The Impact of Initial Financial State on Firm Duration Across Entry Cohorts*

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Abstract

Recent theories of industry dynamics emphasize the role of financial frictions in determining post entry performance of firms. Testing these theories has been difficult because of the lack of financial data on the small, young and private firms. Using a unique data set, this paper considers the survival of new firm in Canadian manufacturing from a financial perspective. Duration analysis quantifies the effects of firm, industry, and aggregate factors. Nonlinear effects are found with firm leverage. Finally, likelihood decompositions of hazard models offer insights into the contributions to firm hazard in the Canadian economy for the period 1985-1997.

Key Words: firm exit; duration; leverage; entry cohort.
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1 Introduction

Recent theories of firm dynamics emphasize the role of financial frictions as determinants of firm entry and exit in industries with high turnover rates. Testing these theories is difficult due to the lack of detailed financial data on small, private firms. Using a unique data set that includes detailed balance sheet and tax information, this paper considers a cohort analysis of the post entry performance of new entrants in Canadian manufacturing from a financial perspective.

Traditionally, economists view entry and exit as serving an equilibrating role for industry dynamics in the absence of any barriers. However, literature surveys by Geroski (1995), Sutton (1997), and Caves (1998) have shown that entry and exit is more complicated. In particular, Dunne, Roberts, and Samuelson (1988) find a high correlation between entry rates and exit rates across manufacturing industries. Industries experiencing high entry rates also have higher exit rates.

There have been a number of theoretical models offered to explain the industry dynamics consistent with firm exit shortly after entering an industry. Firm heterogeneity plays a role in all explanations. For example, Jovanovic (1982) constructs a model in which a firm learns about its quality, and hence its ability to compete, only through production. Thompson (2005) illustrates this mechanism using data from shipbuilding firms. Those firms learning they are among the most productive survive, while those who learn that they are less productive exit. The shake-out period sees only the fittest surviving. Hopenhayn (1992) generates market turnover of firms through productivity. In Hopenhayn's framework, a firm's productivity evolves over time through a known Markov process. A series of bad draws leads to exit. Alternatively, recent literature by Cooley and Quadrini (2001), Cabral and Mata (2003), and Albuquerque and Hopenhayn (2004) find that a firm's post-entry experience depends on both its productivity and financial resources. High levels of debt may constrain a firm's activities, as Myers (1977) illustrates. Lack of financial resources limits a firm's activities, while *deep pockets* allows a firm to overcome initial setbacks and startup mistakes.

T2-LEAP, a unique firm level database combining information from the Corporate Tax Statistical Universe File (T2SUF) with Longitudinal Employment Analysis Program (LEAP) database, allows us to analyze post entry performance of nascent Canadian manufacturing firms from a financial perspective. We examine the role of initial financial state, initial productivity and initial size while controlling for time varying effects associated with tariffs and exchange rates, and unobserved heterogeneity across firms. Successive entry cohorts of firms between 1985 and 1996, inclusive, make up our sample.[1]

The paper makes the following three contributions to the literature. First, we perform a non-parametric and parametric decompositions of the data. The non-parametric decompositions examine overall changes in variables across entry cohorts occurring with age. Distributional changes occur because of two main reasons: (i) within firm changes over time and (ii) compositional effects due to exit. The paper focuses on the relevance of initial firm level conditions for new firm survival. Two non-parametric decompositions provide unconditionally analysis and indicate surviving cohort firms at age one are larger, have lower leverage and are more productive than exits. Using this information, a Cox proportional

[1]Other countries with comparable new manufacturing firm survival studies include: United States, see Dunne, Roberts, and Samuelson (1989) and Audretsch (1991); Canada, see Baldwin, Bian, Dupuy, and Gellatly (2000), Germany, see Wagner (1994) and Boeri and Bellmann (1995); Italy, see Audretsch, Santarelli, and Vivarelli (1999); Greece, see Fotopoulos and Louri (2000); Spain, see Segarra and Callejon (2002); Portugal, see (Mata and Portugal (1994) and Mata, Portugal, and Guimaraes (1995).

hazard model provides a parametric analysis to determine conditional effects of these variables. The parametric analysis decomposes the log-likelihood from various models estimated to evaluate the contributions to entrant hazard from observable firm specific effects, industry variables, time varying trade and exchange rate variables, and unobservable effects related to industry and location of individual firms. The decomposition of the log-likelihood reveals that firm-specific effects and unobserved heterogeneity are the major determinants of the hazard rate (about 80 to 95 percent). Unobserved heterogeneity accounts for about 30 to 60 percent of the log-likelihood while firm-specific effects account for between 20 to 70 percent. Time-varying and industry effects account only for about 5 to 20 percent. The impact of unobserved heterogeneity is reduced for post-1988 cohorts suggesting that more homogeneous firms are entering the market during that time.

Second, we analyze the role of firm-specific financial balance sheet characteristics relative to new firm duration. Following theoretical models of firm dynamics, a firm's exit hazard rate is allowed to depend on both its productivity and financial resources. Hence we measure the importance of what Zingales (1998) calls "Survival of the fittest or the fattest?" on the post-entry performance of these new firms. More specifically, we explore nonlinear effects of initial firm leverage (debt-to-asset ratio) on a firm's duration and find that firms with high levels of leverage, controlling for factors such as productivity and size, face an increasing failure risk with a rise in leverage. Firms with low to moderate levels of leverage have a negative relationship between debt-to-asset ratio and hazard rate. Within the likelihood decompositions, leverage and accounting for nonlinear effects related to leverage provide the biggest contribution to the likelihood for the firm level variables.

As a third contribution, entry cohorts are analyzed at different times in the business cycle. We do not pool cohorts for two reasons. First, by employing a cohort analysis we are able to identify cohort specific effects related to the control variables. Lee and Mukoyama (2008) find entry rates are procyclical while exit rates tend to be acyclical. This finding suggests timing matters in the entry decision of a firm. Thus, firms entering at different times should be treated differently since macroeconomic conditions and the level of competition from other entrants vary with year of entry. The second reason is that our econometrics model requires proportional regressors. Violation of the proportionality assumption occurs with pooled analysis. Therefore, the cohorts are treated individually. The analysis identifies conditions (initial size, productivity, level of leverage) under which firms that enter in different years are successful.

The rest of the paper is organized as follows. Section 2 presents the data. Section 3 discusses the patterns of entry and exit. Section 4 looks at decomposing variable changes over time across entry cohorts. Section 5 presents the econometric methodology and model specification. Section 6 discusses the results and section 7 concludes.

2 Firm and Aggregate Data

2.1 T2LEAP: Firm Level Data

The firm-level data used in this study comes from the T2-LEAP database maintained by Statistics Canada. This database was created through the merging of two administrative databases; employment information from the Longitudinal Employment Analysis Program (LEAP) is linked to financial records from the Corporate Tax Statistical Universe File (T2SUF). A firm is incorporated if it files a corporate (T2) tax return. T2-LEAP uses a business registry number (BSNUM) to track all incorporated firms operating in a given year. The data effectively covers the universe of incorporated Canadian firms hiring workers. The T2-LEAP database contains firm details from 1984 until 1998. A partial reporting problem in the first and last years restricts the usable period as 1985 to 1997.

Given that the paper looks at post-entry performance through new entrant's exit and survival patterns, we need a clear definition of when entry and exit occur. Birth year is measured as the first year in which a firm both hires employees and files a corporate tax return. The birth year is unknown for those firm existing in 1984. A firm's exit occurs in the first year when the firm does not both hire workers (LEAP measure of exit) and file a tax return (T2 measure of exit) status. The firm is removed from the database for all years following its exit. We do not observe the exit year of those firms still existing in 1998. The unique BSNUM each firm receives ensures that exit and re-entry does not occur. [2]

The paper uses the following firm level information available in the T2-LEAP database: annual measures of a firm's employment, sales, assets, and equity. Average Labour Units (ALU) measure a firm's yearly employment. ALUs are calculated by dividing the total annual payroll of an enterprise by the average annual income for a worker in the relevant industry (SIC) (j), province (k), firm size class (l), and time (t) or $ALU_{it} = \text{total payroll}_{it}/\bar{w}_{jklt}$. This definition means that the reported ALUs for a given firm can be thought of as the number of standardized employees working for a firm in that industry, province, size class, and year. A firm's sales, assets, and equity are in terms of book value and are deflated using the consumer price index (CPI). Balance sheet protocol dictates that the value of a firm's assets must equal its liabilities (Assets = Debt + Equity). A firm's debt is calculated using

[2] For example, a name change by a firm will not be recorded as an exit and entry since the BSNUM does not change for this firm.

the deflated values of its assets and equity.

Each firm is classified by a three-digit Standard Industry Classification (SIC) code. The paper only considers manufacturing firms. Tobacco firms are dropped from the analysis due to lack of entrants in this industry, only 8 and 12 firms are in this industry for the period considered. The following generated variables are calculated using the firm information: Leverage (debt-to-asset ratio or $da_{it} = \text{Debt}_{it}/\text{Asset}_{it}$), and labour productivity or ($yn_{it} = \text{Sales}_{it}/\text{ALU}_{it}$).

2.2 Aggregate (Time-Varying) Data

T2LEAP covers a period of time when significant changes occurred in the Canadian economy. The Canada-US Free Trade Agreement (FTA) meant a reduction starting in 1989 of Canadian and US tariffs. The bilateral tariff rates are linked to each firm by year using 3-digit SIC codes. These 3-digit SIC tariff rates changes are calculated in concordance with Head and Ries (1999). Throughout the paper, we work with the change in the difference between the Canada-US tariff rates for a particular industry. The change in this difference is given by: $\Delta TARDIFF_{jt} = \Delta(\text{Canadian Tariff}_{jt} - \text{U.S. Tariff}_{jt})$, where j denotes the industry and t is the year. Figure 1 displays the cross-sectional (industry) and time-series variation of the tariffs.

The real Canada-US exchange rate is calculated using the following formula: $\text{RER}_{jt} = e_t \text{IPPI}_{jt}^{CAN}/\text{IPPI}_{jt}^{US}$, where j denotes the industry and t is the year. e_t is the nominal exchange rate or USD per CAD, IPPI_{jt}^{CAN} is the Canadian Industrial Product Price Index (2-digit SIC) and IPPI_{jt}^{US} is the US Industrial Product Price Index (2-digit SIC). Nominal exchange rates and Canadian IPPIs are found on CANSIM while US IPPI are taken from the BLS. Figure 2 displays the cross-sectional (industry) and time-series variation of this industry real-exchange rate.

3 Patterns of Entry and Exit

Table 1 provides a breakdown across years of the number of entrant firms in each two-digit manufacturing industry. Substantial firm turnover occurs across 2-digit industries. Most industries experience growth and thus an upward trend in the number of firms existing within the industry. Figure 3 plots the empirical hazards for the new entrants (1985-1993 Cohorts). The empirical hazards are steepest for post-1987 cohorts. All entry cohorts experience a non-monotonic drop in hazard rates over time. With the exception of the 1992 entry cohort, hazard rates for each cohort actually rise between 1996 and 1997.[3]

Figure 4 presents entrants and exits as a proportion of the total number of firms within a given year (entry rate and exit rate). In every year, entrants are a higher proportion than exits. The graph also shows that the proportion of exits remains relately flat falling between five and six percent. A recession occurred for the Canadian economy between 1990 and 1993, the entry rate is at its lowest in 1992. However, no clear cyclical pattern emerges for either the entry rate or the exit rate. Although movements for the exit rate are less dramatic, the entry rate appears to follow movement counter to movements in the exit rate. Conditions of high entry match those of low exit.

Figure 5 presents the proportion of total employment within a given year attributable to those firms entering in the previous year and those firms exiting in the next year. The previous figure indicates that entrants are more numerous than exits, while this figure indicates

[3]The analysis focus on the 1985-1993 entry cohorts since the latter cohorts have a relatively short spell length. Five years represents the maximum spell length for the 1993 cohort.

that exits tend to be larger than entrants since exits are a larger share of total employment in most years. The growth of survivors likely accounts for the differences. The cyclical movements of both entrants and exits contribution to total employment match the corresponding movements of entry and exit rates found in figure 4.

Next, we move on to discuss relative position of entrants and exits for firm specific variables. Figure 6 presents the median productivity of entrants and exits relative to the median productivity of all firms. The relative median labour productivity of exits tends to be flat over time remaining at 0.9. Alternatively, the relative median labour productivity for entrants is always above 1. This figure suggests a "survival of the fittest" situation where firms exit because they are relatively less productive, while entrants are more productive. Figure 7 examines the relative median leverage of entrants and exits. Exiting firms have a higher portion of debt financing. Entrants also have a higher portion of debt financing compared to the typical firm. Finally, the relative median leverage of entrants rises during the period 1985 until 1990 then falls until 1993.

4 Decomposition

4.1 FHK Decomposition

This section documents how restructuring within an entry cohort contributes to overall changes in variables. Consider the weighted average of a particular variable for a cohort in year t:

$$P_{it} = \sum_{i \in S_t} s_{it} p_{it}$$

where p_{it} is the variable of interest and s_{it} is the employment share of firm i.

Foster, Haltiwanger, and Krizan (2001) (hereafter FHK) suggest breaking δP_{it} into various components. The FHK decomposition has been modified to account for overall changes from birth until time t for a given cohort:

$$
\begin{aligned}
P_{it} - P_{i1} &= \underbrace{\sum_{i \in C_t} s_{i1}(p_{it} - p_{i1})}_{Within} + \underbrace{\sum_{i \in C_t} (p_{i1} - P_{i1})(s_{it} - s_{i1})}_{Between} \\
&+ \underbrace{\sum_{i \in C_t} (p_{it} - p_{i1})(s_{it} - s_{i1})}_{Cross} - \underbrace{\sum_{i \in D_t} s_{i1}(p_{i1} - P_{i1})}_{Exit}
\end{aligned}
$$

where C_t denotes continuing firms at time t, while D_t denotes firms exiting at or prior to time t. The first or within term in this decomposition shows the contribution to overall change from within surviving firms. The between component captures changes related to changing shares weighted by the deviations of initial firm variable value from initial cohort variable value. The cross term represents covariance. The last term provides the contribution of cohort exits to overall changes.

Table 2 presents the total change from age one until 1997 and the FHK decomposition of this change for the weighted average of labour productivity, debt-to-asset ratio and the logarithm of employment for each cohort. With respect to the shares, a positive share implies the relative part of the decomposition moves in the same direction as the total change. First, consider the results for $\delta \log(Y/L)$ contained in the labour productivity panel of the table. With the exception of the 1993 cohort, each cohort experiences an increase from birth in the weighted average of labour productivity. The within share is always positive and ranges between 31 percent and 127 percent. Both the between share and the cross share can be positive or negative depending on the cohort. The exit component is negative except for the 1992 and 1993 cohorts, which indicates that exits tend to have lower productivity levels compared to survivors.

In the debt-to-asset panel, the total change shows the weighted average debt-to-asset ratio for each cohort falls over time. With the exception of the 1990 and 1991 cohorts, the within component is positive, which indicates surviving firms have a lower debt-to-asset ratio in 1997 than they do at age one. The between component ranges between -37 percent for the 1991 cohort and 31 percent for the 1987 cohort. Only the 1985 and 1991 cohorts have a negative between component. The cross component share is always positive across cohorts with an extreme value of close to 300 percent for 1991 cohort. Except for the 1993 cohort, the exit component share is positive.

The last panel present the decomposition of the change in the logarithm of employment. The total change in the weighted average along with its corresponding within component share and cross component share are always positive. The cross component share is always over 100 percent. The between component share is negative and ranges from -44 percent in 1987 to -383 percent in 1993. For the 1986, 1987 and 1992 cohorts, the exit component is positive, while for all the other cohort the exit component is negative.

4.2 Selection/Survivor Decomposition

Pinto (2006) suggests a decomposition which breaks changes in average values of variables attributable to survivor and selection components. This decomposition is computed for the changes in employment, labour productivity, and leverage. Analysis is done for each entry cohort. The decomposition is given by:

$$\underbrace{\frac{1}{N(S_\tau)}\sum_{i\in S_\tau} X_{i,\tau} - \frac{1}{N(S_1)}\sum_{i\in S_1} X_{i,1}}_{Overall} = \underbrace{\frac{1}{N(S_\tau)}\sum_{i\in S_\tau} X_{i,\tau} - \frac{1}{N(S_\tau)}\sum_{i\in S_\tau} X_{i,1}}_{Survivor} + \underbrace{\frac{N(D^\tau)}{N(S_1)}\left(\frac{1}{N(S_\tau)}\sum_{i\in S_\tau} X_{i,1} - \frac{1}{N(D_\tau)}\sum_{i\in D_\tau} X_{i,1}\right)}_{Selection},$$

where τ is the firm's age, $X_{i,\tau}$ is the variable of interest for firm i in period τ, S_τ is the set of surviving firms at age τ, and D_τ is the set of non-surviving firms at age τ. The survival component captures changes experienced from age one until age τ for only those firms surviving until age τ. The selection component captures exit effects and presents the difference at age one between average variable values for firms surviving until age τ and average variable values for firms exiting at or before age τ.

Table 3 presents the overall change from age one until 1997 in the average value of labour productivity, leverage and log-employment size for each cohort along with a breakdown of this change into its selection and survival components. From the first panel, average labour productivity increases for most cohorts with time. The exceptions are the 1990, 1991 and 1993 cohorts. The selection component is always positive, which implies firms, within a particular cohort, surviving until 1997 are more productive at birth than cohort exitors. With the exception of the 1985 and 1988 cohorts, the survivor component is negative. Cohort survivors appear to have a fall in their labour productivity from birth.

The second panel shows that average leverage falls within each cohort except the 1991 cohort. For each cohort, the selection component shows survivors start with lower leverage at age one than exitors. The negative survivor component shows, in general, leverage falls for survivors relative to their starting leverage. The survival component provides a measure of how the financing mix for surviving cohort members changes from birth. A negative survival component indicates that for cohort survivors the portion of investments financed through debt falls with age. One method firms are able to increase their equity is through retained earnings. This result suggests the possibility that growing cohort survivors finance a disproportionate amount of their growth through retained earnings, thereby lowering leverage.

Finally, the third panel of the table 3 presents the decomposition for log-employment. Average log-employment increases with time for each cohort. Both the selection and survivor components are always positive across the cohorts. Thus, survivors are larger than exitors at age one and survivors' size increases on average from initial size.

These findings regarding each variables selection component suggest that initial conditions do associate with a firm's survival prospects, at least in the early years of life. In contrast for growth, Petrunia (2007) finds that initial leverage associates positively and initial size has a neutral relationship with the employment growth of manufacturing firms ten years after their birth. A new firm's prospects and performance appear to be dependent on a changing underlying production process. The changing process may eventually break any dependence of firm performance on initial conditions. However, given the relatively short time frame of our duration analysis (at most 12 years) and the findings from these decompositions, there is likely a significant relationship for a firm's hazard prospects with its initial employment, initial labour productivity and initial leverage.

5 Econometric Methodology and Model Specification

5.1 Econometric Methodology

Duration analysis is used to model the new firm's instantaneous probability of exit. Unlike logit models, duration models account for the upward bias induced by the right-censored spells.[4] Specifically, we use a Cox proportional hazard model:

$$\theta(t_i|x_{it}) = \phi(x_{it})\lambda(t_i), \tag{5.1}$$

where t_i is the duration of new firm i, with $i = 1, ..., N$, $\phi(x_{it}) = \exp(x_{it}'\beta)$, with x_{it}, which can be time-varying, and, $\lambda(t_i)$ is the baseline hazard for individual firm i, which has a nonparametric specification. As a result, this flexible semiparametric specification is robust to misspecification errors. The baseline hazard is allowed to be time-varying and measures the hazard of an individual firm for whom all covariates are zero at a given time t.

Incorporating time-varying regressors poses two types of problems: first, treating a time-varying variable as a fixed variable may cause misspecification; and second, a time-varying covariate may exhibit feedback, see Cameron and Trivedi (2005). Therefore, the entire history of a covariate must be incorporated. To estimate the parameters of the model a partial log-likelihood is constructed by comparing at each failure time, the risk for the failed subject to the risk for all the other subjects at risk at that time. An individual firm's contribution to the partial log-likelihood depends on the entry date and whether the firm is right-censored. Firms are analyzed by entry cohorts, yielding a cohort-specific hazard ($\theta_{i,c=cohort}$), which accounts for time of entry in the partial-likelihood. The cohort-specific

[4] A right-censored observation is defined as a firm that has a duration that passes the observed period. The upward bias in the logit model is a result of not conditioning on the right-censored spells which have longer durations but are not observed.

partial likelihood of the Cox model with time-varying covariates is:

$$L_{P,c} = \prod_{j \in \text{ Failed Subjects}} \frac{\exp(x'_{jt_j,c}\beta)}{\sum_{l \in \text{ Risk Set at } t} \exp(x'_{lt_j,c}\beta)}.$$

Where the observed failure times are denoted by t_j with $j = 1, ..., T$ and $t_{j-1} < t_j$. For the time-invariant covariates, $L_{P,c}$ compares the covariate $x_{j,c}$ of the failed subject to the covariate $x_{i,c}$ in the risk set at each failure time t. While for the time-varying covariates, $L_{P,c}$ compares the covariate $x_{jt_j,c}$ at time t_j of the failed subject to the covariate $x_{it_j,c}$ at time t_j in the risk set. We can estimate the parameters of interest, specific to each cohort, by maximizing the cohort-specific partial log-likelihood with respect to the parameters of interest ($\beta' s$). To estimate the baseline hazard, an approximate joint log-likelihood is maximized.The parametric component of the estimated hazard is robust to misspecification because of the flexibility of the nonparametric baseline hazard; therefore, the Cox proportional hazard estimator is consistent.[5]

5.2 Model Specification

The empirical specification includes both proportional and time-varying variables. Cohort analysis assesses the experiences of firms entering over different parts of the cycle. Proportional variables capture the time-invariant effects on the hazard rates for a particular entry cohort. The duration analysis investigates whether these differences across firms relate to exit/survival prospects in the future. We are able to directly control for some of these

[5]We use different testing procedures to insure that our methodology is correctly applied and that it estimates the parameters consistently. The key requirement for using a Cox proportional hazard model is to have proportional hazards. The test used for proportionality of hazards is based on Schoenfeld residuals. The test suggests that if the covariates are generating proportional hazards we will observe zero slopes when we do a generalized regression of the scaled Schoenfeld residuals on functions of time ($H_0 : \beta\,(t_j) = \beta$ for all t, which implies that a plot of $\beta\,(t_j)$ versus time has zero slope). One reason we moved away from pooled cohort analysis was that birth cohort dummy variables constantly failed tests of proportionality.

differences. Other unobservable differences are accounted for by allowing for unobserved heterogeneity to enter our hazard estimation framework. These factors will now be discussed in detail.

5.2.1 Proportional Variables

The proportional variables considered are the initial values of the entrants: leverage, labour productivity, employment size (ALU), entry rate of a cohort (entry penetration), and employment share of a cohort. These variables are time-invariant within the proportional side of the duration model. The debt-to-asset ratio provides an indication of the financial position of a firm upon entry. There are a couple of alternative reasons for the debt-to-asset ratio to have a relationship with firm survival. First, Fotopoulos and Louri (2000) suggest too much initial debt creates a future burden on a firm, which limits future activities of the firm. Second, Cooley and Quadrini (2001) note that a firm makes a debt decision by balancing off the benefit of being large against bankruptcy or default costs associated with more debt. One side of this trade-off suggests that firms with a higher debt-to-asset ratio should be less likely to survive because of an increased chance of bankruptcy. However, on the other side of this trade-off, firms with a higher debt-to-asset ratio are likely to be more productive, and thus, should have lower hazard rates.

Initial labour productivity is a measure of starting firm quality. Labour productivity should signal higher profitability so that firms of higher quality will be more likely to survive. Higher initial labour productivity also possibly suggests that the firm begins with a higher level of capital relative to labour. Initial labour productivity should associate negatively with firm hazard.

The next proportional variable is the log of a firm's initial employment as a measure size. Past studies by Dunne, Roberts, and Samuelson (1989), Wagner (1994), Fotopoulos and Louri (2000) and Audretsch, Santarelli, and Vivarelli (1999), among others, find initial firm size has a positive relationship with firm survival. A possible explanation is that a firm's size provides an indication of its financial resources. A firm must raise substantial amounts of financial capital to become large. Larger initial size should indicate a firm has deep pockets [see Telser (1966) and Zingales (1998)]. Therefore, firm hazard should be negatively associated with initial size.

The entry rate of a cohort or entry penetration rate measures the number of entrants as a portion of the total number of firms within an industry at the year of entry. Dunne, Roberts, and Samuelson (1988) note that industry entry rates are highly correlated with industry exit rates. The positive correlation between entry and exit rates across industries suggests that some industries are subject to a greater amount of firm turnover. Caves (1998) documents entry rates and entrant survival across countries and finds this fact is robust. Excess profits are normally thought to induce entry. Jovanovic (1982) suggests entry is also about a firm learning its status within an industry. Easier entry allows for more firms of all types to enter as a means of learning. A larger amount of experimental entry likely leads to a larger amount of failure.[6]

Similarly, employment share of a cohort gives the portion of ALUs belonging to a cohort as a portion of total ALUs within an industry at the year of entry. Across industries, entry cohorts having a larger initial employment share indicates that the entrants are more similar

[6]Alternatively, Ericson and Pakes (1995) show that innovation plays a role in a firm's prospects, as successful firms are the ones who are able develop new technology through "active learning" in a research and development program.

to incumbents in terms of size after controlling for entry penetration rate. Thus, we expect a negative correlation between hazard rates and initial employment share of an entry cohort within an industry.

5.2.2 Time-Varying Variables

The first time-varying variable used in the model is the growth rate of the Canada-US industry real exchange rate by industry. The hazard rates of the new firms will depend on the degree and persistence of industry real exchange rate movements. Other standard macroeconomic variables cannot be included since there is no cross-sectional variation to identify their impacts. These common time-varying effects will be captured in the baseline hazards for each cohort.

The change in the difference between the Canada-US tariffs (3-digit SIC level) is used to capture the natural variation in the tariff rates between Canada and the US because of the Free Trade Agreement. Baggs (2005) finds that trade liberalization (lowering of tariff rates) impacts firm exit. She finds a a positive relationship between Canadian firm survival and US tariff changes, and a negative relationship between Canadian firm survival and Canadian tariff changes. We include the change in the difference between Canadian and US tariffs within an industry to capture both the impact of falling US tariff rates and falling Canadian tariff rates resulting from the Free Trade Agreement. The hazard rates are expected to rise if Canadian tariff rates are falling faster than US tariff rates, with one caveat to the discussion. The analysis focuses on entrants. These firms are likely to feel the greatest impact from these tariff changes. Entrants are naturally split into two groups: those firms that entry before FTA, and those firms that enter after FTA. Post FTA entrants should have a better idea of the impact of tariff changes on their profits compared to the pre-FTA entrants. Therefore, the tariff changes are likely to have the biggest impact on firms that enter before the FTA.

5.3 Specification of the Unobserved Heterogeneity

The baseline hazard captures the effect of duration dependence. However, duration dependence may arise from two types of state dependence: the spurious (SSD) and true state dependence (TSD). The baseline hazard may not capture the true duration dependence when unobserved heterogeneity factored in the model. Therefore, an alternative explanation for duration dependence is the role of unobserved heterogeneity, which defines the spurious duration dependence (SSD).

The models that do not control for SSD (unobserved heterogeneity) assume that observations with the same values for all covariates are identical. If this is not the case, the model is misspecified. To account for the two effects, unobserved heterogeneity can be introduced multiplicatively. A gamma distribution is used to account for unobserved heterogeneity/shared-frailty. The Cox proportional hazard model is altered by adding a distribution term ν_i to the hazard ratio:

$$\theta(t_i|x_{it}, \nu_i) = \nu_i \phi(x_{it}) \lambda(t_i). \tag{5.2}$$

with $g(\nu) = \frac{\nu^{\frac{1}{\theta}-1} \exp(\frac{-\nu}{\theta})}{\Gamma(\frac{1}{\theta})\theta^{\frac{1}{\theta}}}$. These shared-frailty models allow for within-group correlation. The gamma distribution has a positive support with a mean of one and finite variance θ. The unobserved heterogeneity is specified in terms of industrial and regional groupings. The industrial groupings are:

1. Food and Beverage (SIC 10-11),
2. Rubber, Plastic, and Leather (SIC 15-17),

3. Wood, Furniture, Paper, and Printing (SIC 25-28),

4. Primary and Fabricated Metals (SIC 29-30),

5. Machine & Transport Equipment, Electrical, and Non-metal Minerals (SIC 31-35),

6. Refined Petroleum and Chemical Products (36-37),

7. Other Manufacturing (39).

While the regional groupings are:

1. West - British Columbia, Alberta, Saskatchewan, Manitoba, and Territories

2. S. Ont - Greater Toronto Area (GTA)

3. East - Ontario outside of GTA, Quebec, and Atlantic Provinces.

6 Results

The duration analysis is performed on the individual entry cohorts between 1985 and 1993. The year 1997 is the last observed year within our database. The discussion begins by looking at the benchmark model.

6.1 Benchmark Model

Referring to the benchmark hazard model, table 4 presents our results for the initial specification across entry cohorts. The coefficient on a firm's initial debt-to-asset ratio is positive and statistically significant at the one percent level of significance for all individual cohorts. A question to ask is "Why do seemingly similar firms take different levels of debt at start-up?" The positive coefficient suggests a possible role for debt. Debt usage creates obligations for a firm. The cost of debt also includes increased bankruptcy risk. Financing requirements constrain the operations, especially for young firms. Alternatively, more debt enables the firm to increase size and take advantage of scale advantages or profit opportunities. Further, entrants facing a high level of uncertainty might be more willing to finance through the use of debt. Debt financing reduces the amount of equity required to start a business, which limits an owner's potential losses from failure. Failure risk may lead some firms to choose debt to finance start-up operations.

Initial labour productivity has a negative relationship with entrants' hazard rates. The coefficient estimate is negative and statistically significant for most cohorts. The exception is the 1988 entry cohort, where the coefficient is not statistically significant. These results confirm the belief that those firms with higher initial labour productivity should perform better in the future. Initial ALUs, the measure of firm size, has a negative relationship with future firm hazard rates as the estimated coefficient on initial size is always negative and statistically significant. Scale appears to have a positive relationship with survival distinct from productivity. The qualitative relationships between hazard rates with initial labour productivity and initial size are robust across entry cohorts, as the estimated coefficients on both of these variables remain negative and statistically significant for each cohort.

The coefficient on entry rate is positive and statistically significant for most cohorts with the exception of the 1986 and 1993 cohort, which are statistically insignificant. Overall, these results indicate that more entry leads to higher exit. A possible explanation for the impact of entry rates on firm exit is that higher entry penetration results in more competition among new entrants. Some industries have fewer barriers to entry or exit. Firm turnover is likely to be more prevalent in industries with lower barriers. Dunne, Roberts, and Samuelson (1988) find intra-industry variation explains most of the high correlation between entry and exit rates. Therefore, the positive correlation between entry rates and exit may imply lower entry and exits costs.

The final proportional variable included in the duration analysis is the initial employment share of an entry cohort within an industry. The coefficient on this variable is always statistically significant across entry cohorts. However, the coefficient is positive for the 1985, 1990, and 1991 entry cohorts, while the coefficient is negative for the other entry cohorts.

On the time-varying side, the change in the difference between Canadian and US tariffs within an industry has the expected impact on the pre-FTA entry cohorts. A higher reduction on the Canadian tariff rates within an industry relative to the US increases new firms hazard rates. The estimated coefficient for the 1989 cohort is essentially zero. 1989 was the year when the FTA came into effect. A positive and statistically significant coefficient on the tariff variable for the 1990 entry cohort provides a surprising result. The coefficient has a negative value for the last three entry cohorts. These results indicate that changes resulting from the FTA not only impact pre-FTA entrants, but further tell us something about the prospects of post-FTA entrants. The impacts of real exchange rate movements are statistically insignificant across entry cohorts and maybe captured by the baseline hazard.

6.2 Nonlinearities in the Debt-to-Asset Ratio

Table 5 presents the results with a relaxed assumption by allowing initial debt-to-asset ratio to be nonlinear in the specification. Firms are placed into five quintiles based on their initial debt-to-asset ratio. Five indicator variables are derived from the quintile classes. A firm's initial debt-to-asset ratio is then interacted with these indicator variables to account for the nonlinearities on the debt-to-asset ratio within the specification.

The picture emerging is debt-to-asset ratio plays a nonlinear role in firm hazard. Coefficient values are increasing as we move from the first to the fifth quintile for all cohorts The slope coefficients for the lower quintiles suggest a negative relationship between initial debt-to-asset ratio and firm hazard rates (initial debt-to-asset ratio correlates positively with firm survival), while this relationship reverses for the upper quintiles. The ability to raise more debt is probably a good sign for these firms. These firms are young and mainly small. Their source of outside financing likely is limited to debt. Firms who are more productive want to be larger, and thus, choose to borrow more from creditors. However, bankruptcy risk provides a negative cost to firm's financing decisions. The results suggest that too much debt eventually has harmful effects on firm survival. Although not identical, the estimated coefficients on the other variables do not change qualitatively or statistically.

6.3 Model with Unobserved Heterogeneity

Table 7 presents results on the model which allows for a nonlinear specification in the debt-to-asset ratio and a heterogeneity variable accounting for correlations across firms within two-digit SIC industries from specific provinces. The log-likelihood for all cohorts is higher than the similar model without unobserved heterogeneity. In general, the patterns of the signs for the parameter estimates are the same as for the simplified version of the model (without unobserved heterogeneity).[7] For only few cases the sign of the parameter estimates changes, but those are the cases where the parameters were insignificant. The level of the parameter estimates in general decrease in absolute value, except for the labour productivity

[7] There are major differences in the baseline hazards for 1985, 1988, 1991, 1992, and 1993 cohorts, where we observe changes at initial time and also changes over time. For all cohorts, the baseline hazards for the model with heterogeneity are lower then for the model with no heterogeneity. This observation suggests that if heterogeneity is omitted from the analysis, the factors that are common for each cohort overestimate the probability of an instantaneous exit. The steeper slopes for the baseline in the model without unobserved heterogeneity suggest a stronger negative duration dependence than actually occurs. More details are available in Section 5.4 http://mypage.iu.edu/~kphuynh/rsch/cohlong.html.

and employment variables, where the levels of the variables are increasing in absolute value. At the level of significance, entry rate is the variable most affected by the inclusion of unobserved heterogeneity is the entry rate. Entry rate loses its significance for almost all cohorts except the 1991 cohort. Therefore, adding unobserved heterogeneity appears to strengthen the effect of labour productivity and employment.

6.4 Model Likelihood Decompositions

To assess the role of firm-specific, industry-specific, time-varying variables, and unobserved heterogeneity an analysis of a decomposition of the partial log-likelihood is completed. For each cohort and specification the contribution of observables versus unobservables to the partial log-likelihood is presented. Figure 8 presents the decomposition of the benchmark model (without unobserved heterogeneity). The salient features of the decompositions are that firm level variables are contributing approximately 80 percent to the partial log-likelihood, while time-varying variables and industry specific variables account for about the other 20 percent. Specifically, for two cohorts — 1988 and 1992, the time-varying effect is stronger. These two years may overlap with the impending implementation of FTA (1988) and the trough of the Canadian recession (1992). The partial log likelihood is further decomposed, see Figure 9, to evaluate the contribution of each firm-specific variable. The effect of leverage and its nonlinearities is large for earlier cohorts but decreases until 1988 and then rises again for the later cohorts. A finding is that employment size gains in importance for later cohorts (post-1987). For the 1988 cohort the leverage effect and labour productivity are the lowest, while employment size is high.

Next, the decomposition is completed for the model that accounts for unobserved heterogeneity, see Figure 10. The addition of unobserved heterogeneity accounts for roughly 30 to 60 percent of the partial log likelihood depending on the entry cohort. While time-varying and industry specific variables account for about 5 to 20 percent, the impact of observable firm-specific effects is reduced to about 20-70 percent. Within the firm-specific effects the relative proportion of leverage, nonlinearities, labour productivity, and employment size is the same as in the no heterogeneity case. A feature of the decomposition reveals an evolution between unobservables and the firm-specific effects. The role of heterogeneity is muted with later entry cohorts. Higher unobserved heterogeneity for the earlier cohorts implies higher spurious duration dependence and therefore, it is harder to identify the true duration dependence and to make statements about future survival of these firms. Also, the increase in the spurious duration reduces the effect of macro variables in the model.

There are two events, we speculate, that are correlated with these results. The introduction of the FTA combined with the business cycle downturn in Canada between 1990 to 1995 decreased the amount of heterogeneity in the later cohorts. Trade liberalization caused a shakeout of firms and only the most fittest and/or fattest firms survived. Baggs (2005) finds similar results. For the post-FTA cohorts the effect of employment size, labour productivity, and leverage (and nonlinearities) increases. However, for the entry cohorts subsequent to the recession in 1990 the effect of labour productivity and leverage increases whilst employment size decrease.

6.5 Parametric Identification

A concern over the results of the duration models is that it relies on parametric unobserved heterogeneity. If the form of the unobserved heterogeneity is incorrectly specified it may lead to inconsistent estimates. To check the robustness of these results the following procedures are undertaken: 1) check the correlations of the estimated unobserved heterogeneity with the firm-level observables and 2) conduct tests of exogeneity.

6.5.1 Correlations

Table 8 and 9 display the correlations of the estimated unobserved heterogeneity distribution with respect to the firm observables. The unobserved heterogeneity specification undertaken in our model may result in potential correlation with variables at the industry level. However, the model was designed to control for industry level variation (the model controls for entry penetration ratio). The results for both models (with linear debt-to-asset ratio and nonlinear debt-to-asset ratio) show that year 1985 has the highest correlation of entry penetration and the estimated unobserved heterogeneity. Less correlations are observed for years 1990, 1991 and 1988. The model with nonlinear debt-to-asset ratio generates lower correlations of the estimated unobserved heterogeneity with entry penetration ratio, therefore should show better results when the next exogeneity test is considered. For the other variables considered in the model the correlations are very low and mostly insignificant.

6.5.2 Split Sample Test

There is no formal test of endogeneity for nonlinear duration models. Instead an empirical test based on a transformed linear model is used to conduct the tests. The Cox proportional hazard model used in the previous section can be expressed as a linear model or an Accelerated Failure Time (AFT) model if a proper time scale $T^* = -\ln(S_0(T))$ is considered (see van Houwelinge (2000)). In the above transformation, the equivalent time scale $-\ln(S_0(T))$ defines the integrated baseline hazard. The equivalent AFT model can be used for estimation if the T^* is available. However, the time scale (T^*) needs to be estimated and, in this case, we cannot use the exact equivalent AFT model to do our test. Therefore, we relay on an AFT model that uses the observed duration. There are some differences (Cox's model relates the hazard function to covariates, the AFT model postulates a direct relationship between the time to event and covariates) and similarities between the Cox and the AFT models, but for the testing purpose we relay on the similarities of the two models. Solomon (2000), showed that regression parameters for the Cox proportional hazard model and the accelerated failure time models are often approximately proportional, so that qualitative inferences should be robust to misspecification errors especially when moderate censoring is present in the data. Both the Cox model and semiparametric versions of the AFT model are models that leave the baseline hazard (or, equivalently, the baseline survival distribution) unspecified. An extension of the AFT model to incorporate correlated survival data can be done by including random effects in the regression expression as in a classical linear mixed model. The proposed test uses the later specification of the AFT model. A reduced form AFT model is defined as:

$$\log(t \exp(-x'\beta)) = u, \tag{6.1}$$

where t is the observed duration, $\exp(-x'\beta)$ is constant by assumption, and u is the error term. Note that the AFT model has the reverse sign of the parameter estimates than Cox model. Under this specification each coefficient summarizes the proportional effect of absolute changes of the covariate on the survivor function, and $\exp(\beta)$ is defining the time ratio. Taking the logs of the above model, the following linear transformation is obtained:

$$\log(t) = -x'\beta + \log(u). \tag{6.2}$$

Finally, the test for parameter bias will be performed using this linear AFT specification. The test is based on a split sample methodology proposed by Dufour and Jasiak (2001). The intuition of the test relays on using the parameter estimates from a randomly split sample to test the potential bias of the parameters from the other subsample. A transformed outcome variable based on the information from the first subsample is used to do the estimation on the second sample. Define the parameter of interest (β_1) and the nuisance parameter (β_2).Denote $\hat{\beta}_1^1$ as the estimated parameter from the first subsample. The parameter of interest is set by the null hypothesis H_0, but the nuisance parameter remains unknown. In this case, the null hypothesis of interest is $H_0 : \beta_1 = \hat{\beta}_1^1$ or that the coefficients are the same across the split samples. To test the parameters of interest under H_0 using the second sample, the estimates from the first sample are considered as being the true parameters. The following steps are proposed to test for the potential parameter bias:

1. Estimate $\hat{\beta}_1^1$ of the AFT model (6.2) using the first subsample (x_1).

2. Transform the outcome variable $\log(t_2)$ from the second subsample as following:

$$\log(t*) = \log(t_2) - x_2'\hat{\beta}_1^1, \tag{6.3}$$

   where x_2 is data from the second subsample.

3. Estimate the model $\log(t*) = -x_2'\beta_1^2 + \log(u)$ using the second subsample.

4. Under the null hypothesis of no bias in the parameters of interest:

$$H_0 : \beta_1^2 = 0.$$

The asymptotic distribution of the test is $\chi^2(m)$, where m is the tested parameter space.

The results of the split sample tests are at the bottom of Table 8 and 9. They show that the model with nonlinear financial variables poses less bias than the model with linear financial variable. Also, as the results for correlation suggest, there are cohorts that show more bias in the parameter estimates than others. The model with linear financial show bias in the coefficients for years 1985, 1988, 1989 and 1990, however with less bias in years 1989 and 1990. The model with nonlinear financial variables show bias for years 1988, 1985 and some bias for year 1989. We observed that the years that exhibit the highest correlation with the entry penetration rate are also the years that present bias in parameters. However, the underlying story for all cohorts still holds.

7 Conclusions

This paper examines the duration of new entrants firms in Canadian manufacturing belonging to cohorts between 1985 and 1993. These new firms are tracked until 1997 to assess their performance. Duration models are used to quantify the effects of firm-specific, industry-specific, and aggregate factors on the duration of new firms. Initial firm size, initial firm productivity, and initial firm debt-to-asset ratio matter to the future exit prospects of new firms. Hazard rates have an decreasing relationship with a firm's initial size and initial productivity. Labour productivity offers a measure of firm quality; better firms have lower hazard rates. Size measures the resources available to the firm; more resources lead to longer durations. The effect of leverage is nonlinear. Firms in the first-to-fourth quintiles of leverage face lower hazard rates with respect to an increase in leverage while those in the fifth quintile have hazards rates increasing with a firm's leverage ratio. Debt-to-asset ratio measures the financial obligations of a firm; too many obligations appear to hurt the performance of only the most leveraged firms.

Allowing for heterogeneity improves the fit of the model and proxies for firm unobservables that are associated to different provinces and industries. The unobserved heterogeneity impacts both the baseline hazard and coefficients estimates by decreasing the baseline hazards and strengthening the effects of labour productivity and employment. The effect of firm unobservables are muted for the post-1988 cohorts which coincides with trade liberalization. These results suggest a potential latent factor, which is correlated with entry and firm size class, affects the duration of new firms by altering the behaviour of new entrants, especially in terms of productivity and financial outcomes.

Theoretical models of industry dynamics, such as Jovanovic (1982) and Cooley and Quadrini (2001), have used these sources of heterogeneity to describe patterns of industrial entry or exit, and firm survival or growth. Future work should consist of modeling these differences across firms by looking at the entry/exit decision in the context of an industry equilibrium model. Further, interactions occur between policy changes, aggregate fluctuations and the performance of individual firms. Future work should also try to examine the effects of policy changes and business cycle movements on firm performance.

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Table 1: Number of Entrant Firms - Industries in Manufacturing (2-digit SIC)

	SIC	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Food	10	173	144	131	133	118	115	134	114	123	146	227	206
Beverage	11	9	12	15	12	12	9	26	27	23	15	39	37
Rubber	15	15	13	10	10	7	8	14	13	14	17	17	31
Plastic	16	87	92	84	76	81	71	59	77	75	68	98	100
Leather	17	25	16	22	15	12	13	15	13	14	21	43	43
Primary Textile	18	10	10	7	8	7	11	6	9	9	7	11	16
Textile Products	19	72	58	66	75	63	51	41	52	38	63	47	59
Clothing	24	204	193	200	156	159	138	146	156	158	175	228	192
Wood	25	250	237	236	199	188	174	169	174	208	180	186	184
Furniture	26	148	161	118	143	116	121	94	105	101	103	129	107
Paper	27	16	29	22	31	31	27	22	22	28	39	53	46
Printing	28	413	391	357	323	347	376	322	294	274	297	367	355
Primary Metal	29	17	32	30	29	28	30	25	18	32	29	20	32
Fabricated Metals	30	388	393	398	388	371	318	278	247	319	306	413	372
Machine	31	141	155	125	128	132	130	117	115	135	147	173	144
Transportaion Equip.	32	105	113	88	87	87	88	66	73	88	82	89	91
Electrical	33	119	147	106	117	102	122	128	107	95	110	116	98
Non-Metals Mineral	35	73	74	72	77	97	74	67	62	56	51	85	77
Refined Petroleum	36	4	2	5	5	4	5	8	4	4	7	23	17
Chemical	37	61	60	64	63	48	72	62	73	72	66	79	76
Other	39	248	252	233	230	256	205	247	230	230	280	297	280
	Total	2578	2584	2389	2305	2266	2158	2046	1985	2096	2209	2740	2563

Note: Table gives the number of firms entering within a given entry cohort (column) and industry (row).

Table 2: FHK Decompositions

Labour Productivty

Cohort	Total	Within	Between	Cross	Exit
85	0.368	0.180	0.239	-0.081	-0.030
86	0.446	0.146	-0.056	0.301	-0.055
87	0.460	0.144	0.202	0.094	-0.020
88	0.262	0.136	0.138	-0.044	-0.033
89	0.214	0.151	-0.094	0.126	-0.031
90	0.297	0.217	0.380	-0.320	-0.020
91	0.148	0.068	0.129	-0.070	-0.020
92	0.198	0.141	0.118	-0.058	0.004
93	-0.159	-0.201	0.047	-0.023	-0.019

Leverage

Cohort	Total	Within	Between	Cross	Exit
85	-0.160	-0.056	0.041	-0.110	0.036
86	-0.241	-0.065	-0.047	-0.069	0.060
87	-0.215	-0.030	-0.065	-0.075	0.045
88	-0.411	-0.052	-0.098	-0.076	0.185
89	-0.199	-0.068	-0.021	-0.079	0.031
90	-0.159	0.011	-0.017	-0.107	0.045
91	-0.136	0.265	0.050	-0.403	0.048
92	-0.183	-0.061	-0.020	-0.057	0.045
93	-0.146	-0.122	-0.011	-0.031	-0.018

Log of Employment Size

Cohort	Total	Within	Between	Cross	Exit
85	0.774	0.126	-0.580	1.081	-0.146
86	0.615	0.134	-0.645	1.130	0.004
87	0.939	0.178	-0.415	1.257	0.081
88	0.449	0.142	-0.545	0.843	-0.010
89	0.636	0.149	-0.625	0.905	-0.206
90	0.562	0.144	-0.689	1.044	-0.064
91	0.522	0.155	-0.553	0.734	-0.186
92	0.472	0.212	-0.334	0.624	0.030
93	0.127	0.129	-0.487	0.409	-0.076

Note: Total represents the change from age one until the year 1997 in the weighted average of a particular variable for a cohort. The others columns provide the share attributable to each component. A positive share means the component has the same sign as the total change.

Table 3: Survivor/Selection Decompositions

Labour Productivty

Cohort	Total	Survival	Selection
85	0.094	0.045	0.049
86	0.034	-0.020	0.054
87	0.060	-0.037	0.097
88	0.031	0.009	0.023
89	0.031	-0.013	0.044
90	-0.033	-0.082	0.049
91	-0.025	-0.077	0.052
92	0.005	-0.046	0.051
93	-0.120	-0.156	0.036

Leverage

Cohort	Total	Survival	Selection
85	-0.190	-0.089	-0.101
86	-0.219	-0.109	-0.110
87	-0.165	-0.057	-0.108
88	-0.250	-0.105	-0.145
89	-0.181	-0.099	-0.082
90	-0.199	-0.086	-0.113
91	0.007	0.096	-0.088
92	-0.128	-0.026	-0.103
93	-0.102	-0.047	-0.055

Log of Employment Size

Cohort	Total	Survival	Selection
85	0.738	0.648	0.090
86	0.771	0.667	0.103
87	0.672	0.639	0.032
88	0.651	0.552	0.098
89	0.738	0.600	0.137
90	0.780	0.638	0.142
91	0.698	0.582	0.116
92	0.613	0.507	0.106
93	0.602	0.483	0.119

Note: Total represents the change from age one until the year 1997 in the average value of a given variable for each cohort. The survival column provides the survival component, while the selection column provides the selection component.

Table 4: Duration of Firms

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Leverage_{i0}	.09588	.08636	.07895	.01597	.11433	.01866	.09799	.14506	.14722
	(.01036)***	(.00851)***	(.01283)***	(.00431)***	(.0163)***	(.00655)***	(.01258)***	(.01858)***	(.03078)***
Productivity_{i0}	-.03832	-.10533	-.11172	-.01882	-.09837	-.16511	-.17762	-.13074	-.14573
	(.01537)**	(.01598)***	(.01712)***	(.02112)	(.02092)***	(.02258)***	(.02325)***	(.02743)***	(.03271)***
ALU_{i0}	-.03598	-.07875	-.02205	-.09367	-.13265	-.18593	-.16417	-.11818	-.13449
	(.01038)***	(.01142)***	(.01237)*	(.01401)***	(.01523)***	(.01731)***	(.01891)***	(.0209)***	(.02391)***
Entry rate_{j0}	.79778	.00613	.57137	.35772	.58262	.36598	.68102	.36781	-.16809
	(.10807)***	(.08453)	(.12121)***	(.13059)***	(.14911)***	(.12206)***	(.10122)***	(.12104)***	(.18828)
ALU Share_{j0}	.05221	-.1138	-.04902	-.06998	-.0806	.15546	.17138	-.22284	-.18976
	(.02397)**	(.03481)***	(.03428)	(.03213)**	(.04019)**	(.04784)***	(.06031)***	(.05475)***	(.07872)**
Δ(CDN-US Tariff)	-.02395	-.03607	-.03066	-.08822	.00456	.04292	-.06952	-.16808	-.0261
	(.00776)***	(.00897)***	(.01055)***	(.01295)***	(.01654)	(.02114)**	(.02729)**	(.03794)***	(.05702)
ΔRER	.07309	-.02554	.03614	-.1827	-.08002	.04248	-.35356	.08958	-.19004
	(.10478)	(.11585)	(.1308)	(.16722)	(.18661)	(.20112)	(.25903)	(.3574)	(.45508)
Observations	21183	19786	16844	15358	13669	11606	10019	7994	7144
Number of Firms	2578	2584	2389	2305	2266	2158	2046	1985	2096
LogLikelihood	-48632.55	-41904.94	-34702.59	-27901.39	-24106.33	-19253.83	-14631.93	-11422.17	-8442.785

Note: Standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5: Duration of Firms (Leverage Quintiles)

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Leverage_{i0} Q1	-.90227	-.87725	-.7114	-.6594	-.80016	-.88877	-1.20645	-.37799	-1.21389
	(.09529)***	(.10325)***	(.11862)***	(.11864)***	(.14967)***	(.14167)***	(.18706)***	(.20772)*	(.27562)***
Leverage_{i0} Q2	-.57848	-.48805	-.43128	-.15541	-.24743	-.56125	-.63282	-.29417	-.72564
	(.06105)***	(.06425)***	(.07512)***	(.07199)**	(.08766)***	(.09062)***	(.10984)***	(.12527)**	(.16054)***
Leverage_{i0} Q3	-.23582	-.09882	-.11192	-.02518	-.23343	-.45621	-.43485	-.09562	-.75991
	(.05003)***	(.05263)*	(.05974)*	(.05757)	(.07131)***	(.07133)***	(.08577)***	(.09783)	(.13415)***
Leverage_{i0} Q4	-.10851	.08761	-.02287	-.03386	.00958	-.18378	-.12583	.11337	-.09983
	(.04385)**	(.04603)*	(.05318)	(.05077)	(.05926)	(.05352)***	(.06539)*	(.07896)	(.10221)
Leverage_{i0} Q5	.04891	.05488	.03655	.01314	.0653	.00789	.05697	.11934	.03207
	(.0142)***	(.01293)***	(.01712)**	(.00502)***	(.02099)***	(.00882)	(.01913)***	(.02216)***	(.04442)
Productivity_{i0}	-.01684	-.07871	-.08687	-.00566	-.08053	-.13519	-.13691	-.10791	-.10294
	(.01554)	(.01649)***	(.01757)***	(.02152)	(.02131)***	(.02302)***	(.02431)***	(.02819)***	(.03389)***
ALU_{i0}	-.01366	-.05201	-.00753	-.08703	-.11814	-.15664	-.11959	-.09952	-.09055
	(.01052)	(.01153)***	(.0126)	(.01431)***	(.01555)***	(.01768)***	(.01954)***	(.02148)***	(.02448)***
Entry rate_{j0}	.74785	.0292	.58746	.40237	.58569	.35517	.66571	.34767	-.16632
	(.10775)***	(.084)	(.1207)***	(.13096)***	(.1491)***	(.12189)***	(.10165)***	(.12047)***	(.18696)
ALU Share_{j0}	.0552	-.09275	-.0375	-.0658	-.07144	.16872	.17116	-.22358	-.14892
	(.02395)**	(.03475)***	(.03437)	(.0322)**	(.04018)*	(.04839)***	(.06011)***	(.05466)***	(.07912)*
Δ(CDN-US Tariff)	-.0269	-.03617	-.02976	-.08697	.00315	.04311	-.06535	-.1661	-.01097
	(.00774)***	(.00891)***	(.01053)***	(.01296)***	(.01656)	(.02113)**	(.02726)**	(.03802)***	(.05718)
ΔRER	.0776	-.04294	.0388	-.17547	-.06721	.07835	-.32533	.09044	-.13639
	(.1049)	(.11537)	(.13071)	(.16739)	(.18573)	(.19942)	(.25682)	(.35611)	(.45278)
Observations	21183	19786	16844	15358	13669	11606	10019	7994	7144
Number of Firms	2578	2584	2389	2305	2266	2158	2046	1985	2096
LogLikelihood	-48547.21	-41807.78	-34661.65	-27879.61	-24078.72	-19215.92	-14590.73	-11411.96	-8407.304

Note: Standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% levels, respectively.

Table 6: Duration of Firms with SIC and Provincial Heterogeneity

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Leverage$_{i0}$	.14996	.08044	.06606	.01363	.10666	.02399	.13159	.13970	.11422
	(.01539)***	(.00939)***	(.01438)***	(.00448)***	(.01830)***	(.00971)**	(.02267)***	(.02019)***	(.03397)***
Productivity$_{i0}$	-.04189	-.11148	-.11507	-.01892	-.10366	-.15885	-.17693	-.13322	-.13360
	(.01582)***	(.01684)***	(.01832)***	(.02216)	(.02182)***	(.02415)***	(.02459)***	(.02818)***	(.03440)***
ALU$_{i0}$	-.05007	-.07602	-.02985	-.10460	-.14106	-.19030	-.17069	-.12417	-.14610
	(.01103)***	(.01203)***	(.01311)**	(.01485)***	(.01599)***	(.01804)***	(.01951)***	(.02180)***	(.02503)***
Entry rate$_{j0}$	.05793	-.06965	.40246	.10155	.51118	-.00125	.43377	.19607	-.36462
	(.37696)	(.24811)	(.28316)	(.38797)	(.34577)	(.33461)	(.24057)*	(.20898)	(.33090)
ALU Share$_{j0}$	.00776	-.11798	.01254	-.10287	-.07565	.25295	.18685	-.27233	-.22187
	(.07587)	(.08173)	(.08503)	(.07319)	(.08707)	(.09879)**	(.11255)*	(.08425)***	(.12699)*
Δ(CDN-US Tariff)	-.02256	-.01696	-.02462	-.05840	.02354	.04874	-.02966	-.10063	-.02613
	(.00875)***	(.00995)*	(.01309)*	(.01687)***	(.02126)	(.02619)*	(.03622)	(.04759)**	(.07571)
ΔRER	.07255	-.00775	.06391	-.23648	-.04420	.13828	-.32396	.08366	-.09728
	(.10228)	(.11604)	(.13209)	(.17059)	(.18702)	(.19956)	(.24890)	(.34854)	(.44187)
Observations	21183	19786	16844	15358	13669	11606	10019	7994	7144
Number of Firms	2578	2584	2389	2305	2266	2158	2046	1985	2096
LogLikelihood	-48371.66	-41773.51	-34597.18	-27797.32	-24024.1	-19171.48	-14578.67	-11398.31	-8410.164
θ (variance of gamma)	.36482	.24064	.19917	.35657	.2465	.2974	.32276	.13454	.26259
Standard error	.06096	.04899	.04357	.07549	.05579	.06844	.08083	.04216	.07324

Note: Standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% levels, respectively.

Table 7: Duration of Firms (Leverage Quintiles) with SIC and Provincial Heterogeneity

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Leverage$_{i0}$ Q1	-.60920	-.81715	-.66883	-.63984	-.74419	-.80372	-1.14258	-.27490	-1.20284
	(.10266)***	(.10627)***	(.12350)***	(.12317)***	(.15610)***	(.14676)***	(.19593)***	(.21460)	(.28302)***
Leverage$_{i0}$ Q2	-.41655	-.45608	-.40540	-.11331	-.22894	-.51363	-.61728	-.23189	-.69035
	(.06633)***	(.06638)***	(.07862)***	(.07417)	(.09210)**	(.09437)***	(.11542)***	(.12918)*	(.16577)***
Leverage$_{i0}$ Q3	-.12056	-.07963	-.10659	.01648	-.24190	-.40752	-.42653	-.07892	-.76359
	(.05429)**	(.05398)	(.06238)*	(.06023)	(.07445)***	(.07393)***	(.09066)***	(.10047)	(.13739)***
Leverage$_{i0}$ Q4	-.00610	.08810	-.07024	.00073	-.00573	-.17920	-.12501	.10973	-.13057
	(.04747)	(.04756)*	(.05562)	(.05220)	(.06196)	(.05550)***	(.06943)*	(.08080)	(.10508)
Leverage$_{i0}$ Q5	.09450	.05259	.02448	.01099	.05690	.01055	.06314	.11692	.00516
	(.01806)***	(.01316)***	(.01825)	(.00515)**	(.02260)**	(.01016)	(.02316)***	(.02357)***	(.04633)
Productivity$_{i0}$	-.02045	-.08320	-.09271	-.00946	-.08404	-.13111	-.14078	-.11216	-.09039
	(.01607)	(.01742)***	(.01868)***	(.02267)	(.02237)***	(.02451)***	(.02546)***	(.02901)***	(.03560)**
ALU$_{i0}$	-.03034	-.05096	-.01573	-.09911	-.12423	-.16142	-.12751	-.10695	-.10399
	(.01123)***	(.01220)***	(.01345)	(.01521)***	(.01635)***	(.01847)***	(.02024)***	(.02237)***	(.02563)***
Entry rate$_{j0}$	.05504	-.02103	.37974	.14702	.50906	.07732	.42159	.18459	-.35837
	(.36536)	(.23417)	(.27890)	(.39040)	(.34292)	(.32322)	(.22611)*	(.20391)	(.32150)
ALU Share$_{j0}$	.00800	-.12483	.01618	-.11195	-.06460	.24891	.17243	-.26428	-.20044
	(.07364)	(.07776)	(.08359)	(.07375)	(.08626)	(.09649)***	(.10847)	(.08225)***	(.12543)
Δ(CDN-US Tariff)	-.02332	-.01758	-.02598	-.05861	.02630	.05110	-.03002	-.10164	-.01681
	(.00873)***	(.00991)*	(.01306)**	(.01691)***	(.02123)	(.02610)*	(.03594)	(.04734)**	(.07546)
ΔRER	.07896	-.01827	.06839	-.23573	-.04740	.16251	-.31932	.09036	-.07575
	(.10240)	(.11582)	(.13217)	(.17094)	(.18671)	(.19882)	(.24831)	(.34812)	(.44193)
Observations	21183	19786	16844	15358	13669	11606	10019	7994	7144
Number of Firms	2578	2584	2389	2305	2266	2158	2046	1985	2096
LogLikelihood	-48324.01	-41694.77	-34568.12	-27775.41	-24002.51	-19143.47	-14544.29	-11391.66	-8380.213
θ (variance of gamma)	.3352	.20193	.18971	.36522	.24114	.27064	.2724	.1219	.23736
standard error	.0583	.0434	.04263	.07707	.0548	.06395	.07023	.04035	.06974

Note: Standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% levels, respectively.

Table 8: Correlation of Unobserved Heterogeneity with Observables

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Leverage$_{i0}$	-.010	.013	.025	.003	.023	-.003	-.015	.026	.050
	(.010)	(.007)*	(.007)***	(.002)	(.009)**	(.004)	(.008)*	(.007)***	(.012)***
Labour Productivity$_{i0}$	-.001	.003	-.001	-.006	.000	-.010	.002	.005	-.014
	(.009)	(.007)	(.007)	(.008)	(.007)	(.009)	(.008)	(.006)	(.009)
Employment Size$_{i0}$	.014	-.005	.007	.004	.008	-.002	.008	.006	.008
	(.006)**	(.005)	(.004)*	(.006)	(.005)	(.006)	(.006)	(.004)	(.006)
Entry Rate$_{j0}$	.755	.107	.158	.291	.118	.447	.288	.180	.193
	(.061)***	(.035)***	(.045)***	(.054)***	(.053)**	(.047)***	(.037)***	(.026)***	(.048)***
Market Share Size$_{j0}$	.039	.005	-.072	.071	.009	-.043	.023	.078	.034
	(.013)***	(.014)	(.013)***	(.014)***	(.015)	(.017)**	(.019)	(.012)***	(.020)*
Δ(US-Can Tariff)	.000	-.001	.000	.000	-.002	-.002	-.001	.001	.000
	(.001)	(.001)	(.001)	(.002)	(.001)**	(.001)**	(.002)	(.001)	(.007)
Δ RER	-.002	-.005	.005	.011	.007	-.003	.013	-.001	-.006
	(.006)	(.006)	(.005)	(.009)	(.007)	(.009)	(.008)	(.004)	(.013)
Constant	1.831	.222	.002	1.019	.213	.941	.814	.731	.599
	(.130)***	(.098)**	(.112)	(.142)***	(.134)	(.149)***	(.139)***	(.079)***	(.165)***
Observations	21183	19786	16844	15358	13669	11606	10019	7994	7144
Number of Firms	2578	2584	2389	2305	2266	2158	2046	1985	2096
Split Sample Tests									
χ^2 p-value	0.002	0.243	0.229	0.000	0.077	0.071	0.861	0.241	0.477

Note: Standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% levels, respectively.

Table 9: Correlation of Unobserved Heterogeneity with Observables (Nonlinearities)

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Leverage$_{i0}$ Q1	-.265	-.047	-.042	-.027	-.028	-.087	-.052	-.100	.020
	(.055)***	(.041)	(.044)	(.047)	(.054)	(.050)*	(.058)	(.044)**	(.068)
Leverage$_{i0}$ Q2	-.147	-.026	-.022	-.049	-.012	-.056	-.024	-.047	-.032
	.036	.026	.028	.031	.034	.032	.036	.027	.042
Leverage$_{i0}$ Q3	-.109	-.010	-.002	-.046	.021	-.057	-.023	.004	.008
	.030	.022	.023	.025	.028	.025	.029	.022	.034
Leverage$_{i0}$ Q4	-.101	.000	.042	-.033	.024	-.002	.007	.014	.044
	.027	.020	.021	.022	.024	.021	.024	.018	.029
Leverage$_{i0}$ Q5	-.031	.003	.015	.003	.013	-.002	-.001	.012	.030
	.011	.007	.008	.002	.010	.004	.008	.008	.014
Labour Productivity$_{i0}$	-.002	.000	.001	-.002	-.003	-.005	.005	.006	-.013
	(.008)	(.007)	(.006)	(.009)	(.007)	(.009)	(.008)	(.006)	(.008)
Employment Size$_{i0}$	.015	-.005	.008	.005	.005	.000	.009	.007	.010
	(.005)***	(.004)	(.004)**	(.006)	(.005)	(.006)	(.006)	(.004)*	(.006)*
Entry Rate$_{j0}$	.728	.078	.196	.289	.136	.364	.287	.179	.190
	(.057)***	(.033)**	(.043)***	(.055)***	(.052)***	(.044)***	(.035)***	(.025)***	(.045)***
Market Share Size$_{j0}$	.038	.031	-.064	.084	.004	-.032	.032	.068	.050
	(.012)***	(.014)***	(.012)***	(.014)***	(.014)***	(.016)***	(.018)***	(.011)***	(.019)***
Δ(US-Can Tariff)	.000	-.001	.000	.000	-.003	-.002	-.001	.001	.000
	(.001)***	(.001)***	(.001)***	(.002)***	(.001)***	(.001)***	(.001)***	(.001)***	(.006)***
Δ RER	-.004	-.005	.003	.011	.007	-.001	.012	-.001	-.004
	(.005)***	(.005)***	(.005)***	(.009)***	(.007)***	(.008)***	(.007)***	(.004)***	(.012)***
constant	1.883	.317	.156	1.086	.283	.778	.841	.717	.701
	(.123)***	(.093)***	(.109)***	(.143)***	(.132)***	(.141)***	(.129)***	(.074)***	(.157)***
Observations	21183	19786	16844	15358	13669	11606	10019	7994	7144
Number of Firms	2578	2584	2389	2305	2266	2158	2046	1985	2096
Split Sample Tests									
χ^2 p-value	0.137	0.384	0.917	0.000	0.054	0.247	0.835	0.170	0.838

Note: Standard errors are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5% and 1% levels, respectively.

Figure 1: Canada-US Tariff Rates

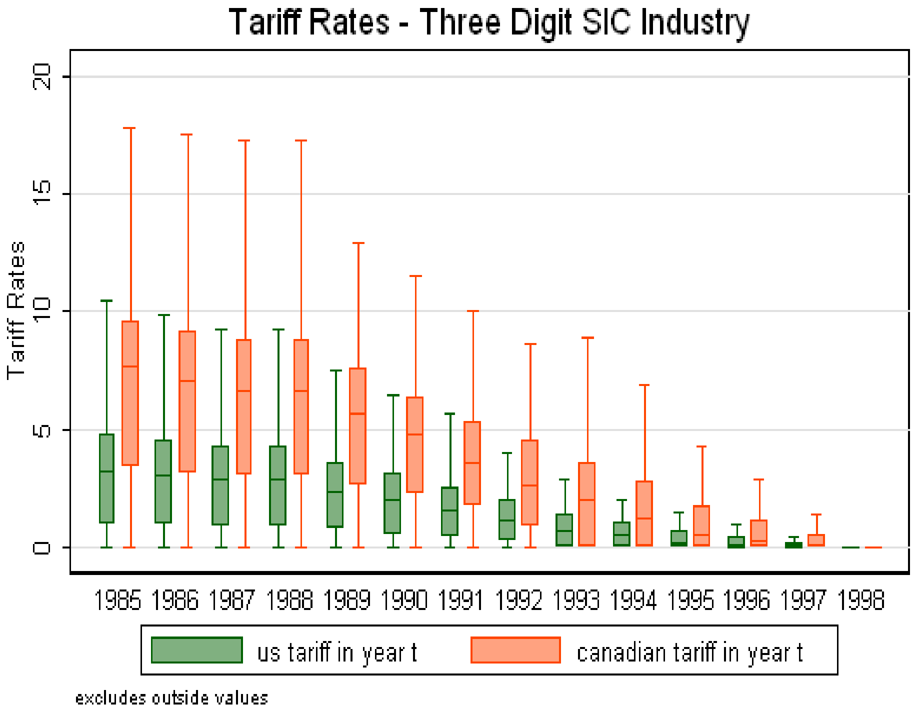

Figure 2: Growth Rate of Canada-US Industrial Real Exchange Rates

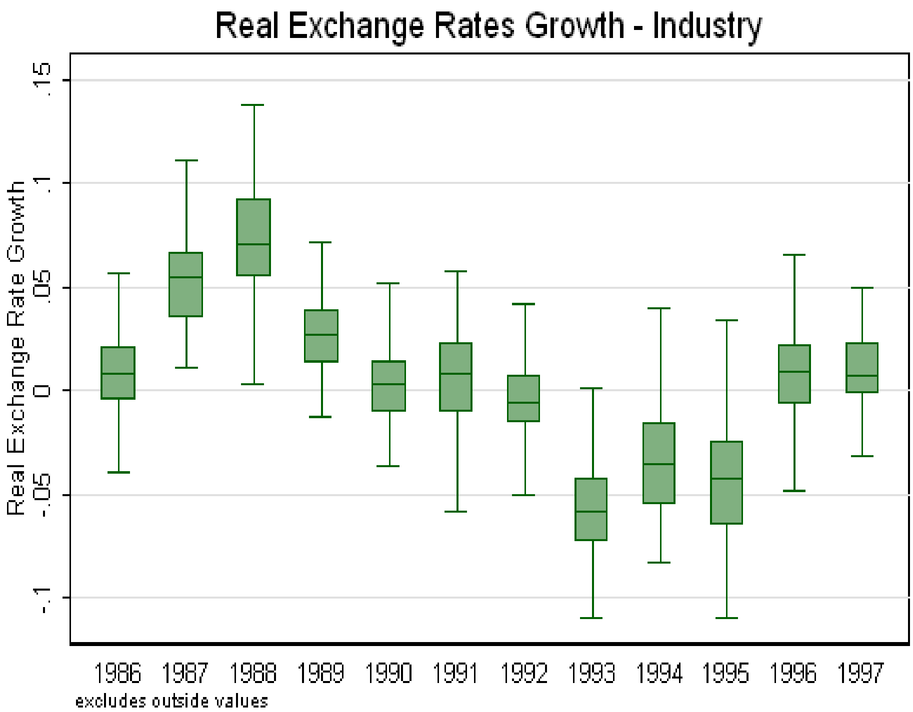

Figure 3: Empirical Hazards of Entry Cohorts

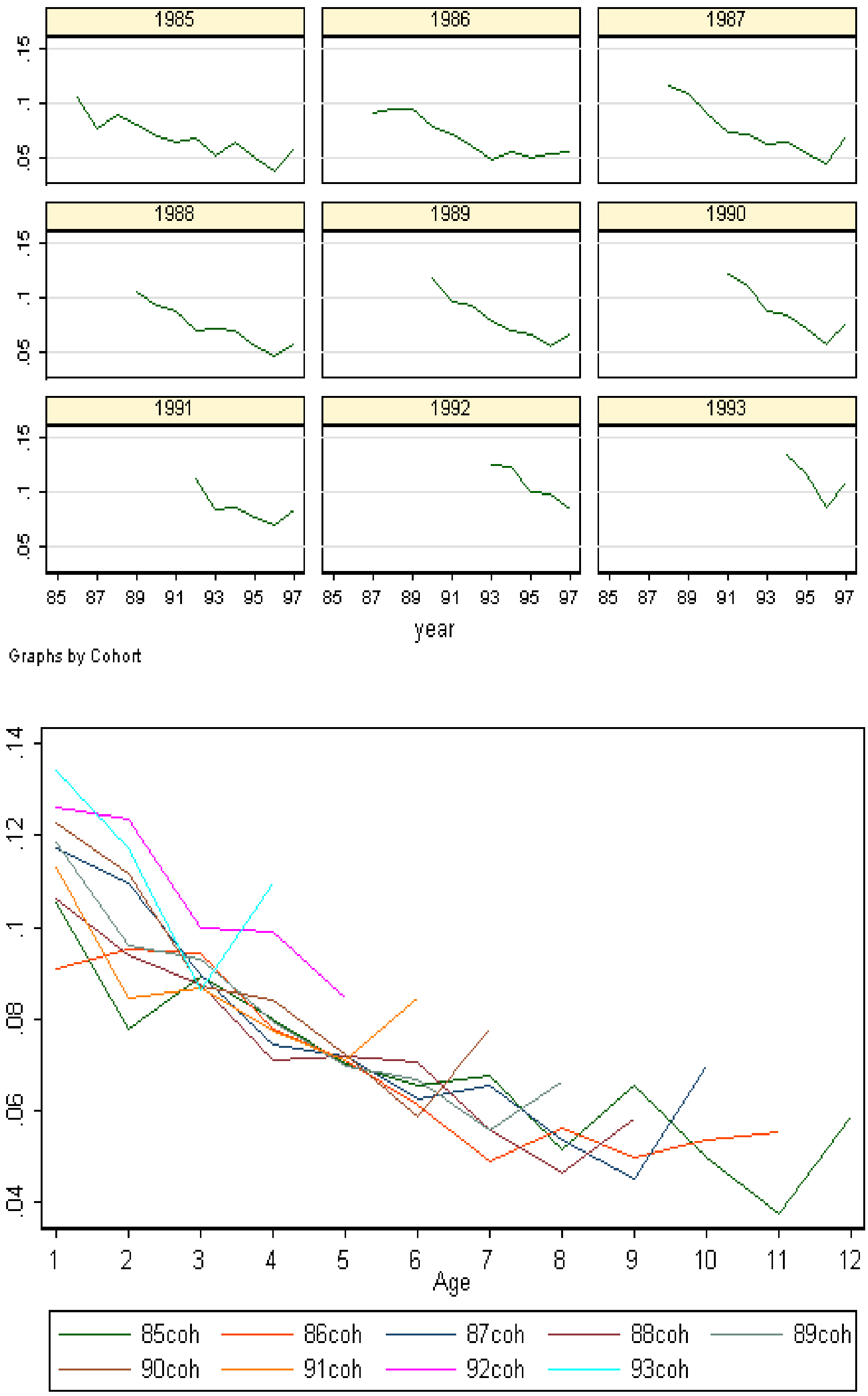

Figure 4: Entry by Cohort

Figure 5: Employment Size by Cohort

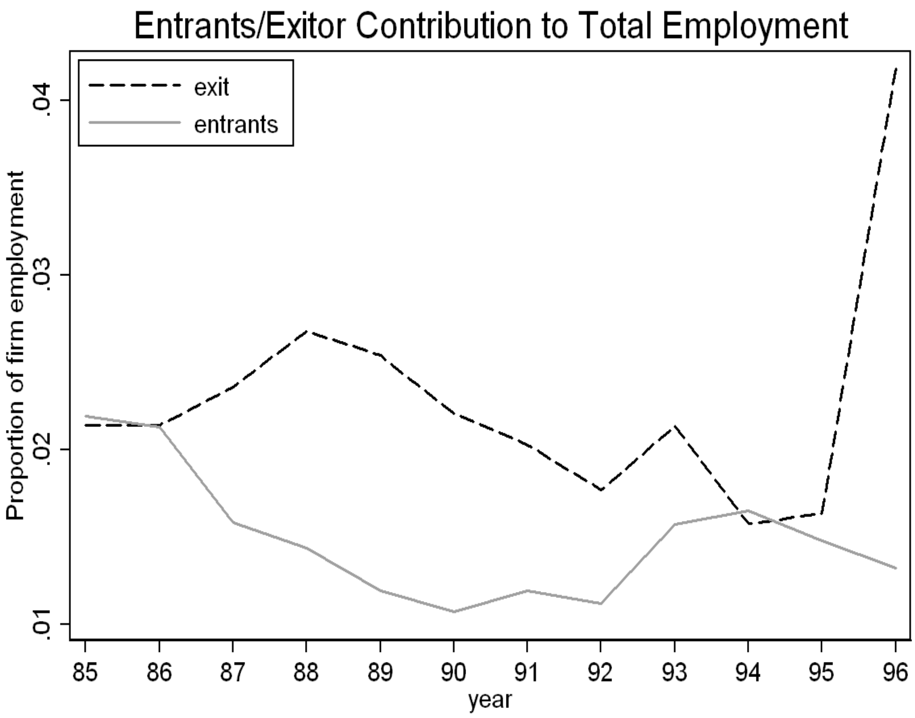

Figure 6: Labour Productivity by Cohort

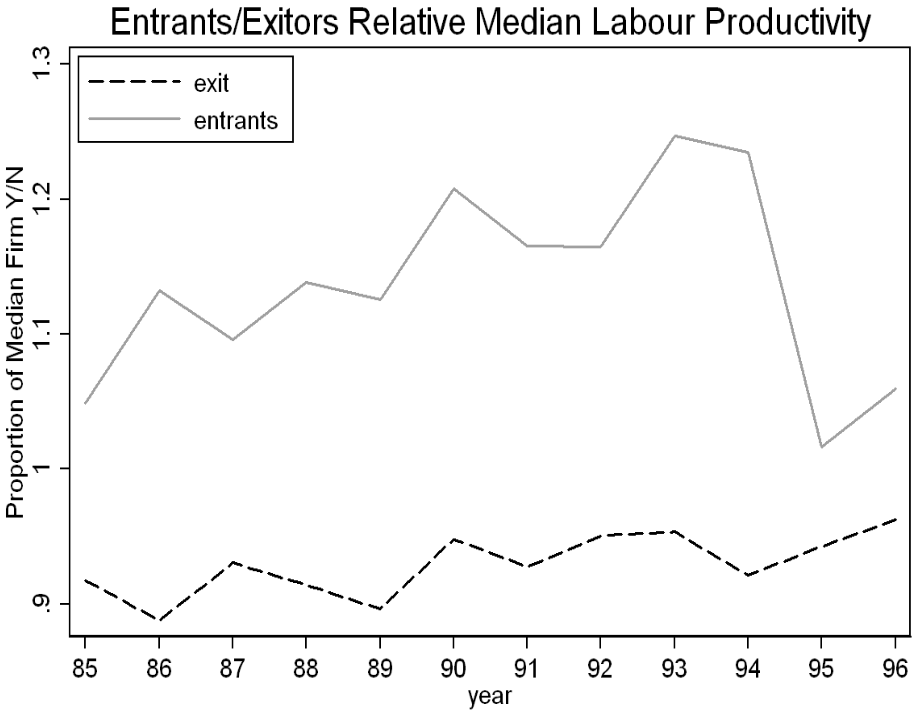

Figure 7: Leverage by Cohort

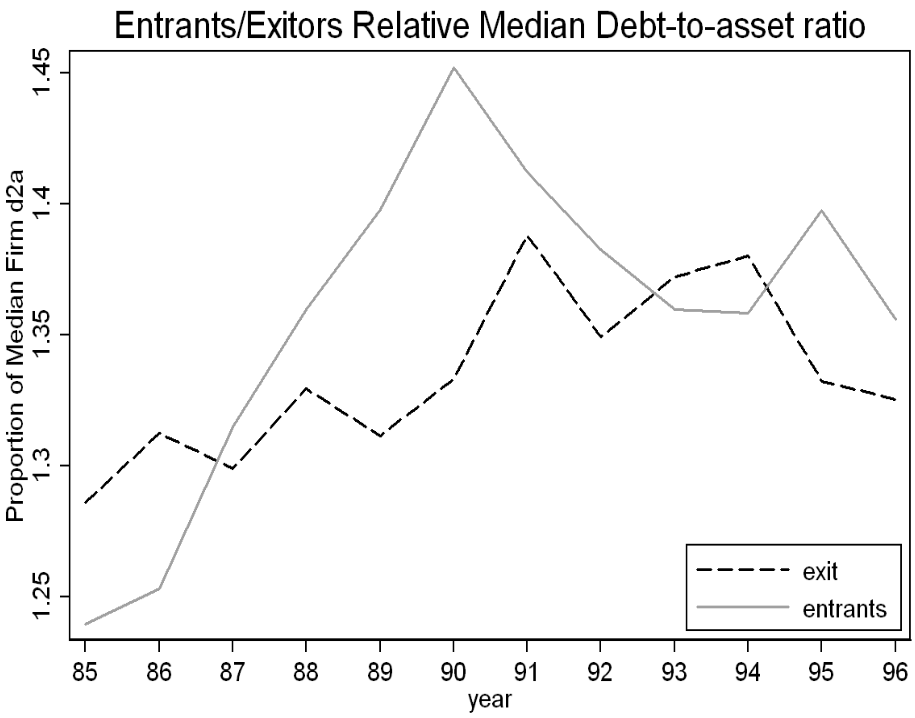

Figure 8: Decomposition of logL: No Heterogeneity

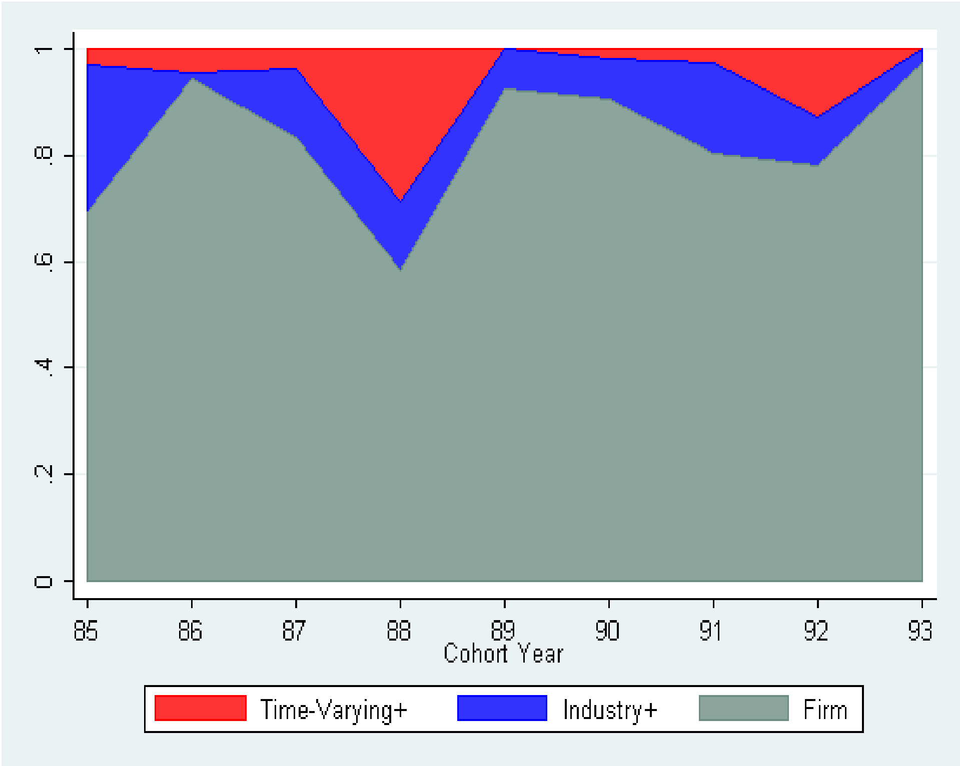

Figure 9: Decomposition of logL of Firm Effects: No Heterogeneity

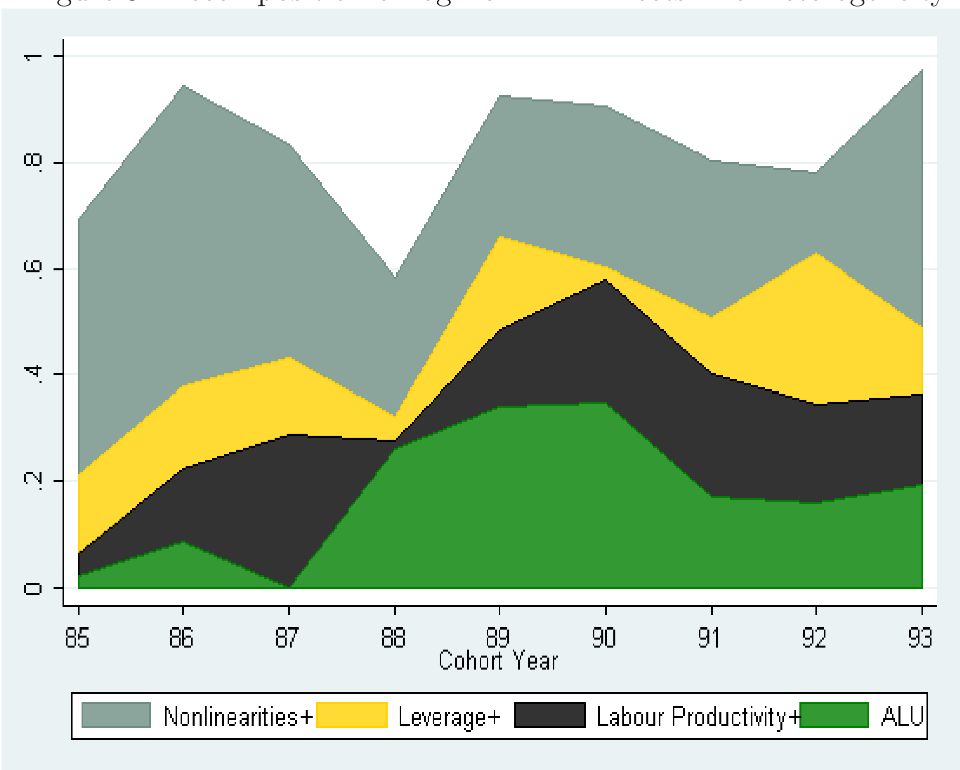

Figure 10: Decomposition of logL: Province and Industry Heterogeneity

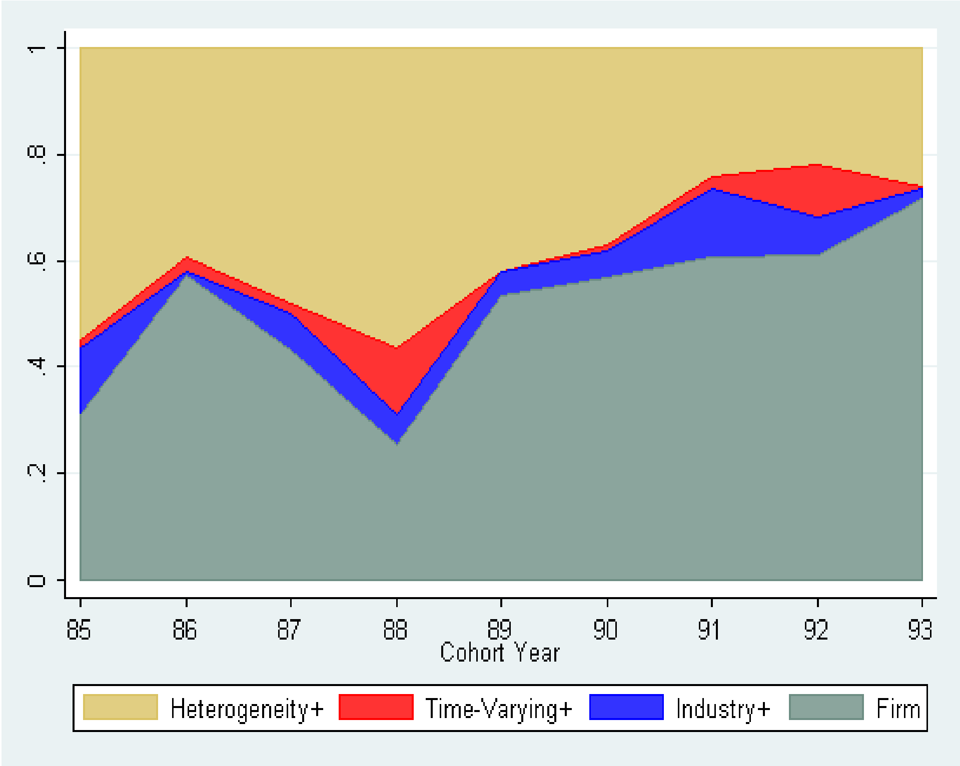

Figure 11: Decomposition of logL of Firm Effects: Province and Industry Heterogeneity