFFK_t$$

$$- \underset{(-5.94)}{0.346}*\ln(RSPI_{t-1}) + \underset{(4.02)}{0.370} * \Delta_4 \ln(RER)_{t-2}$$

$$+ \underset{(1.66)}{0.175}*RAMP0001_t + \underset{(1.91)}{0.256} * TLSC0001_t + \underset{(2.09)}{0.0381}*SCOY1YO_t \quad (4)$$

Sample Range: 1991Q4 to 2014Q4 (93 observations); F-statistic = 34.1
Durbin-Watson Statistic = 1.72; Standard error of regression = 0.063
Mean of dependent variable = -2.17;
Standard deviation of dependent variable = 0.154
R-squared = 0.860; Adjusted R-squared = 0.835
Condition(X) number = 341.
Figures in parentheses underneath the coefficients are t-statistics, and the subscript, t, refers to the time period (in quarters).

Where:
the Bustup Rate is as defined in the previous section of this paper;
RIR_{t-4} is the real interest rate, lagged four quarters;
$\Delta_4 \ln(RGDP)_t$ is the four-quarterly change in the natural logarithm of real GDP;
$DWELLAPP_{t-1}$ and $DWELLAPP_{t-4}$ are dwelling approvals per adult, lagged one and four quarters respectively;
$RAIN_{t-2}$ is the index of rainfall in 10 key Agricultural Regions of Australia;
$FLOOD_{t-2}$ is the flood indicator variable in 10 key Agricultural Regions of Australia;
$DEBTEQU_{t-5}$ and $DEBTEQU_{t-10}$ are the Debt/Equity Ratio, lagged five and ten quarters respectively;
$BUSEFFK_t$ is the Business External Funding Flow Rate;
$RSPI_{t-1}$ is the Real ASX200 Share Price Index, lagged one quarter;
$\Delta_4 \ln(RER)_{t-2}$ is the four-quarterly change in the natural logarithm of the Real Exchange Rate, lagged two quarters;
$RAMP0001_t$ is the ramp-up dummy variable for the permanent effect of structural and legal changes affecting companies in the years 2000 and 2001;
$TLSC0001_t$ is the variable for the persistent effect of structural and legal changes affecting companies in the years 2000 and 2001; and
$SCOY1YO_t$ is the share of companies aged less than one year old.

The overall level of explanation is reasonably high at over 80 per cent, particularly given the variability in the dependent variable and that many of the explanatory variables are lagged. This level of explanatory power is comparable with the equation estimated by Orzechowska-Fischer and Taplin (2010), even though the sample period is longer and includes more of the aftermath of the Global Financial Crisis. The moderately low value of the Durbin-Watson statistic is expected, given the autoregressive nature of the dependent variable and the signs that it may be integrated of the first order.

The signs on all of the estimated coefficients were as expected and most appeared to be statistically significant from zero (as usual, there was no expected sign or level of significance for the constant term). It should be pointed out that the t-statistics are unreliable for a number of reasons. On the one hand, they are likely to be overstated since the equation relates cointegrated series and accordingly shows signs of autocorrelation. On the other hand, they are likely to be understated because there is severe multicollinearity among the explanatory variables, as indicated by the Condition(X) number of 341. In particular, there is likely to be high collinearity between the separate variables for the permanent and persistent effects of the taxation, legal and structural changes in 2000 and 2001 (i.e., RAMP0001 and TLSC0001), and so both variables were retained even though they are marginally statistically significant.

As expected, higher real interest rates are followed around a year later by a higher Bustup Rate. A one percentage point increase in the real interest rate is estimated to increase the Bustup Rate by seven per cent. While this only appears to indicate moderate responsiveness of the Bustup Rate to the real interest rate, it should be borne in mind that the real interest rate has moved over a wide range over the last quarter century. It has fallen from around 10 percentage points in the late 1980s to zero in mid-2014, thence to one percentage point in the December quarter of 2014.

The Bustup Rate is estimated to have a highly elastic response to economic activity in the long run. A one per cent increase in real GDP is estimated to reduce the Bustup Rate by around four per cent in the long run. This is very similar to the absolute value of more than 3.5 for the long-run elasticity with respect to real GDP estimated by Orzechowska-Fischer and Taplin (2010).

A one per cent increase in the dwelling approval rate is estimated to reduce the Bustup Rate by around 0.5 per cent in the long run. This is at the average level of dwelling approvals during the sample period. This is expected to work mainly through the effects on house construction, as the Construction industry is responsible for a disproportionate share of company insolvencies, as was noted in Section 3.12 of this paper. However, it may also be capturing some of the effect of real GDP, given that there is a positive link between economic activity and dwelling approvals.

Lower rainfall, such as when droughts occur, are estimated to raise the Bustup Rate, since droughts can result in farmers and firms that are reliant on farming becoming insolvent. A change from a normal rainfall season in agricultural areas, with rainfall of 450 millimetres per year averaged across the10 key Agricultural regions, to a drought year with only 300 millimetres per year averaged across these same regions, is estimated to increase the Bustup Rate by five per cent in the long run. This represents a relatively inelastic response[15] to rainfall in the 10 key Agricultural regions. However, it should be borne in mind that this is the Bustup Rate across all industries and Agriculture, Forestry and Fishing, even when combined with other sub-industries reliant on it, is a relatively small part of the whole economy. In comparison, higher rainfall in Agricultural regions would reduce the Bustup Rate, except when there is so much rainfall that it results in flooding. A flood of the extent experienced in the March quarter 2012 is estimated to increase the Bustup Rate by around three per cent[16].

A higher (or lower) Debt/Equity Ratio significantly increases (or reduces) the Bustup Rate in the long run, with a substantial lag between changes in the Debt/Equity Ratio and the ultimate effect on the Bustup Rate. A one per cent increase in the Debt/Equity Ratio above its average level in the sample period is estimated to increase the Bustup Rate by 0.4 per cent in the long run.

A one per cent increase (or decrease) in the Business External Funding Flow Rate is estimated to be associated with a decrease (or increase) in the Bustup Rate of 0.03 per cent. While this estimated elasticity is very low, it should be borne in mind that the Business External Funding Flow Rate is volatile around its mean level of approximately one per cent of the enterprise capital stock and has often moved from around ½ per cent to 1½ per cent of the enterprise capital stock (or in the opposite direction) within a couple of quarters.

A one per cent increase in the real share price is estimated to reduce the Bustup Rate by 0.3 per cent in the long-term. While this is inelastic, the real share price tends to be fairly volatile.

A one per cent increase in the annual growth rate of the Real Exchange Rate is estimated to reduce the Bustup Rate by 0.4 per cent in the long-term. While this is inelastic, the Real Exchange Rate tends to be fairly volatile, given that all of the sample period occurred after the floating of the Australian dollar.

The combination of structural and legal changes to companies around the years 2000 and 2001 is estimated to have had a large effect on the Bustup Rate, raising it by around 17 per cent permanently, and also having a highly persistent effect of a slightly larger magnitude (i.e., around 25 per cent).

A one per cent increase in the share of companies aged less than one year old is estimated to increase the Bustup Rate by 0.3 per cent in the long term.

The coefficients from this long-run equation (i.e., equation 4) were used, in conjunction with changes in the explanatory variables (with the appropriate lags applied) to investigate the extent to which the recent fall in the Bustup Rate could be explained by the equilibrium values implied by this model. The fall was measured from

[15] The authors have calculated an elasticity for the Bustup Rate of -0.14 to rainfall in the 10 key Agricultural regions.
[16] This effect was calculated using both the variable for annual rainfall, which was assumed to be 100mm above average, which puts a downward effect of around 3.0 per cent on the Bustup Rate, and the variable for flooding, which is assumed to have the value of one, which puts an upward effect on the Bustup Rate of around 6.4 per cent, with the net effect being an increase of around 3.4 per cent.

the most recent peak in the Bustup Rate in March quarter 2013 (see Figure 5) through to the latest available observation of December quarter 2014. Over this period, the Bustup Rate fell 38 per cent, about three-quarters of which can be explained by the long-run model. The most important contributor was the fall in the real interest rate, which was responsible for over half of the fall in the Bustup Rate over this period, followed by the rise in the dwelling approval rate, which was responsible for just over a quarter of the fall (the reduction in rainfall and rise in share of companies aged less than one year worked the other way, tending to raise the Bustup Rate.)

The second stage of the Engle-Granger procedure consists of regressing the change in the Bustup Rate on the changes in the explanatory variables in equation (4), the lagged error term from equation (4) and other explanatory variables which would affect the short-term but not the long-term relationship.

When the equation was initially estimated, the absolute values of the t-statistics of some of the explanatory variables (such as quarterly changes in the variable for the permanent effects of the taxation, legal and structural changes in 2000 and 2001) were well below 1.0 and were omitted from the preferred equation (of course, they would still have an influence through the lagged residual term). The original equation is available from the authors on request. The preferred equation was:

$$\Delta Ln(\text{Bustup Rate})_t = \underset{(-0.43)}{-0.00274} - \underset{(-7.51)}{0.886} * \text{Residuals for } Ln(\text{Bustup Rate})_{t-1}$$

$$+ \underset{(5.26)}{0.0586}*\Delta RIR_{t-4} - \underset{(-3.72)}{3.34}*\Delta\Delta_4 Ln(RGDP)_t - \underset{(-2.40)}{2.09}*\Delta\Delta_4 Ln(RGDP)_{t-4}$$

$$- \underset{(-2.89)}{0.0966}*\Delta DWELLAPP_{t-1} - \underset{(-2.87)}{0.0875}*\Delta DWELLAPP_{t-4}$$

$$+ \underset{(3.09)}{0.0808}*\Delta FLOOD_{t-2} + \underset{(2.94)}{0.428}*\Delta\ DEBTEQU_{t-10}$$

$$- \underset{(-2.20)}{2.48}*\Delta BUSEFFK_t - \underset{(-3.88)}{0.423}*\Delta Ln(RSPI_{t-1}) + \underset{(3.11)}{0.326} * \Delta\Delta_4 Ln(RER)_{t-2}$$

$$+ \underset{(2.05)}{0.364}*\Delta TLSC0001_t + \underset{(3.15)}{0.0794}*\Delta SCOY1YO_t \qquad (5)$$

Sample Range: 1992Q1 to 2014Q4 (92 observations); F-statistic = 10.5
Durbin-Watson Statistic = 1.99; Standard error of regression = 0.0579
Mean of dependent variable = -0.00669;
Standard deviation of dependent variable = 0.0889
R-squared = 0.636; Adjusted R-squared = 0.576
Condition(X) number = 2.85
The figures shown in brackets underneath the coefficient estimates are the t-statistics for the test that the coefficient is equal to zero.

Where:
Δ denotes the quarterly change in a variable;
the Residuals for Ln(Bustup Rate) were obtained from the long-run equation; i.e., equation (4); and
other variables are as described in the explanation beneath equation (4).

The overall level of explanation is reasonably high at around 60 per cent (the level of explanatory power in a second-stage regression of an Engle-Granger error correction model is almost invariably lower than in the first stage, because the dependent variable is in the form of changes rather than levels and changes are almost invariably more volatile than the levels). As foreshadowed above, the Durbin-Watson statistic is much closer to two than in the first-stage regression.

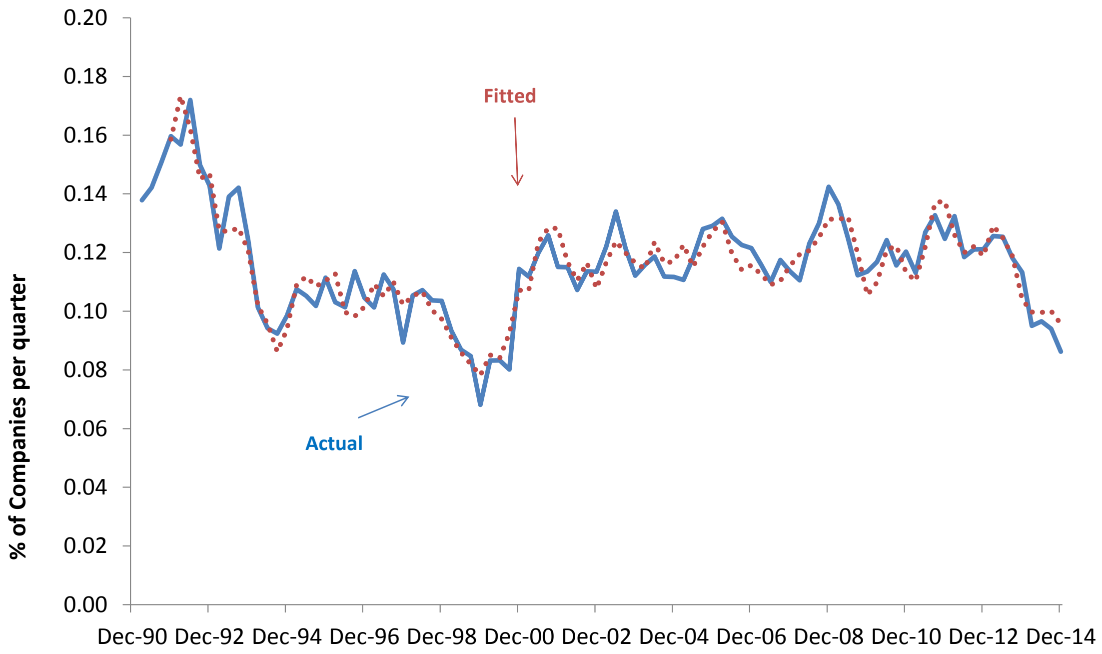
All of the explanatory variables have the expected sign and all are statistically significant (at the five per cent level of significance), except for the constant term, for which no sign nor significance level was expected.

The coefficient on the error-correction mechanism is correctly signed and statistically significant, suggesting that adjustments towards the long-term Bustup Rate are important in determining the short-term changes in the Bustup Rate. A negative sign is expected because a shock which moves the Bustup Rate away from equilibrium in one particular quarter will be followed by a move in the opposite direction in the following quarter, to move the Bustup Rate back towards equilibrium. Since the absolute value of the adjustment parameter is around 0.9, a majority of the adjustment towards the long-run values of the variables appears to take place within a quarter. However, it should be remembered that some of the explanatory variables in the first-stage regression, particularly the Debt/Equity ratio, are lagged by many quarters. Taking this into account, most of the total adjustment to changes in the current values of variables would appear to take place within three years.

The coefficients on the other explanatory variables are generally the same or smaller than in the first stage regression, except for real GDP, where the sum of coefficients is slightly higher.

The results of both stages of the Error-correction model were combined in a static simulation to provide fitted values from the model and these were compared with the actual values of the Bustup Rate (see Figure 9).

Figure 9: **Actual and Fitted Values of the Bustup Rate**



Sources: Actual values calculated and seasonally adjusted by the authors from ASIC data, as explained in Sections 3.2 and 3.3 of this paper; fitted values from the coefficients in equations (4) and (5) of this paper and the explanatory variables as explained elsewhere in this paper.

As shown in Figure 9, there is a close correspondence between the actual values of the Bustup Rate and the fitted values from this model throughout the entire sample period, including the last two years when there has been a substantial fall in the Bustup Rate. Also, there don't appear to be major problems with the residuals (the differences between actual and fitted values) such as major outliers or persistent lags between actual and fitted values.

4.2 The Startup Rate

The first stage of the Engle-Granger error correction model consisted of estimating an equation for the level of the logarithm of the Startup Rate.

Several of the initially specified variables were found to be statistically insignificant and were not included in the preferred equation. In particular, some of the explanatory variables that were statistically significant in the equation for the Bustup Rate were not statistically significant in the equation for the Startup Rate. Noteworthy cases of this were the variables relating to key industries (i.e, the dwelling approval rate and the rainfall and flooding variables) and the financial variables (i.e., the real share price and the Business External Funding Flow Rate). The variable for real household wealth per adult, which was included to represent the growth of superannuation companies, was also statistically insignificant. Details of the non-preferred equations are available from the authors.

The preferred first-stage regression was estimated to be:

$$Ln(\text{Startup Rate})_t = \underset{(22.22)}{0.973} - \underset{(-2.67)}{0.0199}*RIR_{t-2} - \underset{(-2.77)}{0.0218}*RIR_{t-4}$$

$$+ \underset{(7.84)}{3.95}*\Delta_4 Ln(RGDP)_t + \underset{(4.75)}{2.21}*\Delta_4 Ln(RGDP)_{t-4}$$

$$- \underset{(-5.09)}{0.516}*DEBTEQU_t - \underset{(-10.28)}{0.299}*DUMNTSYH_t$$

$$- \underset{(-5.55)}{0.182}*DUMNTS1Y_{t-6} + \underset{(11.22)}{0.384}*ANTSWAIT_t \qquad (6)$$

Sample Range: 1991Q1 to 2014Q4 (96 observations); F-statistic = 91.9
Durbin-Watson Statistic = 1.27; Standard error of regression = 0.0616
Mean of dependent variable = 0.774;
Standard deviation of dependent variable = 0.181
R-squared = 0.894; Adjusted R-squared = 0.884
Condition(X) number = 23.4.
The figures shown in brackets underneath the coefficient estimates are the t-statistics for the test that the coefficient is equal to zero.

Where:
DUMNTSYH, DUMNTS1Y and ANTSWAIT are dummy variables explained in Section 3.5 of this paper for the effects of A New Tax System (and other events that occurred around this time including the introduction of GEERS and other employee entitlements schemes and the introduction of the *Corporations Act 2001*);
other explanatory variables are as previously described; and
the subscript 't' denotes time in quarters. ..

The overall level of explanation is high at over 85 per cent, particularly given the variability in the dependent variable and that many of the explanatory variables are lagged. The moderately low value of the Durbin-Watson statistic is expected, given the autoregressive nature of the dependent variable and the signs that it and its explanatory variables may be integrated of the first order and cointegrated with each other.

The signs on all of the estimated coefficients were as expected and appeared to be statistically significant from zero (as usual, there was no expected sign or level of significance for the constant term). It should be pointed out that some of the t-statistics may be overstated since some of the variables in the equation are integrated and the equation accordingly shows signs of autocorrelation.

The reaction of the Startup Rate to economic activity and the real interest rate is in the opposite direction to the reaction of the Bustup Rate, as expected. That is, higher real interest rates reduce the Startup Rate, while a higher growth rate of real GDP increases the Startup Rate, in the long run.

As expected, higher real interest rates are followed by a lower Startup Rate. A one percentage point increase in the real interest rate is estimated to reduce the Startup Rate by around four per cent in the long run. While this only appears to indicate moderate responsiveness of the Startup Rate to the real interest rate, as previously noted the real interest rate has moved over a wide range over the last quarter century.

The Startup Rate is estimated to have a highly elastic response to the annual growth rate of real GDP in the long run. A one per cent increase in the growth rate of real GDP is estimated to increase the Startup Rate by around six per cent in the long run.

In contrast, the Startup Rate is estimated to have an inelastic response to the Debt/Equity Ratio. A one per cent increase in this ratio is estimated to decrease the Startup Rate by around two tenths of one per cent in the long run.

In common with the Bustup Rate, the structural, taxation and legal events affecting companies around the years 2000 and 2001 were estimated to have had a significant effect on the Startup Rate.

The second stage of the Engle-Granger procedure consists of regressing the change in the Startup Rate on the changes in the explanatory variables in equation (6), the lagged error term from equation (6) and other explanatory variables which would affect the short-term but not the long-term relationship. There was one variable which fell into the latter category and that was the quarterly change in the corporate tax rate. The preferred equation was:

$$\Delta Ln(\text{Startup Rate})_t = -\underset{(-0.15)}{0.000812} - \underset{(-6.30)}{0.674}\text{* Residuals for } Ln(\text{Startup Rate})_{t-1}$$

$$-\underset{(-2.61)}{0.0231}\text{*}\Delta RIR_{t-2} - \underset{(-3.46)}{0.0288}\text{*}\Delta RIR_{t-4}$$

$$+\underset{(3.05)}{2.28}\text{*}\Delta\Delta_4 Ln(RGDP)_t + \underset{(3.28)}{2.29}\text{*}\Delta\Delta_4 Ln(RGDP)_{t-4}$$

$$-\underset{(-2.10)}{0.0143}\text{*}\Delta(RTC)_t$$

$$-\underset{(-3.52)}{0.663}\text{*}\Delta DEBTEQU_t - \underset{(-4.33)}{0.245}\text{*}\Delta DUMNTSYH_t$$

$$-\underset{(-2.64)}{0.122}\text{*}\Delta DUMNTS1Y_{t-6} + \underset{(11.15)}{0.316}\text{*}\Delta ANTSWAIT_t \qquad (7)$$

Sample Range: 1991Q2 to 2014Q4 (95 observations); F-statistic = 23.7
Durbin-Watson Statistic = 2.00; Standard error of regression = 0.0509
Mean of dependent variable = 0.00980;
Standard deviation of dependent variable = 0.0940
R-squared = 0.738; Adjusted R-squared = 0.707
Condition(X) number = 3.0.
The figures shown in brackets underneath the coefficient estimates are the t-statistics for the test that the coefficient is equal to zero.

Where:
Δ denotes the quarterly change in a variable;
the Residuals for Ln(Startup Rate) were obtained from the long-run equation; i.e., equation (6);
RTC is the statutory rate of corporate taxation; and
other variables are as described in the explanation beneath equation (4).

The overall level of explanation is reasonably high for a second-stage regression of an Engle-Granger error correction model at over 70 per cent. As foreshadowed above, the Durbin-Watson statistic is very close to two, indicating that there are unlikely to be problems with autocorrelation or other issues that can cause a high or low Durbin-Watson statistic.

All of the explanatory variables have the expected sign and all are statistically significant.

The coefficient on the error-correction mechanism is correctly signed and statistically significant, suggesting that adjustments towards the long-term Startup Rate are important in determining the short-term changes in the Startup Rate. A negative sign is expected because a shock which moves the Startup Rate away from equilibrium in one particular quarter will be followed by a move in the opposite direction in the following quarter, to move the Startup Rate back towards equilibrium. Since the absolute value of the adjustment parameter is above 0.5, the majority of the adjustment towards the long-run values of the variables appears to take place within a quarter. However, it should be remembered that some of the explanatory variables in the first-stage regression are lagged by many quarters. Taking this into account, most of the total adjustment to changes in the current values of variables would appear to take place within three years.

The coefficients on the other explanatory variables that were included in the first-stage regression are generally the same or smaller than in that previous regression. Interestingly, the short-run response of the Startup Rate to the growth rate of real GDP is also highly elastic.

A one percentage point fall in the corporate tax rate, say from 30 per cent to 29 per cent, is estimated to increase the Startup Rate by around one per cent in the short term.

4.3 The Other Windup Rate

As previously mentioned, a single equation was estimated for the level of the Other Windup Rate. This was done using Ordinary Least Squares regression, with the standard errors estimated in a manner that is robust to the presence of heteroscedasticity, using the method suggested by White (cited on page 301 of Hall and Cummins 2009). Heteroscedasticity is the presence of uneven variance of the residual term at various parts of the sample period. There is an inkling that heteroscedasticity may be present in the data in Figure 8, where it is shown that the Other Windup Rate is more variable in the period from 1990 until early 2003 than afterwards.

Many of the initially specified variables, including those which were statistically significant in the first-stage regression equation for the Bustup Rate were found to be statistically insignificant and were not included in the preferred equation for the Other Windup Rate. In the initial specification, there were signs of negative autocorrelation in that the value of the Durbin-Watson statistic was significantly higher than two. To correct this, a lagged dependent variable was included and as shown below, it had the expected negative sign and inclusion of this variable corrected the apparent problem with negative autocorrelation. Details of the non-preferred equations are available from the authors. The preferred was estimated to be:

$$\text{Other Windup Rate}_t = \underset{(-0.65)}{-0.353} - \underset{(-2.87)}{0.169} * \text{Other Windup Rate}_{t-1}$$

$$- \underset{(-7.30)}{1.852} * \text{RAMP92Q1}_t + \underset{(29.02)}{6.32} * \text{D1992Q1}_t + \underset{(10.75)}{2.34} * \text{D1993Q2}_t$$

$$+ \underset{(2.62)}{0.771} * \text{TLSC0001}_t + \underset{(2.85)}{0.108} * \text{GRTXCI}_{t-1} \qquad (8)$$

Sample Range: 1991Q2to 2014Q4 (95 observations); F-statistic = 51.3
Durbin-Watson Statistic = 2.28; Durbin’s h Statistic = -1.66;
Standard error of regression = 0.452;
Mean of dependent variable = 1.14;
Standard deviation of dependent variable = 0.927
R-squared = 0.778; Adjusted R-squared = 0.762
Condition(X) number = 20.3
The figures shown in brackets underneath the coefficient estimates are the t-statistics for the test that the coefficient is equal to zero.

Where:
the Other Windup Rate is as defined in the sub-section 3.6 of this paper;
RAMP92Q1, D1992Q1, and D1993Q2 are dummy variables for timing aspects of ASIC's reregistration process for non-compliant companies in the early 1990s, as defined in the sub-section 3.6 of this paper;
TLSC0001 is the variable for the persistent effects of structural and legal changes affecting companies in the years 2000 and 2001; and
GRTXCI is gap (difference) between the corporate and average individual tax rates; & the subscript 't' denotes the quarter.

The overall level of explanation is acceptably high, as over three quarters of the variation in the Other Windup Rate is explained by the explanatory variables. After the inclusion of the lagged dependent variable, the apparent problem with negative autocorrelation appeared to be solved satisfactorily.

The signs on all of the estimated coefficients were as expected and appeared to be statistically significant from zero (as usual, there was no expected sign or level of significance for the constant term).

The taxation, structural and legal changes affecting companies in the years 2000 and 2001 are estimated to have raised the Other Windup Rate persistently, just as they were estimated to have done for the Bustup Rate.

An increase of one per cent in the difference between the corporate tax rate and the average income tax rate on individuals is estimated to increase the Other Windup Rate by around one per cent, in both the short and long terms.

5. CONCLUSIONS

A complete quarterly econometric model of company creation and destruction in Australia has successfully been constructed and estimated. This model consists of equation sets for the Startup Rate, the Bustup Rate and the Other Windup Rate. From these, the number of companies can be determined from an identity and the number of companies in the previous quarter.

The Startup Rate was estimated to have a highly elastic and positive response to the growth rate of real GDP. It was also estimated to respond negatively to the real interest rate and the Debt/Equity Ratio. These are the standard economic responses expected in the creation of trading companies.

The Startup Rate was also estimated to respond negatively to the company tax rate in the short term, and to respond in several ways to developments around the time of the introduction of the New Tax System in mid-2000.

The Bustup Rate was estimated to respond in the opposite direction to the Startup Rate to economic activity and the real interest rate. It was also estimated to respond in the expected direction to the following financial variables and ratios: the Debt/Equity Ratio, the real ASX share price, the real exchange rate and the Business External Funding Flow Rate.

The Bustup Rate also responded to developments in key industries and changes in the structure of companies. An increase (or decrease) in the dwelling approval rate was followed by a significant decrease (or increase) in the Bustup Rate, reflecting the disproportionate influence of the Construction industry in the total number of insolvencies and that industry's dependence on the inflow of new housing approvals. The influence of rainfall (especially when there is too much (floods) or too little (droughts) of it) in key agricultural regions was also important in determining the national Bustup Rate. This reflects the volatility of the agricultural industry and firms dependent on it and their reliance on seasonal conditions.

A higher (or lower) share of companies aged less than one year old was associated with a higher (or lower) Bustup Rate. This appears to reflect the direct effect of younger companies lacking experience and becoming insolvent while still young, and probably also reflects an indirect effect of disruptive young companies forcing older companies to become insolvent. To the extent that this finding reflects the former explanation and not the latter, it might possibly have the policy implication that better training of would-be entrepreneurs and better support and mentoring of young companies may reduce the Bustup Rate.

The Bustup Rate was estimated to have been raised, with both a permanent and a highly persistent effect, by the series of taxation, legal and structural changes affecting companies in the years 2000 and 2001. Given the number of changes that occurred during this period and the high collinearity among the explanatory variables in the long-run equation for the Bustup Rate, it was not considered feasible to attempt to disaggregate these effects.

The Other Windup Rate was estimated to be less responsive to economic, financial and company structure variables than the Startup Rate and the Bustup Rate. This fits the pattern of Other Windups being a more regular process and possibly also reflects the construction of this variable as a residual from the identity relating Startups, Bustups and the change in the number of companies. A higher (or lower) company tax rate, relative to the average individual income tax rate, was estimated to increase the Other Windup Rate significantly.

As with the Bustup Rate, the Other Windup Rate was also estimated to have been raised by the series of taxation, legal and structural changes affecting companies in the years 2000 and 2001.

One of the aims of performing this analysis was to construct a quarterly econometric model that could be used to provide inputs on insolvencies and related company statistics to a forecasting model for spending on the Australian Government's FEG programme. The model that has been presented in this paper is considered to be fit-for-purpose: the variables in the preferred model and their estimated coefficients are sensible and plausible; almost all of the estimated coefficients are statistically significant and the model explains a high degree of the variation in company creation and destruction in Australia since the early 1990s. Also, the significant lags on many of the explanatory variables should assist when the model is used in forecasting spending on the FEG programme.

APPENDIX A

VARIABLES FOR TAX, LEGAL AND STRUCTURAL CHANGES IN 2000 AND 2001

In this Appendix, an explanation is given of the methods used to construct two alternative variables (one on the assumption of permanent effects and the other on the assumption of highly persistent effects), for the taxation, legal and structural changes affecting companies in the years 2000 and 2001, which were described in Section 3.4 of this paper.

Given the progressive nature of these structural and legal changes, a dummy variable, RAMP0001, was constructed to reflect this phasing in of structural changes, instead of including separate dummy variables for each change. We have represented the effect as being 0 before 2000, rising in increments of 1/8 from the March quarter of 2000 to the December quarter of 2001, and 1 thereafter (see Figure A.1). Since this variable remains at the value of 1, it represents the permanent effect of these changes.

A second variable, TLSC0001, was constructed to represent the highly persistent, but not permanent effect of these changes. It is based on the alternative assumption that these changes only affected companies that existed at the time that the changes were introduced, but didn't affect companies that started up after then. In turn, this is based on the assumption that companies starting up after 2001 would have taken the new taxation, legal and structural framework into account in deciding whether or not to start up a company. TLSC0001 is set equal to RAMP0001 up until the end of 2001, but declines with the estimated proportion of remaining companies that were started before the start of 2002 after then.

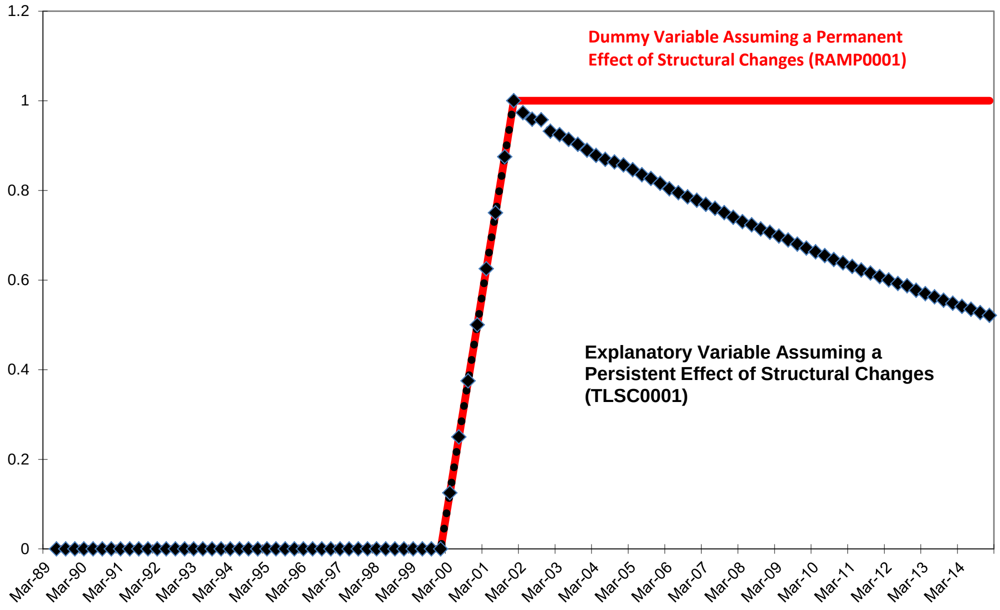
Unfortunately, a continuous and reliable time series of data on the number of proportion of companies formed before the start of 2002 is not readily available. However, the authors have constructed a proxy for this using the following formula:

$$\text{Proportion of Remaining Companies}_t = \text{Proportion of Remaining Companies}_{t-1} * (1 - \text{Bustup Rate}_t/100 - \text{Other Windup Rate}_t/100) \qquad \text{(A.1)}$$

Where the Bustup Rate and the Other Windup Rate are as previously described and the subscript, 't', refers to the time period in quarters.

The values of the variable, TLSC0001, after the start of 2002 are then formed by setting the Proportion of Remaining Companies equal to 1.0 in the December quarter of 2001. The values of this variable are also shown in Figure A.1.

Figure A.1: **The Variables, RAMP0001 and TLSC0001, Representing Effects of Structural and Legal Changes to Companies in 2000 and 2001.**



Source: constructed by the authors as explained in this sub-Section.

APPENDIX B

DEFINITION OF THE DEBT-EQUITY RATIO

The debt/equity ratio was calculated as the ratio of business debt (both business credit and non-intermediated business debt in the form of corporate bonds, asset-backed securities and similar forms of debt) to the market value of the enterprise capital stock, using the following formula:

$$\text{Debt/Equity Ratio}_t = (\text{Business Credit}_t + \text{Private Non-intermediated Debt}_t) / (\text{Real Enterprise Capital Stock}_t * \text{Share Price}_t / \text{Share Price in 2012-13}) \quad \text{(B.1)}$$

Data for the variable, Business Credit_t, were obtained from RBA statistics (data from spreadsheets D01HIST.XLS and D02HIST.XLS were combined to form a break-adjusted series for the level of business credit, in $ billion, current prices and original terms.

Data for the variable, Private Non-intermediated Debt_t, were obtained from RBA statistics, from spreadsheet D04HIST.XLS, in $ billion, current prices and original terms.

The variable, Real Enterprise Capital Stock_t, was constructed in the FoCUS macroeconomic model data base (see Connolly 2011 for an overview of this model) from data on the real capital stock in private and public enterprises from the ABS *Annual System of National Accounts* (ABS Cat. No. 5204.0), and then converted using linear interpolation in the computer programme, TSP Version 5.1 (Hall and Cummins 2009) to quarterly data. This variable is a chain-volume measure of original annual data (but since it is converted by linear interpolation from annual data should have no seasonal pattern) in $ billion, 2012-13 prices.

The variable, Share Price_t, is the S&P/ASX200 Share Price Index for Ordinary Shares in the ASX200 on the Australian Securities Exchange, obtained from RBA statistics, from Table F7.pdf. It is an index with a base of 31 December 1979 = 500. To enable the enterprise capital stock to be converted from real (2012-13 prices) to current prices to match the numerator of this ratio, the share price was converted to a 2012-13 base from a December 1979 base by dividing the share price by its average value in 2013-13 (i.e, dividing by the term, Share Price in 2012-13, in equation B.1).

APPENDIX C

Tests of Stationarity, Integration and Cointegration for the Variables Used in the Analysis

A series of tests, both under the null hypotheses of stationarity (KPSS tests) and integration (Augmented Dickey-Fuller and Weighted Symmetric Tau tests), were conducted to determine the orders of integration of the series for the logarithms of the Bustup Rate, the Startup Rate and the Other Windup Rate, for their explanatory variables and for cointegration between the dependent and explanatory variables. All tests were done in TSP International (Hall and Cummins 2009). All dummy variables were excluded from the testing of integration and stationarity (since a standard dummy variable is constrained to fall within the range of zero and one and is unable to move in a random walk outside these bounds, it is asymptotically stationary by design). However, they were included in the tests for cointegration, otherwise the results of these tests could be adversely affected by structural breaks represented by these variables.

Table C.1: KPSS tests

Variable	H_0: Stationarity around mean Test Statistic (ε_μ)	H_0: Stationarity around trend Test Statistic (ε_τ)	*Conclusion*
Ln(Bustup Rate)	0.135	0.139*	Mean stationary
Δ Ln(Bustup Rate)	0.099	0.099	Stationary
Δ_4 Ln(GDP)	0.209	0.127*	Mean stationary
Δ Δ_4 Ln(GDP)	0.213	0.086	Stationary
RAIN10YT	0.062	0.061	Stationary
Δ RAIN10YT	0.048	0.046	Stationary
FLOOD	0.287	0.067	Stationary
Δ FLOOD	0.047	0.047	Stationary
DEBTEQU	0.940****	0.149**	Integrated
Δ DEBTEQU	0.306	0.135*	Mean stationary
BUSEFFK	0.263	0.163**	Mean stationary
Δ BUSEFFK	0.150	0.059	Stationary
DWELAPP	0.556**	0.049	Trend stationary
Δ DWELAPP	0.061	0.061	Stationary
Δ_4 Ln(RER)	0.265	0.127*	Mean stationary
Δ Δ_4 Ln(RER)	0.065	0.046	Stationary
GRTXCI	0.721***	0.210***	Integrated
Δ GRTXCI	0.103	0.051	Stationary
RTC	0.938****	0.132*	Integrated
Δ RTC	0.111	0.044	Stationary
Ln(RSPI)	0.729***	0.194***	Integrated
Δ Ln(RSPI)	0.167	0.051	Stationary
RIR	0.885****	0.067	Trend stationary
Δ RIR	0.084	0.055	Stationary
Ln(Startup Rate)	0.522**	0.074	Trend stationary
Δ Ln(Startup Rate)	0.217	0.119*	Mean Stationary
SCOY1YO	0.489**	0.070	Trend stationary
Δ SCOY1YO	0.132	0.100	Stationary
Other Windup Rate	0.141	0.104	Stationary
Δ(Other Windup Rate)	0.055	0.050	Stationary

Note: results are for a lag of 9 quarters on the autocorrelated error term in the KPSS test, and were calculated for the sample period of 1991Q1 to 2014Q4, or the longest available subsample.
****/***/**/* indicate rejection of null hypothesis (stationarity) at 1/2.5/5/10% level respectively.

Table C.2: Augmented Dickey Fuller and Weighted Symmetric (tau) tests

Variable	Weighted Symmetric (tau) tests		Augmented Dickey Fuller Tests		Conclusion
	Optimum number of lags	P-value for H_0 of unit root	Optimum number of lags	P-value for H_0 of unit root	
Ln(Bustup Rate)	2	0.66	6	0.07	Inconclusive
ΔLn(Bustup Rate)	5	<0.01	5	0.01	Stationary
Δ_4 Ln(GDP)	7	0.38	10	<0.01	Inconclusive
Δ [Δ_4 Ln(GDP)]	6	0.01	6	<0.01	Stationary
RAIN10YT	10	0.14	10	0.28	Integrated
Δ RAIN10YT	9	0.01	9	0.04	Stationary
FLOOD	5	0.02	5	0.06	Stationary
Δ FLOOD	7	<0.01	7	0.02	Stationary
DEBTEQU	3	0.17	3	0.03	Inconclusive
Δ DEBTEQU	5	<0.01	5	<0.01	Stationary
BUSEFFK	5	0.68	9	0.69	Integrated
Δ BUSEFFK	8	0.01	8	<0.01	Stationary
DWELAPP	3	<0.01	3	0.01	Stationary
Δ DWELAPP	5	<0.01	5	<0.01	Stationary
Δ_4 Ln(RER)	10	0.47	10	0.57	Integrated
Δ Δ_4 Ln(RER)	9	<0.01	9	<0.01	Stationary
GRTXCI	5	0.56	5	0.33	Integrated
Δ GRTXCI	5	<0.01	5	<0.01	Stationary
RTC	2	0.45	10	0.81	Integrated
Δ RTC	2	<0.01	9	<0.01	Stationary
Ln(RSPI)	3	0.30	3	0.20	Integrated
Δ Ln(RSPI)	2	<0.01	2	<0.01	Stationary
RIR	3	0.06	3	0.02	Stationary
Δ RIR	2	<0.01	9	0.01	Stationary
Ln(Startup Rate)	4	0.93	4	0.02	Inconclusive
Δ Ln(Startup Rate)	3	<0.01	3	<0.01	Stationary
SCOY1YO	10	0.64	10	0.65	Integrated
Δ SCOY1YO	10	0.52	10	0.07	Inconclusive
Other Windup Rate	10	0.09	3	<0.01	Stationary
Δ(Other Windup Rate)	6	<0.01	5	<0.01	Stationary

Note: results are for the sample period of 1991Q1 to 2014Q4, or the longest available subsample.

Where variables are as defined in the main body of this paper.

The results for several variables are not particularly clear and there is often a divergence between the Augmented Dickey Fuller and the Weighted Symmetric tau tests for the same variables. Considering both the results of the tests under the null hypothesis of stationarity (KPSS) and integration (Augmented Dickey Fuller and Weighted Symmetric tau), the dependent and explanatory variables are likely to be I(1) at most (i.e., none of the variables are I(2) and some of the variables may be mean or trend stationary).

Tests for cointegration

An Engle-Granger (tau) test for co-integration was conducted between the Bustup Rate and the set of its explanatory variables in the preferred long-run equation (equation 4 in the main body of this paper). The estimated tau statistic from this testing was -4.9 at the optimum number of lags of the lagged dependent variable of two. There was no estimated probability corresponding to this estimate in the results from TSP International, as a result of the sizable number of explanatory variables, but the large absolute value of the tau statistic indicates that the dependent variable is likely to be co-integrated with its explanatory variables.

An Engle-Granger (tau) test for co-integration was conducted between the Startup Rate and the set of its explanatory variables in the preferred long-run equation (equation 6 in the main body of this paper). The estimated tau statistic from this testing was -4.34 at the optimum number of lags of the lagged dependent variable of two. There was no estimated probability corresponding to this estimate in the results from TSP International, as a result of the sizable number of explanatory variables, but the large absolute value of the tau statistic indicates that the dependent variable is likely to be co-integrated with its explanatory variables.

No tests for co-integration were performed for the Other Windup Rate because there is clear evidence that this variable is stationary.

REFERENCES

Archambault, R. and Laverdière, D. (2005), *A Macroeconomic Model for Analysing and Forecasting Levels of Business aand Consumer Insolvency in Canada*, Economic Information and Analysis, Office of the Superintendent of Bankruptcy, Industry Canada, pp 9-13.

Achen, C. (2000), *Why Lagged Dependent Variables Can Suppress the Explanatory Power of Other Independent Variables*, Paper prepared for the Annual Meeting of the Political Methodology Section of the American Political Science Association, UCLA, USA, 20-22 July.

Al Bhadily, Mohammed (2011), "Measuring The Impact Of The Financial Crisis On The General Employee Entitlements And Redundancy Scheme," *Bond Law Review*: Vol. 23: Iss. 1, Article 1. Available at: http://epublications.bond.edu.au/blr/vol23/iss1/1.

Altman, I. E. (1968), *Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy*, Journal of Finance, pp. 23, 4, 589-609.

Beaver, W. H. (1966), *Financial Ratios as Predictors of Failures. Empirical Research in Accounting: Selected Studies*, in Journal of Accounting Research, Supplement, Vol. 4, pp. 71-127.

Blum, M. P. (1974), *Failing Company Discriminant Analysis*, Journal of Accounting Research, pp. 12, 1, 1-25.

Boritz, J. E., Kennedy, D. B., and Albuquerque, A. (1995), *Predicting Corporate Failure Using a Neural Network Approach*, Intelligent Systems in Accounting, Finance and Management, Vol 4, pp 95-111.

Coats, K. P. and Fant, L. F. (1993), *Recognising Financial Distress Patterns Using a Neural Network Tool*, Financial Management, pp 142-154.

___________ (2008), *Is the Trailing Inflationary Expectations Coefficient Less than One in Australia?*, A Contributed Paper presented to the 37th Australian Conference for Economists (ACE08), Holiday Inn, Gold Coast, Queensland, 30 Sept -3 Oct.

___________, Trott, D. and Li, Y. (2012), *Workplace Agreements and Other Determinants of Labour Productivity*, Paper presented to the 23rd Australian Labour Market Research Workshop, Swan Valley Oasis Resort, Henley Brook, Perth, WA, 29-30 November.

___________ (2011), *An Overview of the Four Categories Unemployment Simulation (FoCUS) Model of the Australian Economy*, Seminar presented in DEEWR, 50 Marcus Clarke Street, Civic, Canberra, 14 September.

Deakin, E. B. (1972), A Discriminant Analysis of Predictors of Business Failure, Journal of Accounting Research, pp. 1, 10, 167-179.

Desai, M. and Montes, E. D. (1982), *A Macroeconomic Model of Bankruptcies in the British Economy 1945-1980*, British Review of Economic Issues, pp 4, 10, 1-14.

Econtech (2006), *Assessing the Feasibility of Developing a Model to Forecast Demand for the General Employee Entitlements and Redundancy Scheme*, Revised Final Feasibility Report prepared for the Department of Employment and Workplace Relations by Econtech Pty Ltd, Canberra, 30 May.

Goudie, W. A. and Meeks, G. (1991), *The Exchange Rate and Company Failure in a Macro-Micro Model of the UK Company Sector*, The Economic Journal, 101, pp 444-457.

Hall, B.H. and Cummins, C. (2009), *Time Series Processor: Version 5.1: User's Guide: including an Introductory Guide*, TSP International, Palo Alto, USA.

Hudson, J. (1987), *The Age, Regional and Industrial Structure of Company Liquidations*, Journal of Business, Finance and Accounting, pp 14, 199-213.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P. and Shin, Y. (1992), 'Testing the null hypothesis of stationarity against the alternative of a unit root', *Journal of Econometrics* **54**, pp. 159–178.

Laitinen, T. and Kankaanpaa, M. (1999), Comparative analysis of failure prediction methods: the Finnish case, The European Accounting Review, Vol 8.

Levy, A. and Bar-Niv, R. (1987), *Macroeconomic Aspects of Firm Bankruptcy Analysis*, Journal of Macroeconomics, pp 9, 3, 407-415.

Lincoln, M. G. (1982), *An empirical study of the usefulness of accounting ratios to describe levels of insolvency risk*. PhD thesis, Graduate School of Business Administration, The University of Melbourne.

Ohlson, J. A. (1980), *Financial Ratios and the Probabilistic Prediction of Bankruptcy*, Journal of Accounting Research, pp. 18, 1, 109-131.

Orzechowska-Fischer, E. and Taplin, B. (2010), *Forecasting Corporate Insolvency Rates in Australia*, Paper presented at the 39th Australian Conference of Economists, 27-29 September 2010, pp 8-13.

PC [Productivity Commission] (1998), *Aspects of Structural Change in Australia*, downloaded from www.pc.gov.au.

PC [Productivity Commission] (2000), *Business Failure and Change: An Australian Perspective*, downloaded from www.pc.gov.au.

PC [Productivity Commission] (2014), *Business Set-up, Transfer and Closure: Productivity Commission Issues Paper*, December 2014, downloaded from www.pc.gov.au.

Rose, S. P., Andrews, T. W. and Giroux, A. G. (1982), *Predicting Business Failure: A Macroeconomic Perspective*, Journal of Accounting, Auditing and Finance, pp 3, 20-31.

Salchenberger, M. L., Cinar, M. E. and Lash, A. N. (1992), *Neural Networks: A New Tool for Predicting Thrift Failures*, Decision Sciences, pp 23, 899-916.

Taplin, B., Jilek, P., Antioch, L., Johnson, A., Parameswaran, P. and Louis, C. (1993), *An Introduction to the Treasury Macroeconomic (TRYM) Model of the Australian Economy*, TRYM Paper No. 1, Treasury, Canberra.

Vlieghe, G. (2001), *Corporate Liquidations in the United Kingdom*, Financial Stability Review, pp 2, 141-147.

Wadhwani, B. S. (1986), *Inflation, Bankruptcy, Default Premia and the Stock Market*, The Economic Journal, pp 96, 120-138.

Wickramanayake, J. (1996), *Business Failures and Economy-Wide Factors in Australia 1973-1995: Empirical Analysis*, Department of Banking and Finance Working Paper, Monash University, Victoria, Australia, pp 8-16.

Wilson, R. L. and Sharda, R. (1994), *Bankruptcy Prediction Using Neural Networks*, Decision Support Systems, pp 545-557.