The Persistence of Initial Financial Conditions On Growth and Survival

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Abstract

Little is known about the role of initial financial conditions on the growth and survival of small, young, and private firms. Specifically, how do survival and growth paths change with the removal of average differences in initial financial conditions? To control for the inherent endogeneity of this exercise a counterfactual estimator is proposed based on the nonparametric identification results of Hausman & Woutersen (2008) & Woutersen and Voia (2008). The estimator constructs a counterfactual duration so that a hypothetically-treated sample is created. The hazard and growth rates are recomputed based on the un-treated and hypothetically-treated sample. For most cases there is an increase in the hazard rate (or failure rate) of firms and growth in the first few years is higher. The results suggest that at the micro level there are heterogeneous effects to this **policy**.

Summary of Paper

1. Role of initial financial conditions on firm growth and survival?
2. Growth & Survival are intertwined $\Rightarrow$ casuality statements hard.
3. Nonparametric identification methods (minimal assumptions).
4. Exploit the variation in the initial industry financial differences.
5. Construct **counterfactual durations** using hazard models.
6. Create an un-treated and hypothetically-teated samples.
7. Compare these two samples and...
8. Find differential effects on growth and survival patterns of industries.

Outline

1. Introduction
2. Data
3. Empirical Methodology
4. Results & Discussion
5. Future Work

Models/Motivation

- Selection (Age Effects)
  - Passive-learning: Jovanovic (ECTA, 1982)
  - Pre-entry experience: Thompson (REStat, 2005)
- Productivity (Size Effects)
  - Evolution of a firm: Hopenhayn (ECTA, 1992)
- Productivity and capital structure (Age and Size Effects)
  - Add financial frictions: Cooley and Quadrini (AER, 2001)

$\Rightarrow$ Fattest (financial) versus fittest (productive) - Zingales (JF, 1998)
Miao (JF, 2005) "Optimal Capital Structure and Industry Dynamics"

The role of initial leverage on nascent firm turnover & growth

T2LEAP Database

- Statistics-Canada merge Revenue Canada tax files (T2SUF) with employment data from Longitudinal Employment Analysis Program (LEAP)
- T2LEAP unique administrative database with focus on financial variables
- Coverage period: 1985-1997

Information in database include:

- Firm's birth year is when firm incorporates AND hires workers
- Employment, Sales, Assets, Equity and Debt
- Firm Leverage (debt-to-asset ratio)
- 1980 SIC identifier
- Focus analysis on manufacturing firms in the 1985 entry cohort

Figure 1: Survivor Function, 1985 Cohort

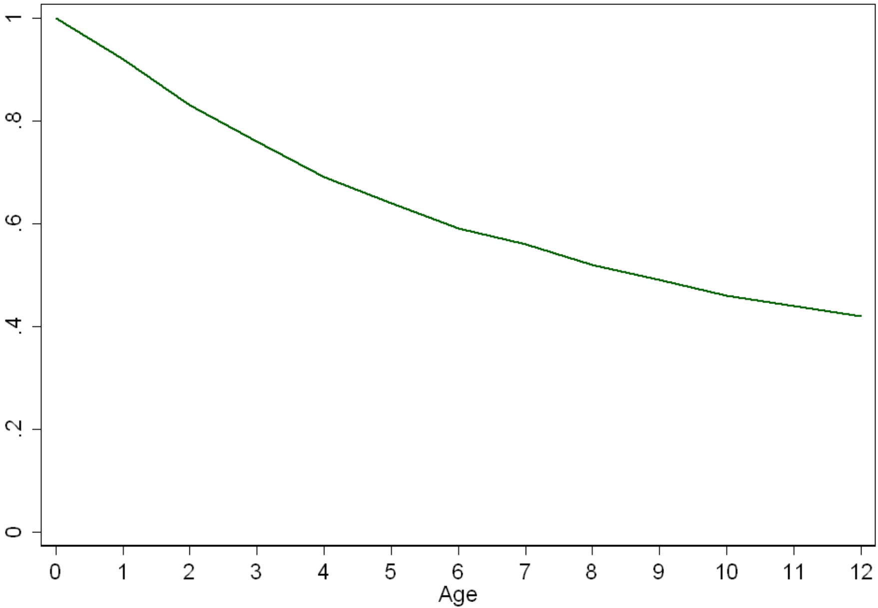


Figure 2: Empirical Hazards, 1985 Cohort

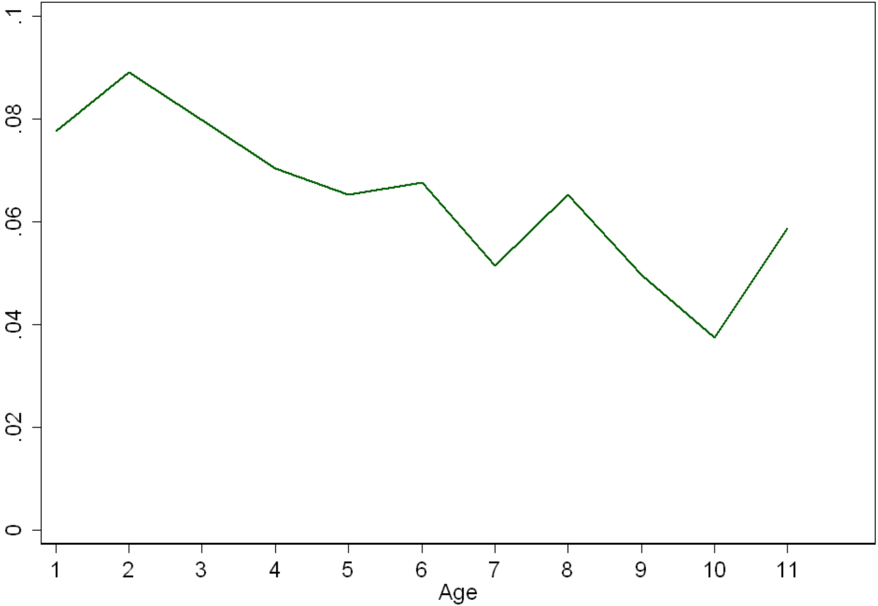


Table 1: Summary Statistics

All (N=2578)	Mean	Median	St. Dev.	25th	75th
Leverage	0.89	0.84	0.71	0.63	1.01
Labour Productivity	4.50	4.44	0.89	4.02	4.95
Employment Size	1.43	1.35	1.32	0.58	2.22
Survivors (N=1233)					
Leverage	0.79	0.78	0.63	0.59	0.95
Labour Productivity	4.55	4.47	0.81	4.08	4.98
Employment Size	1.52	1.43	1.24	0.71	2.23
Exitors (N=1345)					
Leverage	0.98	0.91	0.77	0.69	1.08
Labour Productivity	4.45	4.41	0.95	3.96	4.91
Employment Size	1.35	1.26	1.38	0.46	2.18

Survivor/Selection Decomposition

- Separate overall changes into survivor and selection effects

$$
\begin{aligned}
\underbrace{\frac{1}{N(S_\tau)}\sum_{i\in S_\tau} l_{i,\tau} - \frac{1}{N(S_1)}\sum_{i\in S_1} l_{i,1}}_{\textit{Overall}} \quad &= \quad \underbrace{\frac{1}{N(S_\tau)}\sum_{i\in S_\tau} l_{i,\tau} - \frac{1}{N(S_\tau)}\sum_{i\in S_\tau} l_{i,1}}_{\textit{Survivor}} \\
&+ \quad \underbrace{\frac{N(D^\tau)}{N(S_1)}\left(\frac{1}{N(S_\tau)}\sum_{i\in S_\tau} l_{i,1} - \frac{1}{N(D_\tau)}\sum_{i\in D_\tau} l_{i,1}\right)}_{\textit{Selection}}
\end{aligned}
$$

where τ is the firm's age, $l_{i,\tau}$ 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.

Figure 3: Leverage Selection Decomposition

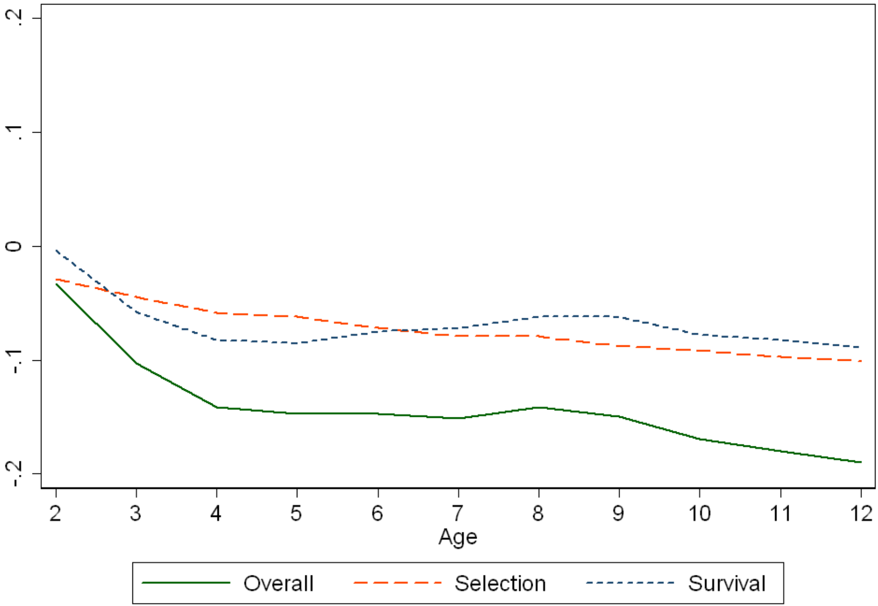


Table 2: Survivor and Exitor Differences in Initial Financial Conditions

	Leverage		Employment Size		Labour Productivity	
Age	Survivors	Exitors	Survivors	Exitors	Survivors	Exitors
2	0.860	1.235	1.458	1.088	4.512	4.342
3	0.844	1.123	1.481	1.155	4.521	4.384
4	0.830	1.089	1.502	1.181	4.528	4.397
5	0.827	1.047	1.509	1.225	4.539	4.395
6	0.817	1.036	1.508	1.266	4.538	4.417
7	0.810	1.022	1.511	1.292	4.545	4.421
8	0.810	1.005	1.515	1.303	4.541	4.437
9	0.801	0.999	1.519	1.316	4.549	4.436
10	0.797	0.992	1.519	1.328	4.548	4.443
11	0.792	0.990	1.517	1.338	4.545	4.451
12	0.788	0.982	1.519	1.347	4.548	4.454

Table 3: Summary of Industries

Industries	SIC	SIC2
Food & Beverage	1011	10-11
Rubber & Plastics	1517	15-17
Primary Textile & Clothing	1824	18-24
Wood, Furniture, Paper, & Printing	2528	25-28
Primary & Fabricated Metal	2930	29-30
Machinery, Transport, Electrical, &NonMetallic	3135	31-35
Refined Petro-Chemicals & Chemicals	3637	36-37
Other	3900	39

Note: Combining of industries is undertaken to maintain the confidentiality of firms in some industries.

Alternative Policy

What is the role of differences in initial financial conditions on firm growth and survival?

- Survivor and exitors initial conditions $\Rightarrow$ Survivors are "bigger, faster, and stronger"
- What would happen if the differences are set to zero (**Selection** component)
- Compute the counterfactual survival and growth patterns.

Econometric Methodology

Consists of three steps:

1. Estimate a panel selection model:
   - Conditional linear dynamic panel model with control function.
   - Control function is a hazard model.
   - Ascertain if selection matters, if yes $\Rightarrow$ proceed...
2. Use the counterfactual estimator to evaluate alternative **policy**. The counterfactual is identified in three steps:
   - Estimate the hazard model under the true and alternative **policy**,
   - Compute the two integrated hazards and equalize them (use the equality of survivals as the identification equation), and
   - Estimate the couterfactual duration by inverting the integrated hazard.
3. Evaluate the effect of the **policy** by comparing the predicted growth in output when the old and new estimated hazard are used in the dynamic equation.

1. Estimate the mixed proportional hazard model (MPH):

$$\theta_i\left(t|W_i,\delta\right) = v_i \exp(W_i\delta)\lambda\left(t\right), \tag{1}$$

where v_i is the parametric unobserved heterogeneity, W_i are the observed covariates, and $\lambda\left(t\right)$ is the nonparametric baseline hazard.
Growth model controlling for non-random exit:

$$\Delta y_{it} = \alpha_i + \gamma y_{i,t-1} + x_{it}\beta + \Phi[\hat{\theta}(\cdot)] + \varepsilon_{it}, \tag{2}$$

where y_{it} is the employment level of firm i at time t, α_i is the firm unobserved heterogeneity, x_{it} are observed covariates, and $\Phi[\hat{\theta}(\cdot)]$ is the estimated semiparametric selection component from the duration model (1).

2. Identification of the counterfactual duration estimator

See Hausman & Woutersen (2008) and Woutersen & Voia (2008).

Key Assumption: Individual firms enter at the same time with similar conditions.

The conditional survival probability of firm i at time t is:

$$S_i(t|v,W) = \exp[-\underbrace{\Theta_i(t|v,W)}_{\text{Integrated Hazard}}], \text{ where}$$

$$\Theta_i(t|v,W) = \int_0^t v_i \exp(W_i\delta)\lambda(u)\,du,$$

Define un-treated (UT) and hypothetically-treated (HT) with regressor set $W^{UT} = [w, z^{UT}]$ and $W^{HT} = [w, z^{HT}]$, respectively. The variable w is common to both groups whilst the only difference is the change in $z^{UT} \neq z^{HT}$ which is the treatment variable.

Counterfactual Identification: By definition, firms with the same duration have the same survival probability, or equivalently:

$$\Theta_i^{UT}(t) = \Theta_i^{HT}(t). \tag{3}$$

Proposition: If the $\{\theta^{UT}, v_i^{UT}, \lambda(t)^{UT}\} \neq \{\theta^{HT}, v_i^{HT}, \lambda(t)^{HT}\}$ due to the alternative policy then the durations must be different. Therefore, the counterfactual duration, t_i^{HT} can be determined as:

$$t_i^{HT} = {\Theta_i^{HT}}^{-1}\Big(\Theta_i(t)^{UT}\Big). \tag{4}$$

Defining with $\Lambda(t) = \int_0^t \lambda(u)\, du$, the counterfactual duration can be identified using:

$$t_i{}^{HT} = \Lambda^{-1}(s_i), \tag{5}$$

where s_i is:

$$s_i = \left(\frac{v_i{}^{UT}}{v_i{}^{HT}} \exp(W_i^{UT}\delta^{UT} - W_i^{HT}\delta^{HT})\Lambda(t^{UT})\right) \tag{6}$$

The counterfactual duration is estimated using the inverse of a weighted nonparametric integrated baseline hazard $(\Lambda^{-1}(s))$. Since, $(\Lambda^{-1}(s))$ is a monotonic increasing function, the following estimator for the inverse is proposed:

$$\hat{\Lambda}^{-1}(\hat{s}) = \min\{t, \hat{\Lambda}(t) \geq \hat{s}\}. \tag{7}$$

Therefore, an estimator for the counterfactual duration can be expressed as:

$$\hat{t}_i^{HT} = \min\left[t, \hat{\Lambda}(t^{HT}) \geq \frac{\hat{v}_i^{UT}}{\hat{v}_i^{HT}} \exp(W_i^{UT}\hat{\delta}^{UT} - W_i^{HT}\hat{\delta}^{HT})\hat{\Lambda}(t^{UT})\right]. \text{ (8}$$

3. Estimate the hazard model for the UT vs. HT sample and compute $(\hat{\theta}^{UT}/\hat{\theta}^{HT})$.

   Estimate the growth equation (2) conditional on $\Phi[\hat{\theta}(\cdot)]^{UT}$ and $\Phi[\hat{\theta}(\cdot)]^{HT}$:

$$\Delta y_{it}^{UT} = \alpha_i + \gamma y_{i,t-1} + x_{it}\beta + \Phi[\hat{\theta}(\cdot)]^{UT} + \varepsilon_{it}, \tag{9}$$

$$\Delta y_{it}^{HT} = \alpha_i + \gamma y_{i,t-1} + x_{it}\beta + \Phi[\hat{\theta}(\cdot)]^{HT} + \varepsilon_{it}. \tag{10}$$

   Compute the predicted values and then compare the the changes in output growth between the two groups $(\hat{y}_{it}^{UT}/\hat{y}_{it}^{HT})$..
   Alternative is to compute a weighted measure by accounting for the *changes in the initial* differences.

$$\hat{\Theta} = \mathbf{E}\left[\frac{\hat{\theta}_{UT}/\hat{\theta}_{HT}}{Selection_{UT}/Selection_{HT}}\right],$$

$$\hat{\Upsilon} = \mathbf{E}\left[\frac{\hat{y}_{it}^{UT}/\hat{y}_{it}^{HT}}{Selection_{UT}/Selection_{HT}}\right].$$

Table 4: Un-Treated vs. Hypothetical-Treated Duration

# Firms$_{UT}$=2376, **# Firms$_{HT}$=2247**	UT	**HT**
Leverage$_{i0}$	0.216	0.402
	(0.022)***	(0.030)***
Employment Size$_{i0}$	-0.066	-0.056
	(0.013)***	(0.013)***
Labour Productivity$_{i0}$	-0.015	-0.003
	(0.020)	(0.020)
Entry Rate$_{j0}$	0.100	0.471
	(0.403)	(0.399)
Employment Market Share$_{j0}$	0.031	-0.092
	(0.083)	(0.104)
$\Delta_{s=1}^{t-1}$ Leverage$_{i,s-0}$ -(**Selection Effect**)	0.018	0.016
	(0.002)***	(0.003)***
$\Delta_{s=1}^{t-1}$ Employment Size$_{i,s-0}$	-0.042	-0.047
	(0.004)***	(0.004)***
$\Delta_{s=1}^{t-1}$ Labour Productivity$_{i,s-0}$	-0.016	-0.021
	(0.004)***	(0.004)***
Δ (US-Canada) Tarriffs	-0.019	-0.021
	(0.009)**	(0.009)***
Unobserved Heterogeneity Variance	0.401	0.332
	(0.069)***	(0.063)***
logL	-37599.98	-35869.98

Figure 4: Untreated vs. Treated Hazard Rates

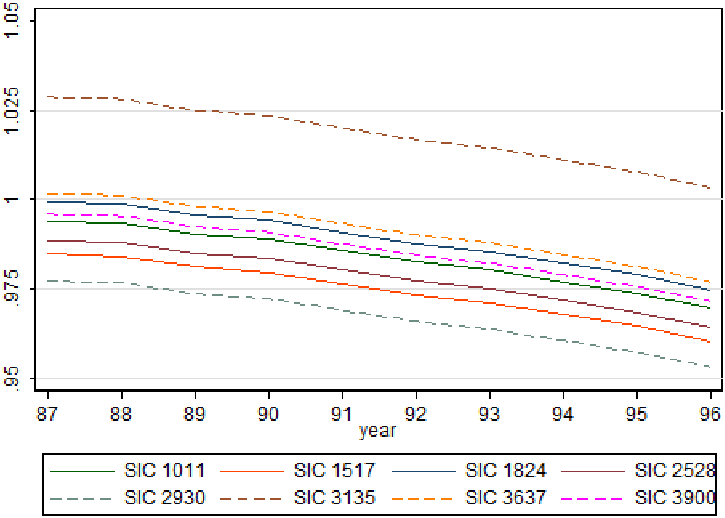


Figure 5: Weighted Untreated vs. Treated Hazard Rates

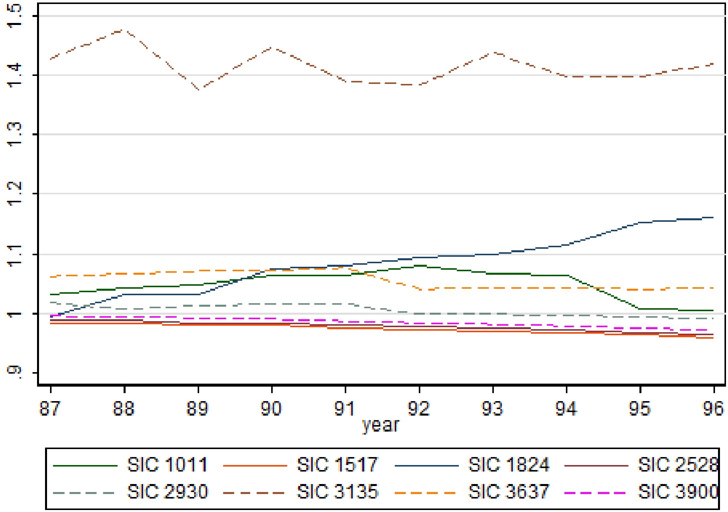


Table 5: Un-Treated vs. Hypothetical-Treated Growth

	UT	**HT**
$\text{Sales}_{i,t-1}$	-0.162	-0.158
	(0.025)***	(0.026)***
$\text{Sales}_{i,t-2}$	0.095	0.094
	(0.019)***	(0.019)***
$\text{Leverage}_{i,t-1}$	0.025	0.026
	(0.010)***	(0.010)***
Age_{it}	-0.891	-0.897
	(0.070)***	(0.071)***
Age_{it}^2	0.237	0.239
	(0.019)***	(0.019)***
$\hat{\theta}_1$	-0.047	-0.061
	(0.021)**	(0.034)*
$\hat{\theta}_2$	0.006	0.025
	(0.003)**	(0.015)*
Hansen-Sargan χ^2 p-value	0.000	0.000
Observations	17590	16137

Figure 6: Untreated vs. Treated Growth Rates

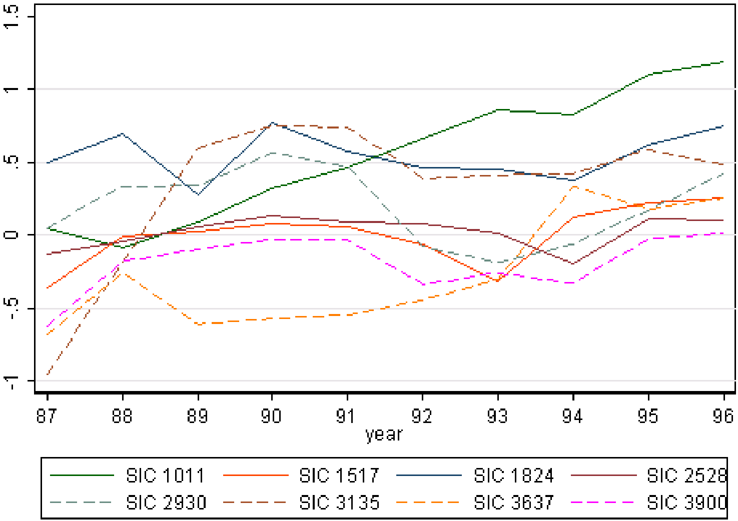
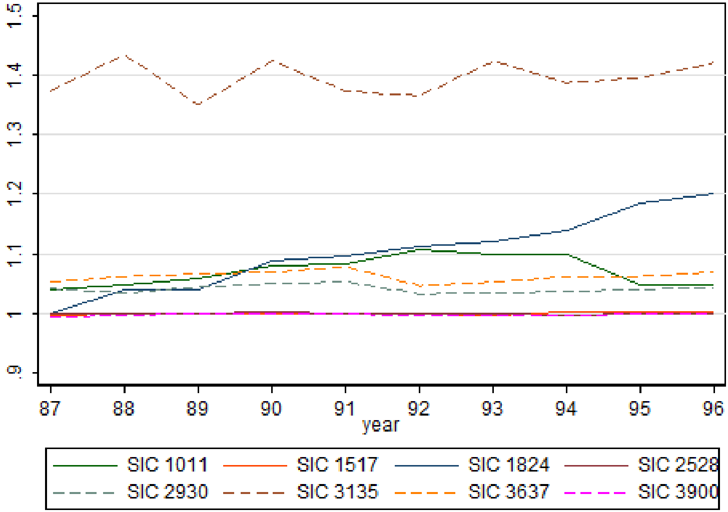


Figure 7: Weighted Untreated vs. Treated Growth Rates



Future Work

- Conduct robust inference on results.
- Learning mechanism?
- Structural model.

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