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Firm Size and Job Creation in Korea: Do Small Businesses Create More Jobs?

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Using the Census on Establishments data in Korea from 2003 to 2012, we study the relationship between firm size and net job growth rate. When we use average size instead of base year size without controlling for firm age, the effect does become weaker, but we still observe a negative correlation between the two. However, when we control for firm age, the negative correlation between firm size and net job growth rate becomes nonexistent, and in some cases there is even a positive correlation. This is the same even when we use establishment level data instead of firm level data.

JEL Classification: L11, L25, O17
Keywords: Firm Size, Firm Age, Net Job Creation

I. Introduction

Between small businesses and large firms, which create more jobs? The belief that small firms create more jobs is widespread among most people. In Korea, small businesses constitute 99% of all firms, and 88% of all jobs are provided by small firms, leading to the creation and popularization of the term 9988. Contrary to popular belief, however, research as to whether the firm size is actually correlated with higher net job growth rates is still under way. In some research, firm size and net job growth rates have been shown to have a negative correlation, but in other papers, the negative correlation has not been clear.

The question of "whether small businesses create more jobs than large firms" first became an issue when David Birch (1979, 1981, 1987) stated that small

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businesses play a major role in job creation. Birch provided data analysis which showed that in the United States, small businesses create most of the jobs in the private sector. Using his data, Birch (1979, 1981) showed that among the new jobs created in the United States between 1968 and 1976, 66% was created in firms with less than 20 employees and 81.5% was created in firms with less than 100 employees. Furthermore, Birch (1987) stated that 82% of the total increase in employment from 1981 to 1985 was created in firms with less than 20 employees. Since then, his research has been used in the United States as evidence to support small business funding. A theoretical interpretation of Birch's results would be that Gibrat's Law[1] is not valid and that the firm size in the previous period has a negative correlation with the increase in the firm size in the current period.

Following the research by Birch, Friedman (1992; 2131) stated that although small businesses play an active role in job creation, we must consider the problem of "regression to the mean" when analyzing the relevant data. In other words, in order to reduce the effects of regression to the mean, he stated that firm size should be measured not by using the previous period's firm size like Birch, but rather by using the average firm size between the two periods.

Davis *et al*. (1996) stated that the problem of "regression to the mean" caused an overestimation of the role of small businesses in job growth. They stated that data regarding manufacturing from the Longitudinal Research Database (LRD) did not show any correlation between average plant size and job growth rate. In other words, when the effects of regression to the mean are taken into consideration, small businesses do not show a higher net job growth rate. Furthermore, they stated that the earlier research, which claimed that most of the jobs created in the private sector were from small businesses, was actually plagued with many statistical errors and measurement errors. Specifically, omission of usable data, no differentiation between net job creation and gross job creation, classification of firm size and the statistical problems of regression to the mean cause problems which prevent accurate measurement of job creation with respect to firm size.

Davidson *et al*. (1998) used data from Sweden to state that small businesses have a higher net job growth rate even when taking into account the effects of regression to the mean. Broersma and Gautier (1997), Picot and Dupuy (1998) and Voulgaris *et al*. (2005) all found that net job growth rate of small businesses was higher than that of large firms with only Hohti (2000) finding results to the contrary. More recently, Neumark *et al*. (2011) used the National Establishment Time Series (NETS) data from 1992 to 2004 and found a negative correlation between the previous period's firm size and current period's firm size growth rate even when they took into consideration the problems raised in Davis *et al*. (1996). In other

[1] Gibrat's Law, also known as the "Law of Proportional Effect", states that the firm size growth rate and the firm size are independent.

words, the smaller the firm size, the more jobs it tends to create. Furthermore, de Wit and de Kok (2014) used the dynamic classification methods[2] presented in Butani *et al*. (2006) and found that in the 27 EU nations, small businesses created more jobs than large firms and that net job growth rate decreased with an increase in firm size.

On the other hand, Haltiwanger *et al*. (2013) stated that the previous research regarding the relationship between the previous period's firm size and current period's firm size growth rate had limitations because it did not take information regarding the firm age into consideration. Haltiwanger *et al*. (2013) used firm age information from the American Census Bureau's Longitudinal Business Database (LBD), and analyzed the relationship between the firm size and firm size growth rate while controlling for the firm age. Like Neumark *et al*. (2011), they found a negative correlation between the previous period's firm size and current period's firm size growth rate when not controlling for firm age. However, they did not find this negative correlation when they controlled for firm age and the interaction term between firm age and its size.

In Korea, several analyses have recently been done on net job growth rate according to firm size or the change in such relationships when controlling for firm age. Job creation has been researched using the Employee Insurance Database and Korean Credit Rating Database by Yun and Go (2009). Also, there have been papers which use mining and manufacturing statistics by Nam (2014). Nam (2014) analyzed the relationship between firm age, firm size, and job creation at the establishment level. However, Nam's (2014) limitation is that he only looked at the change in number of employees. Furthermore, he used the mining and manufacturing statistics data rather than the Census on Establishments in Korea, so he was not able to analyze any of the other industries. More comprehensive analyses were done by Cho *et al*. (2015) and Kim (2015) who used the Census on Establishments in Korea for the analysis over the period of 2006-2011. They employed the fully saturated dummy variable model to analyze the effects of firm age and firm size on job creation at the firm level and at the establishment level. They stated that once firm age is controlled, small entry firms (<5 employees) and very large firms create more jobs than firms of other sizes. Although they did mention the effects of firm entry and firm exit on job creation, they did not extensively analyze the difference between the firm level analysis and establishment level analysis. To explain the differences in results between their analyses and the analyses done in foreign countries, they stated that Korean industries had special characteristics which resulted in more job creation among smaller firms. However,

[2] Butani *et al*. (2006) used the Business Employment Dynamics (BED) data from the United States Bureau of Labor Statistics to compare firm size classification methods, and they reached the conclusion that dynamic size classification was the most ideal method.

by using different methods for cleaning the data and focusing more on differences between firm level and establishment level analysis, we find results that are more in line with foreign literature. Therefore, in this paper, we will use the Census on Establishments over the period of 2003-2012 to see how the firm age or different firm size classification methods affect the relationship between net job growth rates and firm size with an emphasis on the comparison between firm level and establishment level results.

The rest of this paper is structured as follows. In Section II, we will describe the key elements in the controversy regarding the relationship between firm size and net job growth rate. In Section III, we will describe the data we use for our analysis, explain how we altered the data to prepare for analysis, and describe the model we use for analysis. In Section IV, we will explain the results of our analysis, and in Section V, we will summarize the analysis results and the policy implications of the results.

II. The Issues Regarding the Methodology of Analysis

2.1. Firms and Establishments

Due to a lack of data and problems in classifying firm size and measuring firm size growth rates, previous research has shown inconsistent results. These differing results have led to a controversy in the topic. Specifically, the limitations regarding the amount of usable data led to some research using data on the level of firms while other research could only use data on the level of establishments.

An establishment can be defined as a unit of industry located in one physical location, whereas a firm is defined as a legal entity which owns one or more establishments. These establishments can be located in different geographical locations. Ordinarily, employment statistics are cumulated at the establishment level, while economic statistics are cumulated on the level of firms since investment decisions are made at the firm level. For example, statistics regarding unemployment benefits are managed on the level of establishments, whereas tax revenue is managed on a firm level.[3]

According to Haltiwanger *et al*. (2013), job creation and job destruction can bring confusion when approached from just one angle, so we must analyze data on the

[3] In order to account for cases of firms which own multiple establishments, Neumark *et al*. (2011) uses the term "business" as the general term for firms and establishments. See Neumark *et al*. (2011), p.19. On one hand, an establishment generally refers to a business or industrial unit at a single location that distributes goods or performs services. On the other hand, a firm is typically a business organization or entity consisting of one domestic establishment or more under common ownership or control.

scales of both firms and establishments. From the perspective of change in number of jobs, it is easier to analyze at the establishment level because one can just add or subtract the creation or destruction of the internal jobs of the establishment. However, it is not sufficient to measure the net job growth rate solely using data at the establishment level. This is because one could lose firm level information such as firm size or firm age.[4] Nationwide large discount stores provide a good example of such an issue. Large discount stores usually don't increase the size of the establishments but rather create jobs by creating new establishments. However, such an increase in jobs can be attributed not only to the creation of a new establishment but also to the organic creation of jobs of the original firm.

On the other hand, from an economic standpoint, firms are the relevant unit when making business decisions, so there is more interest in data on the level of firms. However, there is much difficulty in figuring out the net change in number of jobs on this level because change in number of jobs due to takeovers, mergers and divestitures must be considered in addition to the firm's organic change in number of jobs. In other words, changes in number of jobs due to takeovers, mergers, and divestitures may seem like a change in total number of jobs even though it is merely a rearrangement of the jobs that were already there. If firm A were to acquire firm B with no change in number of employees, firm B would disappear and show a decrease in employees, but firm A would have an increase in employees equal to that amount, leading to no overall change in the economy as a whole. Another example would be the case of a firm divesting to create a new firm. If a firm with 100 employees were to create a new firm without employing 10 new people but just moving 10 of its employees to the new firm, a new firm would be created but the level of employment in the economy as a whole would not change.

Therefore, in order to define net job growth rate at the firm level, one must differentiate between the organic change in number of jobs and the change in number of jobs created by takeovers, mergers, and divestitures. Since change in employment levels on a firm level also reflect changes caused by takeovers, mergers, and divestitures, in order to find the net growth in jobs, one must exclude the changes created by takeovers, mergers, and divestitures.[5] To do this, one must consider changes in employment both on the level of firms and on the level of establishments. Firm level data allows for differentiation between changes in employment levels due to changes in jobs at the establishment level and changes in jobs due to changes in ownership, while establishment level data allows for differentiation between organic changes in number of jobs at the firm level and

[4] See Haltiwanger *et al*. (2013), p. 348.

[5] LBD data not only contains information about firm age but also provides information about job creation and destruction on both the firm level and the establishment level. Other data doesn't contain information about firm age, and it contains information about job creation and destruction on either only the firm level or only the establishment level.

mere reallocation of jobs caused by takeovers, mergers, and divestitures.

In order to accurately figure out the net change in number of jobs, we need data in which we can identify both the establishments and the firms. The Census on Establishments fulfills at least these requirements. The Census on Establishments has establishment level time series data from 1994, and since 2003, each entry was given a unique establishment identification number and unique corporation number as well as the founding date for each entry. This information allows analysis of the data on both the establishment level and the firm level.

2.2. Problem of Regression to the Mean

When Birch (1979, 1981, 1987) first published analysis on the correlation between firm size and firm employment growth rate, he used the base year (period $t-1$) as the basis for firm size classification. According to Audretsch *et al*. (2004) and Petrunia (2008), firm size growth rates tend to be negatively autocorrelated. In other words, if firm size in the base year ($t-1$) increases (decreases), then there is a high chance that firm size will decrease (increase) in the current period (t). This autocorrelation has a high chance of creating a negative regression to the mean between the firm size of the previous period ($t-1$) and the firm size growth rate of the current period (t).

Regarding this problem, Davis *et al*. (1992, 1996) suggested the use of average firm size as the basis for firm size classification. In other words, they used the average of the firm size in the previous period ($t-1$) and the firm size in the current period (t). This method does not completely eliminate the regression to the mean problem, but it does weaken its effects. However, the average firm size classification method also has its drawbacks. In the case of a fast growing small business, the firm could be correctly classified as a small business with the previous period firm size classification method, but if the firm grows too fast, it may be wrongly classified as a non-small business when using the average firm size classification method.

Despite being able to reduce the effects of the regression to the mean problem, because of the problems of the average size classification method, Butani *et al*. (2006) suggested an alternative method—dynamic size classification.[6] However, Haltiwanger *et al*. (2013; 349) showed that both the average size classification method and the dynamic size classification method produce similar results, since both share the fact that they take the average of transient effects over multiple

[6] Let's consider the case where there is a firm whose number of employees went up from 200 to 290 in one year, and there are two firm size groups: firms with 250 employees or less (group A) and firms with more than 250 employees (group B). When the firm grows from 200 employees to 250, it belongs to group A, and when it grows from 250 employees to 290, it belongs to group B. Therefore, there is an increase of 50 employees in group A and 40 employees in group B.

periods of time. When we sum up all the previous research, it is evident that there is no agreement as to which classification method is the best. Therefore, in our analysis, we will use both the average size classification method and the base year size classification method and see if they produce the same results.

2.3. Firm Age

Neumark *et al*. (2011) used both the establishment and firm level data, and they used the average firm size classification method to curb the effects of the regression to the mean problem. Using this methodology, they found that even though there was a relatively smaller reliance on small businesses compared to the results of Birch, there was still a negative correlation in the firm size and the firm size growth rate. In response, Haltiwanger *et al*. (2013) stated that in addition to the two aforementioned problems, all the previous research failed to incorporate the firm age problem.

Firm level data and establishment level data can reach different conclusions regarding firm age. When a firm acquires a well-known establishment, it can be viewed as the firm being created from the well-known establishment. Also, if a firm changes its name or address without making any other changes, the firm can be viewed as an entry firm. However, in both cases, the firms were classified as incumbent firms rather than entry firms. Furthermore, the age of the oldest establishment at the time the firm ID (Identification Number) was created was used for the firm's age. Even if a firm acquired an establishment which was older than all of the firm's previous establishments, the age of the firm was not changed. On the other hand, when an establishment with the oldest age was divested or closed down, this did not affect the age of the firm. Firm IDs which were created by a change in ownership were not classified as newly founded firms. Similarly, firm IDs which disappeared through changes in ownership structure were not classified as exit firms.[7] In our analysis, we considered a firm in which all of its establishments were entrants as an entry firm, and when all the establishments of a firm were eliminated, we considered that firm as an exit firm. When there was no information regarding the age of the establishment, we replaced the firm age with the age of the firm when it first appeared.

[7] See Haltiwanger *et al*. (2013), web appendix, p. 8.

III. Data and Model of Analysis

3.1. Data and Measurement Problems

In the Census on Establishments in Korea,[8, 9] Statistics Korea provides their own unique firm identification numbers of firms for data gathered after 2003. The data before this period only contains the establishment identification numbers. Since our analysis compares firm level data with establishment level data, the data without the firm identification number did not fit our analysis. So, we do not use any data before 2003. Therefore, for our analysis, we used the Census on Establishments data over the period 2003-2012. This allows us to see not only the ownership in specific years, but also the change of ownership throughout time as well as the establishment's firm level employee number.

We used the KSIC one-digit level large classification of Statistic Korea's 9th standard industry classification to differentiate the industry of the firms in our data. The data from 2003 to 2005 was divided according to the 8th standard industry classification, and the data from 2006 to 2012 were divided according to the 9th standard industry classification. Therefore, we standardized the data to use the 9th standard industry classification. Furthermore, we excluded some of the industries from the analysis. The industries we excluded from the final data set were electricity, gas, and waterworks; construction; finance and insurance; public administration; national defense; social security administration, organizations, and associations; repair and other private service; employment within households and self-consuming production activities; and foreign institutions. These industries are public services or self-consuming private services. Our analysis looks at job creation of the private sector, so we excluded these industries.

3.1.1. Measuring firm size and firm age

The firm size was measured by adding up the number of employees in every establishment which belonged to each respective firm. When deciding the base year firm size, we used the firm size of the firm from the previous period $(t-1)$. In the case of newly founded firms in their first year, since there is no observation for the firm size in the previous period $(t-1)$, we just used the firm size of the current period (t). When calculating the average firm size, we used the average value of the firm size in the previous period $(t-1)$ and the firm size in the current period (t).

[8] The Census on Establishments began to provide establishment level data in 1994, and it has been providing firm IDs since 2003.

[9] The Census on Establishments in Korea collects data from 15 February to 10 March, so firms which were created after 10 March and closed down before 15 February of the following year are not included in the census. However, Haltiwanger *et al*. (2013; 352) states that these firms have little effect on the overall analysis despite having high volatility.

In the case of newly founded firms in their first year, we regarded the firm size in the previous year ($t-1$) to be 0, thus [(0+firm size in period t)/2] was used as the average firm size.[10]

Establishment of the firm age for analysis not only has many conceptual problems, but is also very difficult to measure. In our analysis, we used the bases of Becker *et al*. (2006) and Davis *et al*. (2007), and we applied the methodology of Haltiwanger *et al*. (2013). Our basic principle for firm age establishment is as follows. When an establishment is first observed with a new firm ID, we set the firm age of that establishment and its firm to be the establishment age of the oldest establishment with the same firm ID. We used this method because it allows us to define the entrance and exit of firms with consistency and ease. In the case of an entry firm, the firm's age is 0. Similarly, a firm death is defined as the case where a firm ID disappears and all of the establishments associated with that firm ID cease operations and exit the database

The Census on Establishments in Korea provides the self-reported founding year of each establishment, but several observations include missing values or recording errors, so we had to modify the firm birth year to set the firm age more accurately. When we calculate the establishment age, for cases which had a self-reported founding year before 2003 and there were no errors in the observation, we use the self-reported founding year as the birth year for establishment age calculation. For establishments which were created after 2003, we set their entry year as the establishment's birth year. However, if the entry year within the data and the self-reported founding year had a difference of 3 years or more and we could not find the accurate age through other observations, we exclude the establishments from our analysis. Also, when the difference was 3 years or less, we regarded the year of the first observed firm ID as the firm's founding year. In other words, the age of such firms were regarded as 0.

The self-reported founding year is sometimes different among observations for the same establishment due to recording errors in the data. For these special cases, we use the founding year that was the most common within the establishment observations. If there is a tie among the frequency of the founding years, we use the oldest year out of those years with the highest frequency. In cases where we cannot figure out the proper founding year despite these rules, we exclude the establishment from the analysis. For the firm level analysis, we use the establishment age recorded in the observations.

However, when a new firm ID is observed, that firm's age is not necessarily 0. One example is when two incumbent firms merge to create a new firm. When it is possible to observe the age of the establishments which constitute the new firm, the

[10] See Haltiwanger *et al*. (2013), p. 353. When setting the base year firm size of newly created firms, Birch and other researchers used the firm size of the current period (t) as the base year size.

age of the new firm's oldest establishment is considered to be the age of this firm. With this methodology, we were able to measure the size and age of the firms with respect to ownership change in a consistent manner. In cases of pure ownership change with no business activity changes, we made sure there were no spurious changes to the firm size or age.

3.1.2. Identifying the linkage of firms and establishments IDs

When there are missing links in the observations, we use the other observations and assume that the firm continued existing during the missing period. For example, if the same establishment ID existed from 2003 to 2010, but the data for 2005 was missing, we treat the establishment as entering in 2003 and exiting in 2010 rather than treating it as exiting in 2004 and reentering in 2006. However, since there was no observation of employment level for 2005, the job growth rate calculation could have been affected by this missing data. This was an inevitable compromise because there were too many missing links to just exclude these establishments completely. Finally, The Census on Establishments in Korea does not provide data on spin-offs or M&As. In our paper, we used Haltiwanger's (2013) method to create firm data which tracks the spin-offs and M&A statuses of the firms using the firm IDs and establishment IDs. However, since we cannot track the spin-off or M&A relationships and the ownership structure of firms without the firm ID and the establishment ID, we excluded observations which lacked either variable.

3.2. Basic Statistics

[Table 1] documents the distribution of employment by firm size and age during the period of 2004-2012, demonstrating that most jobs were concentrated in old large firms and relatively young and small firms. The statistics presented in this table are annual averages over the period 2004-2012. For example, the interpretation of the number 840,246 in the top left cell in the Table (0 years of age, 1-4 size) is that, on average, new firms employed 1-4 workers 840,246 workers annually between 2004 and 2012. New firms account for 9.08% of all jobs on average, while firms that are younger than 11 years account for approximately 54% in total.

3.3. Model of Analysis

The main reason we used our model is because it allows us to analyze entry firms, exit firms, and continuing firms in a pooled analysis. Since we must simultaneously consider the entrance and exit as well as the growth and shrinkage of firms when analyzing the net growth of jobs, it is most ideal to use entry firms, exit firms, and continuing firms together in our analysis. However, according to Huber *et al*.

[Table 1] Employment by firm size and age – annual averages 2004-2012

	Age category (years)											
Size category	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	over 17	Total # of workers	Share
1-4	840,246	900,264	614,759	472,049	358,549	275,301	204,111	155,198	121,521	410,941	4,352,940	35.78%
5-9	101,788	268,320	192,823	151,611	115,851	89,252	67,805	50,524	38,618	121,295	1,197,887	9.85%
10-19	65,136	158,961	131,711	118,166	99,111	83,016	67,912	51,704	40,005	145,062	960,784	7.90%
20-49	57,310	133,711	118,152	118,223	111,072	100,738	89,869	71,190	57,249	270,067	1,127,581	9.27%
50-99	21,317	67,867	63,942	66,283	64,785	63,943	60,006	49,818	43,544	291,546	793,052	6.52%
100-199	10,408	38,975	39,265	46,491	49,971	53,594	53,769	46,913	41,794	397,588	778,768	6.40%
200-299	1,966	12,569	15,964	17,299	21,148	21,632	24,738	23,940	23,532	246,718	409,506	3.37%
300-500	2,418	9,761	11,690	15,626	16,645	18,587	21,341	23,473	23,445	276,477	419,463	3.45%
over 500	4,450	11,023	14,259	25,191	37,560	39,649	47,918	49,097	53,088	1,842,480	2,124,715	17.47%
Total # of workers	1,105,040	1,601,450	1,202,566	1,030,940	874,692	745,712	637,468	521,858	442,796	4,002,174	12,164,696	
Share	9.08%	13.16%	9.89%	8.47%	7.19%	6.13%	5.24%	4.29%	3.64%	32.90%		

(2013), [11] such analysis has problems not only economically but also econometrically. In our analysis, we use all firms as the subject of analysis, and in order to see if our results are robust, we compare this analysis with analysis of only the continuing firms.

$$g_{it} = \Gamma Z + \sum_{i=1}^{N}(\sum_{s=1}^{S} \beta_s 1[i \in s] + \sum_{a=0}^{A} \gamma_a 1[i \in a]) + \varepsilon_{it} \tag{1}$$

In the equation above, g_{it} represents the growth rate of the average employee number of firm i between period $t-1$ and period t, s represents the firm size group (less than 5 employees, 5-9 employees, 10-19 employees, 20-49 employees, 50-99 employees, 100-199 employees, 200-299 employees, 300-499 employees, 500 or more employees) and a represents the firm age group (0 years, 1-2 years, 3-4 years, 5-6 years, 7-8 years, 9-10 years, 11-12 years, 13-14 years, 15-16 years, 17 years or more). $1[\cdot]$ represents the indicator function, Z represents the dummy vector of the industry and year, and ε_{it} represents the residuals.

In our analysis instead of firm size growth rate $[\ln(y)_{it} - \ln(y)_{it-1}]$, we used the average firm size growth rate. The average firm size growth rate was defined as follows:

$$g_{it} = 2\frac{y_{it} - y_{it-1}}{y_{it} + y_{it-1}} = \begin{pmatrix} -2 & if\ i \in G_x \\ 2\dfrac{y_{it}/y_{it-1} - 1}{y_{it}/y_{it-1} + 1} & if\ i \in G_c \\ 2 & if\ i \in G_n \end{pmatrix} \tag{2}$$

where, y_{it} is firm i's number of employees in period t, and $G_x = \{i \mid y_{it} = 0\}$ denotes eliminated firms, $G_c = \{i \mid y_{it-1} \neq 0$ and $y_{it} \neq 0\}$ denotes continuing firms, $G_n = \{i \mid y_{it-1} = 0\}$ denotes entry firms.

According to Davis *et al*. (1996), although using the difference in log values is the

[11] From an economic standpoint, the estimated values of each group affect the rate of job creation, and it is unconvincing to state that entry firms, exit firms, and continuing firms all have the same rate of job creation. Huber *et al*. (2013) states that existing research about the factors which go into the decision making of exiting firms show that entry firms, exit firms, and continuing firms all have different expected job creation rates. From a theoretical standpoint, it is unlikely for entry firms, exit firms, and continuing firms to have the same expected job creation rate because Jovanovic (1982) stated that while firms which fail to reach minimum efficient scale exit the market, the firms which survive grow fast. From an econometric standpoint, data analysis on all firms will produce biased and inconsistent estimated values. When applying the fully saturated dummy variable model, we can only get an unbiased estimated value regardless of the distribution of the error term when we assume that the average of the error term is 0 (Angrist and Pischke (2009); 48-51), and the probability of the average of the error term being zero when considering the entry firms, exit firms, and continuing firms together is very low. (Huber *et al*. (2013); 4-5)

most common method of calculating growth rates, it cannot be used in this case because the entry firms and exit firms do not have a defined log value at the point of entry or exit. Instead, they proposed the use of average firm size growth rate, which allows for calculation of firm size growth rate of entry and exit firms. The biggest advantage of using average firm size growth rates is that calculation is possible for all observations. Using this method, firm size growth rates at entry and exit are defined as 2 and -2, respectively, and growth rates of continuing firms are defined as a number between -2 and 2.

In our analysis, we use a fully saturated dummy variable model.[12] First, we use the one way dummy variable model while controlling for just firm size or just firm age, and we observe the differences in the relationship between firm size and firm size growth rate when we use base year firm size and when we use average firm size. Then, we use a two way dummy variable model in which we control for both firm size and firm age. In the two way dummy variable model, we additionally control for the interaction term between firm size and firm age. We do this because if we control for firm age and firm size without the interaction term, it is possible for the estimated firm size growth rate to be outside of the range of -2 and 2. In other words, although we used average growth rate with a maximum value and minimum value of 2 and -2, respectively, in order to allow for analysis of entry firms and exit firms, if we use the two way dummy variable model without using an interaction term, the estimated value of a firm age 0 may not be 2. In our analysis, because we additionally controlled for a dummy variable for year and a dummy variable for industry, the estimated value for firm age 0 is not exactly 2 even if we control for the interaction term.

IV. Results

4.1. Firm Size and Net Employment Growth Rate

We explain the results of our analysis graphically. While controlling for the year dummy and the industry dummy, in order to easily compare the model which controls for firm age, firm size, and their interaction term with the model which just controls for one out of the two variables (firm age or firm size), we focus on comparing the relative difference in effect with the baseline group (or omitted group). In our analysis, the base group in firm size analysis is the group with 500 or more employees, and the base group in firm age analysis is the group with firm age of at least 17 years.

[12] Angrist and Pischke (2009) stated that when the dependent variable is bounded, the fully saturated dummy variable model can avoid econometric problems.

[Figure 1] shows the relationship between firm size and net job growth rate on a firm level. Panel (a) shows the results of regression on all firms, and Panel (b) shows the results of regression on just the continuing firms. In Panel (a), we can see that there is a clear negative correlation between firm size and net job growth rate for all size groups on the line which connects the estimates for base year size when we don't control for firm age. The average net job growth rate of the smallest firm size group is 25.8%p higher than that of the group with 500 or more employees. As the firm size grows, net job growth rate decreases monotonically. The average net job growth rate decreased for the 5-10 employees group and 10-20 employees group to 18.5%p higher than baseline and 12.6%p higher than baseline, respectively.

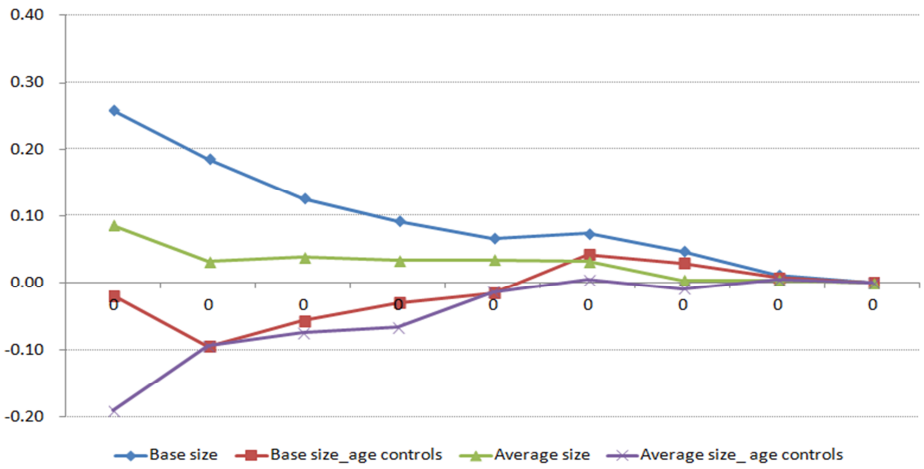
However, as mentioned in the previous sections, using base year firm size to check the relationship between firm size and net job growth rate has some undesirable attributes. Therefore, we must also look at the relationship between firm size and net job growth rate through regression with average firm size rather than base year firm size. If we look at the average firm size estimated value line with no control for firm age, a negative correlation between firm size and net job growth rate persists, but the correlation is much weaker, and the line has a lower slope. When comparing the results of the base year size regression and average size regression with no control for firm age, we can see that the regression to the mean effect was greatest at the smallest firm size group (5 employees or less), and this effect was observed in all the groups with less than 300 employees although the effect became weaker with each larger size group. When we don't control for firm age, we can generally conclude the following: for groups with less than 300 employees, size classification methodology has a large impact on the results. In other words, without control for firm age, a negative correlation does exist between firm size and net job growth rate, but the regression to the mean effect has an impact on the relationship.

On the other hand, when we control for firm age, we find that the relationship between firm size and net job growth rate is very different. When we control for firm age, there is no negative correlation between firm size and net job growth rate regardless of whether we used base year size or average size. When we use base year size, all groups with less than 100 employees show a negative estimated value, and there was only a small negative correlation in the groups with larger than 100 employees. On the other hand, when we use average size, the net job growth rate for all groups is lower than that of the base group. Thus, when we use average size, there is a positive correlation between firm size and net job growth rate for all groups. If we combine the information above, we cannot find evidence to support the claim that firms with smaller size have higher net job growth rate than firms with larger size.

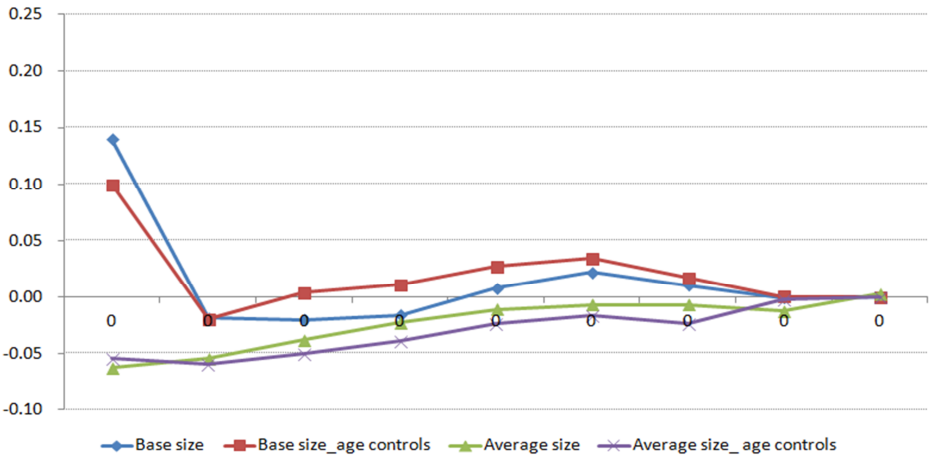
Panel (b) of [Figure 1] shows the results when we restrict the analysis to just the continuing firms. Contrary to the analysis using all of the firms, the effects of

controlling for age are not very noticeable. When using base year size, there is a negative correlation between firm size and net job growth rate only in the groups with less than 10 employees. When using the average firm size, firm size and net job growth rate show a positive correlation regardless of whether we control for firm age, and all the groups have a lower net job growth rate than the base group. In the analysis of continuing firms, we find that firm age does not affect the relationship between firm size and net job growth rate; however, for groups with less than 10 employees, the size classification methodology makes a huge difference in the relationship between firm size and net job growth rate.

[Figure 1 (a)] The relationship between net job growth rate and firm size: All firms

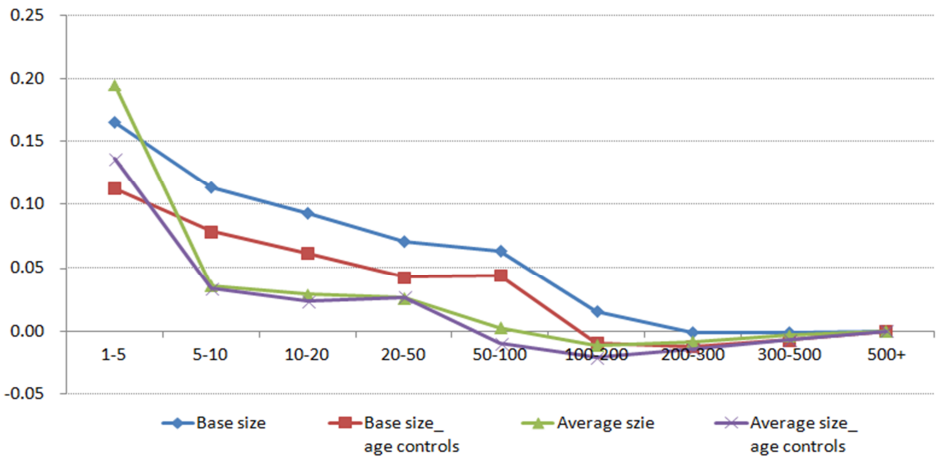


[Figure 1 (b)] The relationship between net job growth rate and firm size: Continuing firms



The difference in patterns between the two panels of [Figure 1] reflects the effects of firm exits. This can be observed in more detail through [Figure 2]. [Figure 2] shows the job destruction patterns of firms by size groups for when we control for firm age and when we don't control for firm age. Job destruction rate caused by firm exit[13] monotonically decreases with larger firm size regardless of the size classification methodology or whether we controlled for age. Therefore, even when we take firm age into consideration, we find that smaller firms have higher exit rates than larger firms.

[Figure 2] Job destruction from firm exit by firm size[14]



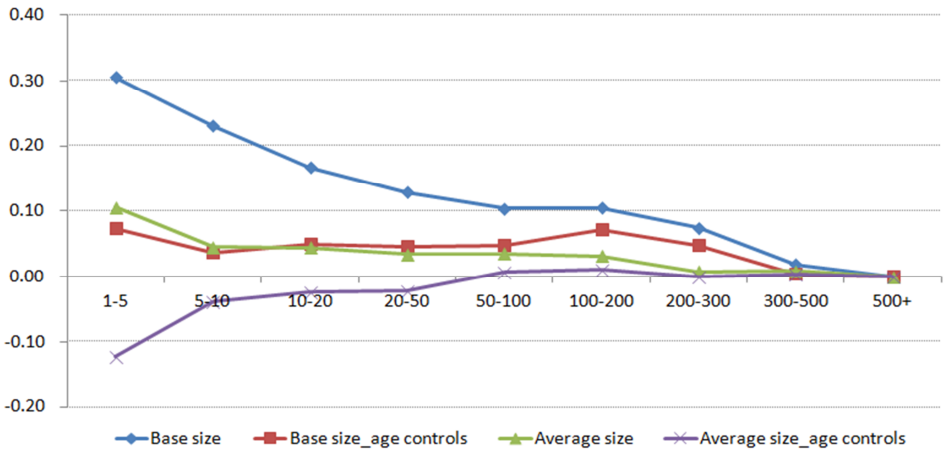
When we combine the results of [Figure 2] with Panel (b) of [Figure 1], it helps us understand the pattern of the part with age control in Panel (a) of [Figure 1]. Panel (b) of [Figure 1] shows that average firm size and net job growth rate are independent for continuing firms when we control for age. When we combine this with the pattern of [Figure 2], in which smaller firms have a higher exit rate, we can find that net job growth rate increases with average firm size when we control for age. Furthermore, in Panel (b) of [Figure 1], when we exclude the group with less than 5 employees, Gibrat's Law seems to stand for the continuing firms. Also, when

[13] Job destruction caused by firm exit can be viewed as the direct weighted average employment of exit firm rate.

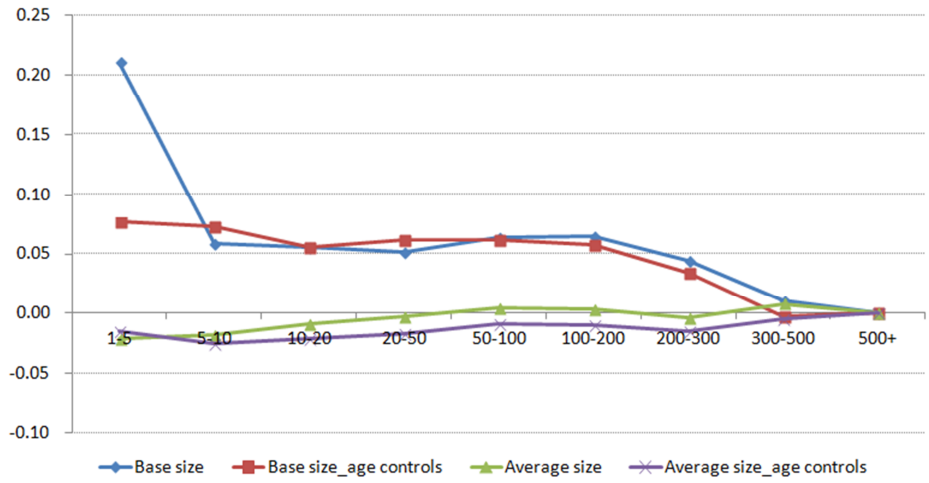
[14] For analysis, we generated a spurious exit firm observation for each which exited before 2012. This spurious exit observation indicates the firm's exit state at that period, and this spurious observation only has the firm ID, establishment ID, size and age ass its variables. We do not give the spurious exit observations an employment value so that they do not affect the other regressions and can only be used for calculating job destruction rates caused by exiting firms. For estimating these job destruction rates, we use the absolute value of the job destruction rates of exiting firms and assign a job destruction rate of 0 to the other firms. Running a fully saturated dummy variable regression using these values as dependent variables allows us to estimate these job destruction rates.

we use average firm size, Gibrat's Law stands for all size groups of continuing firms regardless of whether we control for age.

[Figure 3 (a)] The relationship between net job growth rate and establishment size: All establishments



[Figure 3 (b)] The relationship between net job growth rate and establishment size: Continuing establishments



[Figure 3] uses establishment level information rather than firm level, and it shows the relationship between establishment size and net job growth rate. The net job growth rate levels observed on the graph are overall higher at the establishment level than at the firm level. This means that the difference in net job growth rate between a size group and the baseline size group is larger at the establishment level

than at the firm level for all size groups. This implies that the negative correlation observed between establishment size and net job growth rate is stronger for all establishment size groups than when we use firm level data. Specifically, when we control for firm age, base year establishment size and net job growth rate show a negative correlation with a rather flat slope. This is in contrast with Panel (a) of [Figure 1] which shows a positive correlation for groups with more than 5 employees. Also, when we control for firm age, average establishment size has a positive correlation with net job growth rate. This means that large old firms own many small new establishments. On the other hand, we can see from Panel (b) of [Figure 3] that the results of analysis on continuing establishments is rather similar to the results of analyses on all establishments and on all firms.

4.2. Firm Age and Net Job Growth Rate

Now, we examine the patterns of net job growth rates as the ages of firms increase. For convenience, we will look at just the model for firm age with and without control for firm size.[15] Panel (a) of [Figure 4], which analyzes all the firms, shows the pattern of net job growth rate as the firm age increases. When the firm age is 0, the net job growth rate is about 2, so we excluded this case from the graph.[16] In Panel (a) of [Figure 4], there are contrary results for the relationship between firm age and net job growth rate when we control for firm size and when we do not. When we don't control for firm size, in all sections except for firm age 1-2 years, there is a clear positive correlation between firm age and net job growth rate. On the other hand, when we do control for firm size, there is a negative correlation between firm age and net job growth rate for most sections. Panel (b) of [Figure 4] looks at just the continuing firms, and it shows that the firm age and the net job growth rate are independent for continuing firms. On the other hand, when we control for firm size, there is a clear negative correlation with a pattern that is similar to the case for all firms.

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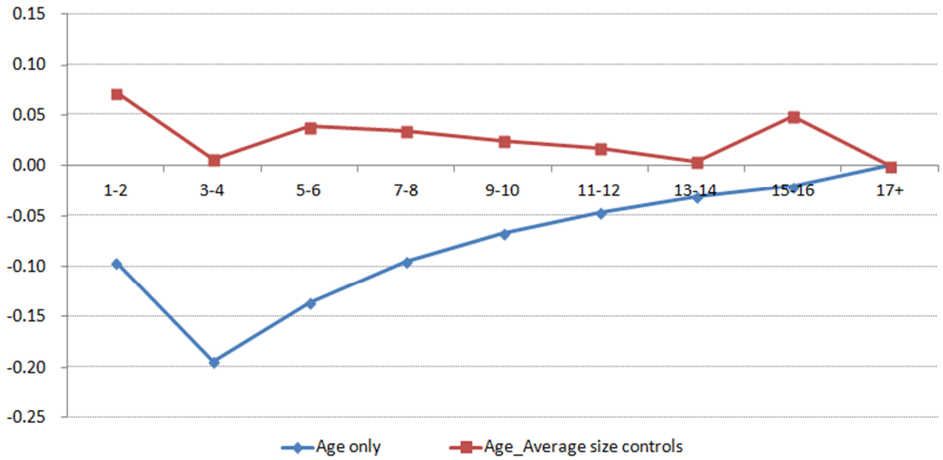
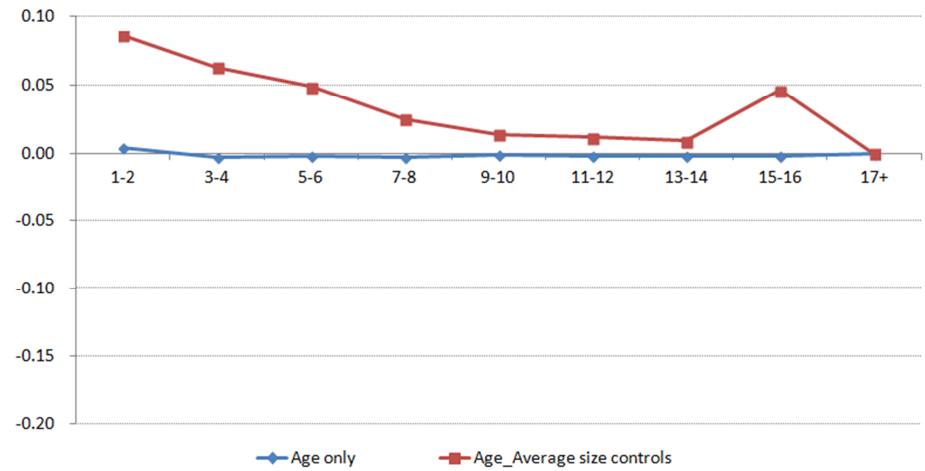
[15] In our analysis, we use the results when we control for the industry dummy variable and the year dummy variable in addition to the base year firm size; for the results when we control only the base year firm size. Estimates for other specifications are available on request.

[16] When using the average employment growth rate, the employment growth rate is 2 when the firm age is 0. When we control for the industry dummy variable and the year dummy variable, the employment growth rate of a firm with firm age 0 is close to 2 but not exactly 2.

[Figure 4 (a)] The relationship between net job growth rate and firm age: All firms

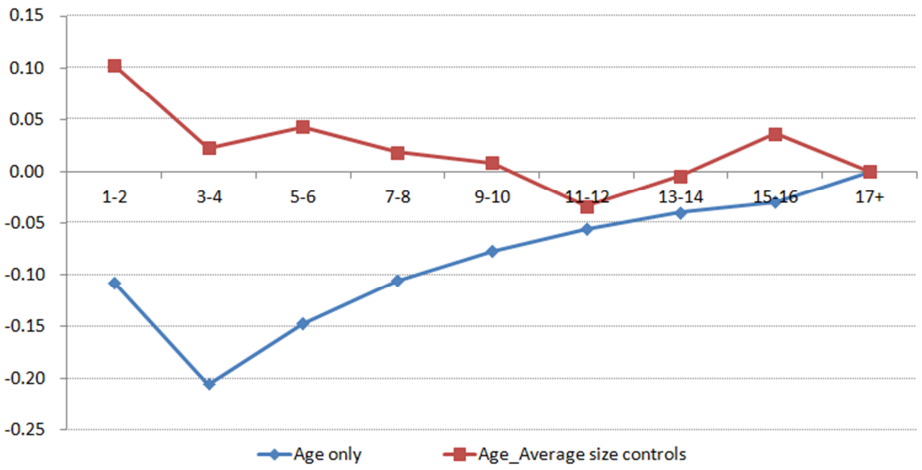


[Figure 4 (b)] The relationship between net **job** growth rate and firm age: Continuing firms

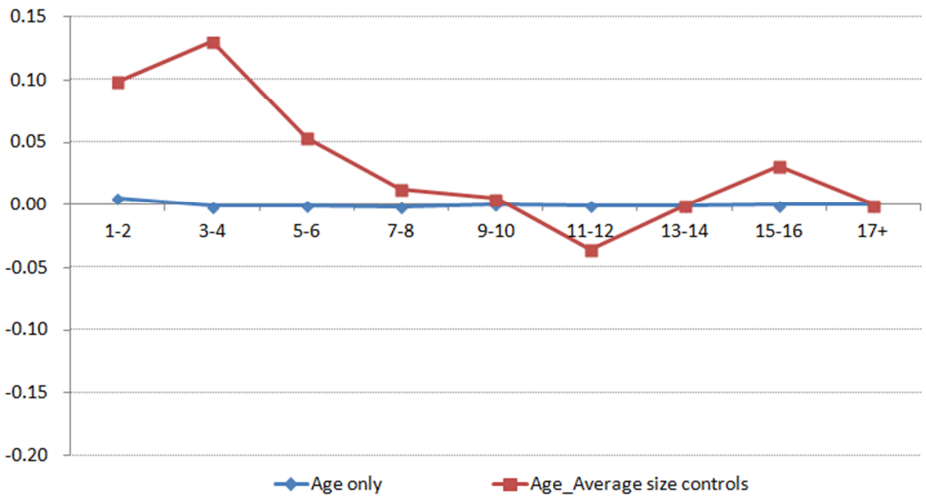


Next, we examine the relationship between firm age and net job growth rate at the establishment level. [Figure 5] shows the relationship between establishment age and net job growth rate on the establishment scale. In the case of continuing establishments without control for establishment size, establishment age and net job growth rate are independent, and it shows a pattern which is similar to the case of the continuing firms without control for firm size. On the other hand, when we control for establishment size, the net job growth rate of establishments under 10 years decreased much more rapidly with establishment age in comparison to the case of the continuing firms with control for firm size.

[Figure 5 (a)] The relationship between net job growth rate and establishment age: All establishments



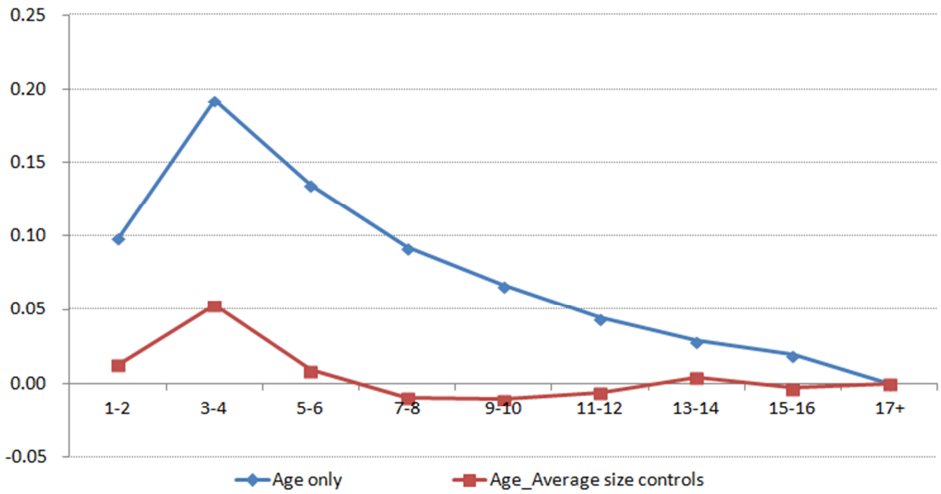
[Figure 5 (b)] The relationship between net job growth rate and establishment age: Continuing establishments



Then, the patterns of panels (a) and (b) of [Figure 4] are combined to examine the relationship between firm age and firm exits. Since both panels of [Figure 4] do not contain entry firms, when comparing the two panels, the only firms which are not included in Panel (b) are the exit firms. [Figure 6] shows the relationship between firm age and destruction of jobs due to firm exits. [Figure 6] shows that without control for firm size, younger firms tend to have much higher job destruction rates due to firm exit than the older firms. Young firms tend to have

higher net job growth rates than old firms, so we can induce that young firms which survive play a major role in job creation. However, when we control for firm size, there is almost no difference in job destruction rate due to firm exit between old firms and young firms. In Korea, regardless of the firm size, young firms tend to have higher firm exit rates, so young firms tend to have higher job destruction rates than old firms. In other words, even when the firm size is large, young firms tend to have higher firm exit rates than old firms.

[Figure 6] Job destruction from firm exit by firm age



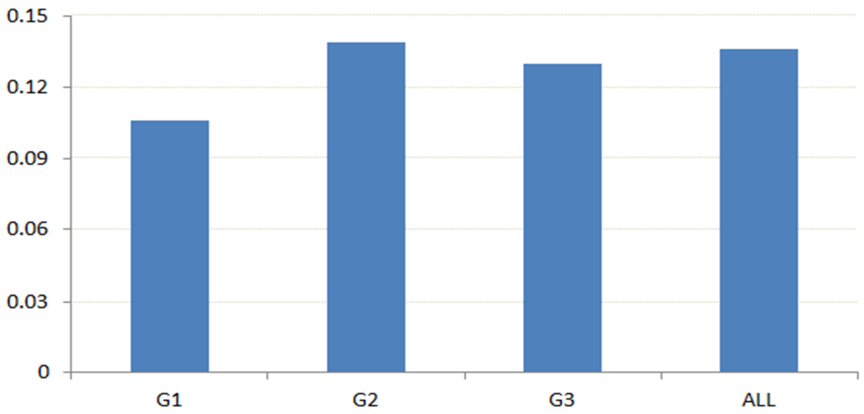
4.3. Relationship between Firm Age and Net job growth Rate by Industry

In the relationship between firm age and the net job growth rate, we find that younger firms tend to have higher net job growth rates than older firms, even though the younger firms tend to have higher firm exit rates than older firms. So it raised the question of whether the relationship is driven by specific industries. It might be possible that the factors that cause the job creation dynamics of younger firms are more important in some sectors than others

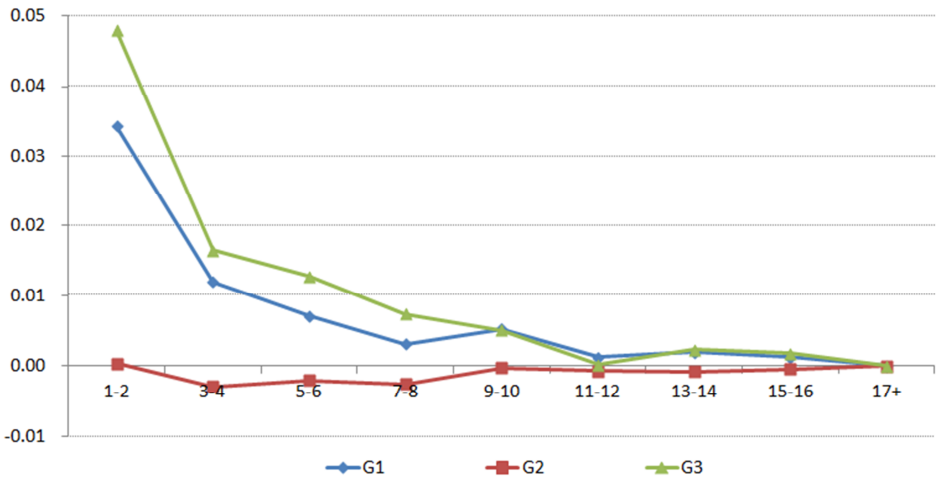
[Figure 7] shows the entry rates of firms when divided into three industry groups based on one digit industry categories—manufacturing industries (Mining and quarrying & Manufacturing industries, G1) , low value service industries (Wholesale and retail trade, Transportation & Accommodation and food service activities industries, G2), and high value service industries(Information and communications, Professional, scientific and technical activities & Human health and social work activities, G3) (G1, G2 & G3 have 19,342,839 observations). The service industries have a higher rate of entry than manufacturing industries, and low value service industries have the highest entry rates out of the three groups.

[Figure 8] shows the relationship between firm age and net job growth rate of the continuing firms for each industry type. While continuing firms in the manufacturing and high value service industries show a negative correlation between firm age and net job growth rate, there is no clear correlation for the low price service industries. Thus, firms in the manufacturing and high value service industries tend to have higher job creation capacities during their early years. To understand why, we examine the firm age and the destruction of jobs due to firm exits for each industry type (shown in [Figure 9]). As [Figure 9] shows, it is likely that high value service industries tend to have higher net job growth rates because the slope of the firm age-job destruction graph was smallest for the high value service industry.

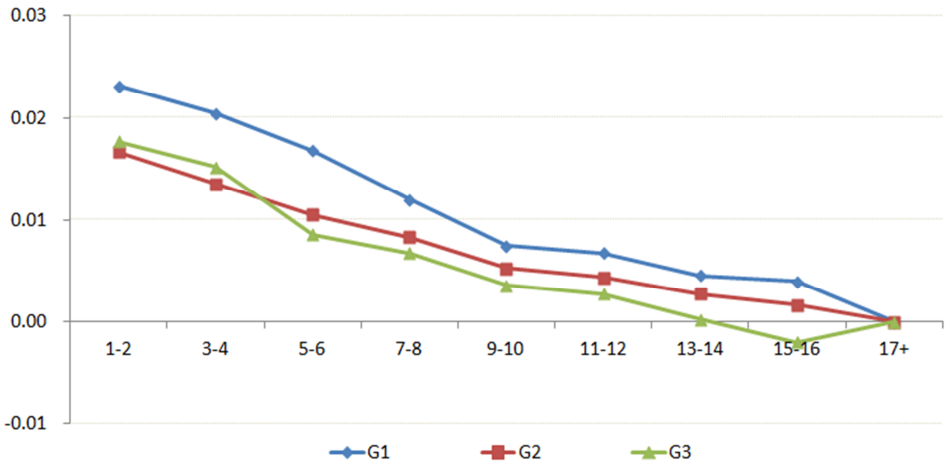
[Figure 7] Firm entry rate by industry



[Figure 8] The relationship between net job growth rate and firm age by industry



[Figure 9] Job destruction from firm exit by firm age for each industry



4.4. Comparison of Net Job Growth Rate Due to Entry and Exit (Between Firms and Establishments)

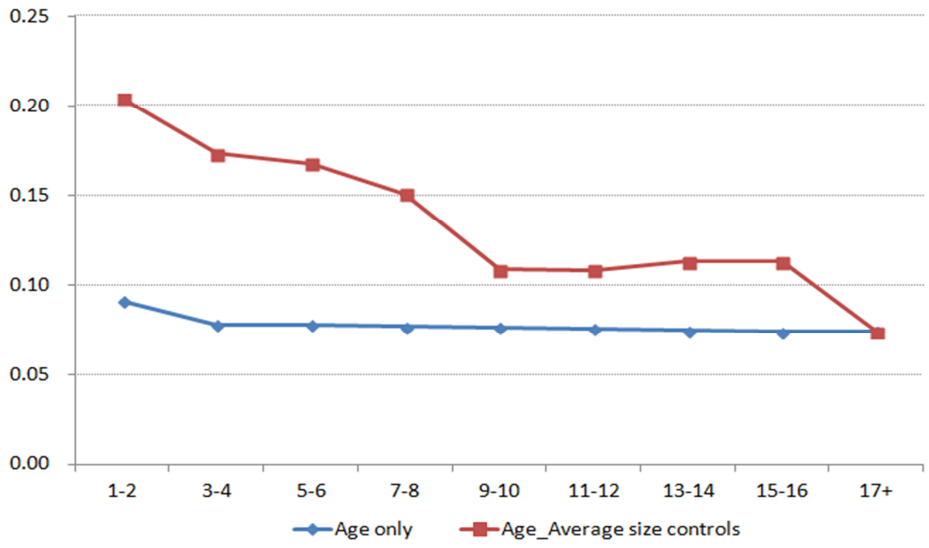
We examine the rate of net job growth rate calculated at the firm level in the case of establishment entry and establishment exit, not firm entry and firm exit.

In Panel (a) of [Figure 10], the rate of net job growth caused by establishment entry tends to decrease slightly as firm age increases, and when controlling for firm size, it decreases at a much greater rate. In Panel (b) of [Figure 10], the rate of net job destruction caused by establishment exit tends to decrease with firm age regardless of whether we control for firm size. [Figure 10] shows that for all firm ages, the rate of net job destruction caused by firm exit is larger than the rate of net job growth caused by firm entry. Also, [Figure 4] shows that newer firms have higher a higher net job growth rate than older firms. This means that newer firms tend to create jobs by expanding establishments rather than creating new ones. Additionally, if we compare [Figure 10] and [Figure 6], we can see that the rate of job destruction caused by establishment exit decreases with firm age at a rate that is smaller than the decrease, with firm age, in the rate of job destruction caused by firm exit. This means that an older firm has a smaller probability of exit than a newer firm, but an establishment which belongs to an older firm has a higher probability of exit than an establishment which belongs to a newer firm.

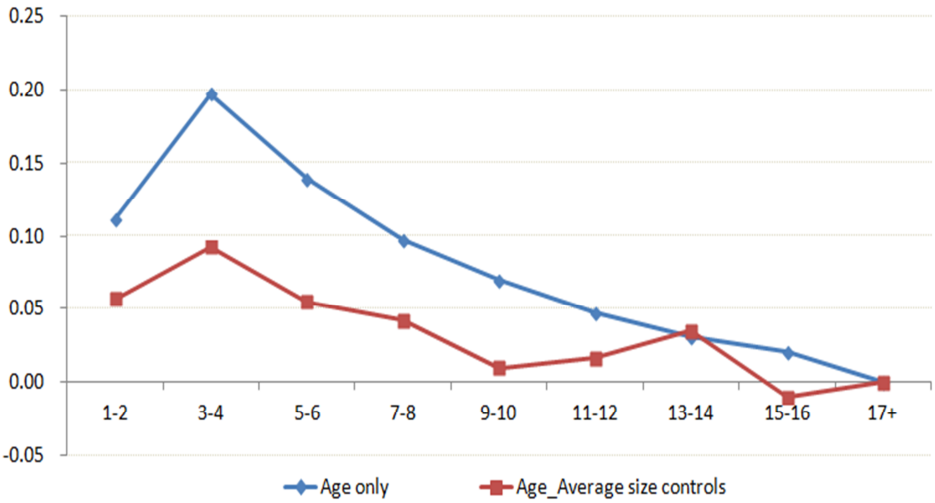
[Figure 11] shows the rate of establishment entry and establishment exit for each firm size. In Panel (a) of [Figure 11], without control for firm age, the rate of job growth due to establishment entry decreases with an increase in firm size, but when we control for firm age, job growth due to establishment entry increases with an increase in firm size. This means that when we control for age, larger firms tend to

expand their current firms by creating new establishments rather than by expanding existing establishments. Panel (b) of [Figure 11] shows that the rate of job destruction due to establishment exit decreases with firm size regardless of whether or not we control for firm age. This means that establishments which belong to smaller firms tend to have a higher rate of exit than establishments which belong to larger firms.

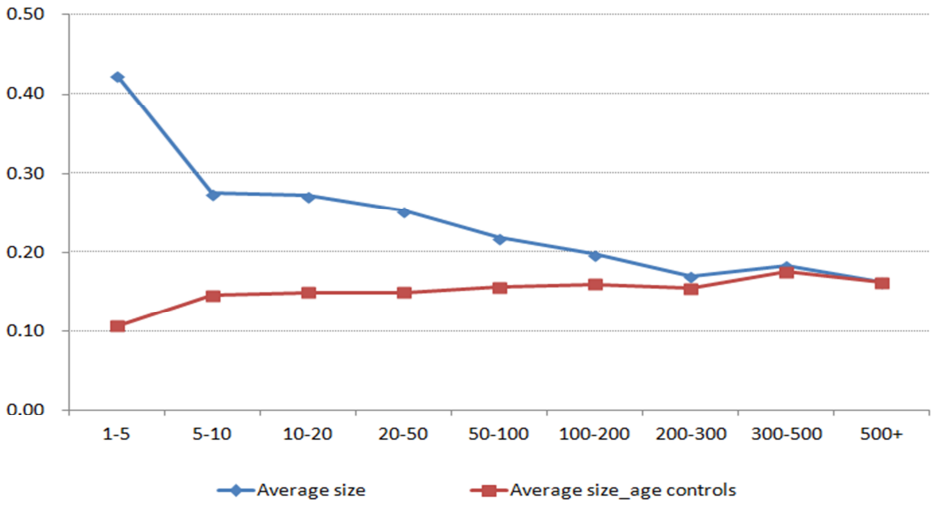
[Figure 10 (a)] Job creation rate from establishment entry by firm age



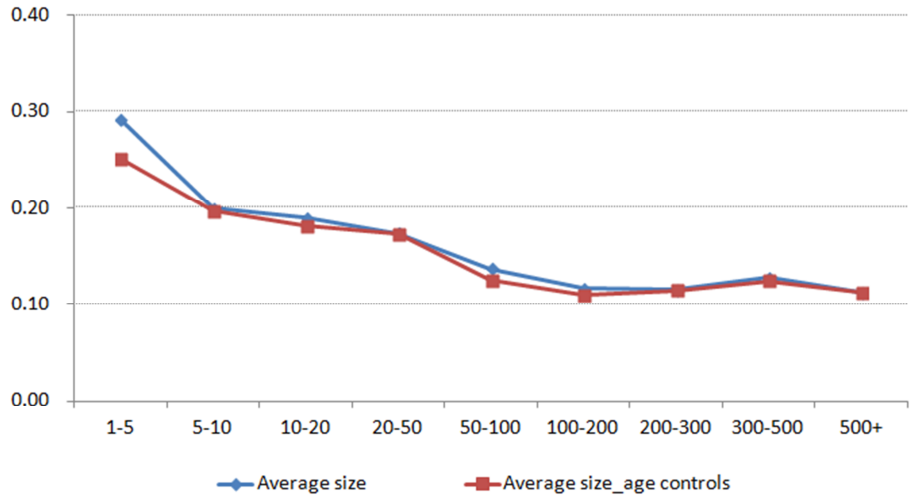
[Figure 10 (b)] Job destruction rate from establishment exit by firm age



[Figure 11 (a)] Job creation rate from establishment entry by firm size



[Figure 11 (b)] Job destruction rate from establishment exit by firm size



V. Conclusion

There is a widespread belief that small businesses create more jobs than large corporations. This is considered common sense not only in Korea but also in many developed countries like the United States. This belief has been backed with many analyses including the research done by Birch (1979). However, Haltiwanger *et al*. (2013) showed that when controlling for firm age, this negative correlation between

firm age and net job growth rate did not stand and sometimes even showed a positive correlation. In this paper, we use the Census on Establishments data over the period 2003-2012. Initially, when we do not control for firm age, there is a negative correlation between firm size and net job growth rate. When we use average size instead of base year size, the effect does become weaker, but we still observe a negative correlation, similar to that documented by Haliwanger *et al*. (2013) in the U.S. However, once firm age is controlled, the negative correlation between firm size and net job growth rate is nonexistent, and in some cases there is even a positive correlation.

Although the sign of the correlation is the same even when we use establishment level data instead of firm level data, the establishment level data shows a much weaker correlation than the firm level data. Furthermore, when we use base year establishment size with control for firm age, establishment size and net job growth rate have a negative correlation. This is quite different from the firm level analysis which shows a positive correlation between base year firm size and net job growth rate. One possible explanation for these differences in correlation is that smaller establishments which are part of a bigger firm have a higher net job creation effect than small standalone establishments.

We also extended the comparison between firm level analysis and establishment analysis to firm age and establishment age in order to see if those analyses also showed differences in correlation. Once firm size is controlled, we document a negative correlation between firm age and growth; young firms tend to grow the fastest and contribute the most to net job creation, in spite of their higher exit rates. However, this negative correlation is found in both the firm level analysis and the establishment analysis with only very slight differences in the size of the correlation. The similarity between the two analyses implies that standalone establishments exhibit job creation dynamics similar to establishments that are parts of bigger firms; younger establishments tend to create more jobs regardless of whether they are part of a bigger firm or not.

In Korea, there have been several analyses on this topic. In particular, Cho *et al*. (2015) and Kim (2015)'s analyses yielded results that were slightly different from ours. According to them, once firm age is controlled, small entry firms (<5 employees) and very large firms create more jobs than firms of other sizes. The difference in results is most likely due to the inaccuracy of the dataset, especially the founding year of the establishment. Because the Census on Establishments in Korea is a survey, there are many errors in the data including missing observations and recording errors. Different methodologies in dealing with these errors are likely to be the cause of the differences in the results of the papers. The results that we obtain are similar to the results from Haltiwanger *et al*. (2013) which used American data for a similar analysis. Our results are also similar to the analysis done by Rijkers *et al*. (2014) in Tunisia which is a small developing country.

This analysis focuses on measurement rather than policy. However, this analysis will definitely affect policymaking decisions and provide information which must be considered when making decisions on how to create jobs. For example, compensating small businesses only by firm size and not considering firm age will have large effects on job creation speed. Likewise, job creation policies, which only focus on firm size and not on firm age, will have a much higher chance of failure. Therefore, for efficient job creation, policies must be designed with consideration for firm age as well as firm size.

This analysis focuses only on the amount of jobs. In order to create efficient policies regarding small businesses, we must also consider elements like the productivity and profitability of small businesses and their effects on small business growth. However, due to a lack of data, a more comprehensive analysis on small business growth is not currently possible. Therefore, we believe that there must be more data collection on business activities. Haltiwanger *et al*. (2013) uses administrative data from the United States in their analysis, but in our analysis, we were only able to use a complete enumeration survey. The most important problem with this is that complete enumeration surveys contain much less accurate data than administrative data in regards to firm age. Therefore, for the establishment of rich and plentiful data on business activities, administrative data must be made available for analysis.

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