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Identifying causes and response strategies of growing pains: Empirical analysis using micro-data in Korean manufacturing

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Abstract

Most firms encounter to stop growing, known as growing pains, after realizing a certain level of growth. However, most previous researches on firm growth focus on determining the success factors of firm growth. The opposite of success factor does not necessarily mean failure or stagnation factor. Therefore, too much focus on the success factors on firm growth may lead to a narrow or inaccurate understanding of firm growth. In order to thoroughly understand the logics behind firm growth, this paper aims to analyze (i) why and when firms experience the growing pains (ii) and how they can overcome this stage. Using growth path of 5,045 Korean manufacturing firms over 10 year time-series (1985-2014), we identify whether each firm has stall points, which starting points of growing pains, and how common they are. 4,521 firms (89.6%) experienced the growing pains. Decreasing of R&D and Debt at the stage of high-growing cause growing pains in the following years. If a firm start growing pains, increasing of R&D and capital investment relates positively to overcome this stage. This paper contributes to draw managerial implications for sustainable growth. Also it helps to understand the logics behind firm growth.

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Using growth path of 5,045 Korean manufacturing firms over 10 year time-series (1985-2014), we identify whether each firms has stall points, which starting points of growing pains, and how common they are. 4,521 firms (89.6%) experienced the growing pains. Decreasing of R&D and Debt at the stage of high-growing cause growing pains in the following years. If a firm start growing pains, increasing of R&D and capital investment relates positively to overcome this stage. This paper contributes to draw managerial implications for sustainable growth. Also it helps to understand the logics behind firm growth.

Keywords: Growing pains, Stall points, Firm growth, Sustainable growth

1. Introduction

Issues that how well industry dynamics works in a country is important factor for maintaining vitality and efficiency of the overall economy. Dynamic economy is actively carried out that a number of start-up firms exist and inefficient firms exit to industry. Also a firm which have comparative advantage can achieve sustainable growth.

However, in reality, most firms encounter to stop growing, known as growing pains, after realizing a certain level of growth. According to a research of 600 firms of 'The Fortune 100' during the past 50 years, 87% for them experienced growing pains (Olson and Van Bever, 2008). Only 13% of them achieved sustainable growth. Among firms that experienced growing pains, only 11% recovered while the rest failed to do so. Garnsey and Heffernan (2005) similarly discovered that among firms that experienced growing pains, 37% of them failed to recover the pre stage of stagnation

Most previous researches on firm growth focus on determining the success factors of firm growth. The opposite of success factor does not necessarily mean failure or stagnation factor. Therefore, too much focus on the success factors on firm growth may lead to a narrow or inaccurate understanding of firm growth. In order to thoroughly understand the logics behind firm growth, it is crucial to analyze why firms experience the growing pains and how they can overcome this stage.

This paper aims to analyze (i) why and when firms experience the growing pains (ii) and how they can overcome this stage. Using growth path of 5,045 Korean manufacturing firms over 10 year time-series (1985-2014), we identify whether each firms has stall points, which starting points of growing pains, and how common they are. Recent researches on firm growth are tendencies to identify growth path (from how much to how, Brenner and Schimke, 2015; Coad et al, 2013; MaKelvie and Wiklund, 2010; Garnsey et al. 2006). This paper contributes to draw implications for sustainable growth. Also it helps to understand the logics behind firm growth.

The remainder of this paper is organized as follows: Section 2 reviews previous researches on firm growth and growing pains; Section 3 explains the data for empirical analysis; Section 4

describes definition of growing pains, the methodology applied such as probit model, event analysis; Section 5 presents empirical results; and Section 6 concludes the paper.

2. Previous researches

2.1 Research on firm growth

Coad (2009) insisted “Firm growth is indeed a multifaceted phenomenon, it has a strong idiosyncratic character, and as a result it is difficult to generalize across firms and circumstances”. Despite such difficulties, many researchers try to explain the logics behind firm growth in a systemic way. According to the resource-based theory, firm’s strategy and competitiveness are determined by the resources firms obtain (Penrose, 1959; Wernerfelt, 1984; Barney, 1991; Hamel and Prahalad, 1990; Amit and Schoemaker, 1993). The resource that firms possess is an important source of gaining competitive advantage and thus this becomes the fundamental basis of firm’s growth and survival. Firms with capabilities and resources that are not easily replicable by competitors allow firms to retain a sustained competitive advantage, and thus, they are can better survive and grow in the long run. According to the evolutionary theory, firms continuously accumulate their knowledge and capabilities during the process of adaptation (Nelson and Winter, 1982; March, 1991). The difference in learning capability, the capability of obtaining a new routine, affects the process of evolution of firms. Firms that continuously adapt to exploit and explore to find the best alternative can survive in today’s uncertain business environment.

Most previous researches on firm growth focus on determining the success factors of firm growth. However, in reality, most firms encounter a stage of stagnation, known as growing pains, after realizing a certain level of growth. The opposite of success factor does not necessarily mean failure or stagnation factor. Therefore, too much focus on the success factors on firm growth may lead to a narrow or inaccurate understanding of firm growth. In order to thoroughly understand the logics behind firm growth, it is crucial to analyze why firms experience the growing pains and how they can overcome this stage.

2.2 Growing pains

Many researches on firm's growth trajectory suggest that it is non-linear. (Garnsey et al., 2006; Brenner and Schimke, 2015). Especially, it has been observed that many growing firms encounter an abrupt stage of stagnation. Garnsey and Heffernan (2005) conducted research based on the 10 years of data of English entry firms and found that only 6% of the firms achieved a sustainable growth while 49% them lost their initial growth momentum and encountered a stage of growing pains. Contrary to the high growth that firms enjoy during their early stage of entry, most firms lose their growth momentum and experience stagnation at a certain stage of their lifecycle.

Growing pains relates to a prolonged decline of growth which reverses the ongoing growth pattern of firms, unlike a temporal decline or turbulence that firms may experience. According to Olson, and Van Bever (2008)'s *Stall points*, growing pain can be regarded as the turning point which determines the ultimate fate of a firm. He named the stage of abrupt decline and slowdown of growth rate after a continuous growth as stall points. Once stall points occur and continue firms face a critical moment of life and death. According to a research of 600 firms of 'The Fortune 100' during the past 50 years, 87% for them experienced stall points. Only 13% of them achieved sustained growth. Among firms that experienced stall points, only 11% recovered while the rest failed to do so. Garnsey and Heffernan (2005) similarly discovered that among firms that experienced growing pains, 37% of them failed to recover the pre stage of stagnation. From the analysis of Korean firms, it has been found that firms re-enter a stagnation stage at a 59% rate on the following year once stagnation begins and this rate increases to 68% after firms experience a two-consecutive-years of stagnation.

Therefore, it can be said that growing pains hampers sustainable growth as most firms experienced growing pain do not recover from it. However, it has been also observed that firms try to minimize the stagnation through exploring for a new growth momentum Many previous studies overlook the important fact that the majority of firms experience a growing pains (Garnsey and Heffernan, 2005).

3. Data: KIS-value database

This paper uses KIS-value database which provides financial and non-financial statements for Korean listed and externally audited firms by National Information & Credit Evaluation Inc (NICE). While the database contains diverse financial firm-level measures including stock index, this paper extracted only some of the relevant data including revenue, number of employees, R&D investment and property plant and equipment(PP&E). Also we included other firm level data including sector, industry (KSIC) and whether firms had IPO.

The main reason using KIS-value database in this paper that it contains a detailed 30-year of time series data. As a continuous time-series data is needed to analyze the growth trajectories of firms, external audited firms that have a gap year in between are excluded. Panel data are constructed by eliminating observations that fail to continue for ten consecutive years. The final dataset is composed of 5,045 Korean firms and 94,681 observations without a gap from the year 1985 to 2014.

4. Model

In this paper, we conduct two stages analysis. First, we identify whether each firms has stall points, which starting points of growing pains, and how common they are. Second, we conduct regression to find why and when firms experience the growing pains and how they can overcome this stage.

4.1 Identify stall points

Using panel data, we identify whether each firms has stall points, which starting points of growing pains, and how common they are. Growing pains relates to stop growing which reverses the ongoing growth pattern of firms, unlike a temporal decline or turbulence that firms may experience. Therefore, we follows the definition of stall points as Olson, and Van Bever (2008). We calculate the compound annual growth rate (CAGR) of each firm's sales for 4 years before and 4 years after every year. We qualify as having stalled in a given year when

matched the following conditions; i) At least 1% for the 4-year before, ii) Below 1% for the 4-year after and iii) the maximum difference in CAGR for the 4 years before and after under i) and ii).

As definition above, we can classify types of firm by growth path. [Figure 1] shows the example of a firm's growth path by classification of firm. (a) shows sustainable growth firm without the growing pains in a whole time-series. (b)[(c)] shows firm experienced the growing pains with [without] overcoming.

[Figure 1] goes about here

4.2 Model specification

We conduct regression to find why and when firms experience the growing pains and how they can overcome this stage. We can use probit model for estimating why firms experience the growing pains. Probit model can analyze the determinants that generate a specific event. That is, this model can be to analyze factors to occur stall points. The regression model is expressed as follows:

$$\Pr(y_{i,t} = 1) = \Phi(\alpha + \beta_1 \Delta R\&D_{in_{i,t}} + \beta_2 \Delta R\&D_{in_{i,t-1}} + \beta_3 \Delta Capital_{in_{i,t}} + \beta_4 \Delta Debt_{ratio_{i,t}} + \sum_{j=4}^n \beta_j X_{ij,t} + \mu_t) \quad (1)$$

where dependent variable is 1 if stall points starts, 0 otherwise at t ; independent variables are R&D intensity, Capital intensity and Debt ratio; X is control variables affecting stall points such as IPO, economic cycle, lag growth rates etc.; and μ_t stands for error term. We focus on investment strategies which affecting stall points such as R&D, capital and debt. Changes of organization's strategic misfit to firm growth (Makinley et al., 2014). Therefore, these strategies are important for sustainable growth.

Next we can use event analysis for estimating how firm overcome the growing pains. One of event analysis use Cox proportional hazard model. This model can be to analyze risk factors that influence to overcome the growing pains. We set event when firm overcome the growing

pains at t . We can derive the duration of the growing pains until overcoming and influence factors. Eq(2) is the basic model of the Cox hazard model with time varying covariates.

$$h(t, x) = h_0(t) \exp\{\beta_j x_j + \dots + \beta_i x_{it}\} \quad (2)$$

The regression model is expressed as follows:

$$h(t) = h_0 \exp(\beta_1 \Delta R\&D_{in_{i,t}} + \beta_2 \Delta R\&D_{in_{i,t-1}} + \beta_3 \Delta Capital_{in_{i,t}} + \beta_4 \Delta Debt_{ratio_{i,t}} + \sum_{j=4}^n \beta_j X_{ij,t} + \mu_t) \quad (3)$$

where independent variables are R&D intensity, Capital intensity and Debt ratio; X are control variables affecting overcoming the stage such as IPO, age, economic cycle etc.; and μ_t stands for error term.

5. Results

5.1 Identifying stall points: When do growing pains start?

We identify whether each firms has stall points, which starting points of growing pains, using the definition introduced in previous section. [Table 1] presents classification of the firms by growth pattern. 4,521 firms (89.6%) can be identified to stall points. Only 524 firms (10.4%) show sustainable growth without growing pains. As the results of Garnesy and Heffernan (2005), sustainable growth is rare and continuous growth unusual. 25.5% firms among the firms experienced growing pains stabilize as sustainable growth through overcoming. However, most firms can't overcome it. It implies that it is hard to overcome if growing pains have started.

[Table 1] goes about here

[Figure 2] shows path of growth rates before and after stall points ($t=0$). Compared to the average growth rates of total firms is 13.55%, it can be seen relatively high growth rates before

stall points. This implies that stall points occur with high probability after high growing phase (Garnsey and Heffernan, 2005). After four years (+4) of stall points, a firm returns to positive growth, however, does not restore the growth rates before stall points.

[Figure 2] goes about here

[Figure 3] shows ratio of firms starting stall points by age bins. Because of the different observations for each age bins, we derive the ratio, the number of firms starting stall points at specific bins / the number of total firms at specific bins. It shows the highest ratio around 10 age. According to stylized fact on firm growth, entry firm shows high growth rates than others. They are low possibility to starting stall points. After early stage, many firms are to fail to maintain growth momentum and fall back to growing pains. If firm is tolerant at around 10 age, it decreases the possibility of starting stall points over age.

[Figure 3] goes about here

As similar to [Figure 3], [Figure 4] shows the ratio of firms starting stall points by size bins. Small-Medium firms show the low ratio. After 10 million won, it shows high probability to start stall points. It implies that larger firms are more likely to experience growing pains. Larger firms are hard to maintain growth momentum due to inertia, bureaucracy (Coad, 2009).

[Figure 4] goes about here

Previous figures are derived without controlling other effects. Therefore, we conduct regression to confirm the dates of stall points started. [Table 2] shows the result of probit analysis. Because stall points is affected by economic cycle and industry, we control these effects by using year dummy, industry dummy. Model (3) is included all independent and control variables. As [Figure 3], we confirm the highest probability to start stall points at 10-

14 age bins (reference group: <5 age bins). After this age bins, it decreases the probability over age. In the case of sales, it show the highest probability at [100,200) size bins (reference group: [0, 5) size bins). According to classification of firm by Korea Statistics, firms are classified as small-medium firm if the average sales lower than 100 billion won in manufacturing. Our results imply that a firm into large to small-medium firm has high pressure to growing pains. As small firms become larger, they confront considerable organizational stresses (Hannan and Freeman, 1977).

[Table 2] goes about here

5.2 Causes of stall points: Why do growing pains occur?

When does not mean why. Therefore, it is necessary to analyze why growing pains occur at specific age and size. A firm faced shortage of vital resources and the problems of resource coordination can lead to change low growth phase (Garnsey and Heffernan, 2005). Therefore, it is important growth strategies to sustain growth. In this paper, we focus on strategies such as i) R&D investment, ii) capital investment and iii) debt ratio to effect on growing pains.

[Figure 5] shows the pattern of R&D intensity before stall points. It shows R&D intensity decreases before stall points. [Figure 6] shows pattern of capital intensity before stall points. It also shows capital intensity decreases before stall points. [Figure 7] represents the pattern of debt ratio of before stall points. It decreases before stall points. Totally, all strategies decrease before the stall points. Even with the high growing phase, they decreases investment. It is expected the reason that stall points occurs.

[Table 5] goes about here

[Table 6] goes about here

[Table 7] goes about here

We conduct regression to effect of growth strategies on growing pains. [Table 3] represents the result of probit analysis. $\Delta R\&D_in$ and $\Delta Debt_ratio$ show statistically significant and negative coefficients. That is, the ratio of the change in R&D intensity, and debt ratio are negatively associated with stall points. Innovation activities are high uncertainty, if success, these are important role on firm growth in that they provide the opportunity for high-growth. Higher debt ratio implies that a firm actively utilize from external funds (leverage effect, Lopez-Garcia and Puente, 2012). Therefore, it is important to increasing R&D investment to sustain growth using not only internal but external funds.

In control variable, the coefficients of $\Delta Growth$ is positive and significant. This implies that stall points occur with high probability after high growing phase (Garnsey and Heffernan, 2005). Dum_IPO is also positive and significant. This implies that Post-IPO performance is not good in Korean manufacturing. Finally, Dum_Crisis is positive and significant. Recession effects on stall points.

[Table 3] goes about here

5.3 Response strategies: How to overcome the growing pains.

We conducted regression to derive response strategies after stall points. Most firms are experienced the growing pains. Therefore, it is important that this regression to derive strategies for minimizing the duration of the growing pains. [Table 4] shows the result of the response strategies to overcome growing pains. The positive coefficient means it has positive impact on overcoming growing pains. $Up_R\&D_in$ relates positively to overcome the growing pains. It indicates that devoting more R&D effort than before stall points enable a better performance. $Up_Capital_in$ is also positive and significant. Capital investment is and can lead to overcome growing pains

However, a firm in growing pains lacks the internal resources. It is hard to invest in R&D capital without external funds. Our results imply higher debt ratio has negative impact on overcoming. These results imply that if the stall points start, it is hard to overcome. Therefore,

preventing the stall points is the first priority aim of the firm for the sustainable growth.

[Table 4] goes about here

6. Conclusions and Implications

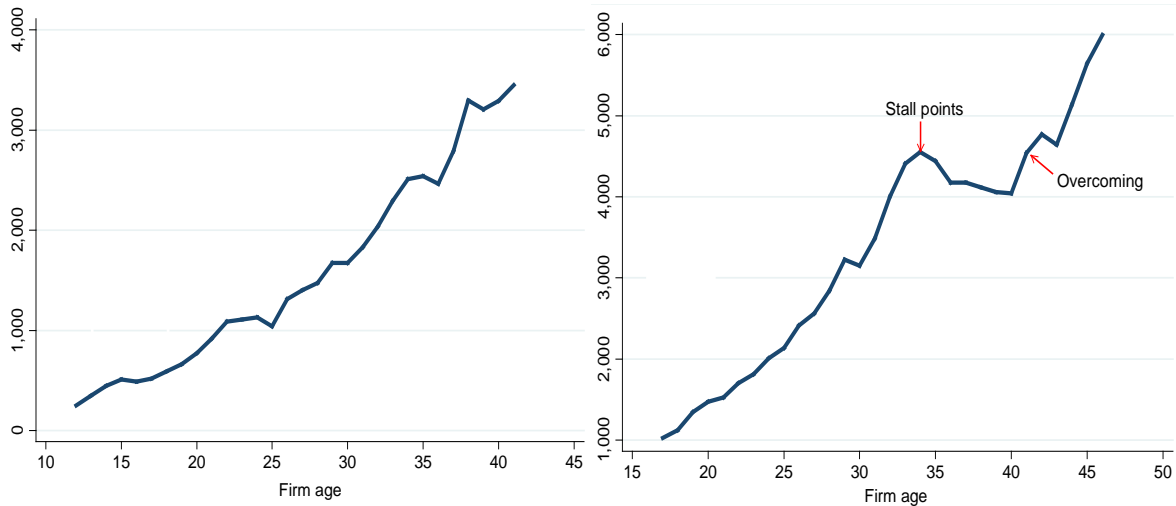
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This paper contributes to draw managerial implications for sustainable growth. In reality, most firms encounter to stop growing. This pains threatens existence of the firm. Therefore, it is important for manager to prevent the growing pains. The results of this paper suggest growth strategies for sustainable growth. Also, to build an environment in which firms can continue to grow, it can promote entry firms due to incentives for growth opportunity. It can make the virtuous cycle of the ecosystem of the industry.

Reference

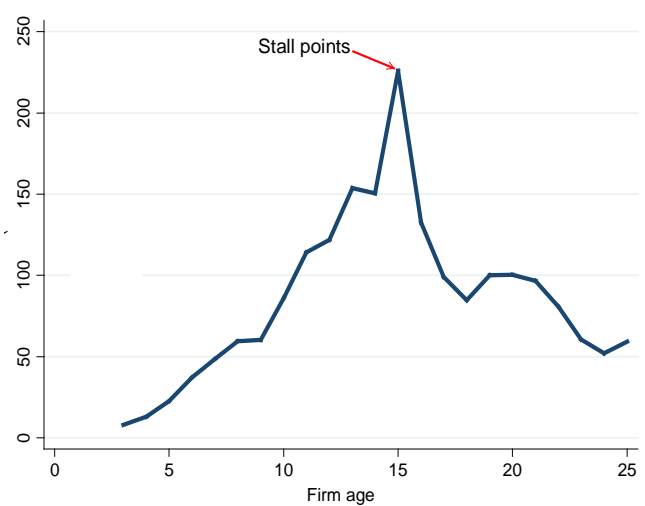
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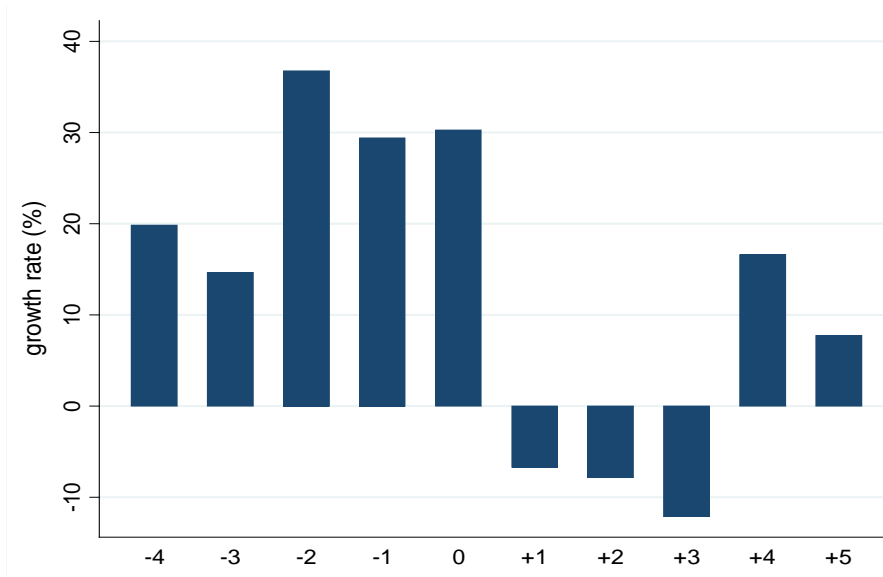
(a) Sustainable growth firm

(b) Firm experienced growing pains with overcoming

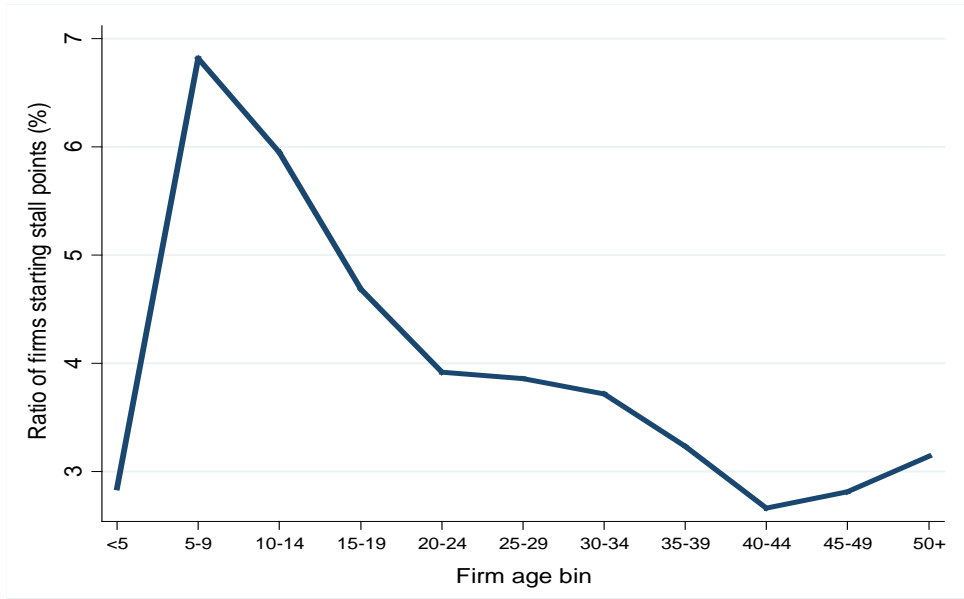


(c) Firm experienced growing pains without overcoming

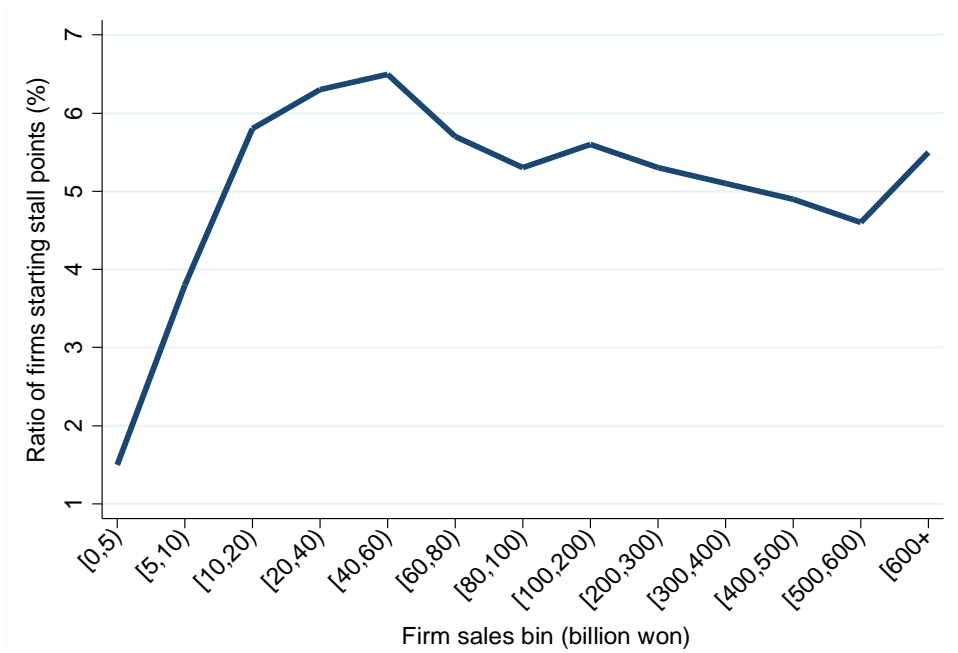
[Figure 1] The example of a firm's growth path by classification of firm



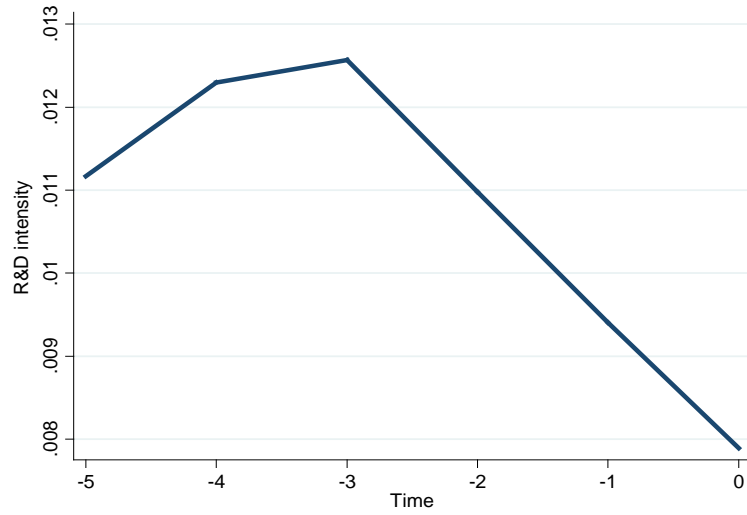
[Figure 2] Path of growth rates before and after stall points ($t=0$)



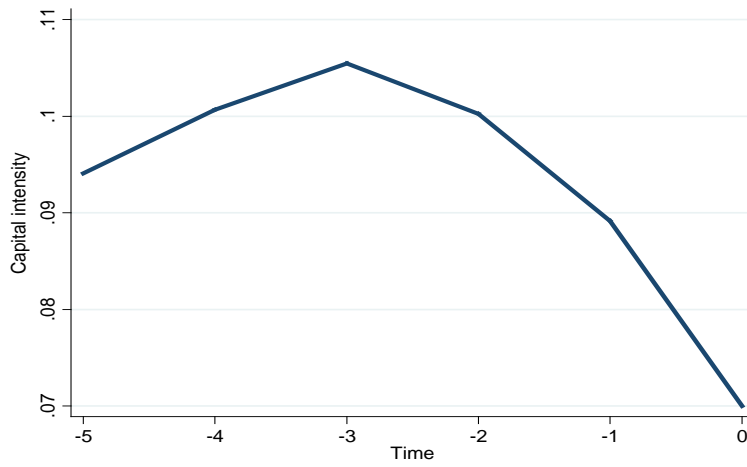
[Figure 3] Ratio of firms starting stall points (by age bins)



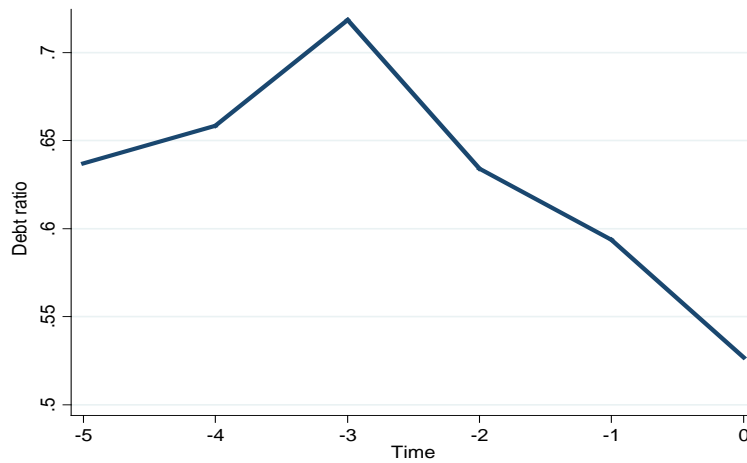
[Figure 4] Ratio of firms starting stall points (by size bins)



[Figure 5] Pattern of R&D intensity before stall points (Time=0)



[Figure 6] Pattern of Capital intensity before stall points (Time=0)



[Figure 7] Pattern of Debt ratio before stall points (Time=0)

[Table 1] Classification of firms by growth pattern

Total firms	Growth pattern of firm		No. of firms	
		Sustainable growth firm	524 (10.4%)	
		Overcoming firm	1,284 (25.5%)	
5,045 (100%)	Firm experienced growing pains	Exit from audited firm	4,521 (89.6%)	782 (15.5%)
		Non-overcoming firm until 2014	2,455 (48.6%)	

[Table 2] Result of probit analysis: When do growing pains start?

Stall points	Model (1) Coef. (std. err)	Model (2) Coef. (std. err)	Model (3) Coef. (std. err)
Age	5-9	0.380*** (0.034)	0.323*** (0.036)
	10-14	0.506*** (0.036)	0.386*** (0.038)
	15-19	0.528*** (0.038)	0.347*** (0.041)
	20-24	0.469*** (0.043)	0.258*** (0.045)
	25-29	0.500*** (0.047)	0.252*** (0.049)
	30-34	0.502*** (0.053)	0.236*** (0.055)
	35-39	0.570*** (0.065)	0.274*** (0.067)
	40-44	0.515*** (0.079)	0.173** (0.081)
	45-49	0.399*** (0.102)	0.055 (0.104)
	50+	0.436*** (0.126)	0.131 (0.128)
	Size bins	[10,20)	
[20,40)			0.850*** (0.038)
[40,60)			0.964*** (0.047)
[60,80)			0.949*** (0.058)
[80,100)			0.859*** (0.066)
[100,200)			0.987*** (0.053)
[200,300)			0.909*** (0.083)
[300,400)			0.703*** (0.113)
[400,500)			0.669*** (0.138)
[500,600)			0.549*** (0.190)
[600+)			0.853*** (0.084)
Constant	-0.393*** (0.108)	-0.575*** (0.109)	-0.850*** (0.113)

Industry Year	Included Included	Included Included	Included Included
Pseudo R-sq	0.117	0.136	0.141
Observations	40,125	40,125	40,125

- Dependent variable: 1 if stall points starts, 0 otherwise at t

- Numbers in parentheses are standard errors; * p < 0.10; ** p < 0.05; *** p < 0.01

[Table 3] Result of probit analysis: Why do growing pains occur?

Stall points		Model (1) Coef. (std. err)	Model (2) Coef. (std. err)	Model (3) Coef. (std. err)
Strategy	$\Delta R\&D_in$ (t)	-0.570** (0.281)		-0.420 (0.276)
	$\Delta R\&D_in$ (t-1)	-0.750*** (0.215)		-0.496** (0.212)
	$\Delta Capital_in$ (t)	-0.005 (0.021)		0.001 (0.021)
	$\Delta Debt_ratio$ (t)	-0.194*** (0.023)		-0.200*** (0.023)
Control	$\Delta Growth$ (t-1)		0.193*** (0.020)	0.187*** (0.020)
	Dum_IPO (t-1)		0.096** (0.049)	0.105** (0.049)
	Dum_large firm (t-1)		-0.048 (0.060)	-0.048 (0.060)
	Dum_Crisis (t-1)		0.077*** (0.024)	0.080*** (0.024)
	Constant	-1.159*** (0.009)	-1.211*** (0.011)	-1.218*** (0.024)
Obs	34,157	34,157	34,157	
Wald Chi2	93.84	93.84	105.23	

- Dependent variable: 1 if stall points starts, 0 otherwise at t

- Numbers in parentheses are standard errors; * p < 0.10; ** p < 0.05; *** p < 0.01

[Table 4] Result of Cox proportional hazard model: How to overcome growing pains.

Overcome growing pains		Model (1) Coef. (std. err)	Model (2) Coef. (std. err)	Model (3) Coef. (std. err)
Strategy	UP_R&D_in	0.151*** (0.055)		0.145*** (0.055)
	UP_Capital_in	0.184*** (0.057)		0.176*** (0.057)
	UP_Debt_ratio	-0.279*** (0.056)		-0.276*** (0.056)
Control	Age (t)		-0.002*** (0.000)	-0.001*** (0.000)
	Dum_IPO (t)		0.062 (0.057)	0.054 (0.059)
	Industry	Included	Included	Included
	Year	Included	Included	Included
	Obs	35,876	5,876	5,876
	Wald Chi2	1291.29	1311.98	1354.65

- Event: overcoming the growing pains at t

- Numbers in parentheses are standard errors; * p < 0.10; ** p < 0.05; *** p < 0.01