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DataFirst Technical Papers

The Life Cycle of South African Manufacturing Firms

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Technical Paper Series
Number 33

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Recommended citation

Kerr, A. (2015). The Life Cycle of South African Manufacturing Firms. A DataFirst Technical Paper 33. Cape Town: DataFirst, University of Cape Town

The Life Cycle of South African Manufacturing Firms

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DataFirst Technical Paper 33
University of Cape Town
June 2015

Introduction

In this paper I use a new source of firm level panel data to describe and better understand the life cycle of South African manufacturing firms. An important point to emerge from recent firm level work is that there are substantial cross country differences in the size of firms and in the relationship between plant age and size (Hsieh and Klenow, 2014), generated by differences in the importance of selection and within firm growth as well as changes in size of entering cohorts (Sandefur 2010, Davies and Kerr 2015). These differences may indicate substantial misallocation of resources and low firm level investment in developing countries.

South Africa is an interesting country to study in this regard because the importance of informal firms is small and the problems usually associated with running formal firms in developing countries, such as a lack of contract enforcement and the resultant lack of hiring non-family managerial labour (Akcigit, Alp, and Peters 2014), thin land markets, and financial frictions (Hsieh and Klenow 2014), are not as prevalent. But clearly - given the extremely large levels of unemployment– South African firms are not generating enough employment. A lack of within firm growth, high equilibrium levels of exit or low equilibrium levels of entry are possible reasons for the low employment equilibrium South Africa finds itself in.

I investigate these possibilities further by exploring the life cycle growth of manufacturing firms using a new source of firm level panel data. The Cape Town RSC panel data set is a census of formal firms in the City of Cape Town between 2000 and 2006. Yearly administrative data is available on basic firm characteristics (wage bill and revenue) and operating status and an initial survey collected more detailed data on around two thirds of the firms that were operating in 2000. I use the subset of manufacturing firms in this paper.

In this paper I do not use data on informal firms. In South Africa this is not as important an omission as in many other low or middle income countries because the informal sector is so small (Kingdon and Knight, 2004, Magruder, 2012). The 2001 population census shows that of those individuals working in manufacturing in Cape Town, 97.5% reported working in formal registered firms. This was higher than the country average where 91% of those employed in manufacturing reported working in formal registered firms and for all industries where 78% of the employed stated they worked in formal registered firms (outside agriculture). Thus in using data from formal firms I am excluding firms that account for only 2.5% of manufacturing employment in Cape Town.

In the next section I describe the RSC data in more detail. I then provide a descriptive overview of the data before describing the life cycle of South African firms and then exploring the possible reasons for these life cycle patterns.

The RSC data

Until 2006 metropolitan and district councils in South Africa, which were previously called Regional Services Councils (RSC), were permitted to raise revenue by taxing firms that operated within the council area. The City of Cape Town taxed firms based on their turnover and wage bill but also used the administration of the RSC levy, as the tax was called, to create an administrative dataset of firms. The city used this data to calculate Gross Geographic product and produce a number of reports on the local economy (cf City of Cape Town 2001). As part of this undertaking the city ran a survey of all firms on the RSC tax database in 2000 (Van Eeden 2003), and linked the firms to location based GIS data. The RSC data is thus a mixture of administrative and survey data. The data I have accessed is yearly data from 2000 to 2006[2].

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[2] As part of the levy collection other metropolitan areas also collected firm level data. We know that some data exists for both Durban and Pretoria and are trying to obtain this data and make it available to researchers through DataFirst.

Very basic information was collected as part of the administration of the tax. In every year the wage bill and revenue of each firm in the database is known, as well as whether the firm had exited and when this exit took place and the activity of the firm (from which a SIC code was created). The survey run in 2000 asked firms their age, the number of employees, exporter status and use of IT in the firm and a few other questions. Around two thirds of the active firms in 2000 responded to this survey. Some of this survey data (particularly employment) was supposed to be updated every year but in practice we only have useable survey data for the first year of the panel. Much of the employment data was imputed in subsequent years and cannot be used. New entrants were captured in the database but some of the survey information is not available for these firms.

In theory any enterprise employing at least 1 worker or with a revenue of R10 000 a year was supposed to pay the RSC levy and thus be included in the data. Thus the data should be a census of all formal firms operating with the city of Cape Town, except the very smallest self-employed operators. In practice those familiar with the RSC have said that there was some evasion of the tax but the proportion of firms evading is not known. I do not make any adjustments for potential evasion of the tax.

A firm level identifier was created for this paper to link firms across waves using the dataset obtained from the city. It was created from a reference number assigned to each firm, and the name of the firm in some cases where the reference number was not helpful in matching firms across waves.

The firm-level panel aspect of the RSC levy data has not been used in any other work that I am aware of. Some other published articles have used parts of the data. Turok and Sinclair-Smith (2012) created a panel of areas to explore where firms in Cape Town were located and the changing relative importance of different areas in the total wage bill of Cape Town between 2001 and 2005. Rospabe and Selod (2005) used one round of the RSC data from 2000 to create a measure of how far employment was from households surveyed for another unrelated survey.

Given that the all firms have wage bill and revenue but only 80 percent of the manufacturing firms responded to a survey which added data on firm age, SIC and employment I have also created a set of weights to be used when analysing data coming from the survey. These were created by giving all firms that responded a weight of 1 and then adjusting up the weights of these firms by the inverse of the group non-response rates – where groups were defined in terms of wage bill quintile, revenue quintile and 1 digit SIC code. Only variables known for all firms, not just firms responding to the survey, could be used as grouping variables.

Descriptive Statistics

Table 1 gives some descriptive statistics for the manufacturing firms with positive wage bill in each wave. It shows that the number of firms reporting a positive wage bill or revenue shrinks after the first year of the available data. It is not clear why this occurred. I attempted to find answers from the City and other researchers that used the data but received no clear answer. One suggestion was that the boundaries of the city may have changed and some firms excluded. I did check this and the firms that exited after the first year were not all located in a particular area.

I did some further investigation of this issue. Figure 1 show that the firms that disappear after 2000 have a smaller average wage bill than the firms that did not disappear in the subsequent period. I checked a publicly available register of companies and several of these disappearing firms were still operating in 2014. Thus they definitely did not all exit. One other suggestion was that there may have been an administrative error in creating the RSC database I use. Another was that these were firms that were forced to pay the tax as a result of the survey that was undertaken but that they evaded the tax in the following periods and then dropped out. Unfortunately I have not been able to finalise an answer as to the cause of the disappearance of these firms. As a result of this anomaly I use the post-2000 data in any panel analysis.

The median wage bill and revenue increases after the first year, where I have noted that small firms seem to have disappeared. The medians increase again in 2003- by about 40% for wage bill and 30% for revenue. There is no decrease in the number of firms though in 2003. The number of exits drops off in the last 2 years.

Table 2 shows the response rate to the survey conducted in 2000 by wage bill quintile, where all firms are included in the quintile calculation. Table 2 shows that small firms were less likely to have been contacted. As a result I use weights adjusted for non-response in analysis that requires use of the data collected from the survey.

Table 3 compares the 2000 total manufacturing employment from the RSC to the 2001 population census data for manufacturing employment within the City of Cape Town. There is slightly more employment recorded in the RSC once the data is weighted for firms that did not respond to the survey. Wittenberg (2005) reports a similar but slightly larger differential between the 1996 population census manufacturing employment data and the 1996 manufacturing census of firms. He suggests that some of the difference may be due to individuals living outside of the City of Cape Town who commute to firms located within the city.

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The number of firms reported by Wittenberg (2005) for Cape Town in the 1996 manufacturing census was 3185, compared to 3937 with positive wage bill in 2000 in the RSC and then 2828 in 2001 after the unexplained drop in the number of firms. Thus the 1996 manufacturing census and the 2000 RSC data report similar number of firms and total employment. This suggests the RSC data is a decent source of data, even if there are some anomalies.

I also compare the RSC employment data in 2000 to the Quarterly Employment Statistics (QES)- a firm survey undertaken by Statistics South Africa, although the QES data used by Kerr et al (2014) is from a more recent period – 2005-2011. Kerr et al (2014) report a median firm size of 10 employees in manufacturing, whilst the median employee works in a firm of size 155. The RSC has a smaller median of 7 workers but the median worker worked in a firm of size 200 in 2000. The lower median suggests that smaller firms are included in the RSC but not in the QES. The QES sample frame is VAT-registered firms and only firms with a turnover of R300000 or more were required to register for VAT (firms below the threshold with more than R20 000 turnover were allowed to register for VAT[3]). In the RSC manufacturing data around 20% of the firms in 2000 were below this threshold. This may be part of the explanation for the smaller median employment size in the RSC data relative to the QES.

Investigating the firm life cycle

The median South African manufacturing employee works in a much larger firm than employees in comparable developing countries. Hsieh and Klenow (2011)[4] report that whilst manufacturing plants in Mexico, a country with GDP per capita roughly 30% higher than South Africa, had median size of 7 employees in 2003, the same size as in the RSC data from 2000, the median Mexican manufacturing employee worked in a plant of size 24, compared to 200 in the RSC enterprise level data in 2000 (and 155 from the nationally representative enterprise based QES between 2005 and 2011, as reported in Kerr et al 2014). Despite there being a substantial number of large manufacturing firms South Africa is clearly lacking employment relative to comparator countries.

In this section I explore the patterns of life cycle growth and compare them to results from other developing countries, investigating whether these can shed any light on the low employment equilibrium in South Africa. Because the RSC data contains data over time only for wage bill and not

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[3] These were the regulations before 2010 when the compulsory VAT registration threshold was increased to R1 million.
[4] This is an earlier version of Hseih and Klenow (2014) that contains the descriptive statistics reported in this paragraph. These were not included in the published 2014 version.

employment I concentrate on wage bill in the rest of the paper. However below I do also show the cross sectional patterns I present using firm wage bill also hold for employment.

Hseih and Klenow (2014) show that in cross sectional data older Indian firms are no larger than young firms whilst older Mexican firms are only slightly bigger than the youngest firms. The authors argue that these patterns over the life cycle are caused by lower levels of firm investment which in simple general equilibrium models can lower productivity by 25% relative to the US, indicating that differences in life cycle patterns across countries are important.

To explore this in South Africa in Figure 2 I show the relationship between firm size measured by log of wage bill and age in the 2001 cross section, controlling for 2 digit industry and normalising firm size to 1 in the smallest age category. To do this I calculate weighted medians within 2 digit SIC categories for each age category. The weights I use to calculate each median are the weights created to adjust for non-response to questions about age. I then take a weighted average over 2 digit SIC, using as weights a basic measure of value added- revenue minus wage bill, which is the best one can do using the RSC data. This is a similar method to that employed by Hsieh and Klenow (2014), except they use means instead of medians. I use medians since there are sometimes small numbers of firms in an age-size category and the mean is more susceptible to outliers in this case. I am using a census of roughly 4000 firms whereas the numbers from Hsieh and Klenow (2014) are much larger- around 300 000 to 400 000 in Mexico and around 150 000 in India.

Figure 2 shows that in the RSC data older firms are indeed bigger - firms 35 years and older are about 9 times larger than firms less than 5 years old. This is a larger difference than reported by Hsieh and Klenow (2014) for US manufacturing where firms in the oldest category are 7 times larger than the youngest firms. The pattern for South Africa is very different to Mexico and India- Hsieh and Klenow (2014) report that for Mexico firms only double in size over the same ages in the cross section and that the oldest Indian firms are only 40 percent larger than the youngest firms.

Given that the RSC data contains wage bill data over all waves but employment data in wave 1 only and that other studies typically use employment to measure firm size in Figure 2 I also show that the same pattern that holds for wage bill also holds for employment- the oldest firms are ten times larger than the youngest firms. In the rest of the paper I use wage bill rather than employment, which I deflate using the CPI to compare across years.

The lack of growth of young firms may have important aggregate effects if few firms survive to ages 20 and older where growth seems to occur. In Figure 3 I plot yearly exit rates by age computed from data between 2001 and 2005, calculated within 2 digit SIC and then weighted by value added within

2 digit SIC. Exit probabilities for all manufacturing firms are just less than 2 percent per year, or roughly 10 percent over 5 years. This is fairly low and suggests many young firms would survive and grow. The exit rates are lower than the exit probability reported by Kerr et al (2014) using the nationally representative QES, which suggested a 14% exit probability over 4 years. It may thus be that the RSC data did not capture all exit.

The small exit rates and large size of older firms are partly shown in the large share of total wage bill of the oldest firms. This is shown in Figure 4. The oldest firms have an average 33% share of total wage bill. Apart from this the pattern is a declining share of wage bill for older firms. These patterns are similar to those for employment share patterns for the US shown by Hsieh and Klenow (2014) and different to Mexico and India- where although there is a declining share by age the oldest firms have much lower shares than in South Africa.

Moving beyond Cross Sectional Growth patterns

The cross sectional patterns of firm size by age in Figure 1 suggest large growth in firms over the life cycle. But this large size difference between young and old firms can be generated by a number of different patterns that may have very different causes and implications for policy. For example it could be that small older firms are exiting and larger older firms are not growing (as Hseih and Klenow (2014) show is true in India for all firm ages). Alternatively there may be strong within firm growth (as Hsieh and Klenow 2014 showed for the US). Another possibility is that entering cohorts have become smaller over time and there is neither exit correlated with size nor within firm growth (as in Ghana- see Sandefur (2010) for evidence that later cohorts were smaller than earlier ones and Davies and Kerr (2015) for evidence that there was neither firm growth nor selection between 2003 and 2013- contradicting Sandefur's finding of strong evidence for selection in an earlier period).

To explore different explanations for the positive age-size correlation I first follow Hsieh and Klenow (2014) in imputing life cycle growth from changes for different cohorts over the 5 years between 2001 and 2006. To do this requires assuming the same rates of exit and employment growth for each cohort over its life cycle. Figure 5 computes growth over the life cycle from cohort changes in two ways. The first is to look at average wage bill for one 5 year age category and then compare this with average wage bill in the next older age category 5 years later- Hseih and Klenow (2014) call this synthetic cohort analysis. Similar work exists in South Africa for worker level analysis (Branson and Wittenberg 2007) but here the focus is on firms. Figure 5 shows that when using this method firm growth is higher than when looking at the cross section.

This cohort analysis is a step beyond the cross section. But because firms that do not survive are not included in the cohort in the next period, differential selection rates by size may be causing the high cohort growth we observe. This will be true if smaller firms are more likely to exit for example and the larger surviving firms push up the average when in fact they may not have grown at all. Because we have a panel of firms we can actually explore how employment changes in surviving firms, and again if we assume the same rates of exit and growth for all cohorts we can compute the firm life cycle. Figure 5 shows that the age- size relationship is not nearly as strong when computing changes in wage bill from firms that survive between 2001 and 2005. But there is still a positive age- size correlation. This suggests that differential selection may be responsible for some but not all of the growth as firms age when using the cohort analysis.

A direct test of the importance of selection or growth in the evolution of the firm size distribution

The previous analysis showed that surviving firms do grow and that the positive age- size relationship in the cross section is simply not an artefact of selection- although growth is much lower than when calculated in the cross section or cohort analysis. The previous work did not address the relative importance of selection and growth, however, which has been a matter of some debate. Jovanovic (1982) put forward a theoretical model of the evolution of the firm size distribution with selection as the key mechanism, whilst Cabral and Matta (2003) showed that growth and not selection explained the evolution of Portuguese firms. To directly test the relative importance of selection versus growth I use the simple test of Cabral and Matta (2003). These authors explore the evolution of the firm size distribution, and particularly whether the size distribution of a cohort of new firms evolves mainly due to selection or growth. They find that growth explains most of the evolution in Portugal, with selection playing a negligible role, despite the prominent role given to selection in the theoretical literature.

The test involves comparing the size distribution of 3 groups of firms: All firms in the initial period, surviving firms in the subsequent period and the distribution of firms known to survive in the initial period. If the distribution of all firms in the initial period is to the right of the distribution of the firms known to survive from the initial period then this suggests that survivors were larger to begin with and that selection is causing a positive age-size correlation. If the distribution of the survivors in period two is to the right of the same distribution in period one then this suggests that growth is driving the evolution of the firm size distribution. Again because the test involves using panel data I am required to use wage bill data rather than employment- which was used by Cabral and Matta (2003).

Figure 5 presents the evidence for the firms in the youngest category- between 0-4 years. It suggests that over the 5 years between 2001 and 2006 surviving firms experienced substantial with-firm growth but were initially no larger than the firms that did not survive until 2006. This means that growth rather than selection is playing the dominant role in explaining the evolution of this cohort. In results not presented I find that this is true for all age categories.

As noted above a positive age-size correlation in the cross section may result because of differential sizes of entering cohorts over time. Cabral and Mata (2003) did not consider this as the firm size distribution in Portugal over the period they examined was very stable. There is some evidence that this may be an important part of the evolution of the firm size distribution. Sandefur (2010) reports that the average firm size halved in Ghana between 1987 and 2003 and suggests that decreasing sizes of entering cohorts may have been part of the explanation. Unfortunately the RSC data does not allow us to explore this issue since the data on entry is not very good and there is only a short time period. Nevertheless the results discussed here suggest that growth rather than selection explains the evolution of the firm life cycle across all cohorts between 2001 and 2006. Changes in cohort sizes may have important aggregate effects but the existence and impact of possible changes in cohort size cannot be tested using the RSC data.

Conclusion

Differences in firm life cycle patterns across countries may reveal important frictions in labour, credit or land markets that distort the allocation of resources away from more productive firms. Hseih and Klenow (2014) have shown that in India and to a lesser extent Mexico these differences are large relative to the US and can result in a 25% drop in productivity in general equilibrium models. In this paper I have shown that South African firms look more like US than Mexican or Indian firms- they are larger and grow substantially as they age, even more than in the US- at least in the cross section and when doing cohort analysis.

In using the test suggested by Cabral and Matta (2003) I found that, as in Portugal, the evolution of South African firms is driven almost entirely by within firm growth rather than selection. Again this means South African firms are similar to those in developed countries.

In looking for the culprit for South Africa's low employment equilibrium the results from this paper suggest researchers look elsewhere than a low-growth firm life cycle. I also showed that exit rates in the RSC data are quite low and thus high firm failure rates are also unlikely to explain low levels of employment. Better understanding possible low equilibrium levels of entry thus seems an important part of the future research agenda.

References

Akcigit, Alp, and Peters 2014. Lack of Selection and Limits to Delegation: Firm Dynamics in Developing Countries. Mimeo. Accessed at http://econ.la.psu.edu/classes-seminars/seminars/Ufuk.pdf

Cabral, L. M. B., & Mata, J. (2003). On the Evolution of the Firm Size Distribution: Facts and Theory. *American Economic Review, 93*(4), 1075–1090.

City of Cape Town 2001 City of Cape Town, Cape Town's Economy: Current Trends and Future Prospects. Accessed at https://www.westerncape.gov.za/text/2003/12/ct_economy_current_trends_future_prospects.pdf.

Davies, E and Kerr, A (2015) Firm Survival and Change in Ghana, 2003-2013. CSAE Working Paper WPS/2015-06.

Hsieh, C-T and Klenow, P (2011). *The Life Cycle of Plants in India and Mexico*. Chicago Booth Paper No. 11-38, June.

Hsieh, C.-T., and Klenow, P. (2014). The life cycle of plants in India and Mexico. *Quarterly Journal of Economics, 129* (3), 1035–1084

Kerr, A and Wittenberg, M and Arrow, J. (2014). Job Creation and Destruction in South Africa. *South African Journal of Economics* 82 (1), 1-18

Kingdon, G and Knight, J (2004). Unemployment in South Africa: The nature of the beast. *World Development*, 32(3): 391-408

Magruder, J. (2012) High unemployment yet few small firms: The role of centralized bargaining in South Africa. *American Economic Journal: Applied Economics*, 4(3): 138-166.

Rospabe, S. and Selod, H. (2006) 'Does city structure cause unemployment? The case of Cape Town', in H. Bhorat and R. Kanbur (Eds.) *Poverty and Policy in Post-Apartheid South Africa*, pp. 262-287. Cape Town: HSRC Press.

Sandefur, J. (2010). On the Evolution of the Firm Size Distribution in an African Economy. *CSAE Working Paper* ,2010-5.

Sinclair-Smith, K and Turok, I, 2012. The changing spatial economy of cities: An exploratory analysis of Cape Town, *Development Southern Africa*, 29(3), pages 391-417.

Van Eerden, A (2003) Financial GIS applications- Strategic decision making tools for Sustainable Future Development in the City of Cape Town. Accessed at www.icaci.org/files/documents/ICC_proceedings/ICC2003/Papers/009.pdf

Wittenberg (2004). The mystery of South Africa's ghost workers in 1996: measurement and mismeasurement in the manufacturing census, population census and October Household Surveys. *South African Journal of Economics* 72 (5), 1003-1022.

Tables

Table 1: Descriptive Statistics for Manufacturing firms in the RSC panel

Year	No of firms	No of exits	Exit %	Median wage bill	Median revenue
2000	3937	188	4.8	287329	1409334
2001	2828	209	7.4	390938	1929718
2002	2683	281	10.5	357194	1918461
2003	2869	295	10.3	517777	2564962
2004	2917	198	6.8	519923	2488407
2005	2784	74	2.7	644022	2945796
2006	2789	0	0.0	623477	2649319

Table 2: Response rate to survey by wage quintile

	Wage Quintile					
Survey response	1	2	3	4	5	Total
0	46	216	208	202	215	887
	33.58	37.11	26.74	19.8	12.07	20.63
1	91	366	570	818	1,567	3,412
	66.42	62.89	73.26	80.2	87.93	79.37
Total	137	582	778	1,020	1,782	4,299
	100	100	100	100	100	100

Note: wage quintile was calculated for all firms, not just manufacturing firms.

Table 3: RSC, Population Census and QES Manufacturing Employment statistics

Manufacturing Employment statistics						
RSC Total employment	RSC Total employment weighted	2001 population Census employment	RSC Median employment	QES median employment	RSC Median worker firm size	QES Median worker firm size
132833	171293	155661	7	10	200	155

QES statistics from Kerr, Wittenberg and Arrow (2014). Census 2001 figures from the Census 2001 Community Profiles.

Figures

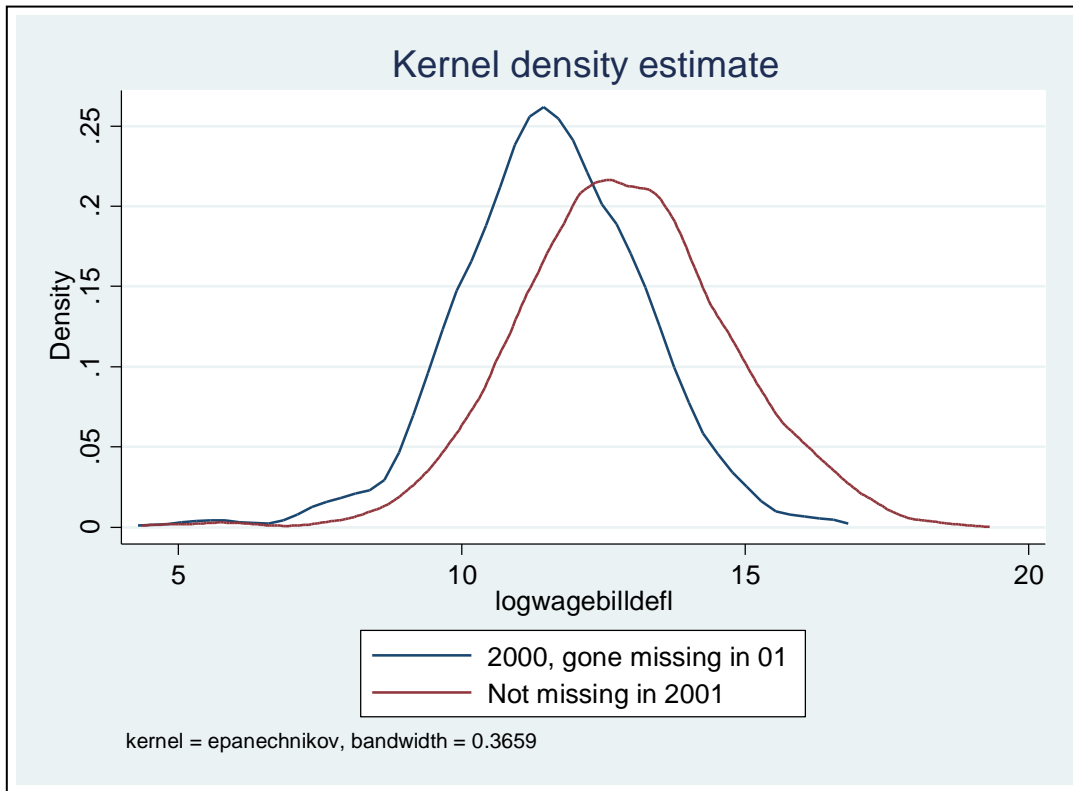**Figure 1: Density for firms present in 2000 but not in 2001.**
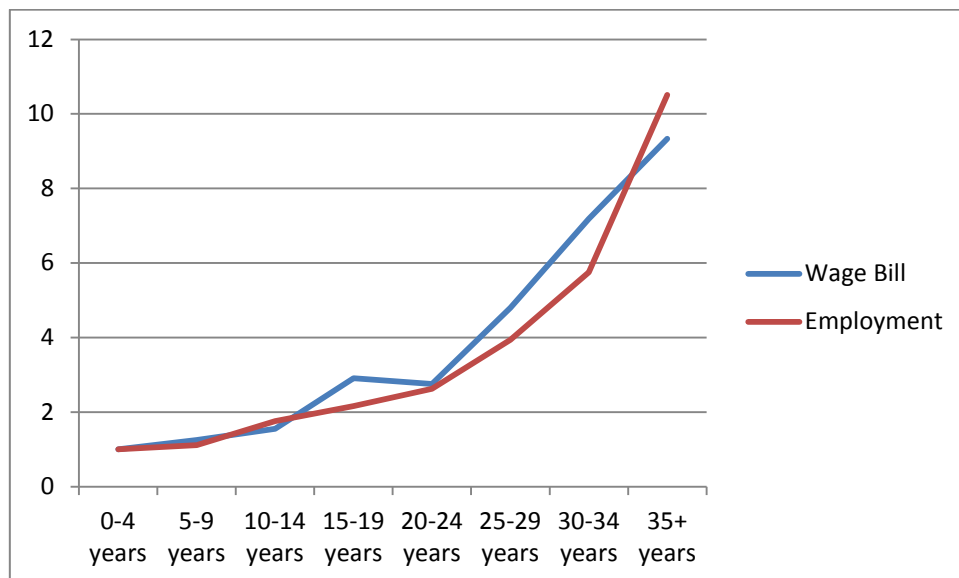

Figure 2: Cross sectional Growth

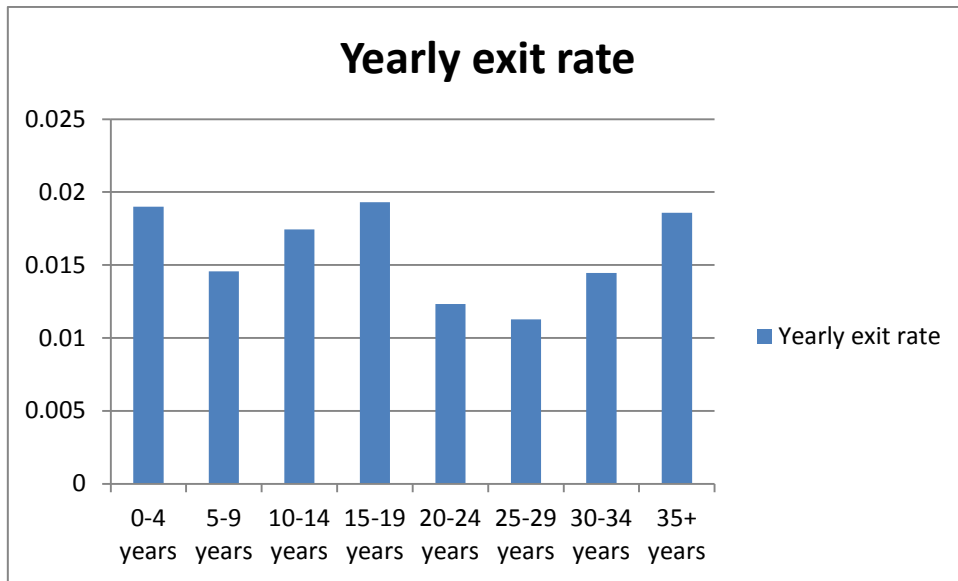**Figure 3: Annual Exit rates calculated from 2001-2006 RSC panel data**

Yearly exit rate

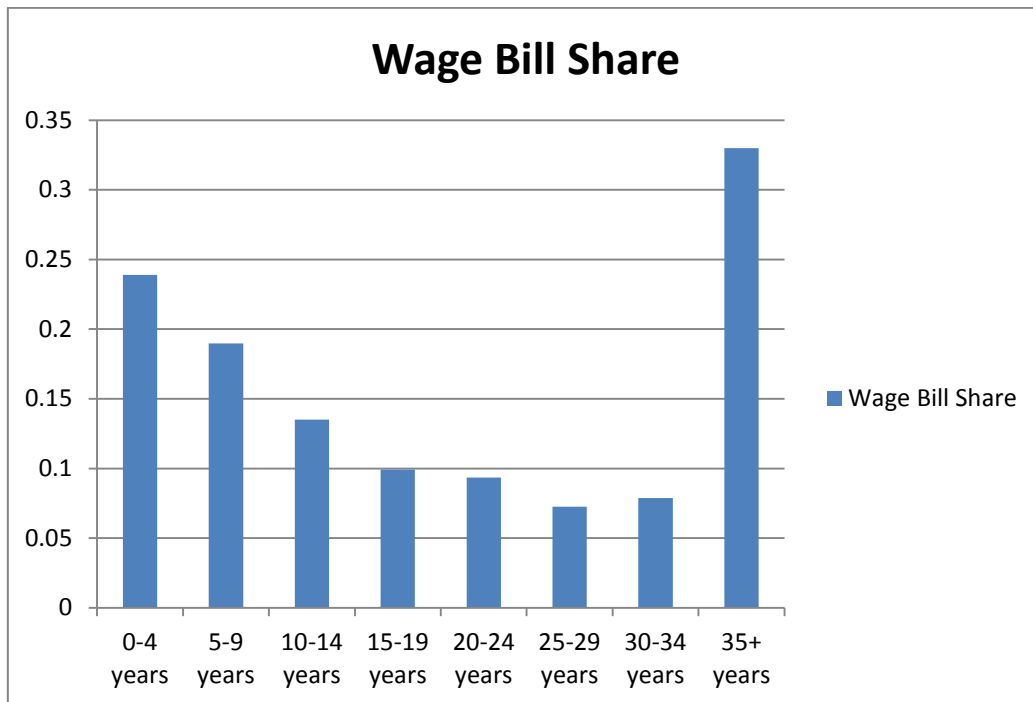**Figure 4: Wage Bill Share by Age in 2001**
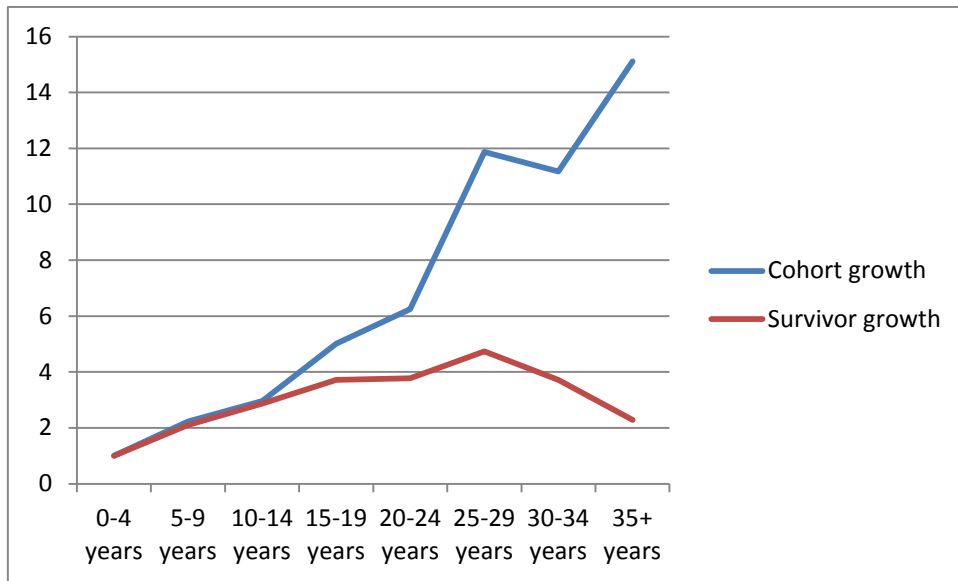
Wage Bill Share

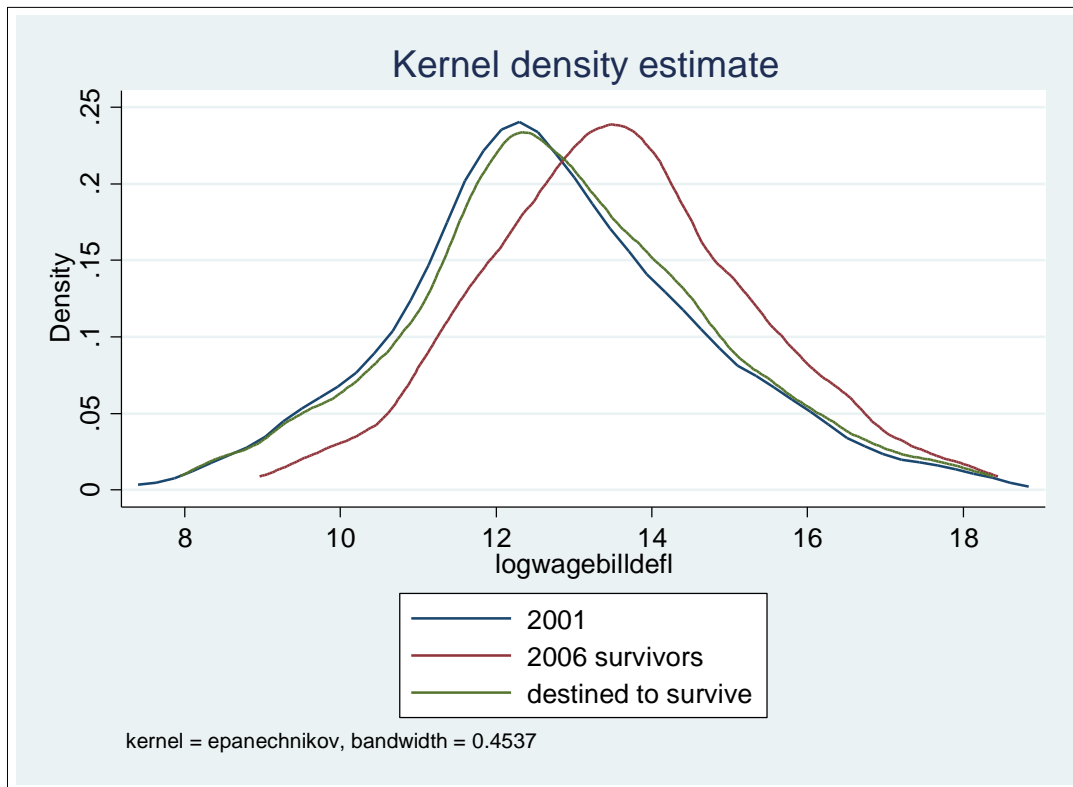**Figure 5: Growth using Cohorts and Survivors**

Figure 6: Test for growth versus selection for the youngest cohort

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