THE INTERDEPENDENCIES IN THE DYNAMICS OF FIRM ENTRY AND EXIT: EVIDENCE FROM UNITED STATES

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A research project submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF ECONOMICS (HONS) FINANCIAL ECONOMICS

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF BUSINESS AND FINANCE DEPARTMENT OF ECONOMICS

APRIL 2014

DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this research project has been submitted for any support of application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the research project.

(4) The word count of this research project is 13,439 words.

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Date: 18th April 2014

ACKNOWLEDGEMENT

We are the student from the Faculty of Business of Finance (FBF) would like to take this opportunity to acknowledge the contributions of a number of people. This research project could not be done without the support and help from this group of people.

Firstly, we would like to express our sincerest gratitude to our beloved research project supervisor, Dr Eng Yoke Kee for helping us by providing us with useful information and valuable knowledge during the research project. She is a patient, experienced and diligent person. She is willing to sacrifice her valuable time to assist us by supporting us with better ideas, suggestions and feedbacks. She gave us clear direction when we are in trouble. Without her guidance, we would not able to complete this paper.   We would also want to thank other lecturers from the Faculty of Business and Finance that helped us in the completion of this research paper.

Besides that, we would like to thank Universiti Tunku Abdul Rahman. The university gave us a chance to take part in this research project. Facilities such as the library and the online databases were provided by the university.

Furthermore, we also like to thank our group members that given their full commitment to complete this research project. Your effort and hard work were shown on this paper. Last but not least, we would want to express our gratitude to our classmates, seniors, friends and family who motivated and encouraged us along this research.

We appreciate all your help in helping us completing this research project. Without all of you, this research project would not be a success. Thank you very much.

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LIST OF ABBREVIATIONS

ADF   Augmented Dickey Fuller

AIC   Akaike Information Criteria

CLRM   Classical Linear Regression Model

ECT   Error Correction Term

ER   Entry Rate

JB   Jacque Bera

LM   Langrange Multiplier

MAIC   Modified Akaike Information Criteria

MIC   Modified Information Criteria

NAICS   North American Industry Classification System

OLS   Ordinary Least Square

VAR   Vector Autoregressive Model

VEC   Vector Error Correction

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PREFACE

This thesis is submitted in partial fulfillment of the requirement for UTAR Bachelor's Degree in Economics (Hons) Financial Economic for five of us. We have spent 28 weeks to complete this research. Our supervisor for this research paper is beloved Dr. Eng Yoke Kee. We have been doing a lot of brainstorming before we come out with this research topic. The reason we choose to do this research topic is because we have interest to learn and understand more about this topic.

We have spent much time on looking for the appropriate data and employ the right methodology. Soon after we have decided the data and methodology, we begin to study many related journals to help us proceed with the works. Each of us has given full commitment throughout the whole process to complete this project.

It is not easy working on this research, but we are very grateful that Dr. Eng has given us her full support by guiding us and sharing her knowledge with us. Last but not least, we have learned so much and we believe it would certainly benefit us on our future study.

ABSTRACT

This study investigates the interdependence between firm entry and exit from an industrial dynamics perspective. We discuss how entry and exit rates in industrial sectors are influenced by previous exit and entry rates. Economic theory presents two different approaches to influence the interaction of firms' entry and exit, the multiplier effect and the competition effect. This paper intends to investigate which force is the predominant one, for entry and exit patterns, respectively. The empirical analysis is based on data for 7 United States industries at the 2-digit NAICS level, during the period 1977–2011. In the empirical work the study applies a pure time series data approach With respect to entry, the empirical results support the multiplier effect such that entry stimulates future entry is predominant; except for the entry patterns of retail trade, in which having a competition effect such that past exit induces additional entry. With regard to exit, on the other hand, the multiplier effect rules in every industry, implying that previous entry causes subsequent exit and previous exit reduces subsequent exit.

Chapter 1: Research Overview

1.0 Introduction

The transition of firms' entry and exit is closely related to structural change within an industry over the time. The processes of industrial change are in response to two major factors which are, first, economic growth and second, forces that boosting the new firms' formation and the shutdown of incumbent firms. When firms entered or exited an industry, it is important to know whether it will improve the overall attractiveness of industry for new entrants or increase the competition in the industry, which in turn causes further entry of new firms or exit of incumbent firms of the industry. Therefore, in order to understand the industrial changes, it is essential to study and understand relationship between entry and exit.

In recent years, the relation of entry and exit has been widely studied in different context. Naturally, the findings of relationship between entry and exit are different and sometimes contrary to others when studies are carried out in different countries and different industries. Subject to the difference, we included seven industries in Unites States (U.S.) in our study which are agriculture industry, construction industry, manufacturing industry, mining industry, retail trade industry, services industry, and wholesale trade industry.

Given the idea of previous entry and exit will stimulate further entry and exit in the future, we examine the presence of interdependencies between entry and exit of firms in each industry. But why stop there? We further investigate on the underlying forces of new firms' entry and existing firms' exit in each industry. Besides, our study also identifies what forces are determining the exit and entry patterns of each particular industry. For instance, an opening of new outlet might improve the attractiveness of a shopping place to consumers, which in turn

become a magnet for potential new entrants as well as reducing the possibilities that other outlets in the shopping place to shut down. An opening of new outlet on the other hand might also giving the hard time to other outlet by increasing the competition in the shopping place, and thereby act as a means of stimulating the outlets which less competitive to close down.

For the example given above, the study of Johnson and Parker (1994) has given more technical terms to these phenomenons. When previous firms' entry stimulates further entry and reduces exit of firms in the future, it is known as **multiplier effect**. On the other hand, when previous firms' entry stimulates further exit of incumbent firms and reduces new entrants in the future, it is known as **competition effect**. These two opposing forces will be widely discussed in the following chapters.

In our study, we further investigate the interdependencies of entry and exit to examine the predominant forces (multiplier effect and competition effect) for industries in the United States. This study investigates the interrelationship between firm entry and exit on industry level in the United States. As explained by Nobel lecture, James Heckman, about "the evidence on pervasiveness of heterogeneity and diversity in economic life" it can be agreed on that all firms in an industries experiencing enter, growth, shrink and exit in the life cycle of a firm. Entry and exit of firms in an industry is fundamental as it is one of the main driving forces to a country's economic growth.

Despite wide recognition of entry and exit, we have little known of the actual pattern of entry and exit of firms in the United States. Therefore we are going to find out the multiplier and competition effects within several industries in the United States. Besides, it is important for us to know which industries are experiencing the same kind of effects. This is the reason why we include different industries in our research paper. Last but not least, in order to strengthen our aims, we will also going to find out which effect is dominant in the seven industries respectively.

1.1 Research Background

Firms' entry and exit are important parts for structural changes in industries. It is widely recognized and famously introduced by Schumpeter (1942) on his concept of creative destruction. Schumpeter (1942) emphasizes on a concept and mentioned competition aspects of industrial dynamics, the important form for competition comes from cost efficient source of supply, technology innovation, and the effective organization structure. Economic theory presents on firms' entry and exits are interrelated with two different approaches, multiplier effects and competition effects. The competition effect mentions that entry causes future exit. For instance, entry cause exit because of the new firm is more productive and efficient than the incumbent firm. In other way, exit causes reduce in future exit. This is because it weakens the competition within the market which causes the current exit to be reduced. On the other hand, multiplier effects which include the demand side effect and along the welfare for agglomeration caused by entry of firm that may imply more firms to enter. In other words, entry causes more firms to enter. Industries and markets each with its own uniqueness as in barriers where the entry and exits for firms can be expected to be varies in results.

1.1.1 Agriculture industry

The agriculture industry consists of the establishment or formation in which primarily engaged in planting crops, harvesting timber, raising animals, harvesting fish and other animals from a farm. Due to the business nature of agriculture industry, it can be characterized as labor intensive industry compare to other industry.

1.1.2 Construction Industry

The construction industry includes establishments primarily engaged in the building or engineering projects. Construction major activities included new projects, flourishes, modifications and maintenance. The construction industry requires a high degree of architectural knowledge, building skill as well as experience.

1.1.3 Manufacturing industry

This sector incorporates of formations which involving in the transformation of mechanical and chemical raw materials into new products. The establishments in this industry are frequently classified as factories, mills, or plants and can be characterized as massive production industry. Manufacturing formation usually cooperate with other manufacturing establishments to produce and supply their materials for them.

1.1.4 Mining industry

The mining industry primary establishments included crude petroleum extraction firms, and gas mining firms, mine site developing firms, and such. It is widely understood that mining activities include quarrying, rocks extraction and beneficiating, customarily done at the mine site. Similar to agriculture industry, mining industry also can be characterized as labor intensive industry.

1.1.5 Retail trade industry

Retail trade industry consists formation involved in retailing processed goods, generally without transformations, and rendering services needed in the sale of merchandise. It is the last phase in the process of distribution of processed goods. Retailers are practiced to sell merchandise in small amounts to consumers. In compare to other industry, the retail trade requires minimum of skills and cost in the establishment.

1.1.6 Services industry

Service industry consists of the establishment in which involving in provision of services to businesses as well as to consumers. It includes the financial and banking services, accounting, tourism, healthcare services and so on. Hence it is an industry which requires high degree of knowledge and expertise.

1.1.7 Wholesale trade industry

Wholesale trade industry comprises the establishments in which practicing wholesaling merchandise, normally no products transformation and offering services incidental to sell merchandise in a great amount. Wholesaling is practicing an intermediate process in the distribution of merchandise between wholesalers and clients which can be characterized as a long standing business relationship.

1.2 Problem Statement

Since firms' entry and exit are playing essential role in the industrial structure change process, therefore what are the forces driving the transition of firms' entry and exit over the time? By recognizing the interrelation between firms' entry and

exit, and hence we able to determine the forces that contribute to the new firms formation and also the shutdown of incumbent firms; given that we acknowledge what forces are determining the firms' entry and exit patterns in the certain industry, it can provides useful information in the movement of industrial changes. In fact, in related to this issue, the interrelation between firms' entry and exit was widely discussed and studied in literatures, and the empirical researches carried out by previous researches have boundlessly contributed to the policymaker by providing useful information regarding industrial change process.

In our study, we use different sectors to examine the interdependency of entry and exit as we believe different industries may has their own pattern of entry and exit. That is what motivates us to find out the forces contributing to structural change within each industry. Based on previous studies, they only look at one industry to determine the interrelationship of firms' entry and exit. In our research, what we are doing is to extend the research from previous studies. This helps policy makers to reevaluate current economic policies and also carrying out effective policies to solve current problems related to industries' entry and exit.

Moreover, the similar previous study done by (Johnson and Parker, 1994) in the United Kingdom's retail trade industry and where results are inconsistence and even contrary to and (Kangasharju & Moisio, 1998) in which the empirical study is done by using United States aggregate data. In general, different industry may be subject to the influential behaviors of each individual industry Therefore the expected interrelationships between firms' entry and exit is different from industry to industry. In other words, we cannot conclude the interactions of firms' entry and exit in each industry based on aggregate or even one industry.

Besides, we observe inconsistence of findings in between the previous studies by which using the same panel data empirical study. For example, Nyström (2007b) was using the dynamic panel data, her study's result shows that the competition effect is predominant in explaining the both firms' exit and entry patterns of Swedish manufacturing industry.

Recently, however, Resende, Ribeiro and Zeidan (2013) conducted a similar empirical research on the entry and exit linkages in the Brazilian manufacturing industry using panel data of entry and exit rates in 10 years period from 1996-2005. The study shows that the multiplier effect is the dominant force in explaining the firms' entry and exit patterns for Brazilian manufacturing industry. Therefore, we suspect the accuracy of employing the panel data approach in examine the time specific effect for the interdependencies of firms' entry and exit.

Furthermore, Dunne, Roberts and Samuelson (1988), Johnson and Parker (1994) and Nyström (2007b) have pointed out in their study said that the empirical work on firm's entry and exit conducted in the past has been lagged behind theoretical developments mainly because of the insufficient time series data collected. It leads to unconvincing result to prove the relationship of entry and exit. As a result, we address the above problem by using the pure time series to examine the interrelation between firms' entry and exit instead of using the dynamic panel data. The sample size of a panel data is insufficient for a more robust result, thus we will carry out our research with pure sufficient time series data of 35 years from 1977-2001. Furthermore we conducted our research on 7 main sectors of the United States.

1.3 Research Objectives

Many researchers have conducted series of test and research regarding the entry and exit of the firms in different time period and comprehensive data sets. Now, our objective is to improve the studies of previous researchers on interdependencies between firm entry and exit. However, we do not only focus in one industry but several industries in the United States.

1.3.1 General Objective

To specify our aim in the research, we focus on enhancing the previous researcher's model and make it into a more efficient model. Our goal is to use pure time series approach to provide readers with a better understanding of interdependencies between entry and exit by using seven industries in the United States.

1.3.2 Specific Objectives

To make our objectives more specific, we would like to focus on several industries on our research. There are three main objectives in our research.

1. To determine the interdependencies of industries' entry and exit.
2. To identify the presence of multiplier and competition effects in each industry.
3. To determine which forces (multiplier or competition effects) is more dominant in explaining the exit and entry pattern individually.

1.4 Research Question

To further extend our research objectives, we wish to clarify several questions that will be established in our research. The first question arise from our research is whether there is an interrelation between firms' entry and exit. Secondly, whether the multiplier and competition effect are exists to explain the exit and entry patterns of each industry. The last question and also the third question is which effect (multiplier or competition) is more dominant in explaining the exit and entry patterns of each industry.

1.5 Hypothesis of the study

Four basic hypotheses are drawn from our research. Firstly, we hypothesized that there are interdependencies between industries' entry and exit. Secondly, we hypothesized that there are multiplier and/or competition effects in each industry.

Thirdly, we hypothesized that the competition effect is more dominant in explaining the entry patterns of an industry. Lastly, we hypothesized that the multiplier effect is more dominant in explaining the exit patterns of an industry.

The third and fourth hypothesis is formed based on the Johnson and Parker (1994) which suggesting the competition effect is determined the birth of new firms and the multiplier effect is determined the death of existing firms.

1.6 Significance of the study

This empirical study contributes to the existing literature on the interactions of firms' entry and exit by investigating the influential of multiplier effect and competition effect to the on the basis of 7 United States' major industries data which is having the longest time period compare to previous studies. The findings of our study will benefit the policymakers who intend to achieve higher new firms formation as well as reducing the likelihood of incumbent firms to quit in each industry. In response to the predicted industrial changes due to the firms' entry and exit, policymakers able to assess and develop the economic policies effectively to achieved their target. In other words, the extension on including seven U.S. major industries to the study due to expected dynamic relationships between firms' entry and exit are different form industry to industry. Therefore, this study has ultimately benefited the policymakers and entrepreneurs to have better

understanding about the structural industrial change for each industry in the United States.

Methodologically, our study's contribution has extended the previous studies by using the pure time series regression, which was developed in order to fully investigate the time specific effects. The study is using a long time series data which overcome the sample size problem that arose in previous studies. Firms foundation takes years as well as the firms will not exit the industry immediately when the firms are making losses; therefore, by having a long time period data we can fully investigate in response to the event of previous firms' exit and entry, how long does it takes to effect the future firms' exit and entry.

1.7 Chapter layout

Literature review is presented on the Chapter 2 to provide a comprehensive review of published sources from different perspective on this topic. Following that, Chapter 3 will be the methodology of our research. Chapter 4 presents the data analysis from our research that helps us to achieve our objectives. The last part of the paper, which is Chapter 5, we will come to discussion, conclusion and implication of the research topic.

1.8 Conclusion

Soon after we come out with the title of our research, we begin to identify the problem statements, objectives and significant of studies. What differentiate us from previous researchers is that we look more in depth of the entry and exit of

industries from the United States. We examine it with multiplier and competition effect to detect which forces is more dominant in explaining the firms' exit and entry patterns. We believe our studies will be useful to the future researchers in this area of research. In order to have in depth studies of our topic, we will then proceed with the literature reviews in chapter 2.

Chapter 2: Literature Review

2.0 Introduction

Due to the fact that entry and exit act as a vital role to the industrial changes several studies on entry and exit have been done by the researchers worldwide, conducted in many countries by using different sources of data and various kinds of methods. Indeed, existing literatures supports firm births and deaths are interrelated. In recent years, quiet a number of empirical literatures and experiential works are focused on the interdependency of firms' entry and exit; and the concept of competition effect and multiplier effect are widely discussed.

2.1 Review of the Literature

Dunne, Roberts and Samuelson (1988) suggests a positive correlation between entry rates and exit rates for U.S manufacturing industries specifically entry rates in previous period are positively correlated to the exit rates in next period. This has led us to further the study by investigate the interactions of firms' entry and exits across different industries. In related to investigate the interactions of entry and exit, Mayo and Flynn (1989) conduct the Granger approach to test the causality between firm entry and exit for manufacturing and non-manufacturing industries in Knoxville, U.S. Indeed, they found strong evidence of bidirectional causality in firm entry and exit.

However, Agarwal and Gort (1995) suggest that the stage of products is a key in explaining entry, exit and survivability of firms. They further suggest that the survivability of firms depends strongly on firms attributes. For example, in related

to product life cycle, new entrants with high technology products are having higher survival rates compared to incumbent firms in new market (early stage of product life cycle). In this sense, the linkage between entry and exit is strongly proved that the mortality of existing firms is high due to entry of competitive firms.

In the theoretical study of Geroski (1995) suggest that high entry rates are frequently followed by high level of innovation and efficiency. On the account of high entry rates, there are two opposing impacts are being explained. Firstly, new entrants with higher technology and efficient will cause the incompetent existing firms to quit the market; which in turn can be expressed by high entry rates leads to high exit rates. This suggestion is line with the empirical findings by Lay (2003) which is the new entrants are moderately significant to displace the inefficient existing firms; however there is no new entrants tend to enter and replace the exited incumbent firms.

Secondly, the higher level of technology and efficiency brought by the high entry rates can be linked to higher growth rates of incumbent firms. This can be explained by knowledge and technology spillovers effect. Goreski (1995) suggest new entrants are frequently promotes overall efficiency of existing firms by benefiting them via bringing in new technology, new resources, and efficient organizational structure. This suggestion is consistent with the findings in (Eriksson, 1984) who found that increase in production among industries requires growth of existing firms and increase in new entrants simultaneously. In other words, given that new entrants increases the overall productivity and encourages growth for existing firms, the likelihood of existing firms to exit has therefore decrease.

Empirical study of Baldwin and Gorecki (1991) examine the importance of firms' entry and exit to the Canadian Manufacturing Sectors in the 1970's. They found that the mortality rate among new establishments is higher than the existing firms. Although the new entrants able to prevent further exit of incumbent firms but new entrants contribute to most of the firms' death in the future.

These existing literatures have suggesting the several influential factors that moderating the interrelationships between firms' entry and exits. Johnson and Parker (1994) have then carried out an empirical study on the interrelationships of entry and exit in United Kingdom's retailing sector. Their study has significantly contributes to the existing literatures in the context of interdependencies between birth and death of firms, they recognized two opposing force as moderate variables namely multiplier effect and competition effect that influencing the interrelationships of firms' entry and exit. There are quite a numbers of researchers have extended the empirical study of Johnson and Parker (1994) in different regions and industries, which will be discussed in following sections.

2.2 Review of Relevant Theoretical Models

As mentioned previously, Johnson and Parker (1994) have done a research based on the analysis of the interrelationship between creation and destruction in the United Kingdom retailing sector (1980-1990). The vector regressions (VARs) with panel data were subtly used in order to estimate the interrelations between exit rate and entry. Their results confirmed the presence of multiplier effect and competition effect in the interrelationship of entry and exit. On the top of that, Johnson and Parker (1994) explained that the multiplier effect is generated when past entries creates further entries and reduce exits in the future, as well as past exits creates further exits and reduce entries in the future; the competition effect, on the other hand, is generated when past entries creates further exits and reduces entries in the future, as well as past exits increases entries and reduces exits further in the future.

Interestingly, Johnson and Parker (1994) concluded that competition effect is determining the entry patterns; however the multiplier effect is determining the exit patterns. By using the extended method, Kangarshaju and Moisio (1998) estimated the interactions of firm entry and exit at sub-regional level in Finnish (1989-1993). Methodologically, Kangarshaju and Moisio (1998) used instrumental

variables instead of OLS estimator, the result is completely contrary to the (Johnson and Parker, 1994). In this sense, different time period, methods and regions are the main factors that lead to different result.

Besides, Dejardin (2004) extended the study of Johson and Parker (1994) using Belgium data, the analytical framework incorporates the industrial and cross-industrial dimension of firms' demography. His study suggest that the occurrence of competition effect is more likely for the firms' entry and exit within the same industry; the multiplier effect, however, is more prevail for firms entry and exit from different industries. What has been strongly pointed out is that the multiplier effect is more probable when the conducts of firms are similar and complementary (Dejardin, 2004).

Similarly, Nyström (2007b) has also carried out a study on the interdependencies between entry and exit on industrial perspective which used 2 digit-SIC level of 25 Swedish manufacturing industries from 1991 – 2001. The variables contained in the empirical analysis which are the rates of entry and exit, lagged rates of entry and exit. The beauty of her study is identified which force (multiplier effect or competition effect) are more robust in explaining the entry and exit patterns. But the results are moderately convincing due to short time series and the heterogeneous of data source (Nyström, 2007b).

Interestingly, Lay (2003) focuses her study in Taiwan's manufacturing industry on the on the context of competition effect, which can be expressed as previous producers failure creates more starts-up of plants in the future (replacement effect); and also, previous producers enter increases the failure of incompetent incumbents plants (displacement effect). She found moderate significant displacement effect but insignificant replacement effect for Taiwan's manufacturing industry.

Based on the related existing literatures above, the interrelations of firms' entry and exit are explicitly incorporates the multiplier effect and competition effect. These two opposing effect are originally offered by economic theories and will be widely discussed in following section.

2.3 Proposed theoretical and conceptual framework

Interdependencies of entry and exit suggest that the variations of firms' entry and exit are in response to previous firms' entry and exit. Such interrelations are explained by the multiplier effect and competition effect. These moderating variables (multiplier and competition effect) will be widely reviewed as below.

2.3.1 Multiplier Effect

Starting in the early twentieth century, the concern of industrial dynamics in term of firms' entry and exit is strongly perceived. The agglomeration theory introduced in (Marshall, 1920) suggested that the agglomeration brings positive externalities such as new firm may facilitate industrial dynamics through knowledge and technology spillovers. Such industrial dynamics will encourage new firms formations in the future. In contrast, the agglomeration also may deteriorate the industry structure via the failures of firms which demolished the cooperative relations and opportunities, thereby, creates further firms' failure and decrease new firms formations.

The empirical study of Nyström (2007a) suggest that, in term of closed economies (localization economies), agglomeration is explicitly significant to encourage regional new firm formations in Sweden. In other words, an

agglomerate of new firms and existing firms which are protected from foreign rivals are expected to experience a growth in number of firms in the future.

Besides, Pe'er and Vertinsky (2007) found that the persistence of high failure rates of firms will deter new entrants; this finding support the existence of multiplier effect that past firms' exit will negatively affects future firms' entry.

Furthermore, Fritsch and Schindele (2011) investigate the contribution of new firms' formation in German of the time period 1984-2002. The study suggest that the success of agglomeration are depends heavily on the quality of local workforce; thereby, in related to successful agglomeration, the success of new entrants is not based on the expenses of existing firms, but both new entrants and existing firms are likely to be positively related. In this sense, on the account of agglomeration, the previous entry will attract further entry in the future, which once again confirmed the multiplier effect.

2.3.2 Competition Effect

Schumpeter (1942) is perhaps the one of the most having authoritative improvement in this study field, which came out with "The process of creative destruction". In accordance to this concept, the main form of competition derived from the technology innovation, new commodity, cost effective resources and the efficient organization structure. This concept emphasizes about the competition effect of industrial dynamics. It means when a new firms come in, it brings for instance new technology which causes the low tech firms to be replaced and forced to exit the market. It is the competition effect which indicates entry causes future exit. Schumpeter (1942) only focused on how competition effect caused exit in the future in the topic of entry and exit.

The empirical study of Fritsch and Mueller (2008) points out that the new firms formation contributes a greater effect on unemployment through an indirect effect than the jobs created directly from the new establishments. The indirect effect can be explained as increase in new entrants intensifies the competition in the market, and causes the less competitive incumbents to quit, thereby creates higher unemployment rate. Their study is obviously support the presence of competition effects in the entry-exit relationship.

Furthermore, Pe'er and Vertinsky (2007) also suggest that mortality of incumbents increases new entrants, given that the new entrants are more productive. This study is carried out in Canadian manufacturing industry, compare to (Lay, 2003) which carried out in Taiwan's manufacturing industries; Pe'er and Vertinsky (2007) found an insignificant replacement effect (exits creates further entry), but the Lay (2003) did not. Anyway, their studies are both support the presence of competition effect.

2.4 Hypothesis development

(Johnson and Parker ,1994; Kangasharju and Moisio, 1998; Dejardin, 2004; Nyström, 2007b) carried out several researches in studying the interaction of firm's entry and exit over a particular historical period, in different regions, and different industry, as well as vary analytical framework. Thereby we formed our first hypothesis:

H1: There are interdependencies between entry and exit.

The interrelations of firms' entry and exit are influenced by multiplier effect and competition effect which can be explained by the nature of industrial economics (Johnson and Parker, 1994). Therefore, we form our second hypothesis accordingly:

H2: The competition and multiplier effect are presence in the interaction between firms' entry and exit.

In term of entry-exit relationship, the presence of competition effect can be expressed as, previous firms entry will displace the less competitive incumbent firms; also, the previous exit of incumbents will replace by new entrants. Johnson and Parker (1994) found that the competition effect is the determinants of firms' exits. By which we have developed our third hypothesis as below:

H3: The competition effect is more dominant in determining firms' entry patterns.

The agglomeration theory introduced in (Marshall, 1920) suggests that the multiplier effect is taking place in the event of previous entry of firms will stimulate more firms to enter; and past exit of firms will create more firms' failures. Johnson and Parker (1994) found that the multiplier effect is the determinants of firms' exits. By which we developed our fourth hypothesis as below:

H4: The multiplier effect is more dominant force in determining firms' exit patterns.

Collecting the opinions and suggestions of existing literatures, one might expect that interactions of firms' entry and exit are vary significantly between different industries, regions, and employed analytical framework. As strongly suggested in most of the previous researches, we are using a long time series data (35 years) in order to fully investigate time specific effects in the interrelationships of firms' entry and exit. Additionally, we investigate the interdependencies of firms' entry and exit of seven individual main industries of United States.

2.5 Conclusion

In nutshell, we can see that many researchers have done studies about interrelationship of entry and exit. Although this topic has not been widely discussed, but the different concepts, theoretical framework and economic modeling have been introduced by previous researchers into this topic area. Importantly, Dunne, Roberts and Samuelson (1988), has first introduced to the idea of interdependencies of entries and exits; the study of Johnson and Parker (1994) support the presence of multiplier effect and competition effect in the interdependencies of firms' birth and death; Nyström (2007b) examined which forces (multiplier effect and competition effect) is predominant in the interrelationship between entry and exits. We are keen to further studies the interrelationship between entry rates and exits rates with pure time series approach, and based on all these previous researches, it gives us an insight and better understanding into our research area.

Chapter 3: Methodology

3.0 Introduction

We retrieved the data from United States Census Bureau of Statistic, the reliability and accountability of the data sources is unquestionable. We are using the entry rates and exit rates according to industry to investigate the interrelations between firm's entry and exit for each selected industry.

There are two opposing effect that influential to the firm's entry and exit, which are multiplier effect and competition effect. These significant effects will be widely discussed in this chapter. Given that we have possessed the longest time series data of firms' entry and exit rates, our empirical strategy is to use the pure time series approach instead of panel data approach in order to fully investigate the time specific effect from interactions between firms' entry and exit. Compare to the previous similar empirical studies carried out in different via dynamic panel data, the results are different and even contrary.

3.1 Data description

Our data retrieved directly from the database United States Census Bureau of Statistics. The U.S. Census Bureau Statistics is under a principal agency of U.S. Federal Statistical System which is mainly responsible for collects, process, analyzes and publicizes the data regarding of United States' economy. The main objective for the U.S. Census Bureau of Statistics is conducting U.S. Census which is decennial census every ten years. In addition to that they also conduct other census and surveys which included American Community Survey, the U.S. Economic Census and the Current Population Survey. As forth, their published

data are comes from survey using the professional method of collecting and analyzing economic data. They contain first-hand information on the conditions of all states in U.S. The survey mainly is to produce a general view that can be used for comprehensive studies for the U.S social and economic conditions.

After selection of sectors we have to define firms' entry and exits of firms. This step has been conducted by many previous researchers as some may have leads to inconclusive decision. To prevent such catastrophe, we have adapted formula from United States Census Bureau of Statistics. It is as follow:

$$Entry\ rate, NR_{i,t} = \frac{\sum_{s=7}^{35} Entry_{i,t}}{\sum_{s=7}^{35} N_{i,t}} \qquad (1)$$

$$Exit\ rate, ER_{i,t} = \frac{\sum_{s=7}^{35} Exit_{i,t}}{\sum_{s=7}^{35} N_{i,t}} \qquad (2)$$

According to equation (1) and (2) on above, the entry rates, $NR_{i,t}$ are computed from $Entry_{i,t}$ = amount of new entrants divided by the amount of existing firms, $N_{i,t}$, in the industry i at the time t. exit rates, $ER_{i,t}$ are computed from $Exit_{i,t}$ = amount of firms' exit divided by the amount of existing firms, $N_{i,t}$, in the industry i at the time t.

The entry rate is refers to the measurement of new firms entrants in related to the amount of existing firms that in the industry, this also applies to the firms' exit rates. This can also be called ecological approach; therefore, it will be the specific definition on firms' exit and entry rates that will be used in this research paper. Given that our objectives in this research paper is to identify the relationship of firms entering and exiting industry, as mentioned by Fritsch (1997), ecological approach entry and exit of firms are represented by birth and death of firms or plants. Given this explanation, it is in sync with our objectives thus we have chosen this particular method.

We have selected industries with substantial turnover that has contribution to the economy and is important for this study and to be focus for the other studies.

Specifically, the industries under study are selected by following the 2 digit North American Industry Classification System (NAICS) level; they are agriculture industry, construction industry, manufacturing industry, mining industry, retail trade industry, services industry, and wholesale trade industry. These industries under study contain mix of heavy and light industries from observation year 1977 to year 2011 with total observation of 35 years.

3.2 Theoretical Framework

We will discuss the theories underlying in our study, rationale of variables selecting, and the expected outcomes in our study.

3.2.1 Theories Underlying

(Johnson and Parker, 1994) suggest the presence of two opposing forces (multiplier effect and competition effect) in the interdependencies between firms' birth or death and future birth or death of another in United Kingdom's retailing sector.

The multiplier effect can be expressed based on the theory of agglomeration, Marshall (1920). In the event of previous firm entry that stimulate further new entrants in the future, or when previous exit of incumbent firms creates more incumbent firm exit from the industry. It is known as multiplier effect. Generally, they are several effects that may generate the occurrence of multiplier effect. Firstly, the demonstration effect takes place; for example, service industry, the establishment of security guard service firm in the area with high crime rate may lead to other potential new entrants to consider a similar venture. This is because the potential new entrants would establish a new firm in order to meet the need of that market, since they are aware of the market availability or any limitation of existing firms.

Thereby, previous firms' entry stimulates more firms to enter the market. Secondly, there is the income effect. For example, an exit of gigantic manufacturing firm may significantly decrease the income of the area, and hence, the demand of manufacturing goods dwindles, which in turn creates additional manufacturing firms to close down in the future.

The competition effect occurred when the firms' entry causes future firms to exit; or, the exit of existing firms will cause more entrants in the future. For instance, the entrants of more competitive and innovative firms will have more competitive advantage than the incumbent firms in the area and thereby the less competitive firms will be forced to exit the industry. The example above can be expressed as displacement effect. On the other hand, the existing incumbent firms may also encourage future new entrants in at least two ways. Firstly, the closing of incumbent firms may attract potential new entrants by offering lower price of used equipment and other resources. Secondly, the closing down of firms will lead to increase in unemployment. As a consequence, the unemployment labors may have potential entrepreneurs that with the view of to set up new firms. Thereby, increase new firms formation in the future.

3.2.2 Variables

There are two approaches which are the labor market approach and the ecological approach that commonly used by the authorities to compute firms' entry and exit related data. For the labor market approach, it relates the number of labor forces in the industry with the entry and exit rates of firms. Some prefer to use the labor approach due to the approach provided have an instant connection to theoretically entrepreneurship view and the set-up of a new firm as a new firm is formed by the decision of the employee whether to be either self-employed or employed. Workforce can be defined as the potential entrepreneurs (Armington and Acs, 2002).

However, there are some problems and difficulty of this approach is it is ambiguous to allocate the unemployed to different industries since certain amount of them should also be include in the workforce or classify them into potential entrepreneurs (Fritsch, 1997).

On the other hand, the ecological approach refers to the method in which collecting and analyzing the actual number of entry and exit of the firms in the industry. Fritsch (1997) suggest that ecological approach explicitly refer the firms' entry and exit as the birth and death of the population of total establishments. Obviously, the data collected through ecological approach is most suitable for our empirical study since our research focuses on industrial changes

3.2.3 Expected outcomes of studies.

According to the Johnson and Parker (1994), the study summarizes the competition and multiplier effects into Figure 3.1 by demonstrating their expected signs assuming one year lag. There are some studies which had examines the interdependency between the entry rates and also the exit rates follow the study such as Kangasharju and Moisio (1998), Nyström (2007b), and Resende, Ribeiro and Zeidan (2013). However their findings are different from Johnson and Parker (1994) due to the use of different time periods, region under investigation, and also econometric techniques applied. While, our study focuses on the different industries of United States, from 1977 to 2011.

3.2.3.1 Multiplier Effect

Refer to figure 3.1, the phenomenon of multiplier effect can be explained by "demonstration" effect and income effect. The argument for demonstration effect is simple, market entrance signals market

Figure 3.1 Expected Signs for Competition and Multiplier effect
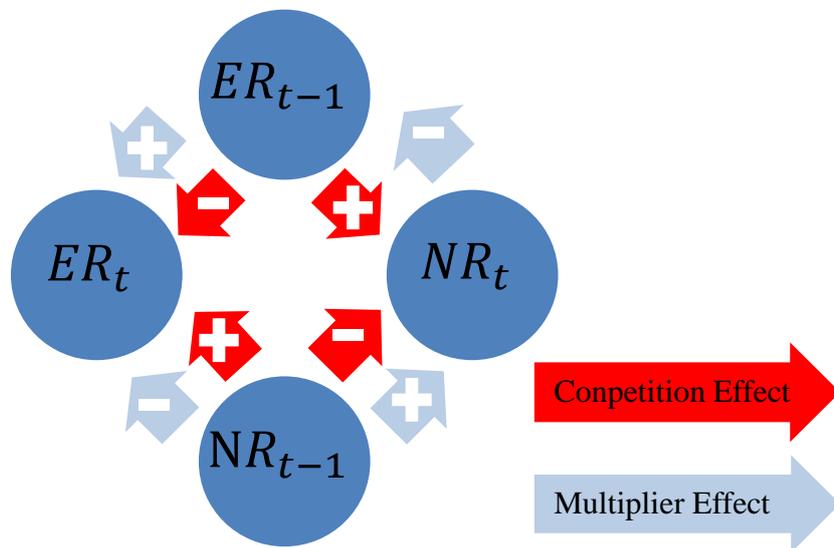
Source: Johnson and Parker (1994)

opportunities to other firms, and creates economies of scale based on the size of the market, one of the main reasons for clustering. It can also link with the technology and knowledge spillovers by (Marshall, 1920) theories on agglomeration. New firms can benefit from enjoying the shared market of skilled labor, knowledge spillovers and also the accessibility of local inputs. On the other hand, Income effect can be explained by new entrants create more incomes for employees and entrepreneurs, therefore increases the aggregate demand, and it attracts new firm entering into the market. As a consequence, the **previous entry can creates further firms entry**.

Similarly, **previous entry negatively affects current exit** also refers to multiplier effect. When more firms entered into a market in the previous period, it will help to generate higher incomes and increased demand, thereby higher the prosperity of the area, which in turn lower the probability of incumbent firms in the area to close down.

Furthermore, when **previous exit negatively affects current entry** is also represents the occurrence of the multiplier effect. Given that the incumbent firms were quit, the income of the area will be significantly reduced followed by weakening of the purchasing power and demand which therefore, leads to discouragement of potential entrants.

Likewise, if **previous exit positively affects current exit** it shows that there is multiplier effect. If a firm exit the market, this imply that other firms will also be affected since the cooperation opportunities is now demolished and other firms will start to aware of survival problem in the particular market. For instance, if one partner firm decide to exit the market, its other partners will get affected and will exit the market too because the cooperation opportunities is disappear. Previous exit negatively affects current exit indicate there is a competition effect. The rationale behind it is when firms exit the market; it weakens the competition within the market which causes the current exit to be reduced.

3.2.3.2 Competition Effect

When the **previous entry negatively affects current entry**; this indicates that there is a competition effect which can be explained by previous increased entry intensifies competition from rapid innovation, therefore, expected to restrain further entry for some period of time. More firms in an industry means higher competition, it will act as a barrier for entry. Besides, talking about production capacity, if there is an excess production capacity it forces the less efficient firms to exit. In addition, when a new firm can produce a more superior good, it increases the profit of the firm. The firm will then be able to pay more for its employee and also for the input prices. This drive up the price of inputs and causes firms who could not afford to pay the high price of inputs and at the same time run a profitable business to exit from the market.

In the event of **previous entry positively affects current exit**, we known that as the competition effect. For example, when a new entrant will outcompete the incompetent existing firms with the relatively higher efficiency, and force incumbent firms to close down. According to Fritsch and Mueller (2008) suggest that increased competition between firms, has causes greater unemployment than the direct jobs creation from new establishments. In other words, in response to firms' entry, more firms will quit later due to more competitive environment, thereby longer the unemployment line. Same goes with the **previous exits causes future exits to decrease**, as some of the existing firms quit, it will ease up the competition within the industry, which in turn fewer firms will have to quit in the future.

On the other hand if **previous exit positively affects current entry**, it implies a competition effect. There are two forms of explanations here. The first is based on "push" factor (Storey, 1994) which explain when firm exits, more people will become unemployed. This could motivate those unemployed to start a new business. The second reason is because when firms closed down, it leads to the availability of various resources that previously own or occupied by previous firms. Therefore potential entrants may take this advantage to enter into the market.

3.3 Empirical Framework

3.3.1 Research Design

Competition and multiplier effects can be tested by assessing the effect of coefficients related to lagged variables. However, it is important to impose strict endogenous assumptions in our regression modelling. Therefore, our model is benefit in the way that we do not need any extensive microeconomics theories to explain the exogenous variables.

Subsequently, by using a pure time series, we also facing several econometric problems the relation of variables in level form is being criticized that they may be facing spurious regression problem. In other words, they may be statistically significant but theoretically meaningless. Spurious regression has high R-squared and t-statistics and appears to be significant but actually they are theoretically meaningless. Therefore the error term may conclude that the t-test, F-test and R-squared values are unreliable and thus the estimated result will be misleading.

In order to overcome the spurious regression problem, we will apply the Engle Granger cointegration method. So, in this study we will focus on ADF unit root method to test the stationary of the variables. We will then need to first difference the data set if it is not stationary in level form. As a result, our objective will be violated when trend pattern is taken into estimation. We must also make sure that we fulfill the Classical Linear Regression Model (CLRM) assumptions to avoid heteroscedasticity, autocorrelation, multicolinearity and misspecification problems.

3.3.2 Augmented Dickey Fuller (ADF) Test

As preliminary analysis, we investigate the T-statistics properties of the series before proceed to the regression analysis. Among the Unit root test, we employ the standard ADF test. The ADF regression are express as follows:

$$\Delta y_t = \alpha + \emptyset y_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta y_{t-1} + \varepsilon_t$$

(1)

and

$$\Delta y_t = \alpha + \emptyset y_{t-1} + \gamma t + \sum_{i=1}^{p=1} \beta_i \Delta y_{t-1} + \varepsilon_t$$

(2)

Model (1) possesses a intercept, τ_μ. Model (2) incorporates an intercept and a time trend, τ_τ. The null hypothesis for ADF test is:

$$H_0: \emptyset = 0$$

with the alternative,

$$H_1: \text{-}2 < \emptyset < 0.$$

Importantly, if the lag length for ADF test is pre-selected without appropriate determination, the t-statistics of the series will subsequently become bias. Ng and Perron (2001) compared the standard information criterion to the Modified information criterion (MIC) in selecting lag length for ADF test, turns out the latter one is outperformed the former one due to the "principle of parsimony". Therefore, we employ the Modified Akaike Information Criterion (MAIC) to select the optimal lag length for the ADF test.

3.3.3 VAR framework

If the series is stationary in level form and it does not violated CLRM

assumptions, we will proceed with Ordinary Least Square (OLS) estimation as VAR framework. Since our objectives are to examine the interdependencies of entry and exit rates and so on, which hypothetically suggest a bidirectional relationship between exit rates and entry rates. The theoretical discussion in this chapter can be made more precise with the help of VAR model, the model can be expressed as the following two equations:

$$ER_t = \alpha + \sum_{l=1}^{m} \beta_l ER_{t-l} + \sum_{l=1}^{m} \gamma_l NR_{t-1} + \varepsilon_{1t} \tag{3}$$

and

$$NR_t = \delta + \sum_{l=1}^{m} \theta_l ER_{t-l} + \sum_{l=1}^{m} \emptyset_l NR_{t-1} + \varepsilon_{2t} \tag{4}$$

Where $\beta_l, \gamma_l, \theta_l, \emptyset_l$ are coefficients to be estimated, ER_t denotes exit rates, NR_t denotes entry rates, ER_{t-l} denotes past exit rate, NR_{t-1} denotes past entry rate, m denotes lag length and t signifies each time period.

In the context of investigating which effect is more dominant, we observe the estimated sign of the coefficients in equation (3) and (4) as suggesting in Figure 3.1, at the same time, the study of Nyström (2007b) points out a simple and straight forward method to indicate which forces is predominant, that is by comparing the magnitude of coefficients.

Table 3.1 Comparison of variables' coefficients

	Dominant Forces
Exit equation, ER_t	
$\quad \beta_l > \gamma_l$	Multiplier Effect
$\quad \beta_l < \gamma_l$	Competition effect
Entry equation, NR_t	
$\quad \emptyset_l > \theta_l$	Multiplier Effect
$\quad \emptyset_l < \theta_l$	Competition effect

Refer to Table 3.2, lets assume the coefficients taken from equation (3) and (4) is positive signed, the magnitude coefficients of previous exit and previous entry explicitly providing the information of which force is greater or it is more dominant than one another in each equation.

3.3.4 Engle-Granger Approach

If the series is non-stationary in level form, we will examine the series at first difference with ADF model with intercept and without trend. If the series are I(1), we will conduct cointegration test using Engle-Granger 2 step approach to identify whether there is a long run equilibrium relationship between two series.

Engle-Granger (1987) suggest that if two series are sharing a common trend, there might be not spuriously related, furthermore, we can establish a long run equilibrium from the related series by using a cointegration test. They consist of two steps.

Step 1:
$$Y_t = \beta_0 + \beta_1 X_t + u_t \qquad (5)$$

Step 2:
$$\Delta e_t = \emptyset y e_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta e_{t-1} + v_t \qquad (6)$$

The hypothesis testing for Engle-Granger cointegration test are as below:

$H_0: \Psi = 0$ (unit root: no cointegration)

$H_1: \Psi < 0$ (stationary: cointegration)

The t-statistics of **ψ** as the in case of ADF test is based on a non-normal distribution. If the t-statistics is lower than the critical value provided by MacKinnon (2010), the hypothesis of no cointegration will be rejected. In other words, the series are cointegrated. If the variables are cointegrated, we can examine the interrelation between them using a VAR framework in Vector Error Correcting Model (VECM). The equations are as follow:

$$\Delta ER_t = \alpha + \sum_{l=1}^{m} \beta_l \, \Delta ER_{t-l} + \sum_{l=1}^{m} \gamma_l \Delta NR_{t-1} - \lambda \hat{u}_{t-1} + \varepsilon_{1t} \qquad (7)$$

and

$$\Delta NR_t = \delta + \sum_{l=1}^{m} \theta_l \, \Delta ER_{t-l} + \sum_{l=1}^{m} \emptyset_l \Delta NR_{t-1} + \rho \hat{u}_{t-1} + \varepsilon_{2t} \qquad (8)$$

The error correction coefficient, λ and ρ are called adjustment coefficient or error correction term. It tells us how equilibrium takes place or how much the equilibrium error is adjusted each period. Interestingly, the ΔER_t in the equation (7) negatively adjusted (falls) towards long run via a negative error correction coefficient (λ); however the ΔNR_t in the equation (8) positively adjusted (rises) towards long run via a positive error correction coefficient (ρ); both simultaneous adjustment ensures the error correction.

3.3.5 Rewrite from VEC to VAR form

After we collected the error coefficient terms, we rewrite the VEC model to the VAR form in order to examine the sign and magnitude of the coefficients in the entry and exit equations (Refer to Appendix 4.2).

3.4 Conclusion

In the summary of this chapter, for theoretical framework we have theories underlying in our study of interdependencies between firms' entry and exit; those are multiple effects and competition effects. After the underlying theories, data of variables are collected using ecological approach is briefly explained. Later, discussion of expected outcome of studies are created based on summarize of empirical result from several previous studies. Then, focus will be on the econometric techniques applied to test the interrelation between firms' entry and exit. With all those in mind, we have proposed an appropriate empirical framework in order to test our hypothesis.

Chapter 4: Empirical results

4.0 Introduction

This study adopted an appropriate pure of time series methodology to fully investigate the interactions between firms' exit rates and exit rates of United States' industries over the time (1977-2011). The industries under study are select follow the 2-digit NAICS level, namely, agriculture industry, construction industry, manufacturing industry, mining industry, retail trade industry, services industry, and wholesale trade industry. After discussing the descriptive statistic, the unit root test results are summarized and discussed. The Vector Autoregressive (VAR) estimation and Vector Error Correction Model (VECM) estimation results are presented next.

More importantly, after the VAR estimation and VECM estimation, we collect the coefficients from the entry and exit equations of each industry and compare its estimated signs and magnitude in order to examine the hypotheses of the study.

4.1 Descriptive statistics

Table 4.1 summarizes the descriptive statistics of the variables used in the regression for each sectors and industries under study.

The highlights from observing the average value of exit rates and entry rates, we can see that the entry rates are greater than the exit rates for almost all the industries over 35 years. In other words, on average, the number of new firms' formation is greater than the number of incumbent firms closing down over then time (35 years). A greater new firms' formation take place in industries will

stimulates economic growth by more jobs creation. Hence, we can conclude that all industries under study are healthy.

As we mentioned in Chapter 1, the manufacturing industry and wholesale trade industry are characterized as having a long standing cooperative relationship with other similar establishments, and thus the firms from these industry will not easily enter or exit the industry. Which in turn, the entry and exit rates of these industries are relatively lower than others as reported in Table 4.1.

The Jarque-Bera (JB) test indicates that all exit rates (ER_t) of each industries are normally distributed except for agriculture industry, construction industry, and mining industry; also, all the entry rates (NR_t) are normal except for mining industry, and retail trade industry. These not-normal variables of mentioned industries are skewed (skewness > 0, should be closed to zero to fulfill the normality assumption); and it is follow a leptokurtic distribution (the kurtosis are greatly higher than 3), in other words, there are high probability for extreme values. However, these aspects are not a matter for worry because the employed of more sophisticated time series regression will address this issue satisfactorily.

Table 4.1 Descriptive Statistics of Variables

	Agriculture		Construction		Manufacturing		Mining		Retail Trade		Services		Wholesale Trade	
	ER_t	NR_t	ER_t	NR_t	ER_t	NR_t	ER_t	NR_t	ER_t	NR_t	ER_t	NR_t	ER_t	NR_t
Mean	12.35	15.91	14.16	14.67	9.34	9.27	11.97	12.34	11.77	12.59	10.07	12.74	9.55	10.32
Median	11.90	15.20	13.40	14.80	9.40	9.10	11.70	11.40	11.50	12.30	10.00	12.40	9.50	10.50
Maximum	19.20	19.90	19.60	21.90	11.50	12.40	20.80	23.60	16.00	19.00	12.40	17.10	11.90	15.40
Minimum	10.00	11.40	11.60	6.60	7.80	5.60	7.40	8.70	8.90	9.00	8.40	9.40	7.90	7.70
Std. dev.	2.00	2.37	2.04	3.87	0.91	1.77	2.78	3.36	1.82	2.10	0.90	1.62	1.02	1.69
Skewness	1.53	0.26	1.01	-0.06	0.41	-0.19	0.85	1.77	0.45	0.92	0.53	0.62	0.58	0.74
Kurtosis	5.53	1.95	3.27	2.40	2.60	2.14	4.36	6.09	2.99	4.23	3.21	3.62	2.85	3.85
Jarque-Bera	23.00	2.00	6.10	0.56	1.21	1.27	6.93	32.18	1.19	7.13	1.73	2.82	2.01	4.27
Probability	0.00	0.37	0.05	0.76	0.55	0.53	0.03	0.00	0.55	0.03	0.42	0.24	0.37	0.12
Sum	432.10	556.90	495.60	513.50	326.80	324.60	418.80	432.00	412.00	440.70	352.50	445.80	334.10	361.30
Sum sq. dev.	135.65	191.70	141.44	508.49	28.28	106.17	263.04	383.41	112.07	149.97	27.49	89.28	35.09	96.98
Observation	35	35	35	35	35	35	35	35	35	35	35	35	35	35

Note: Std. dev. is standard deviation. ER_t and NR_t are exit rates and entry rates respectively. All variables are in level form.

4.2 Augmented Dickey Fuller (ADF) unit root test

Among various testing methods, we test the stationarity of each exit rates and entry rates by employing Augmented Dickey Fuller (ADF) unit root test.

Table 4.2 Results of Unit Root Test (ADF)

Level		Intercept, τ_μ	Intercept with Trend, τ_τ
Sector/Industry	**Variables**		
Agriculture	ER_t	-2.3413(2)	-1.8469(6)
	NR_t	-1.3102(1)	-2.4437(1)
Construction	ER_t	-2.4023(0)	-0.0778(6)
	NR_t	-1.6019(0)	-1.3311(8)
Manufacturing	ER_t	-0.5578(7)	-4.6012(0)***
	NR_t	-1.5235(0)	-4.5003(0)***
Mining	ER_t	-1.0717(2)	-2.7698(1)
	NR_t	-2.4886(0)	-2.7504(0)
Retail Trade	ER_t	-1.6071(4)	-6.0021(0)***
	NR_t	-0.2309(6)	-6.2929(0)***
Services	ER_t	-3.9728(0)***	-4.0130(0)**
	NR_t	-3.2480(0)**	-4.9885(0)***
Wholesale Trade	ER_t	-1.8401(4)	-5.0617(0)***
	NR_t	0.3965(4)	-6.5421(0)***
First Different			
Sector/Industry	**Variables**		
Agriculture	ER_t	-6.5301(0)***	-6.7074(0)***
	NR_t	-8.1867(0)***	-8.05390)***
Construction	ER_t	-5.4024(0)***	-5.3686(0)***
	NR_t	-5.4858(0)***	-5.4172(0)***
Manufacturing	ER_t	-8.0218(0)***	-7.9063(0)***
	NR_t	-8.6058(0)***	-8.4760(0)***
Mining	ER_t	-7.2857(0)***	-7.1683(0)***
	NR_t	-6.3205(0)***	-6.2167(0)***

Retail Trade	ER_t	-8.5684(0)***	-8.4682(0)***
	NR_t	-9.1016(0)***	-8.9257(0)***
Services	ER_t	-7.0134(0)***	-6.9831(0)***
	NR_t	-9.3744(0)***	-9.1918(0)***
Wholesale Trade	ER_t	-8.0048(0)***	-7.8599(0)***
	NR_t	-9.2828(0)***	-9.0788(0)***

Numbers in parenthesis are t-statistics.

* (**) *** denotes significance at 10% (5%) 1% respectively.

The empirical findings for the stationarity of both Exit rates (ER_t) and Entry rates (NR_t) for each industry are presented in Table 4.2. It shows that manufacturing, retail trade, services, and wholesale trade are stationary in level, I(0). Based on the decision procedures, we will proceed with estimating the interrelation between ER_t and NR_t using a VAR framework. By using a VAR framework, the interrelationship between firms' exit and entry can be established from the direct linkages between exit and previous exit, entry and previous entry, exit and previous entry, as well as entry and previous exit.

On the other hand, the ADF tests result presented in Table 4.2 explicitly shows that the exit and entry rates of agriculture, construction and mining consist of unit-root in the level form. However it is convincingly accepted to be 'stationary' in the first difference, thereby insures an integration order of 1, I(1). Therefore, a simple VAR estimation is no longer required because the variables might be spuriously related, following the decision procedure, we will using the simple cointegration test (Engle-Granger two step approach) to examined the long run equilibrium relationship between exit rate and entry rate for regarding industries.

4.3 Estimation of Vector Autoregressive (VAR) model

To investigate the interdependencies between entry and exit rates, we estimate a VAR (p) model where p is the optimal lag with a maximum lag length of three, the AIC Criteria suggested that the optimal lag length is 1 (See Table 4a in Appendix 4.1). We found that the lag structure of one year for the VAR model for every industries under study. In other words, the maximum effect of previous exit and entry reached after 1 year. Therefore we will estimate the equation as Vector Autoregressive, VAR (1).

Table 4.3 Results of VAR estimations

	Constant	ER_{t-1}	NR_{t-1}	F-value	p	LM(2)
Manufacturing						
ER_t	4.7655***	0.2821*	0.2041**	7.1189***		
	(3.3293)	(1.6987)	(2.3601)			
					1	0.2038
NR_t	-2.0455	0.4035***	0.7964***	84.4892***		
	(-1.6168)	(2.7498)	(10.4176)			
Retail Trade						
ER_t	2.2143*	0.4421***	0.3318**	27.2786***		
	(1.7094)	(2.8068)	(2.4664)			
					1	0.8410
NR_t	2.3151*	0.6610***	0.1777	29.9647***		
	(1.7534)	(4.1169)	(1.2954)			
Services						
ER_t	5.4836***	0.3627**	0.0692	3.5539**		
	(3.1662)	(2.2836)	(0.7645)			
					1	0.0998
NR_t	2.4266	0.2741	0.5797***	15.0232***		
	(1.0571)	(1.3019)	(4.8333)			
Wholesale Trade						
ER_t	6.6604***	0.1556	0.1289	1.9943		
	(4.1591)	(0.8505)	(1.2300)			
					1	0.4508
NR_t	2.3916	0.1770	0.5827***	15.8524***		
	(1.2392)	(0.8028)	(4.6137)			

N*umbers in parenthesis are t-statistics.*

* (**) *** denotes significance at 10% (5%) 1% respectively.

p denotes the lag of VAR model selected based on AIC.

Based on the VAR estimations in Table 4.3, the one year previous exit (ER_{t-1}) having a positive coefficient in all the VAR estimation and significantly affects the present exit rates (ER_t) in all estimations except for wholesale trade industry. We therefore accepted the hypothesis that previous exit causes later exit, thereby confirmed the multiplier effect. Similarly, the one year previous entry rates (NR_{t-1}) is also having a positive coefficient in all the estimations and significantly affects present exit rates (ER_t) except for the services industry and wholesale trade industry. This result, however, confirmed the hypothesis that competition effect is presence, in other words, the previous entries causes present exits due to the increasing intensity of competition among firms.

On the other hand, apparently the one year previous exit rates (ER_{t-1}) is positively and significantly affects the present entry rates (NR_t) in all the VAR estimations, except services industry and wholesale trade industry. The result empirically proving that previous exits of firms will cause subsequent entries of firms to increase, therefore confirmed the hypothesis of competition effect is presence. Besides, the coefficients of one year previous entry rates (NR_{t-1}) is positive coefficient in all the estimations and significantly affects the present entry rates (NR_t) except for the retail trade industry. This result, however, supports the hypothesis about the multiplier effect, in other words, the previous entries causes present entries to increase.

The results, indeed, statistically proven that the interrelationship between exit and exit rate does exist. This is especially apparent if we look into the Table 4.3, it shows a strong evident of dynamic interaction between two series; each industry shows at least one explanatory variable which significantly affects the dependent variables. In other words, from our results above, we can conclude that the past exit and entry of firms does matter the present exit and entry of firms among all the industries we have examined. Therefore, the hypothesis of presence of interrelationship between entry and exit is accepted.

In order to ensure whether the representation of VAR models is appropriate, we therefore employ the Langrange Multiplier (LM) test to examine whether the

model is having the serial correlation problem. Null hypothesis is that there is no serial correlation problem at the lag order of two, LM (2). Table 4.3 presents the results of the LM test for the VAR residual serial correlation. Given that the p-values of the LM tests are greater than the 5% level of significance, thereby the hypothesis of no serial correlation is accepted; in other words, all of the VAR models are represented appropriately, because there is no explicit serial correlation problem for the estimated VAR models.

From the Table 4.4, we conclude the estimated result from Table 4.3, for the manufacturing industry, the multiplier effect and competition effect are co-exists; in other words, both competition effect and multiplier effect are determining the exit rates and entry rates and which forces is predominant is inconclusive. For the Retail trade industry, both competition effect and multiplier effect are explaining the exit rates; and the entry rates are significantly determined by competition effect. Based on the results, the multiplier effect alone explains both the exit rates and entry rates for the services industry. Lastly, for the wholesale trade industry, none of the force is explaining the exit rates, and the multiplier effect alone explains the entry rates.

Table 4.4 Comparison of empirical results

	Manufacturing	Retail Trade	Services	Wholesale Trade
Exit				
ER_t/ER_{t-1}	Multiplier	Multiplier	Multiplier	Not Significant
ER_t/NR_{t-1}	Competition	Competition	Not Significant	Not Significant
Entry				
NR_t/NR_{t-1}	Multiplier	Not Significant	Multiplier	Multiplier
NR_t/ER_{t-1}	Competition	Competition	Not Significant	Not Significant

Surprisingly, there is neither significant multiplier effect nor competition effect in the exit equation of wholesale trade industry. This is because the wholesale trade firms are characterized by having a long-standing business relationship, therefore the wholesale trade firms might takes a longer period to exits the industry

compare to other industries. As a consequence, the study of interrelation of entry and exit in wholesale trade industry requires a longer time period data.

Crucially, the study of Nyström (2007b) points out a simple and straight forward method to indicate which forces is predominant, that is by comparing the magnitude of coefficients. For the case like manufacturing industry, which of the forces is predominant is still under determine.

From the estimated results in Table 4.3, we find that, in the entry equation (NR_t), the magnitude of all the coefficients for previous entry rates (NR_{t-1}) is greater than the coefficients for previous exit rates (ER_{t-1}) except for retail trade industry; also, in the exit equation (ER_t), the size of all the coefficients for previous exit rates (ER_{t-1}) is greater than the coefficients for previous entry rates (NR_{t-1}). These indications have regarded the multiplier effect as greater effect in explaining both firm's exit and entry patterns compare to competition effect. These findings are in line with the (Resende, Ribeiro & Zeidan, 2013), who suggest multiplier effect where synergetic factors prevail either by entry inducing entry or by exit inducing exit. The summary results of comparing the coefficients are shown in Table 4.5, as below:

Table 4.5 Results from comparison of variables' coefficients

	Manufacturing	Retail Trade	Services	Wholesale Trade
	Dominant Forces			
Exit	Multiplier Effect	Multiplier Effect	Multiplier Effect	Multiplier Effect
Entry	Multiplier Effect	Competition Effect	Multiplier Effect	Multiplier Effect

If we look at the Table 4.5, given the multiplier effect is dominant in the exit equation for retail trade industries; it is a little surprise to find a dominant competition effect in the entry equation in the same industries. The suggestion that increases in firms' exit will positively affect the later firms' exit because previous exit destroyed the opportunities for incumbent firms to cooperate, therefore future exit increases. At the same time, the increases in firms' exit also will cause the later entry to increase, whereas previous exit creates a favorable business

environment, and therefore enhances the later entry. For example, exit of a retail store may make the business of other retail stores less viable and hence creates further exits of incumbent retail stores within the same area; meanwhile, the exit of a retail store has create displacement of new entrants since the exits of incumbent has devalued the resources required by a potential new retailer. industry, and our findings on this particular industry are consistence with what they have found.

On the other hand, we find that the multiplier effect is more dominant in determining the firms' exit and entry patterns of manufacturing industry, services industry, and wholesale trade industry, whereas previous exit cause the increase in future exit; and previous entry cause the increase in future entry. For instance, the establishments of manufacturing firms are described as plants, mills and factories, a birth of manufacturing firm will increase (decrease) the incomes in the area, and therefore increase (decrease) the demand of manufactured goods, which in turn creates more new entrants (exits) of manufacturing firms.

The activities of services firms requires high degree of expertise and skills, therefore there is high possibility of "demonstration" effect at work. For instance, the establishment of a computer services in an area might attracts potential new entrants to open up a similar firm if they find that particular area is profitable; in other words, the previous entry of services firms will makes the potential new entrants sharply aware of market availability or some possible limitations of the existing firms that could be addressed with a new establishment. In contrast, the exit of a services firm indicates that the market is no longer profitable, and thereby discourages the potential new entrants to start up a firm which offering similar services; as well as signals the existing firms to exit the industry since it is not profitable.

As we mentioned previously, the **agriculture**, **construction** and **mining industry** were found to be integrated of order one, I(1). In order to investigate whether the variables are cointegrated, we have employed the Augmented Dickey Fuller (ADF) Test to test the residuals (error term) of the regression equation are whether

stationary. If the residuals are accepted to be stationary, I(0), by which insures a long-term or equilibrium relationship between variables because that the variables under study are cointegrated.

The results of the cointegration test based on the ADF test suggests that the residuals of regressions for agriculture, construction and mining industry are evidently stationary, and thus, the null hypothesis of no cointegration is convincingly rejected. In other words, there is long-run equilibrium relationship between exit rates (ER_t) and entry rates (NR_t) of firms among the agriculture, construction and mining industry.

Since our variables are cointegrated, we can examine the interrelation between ER_t and NR_t using a Vector Error Correction Model (VECM); in other words, we able to estimate both the short and long relationship between ER_t and NR_t by including the lagged residuals (e_{t-1}) from the cointegrating regression as our measure of the error correction mechanism. Refer to equation (9) and (10).

As a preliminary procedure, in order to identify the optimal lag length it is necessary to estimate the VAR model in level. We find that the optimal lag length based on the Akaike Information criteria (AIC) was 1 lag (See Table 4a in Appendix 4.1). When we estimate the model as VECM, the lagged term will decrease as the order of integration increase, in this case the order of integration is 1, I(1), therefore the lagged term will subtracted by 1, p-1. As a result, the initially VAR (1) is become VECM without lagged terms. Refer to the (Appendix 4.2), the VECM are expressed as equation below:

$$\Delta ER_t = \alpha_{10} + \alpha_{11}(e_{t-1}) + e_{1t} \qquad (9)$$

and

$$\Delta NR_t = \alpha_{20} + \alpha_{21}(e_{t-1}) + e_{2t} \qquad (10)$$

The α_{11} and α_{21} are known as error correction coefficients, so named because they show how much ΔER_t and ΔNR_t respond to the cointegration error, e_{t-1}. The VECM is a augmented VAR process in first differences, I(1) for cointegrated relationship between firms' exit and entry rates series. The VECM framework has offered two important features in order to provide an accurate representation for the series.

Table 4.6 Error correction estimates for Equations (9) & (10)

Industry/Sector	Constant	ECT (α_{11} & α_{21})	F-value	p
Agriculture				
ΔER_t	-0.1971	-0.4206***	18.3906***	
	(-1.0068)	(-4.1884)		
				0
ΔNR_t	-0.2000	0.0964	0.6206	
	(-0.8188)	(0.7878)		
Construction				
ΔER_t	0.0059	-0.2821**	5.7786**	
	-0.0227	(-2.4039)		
				0
ΔNR_t	-0.3529	0.2523**	4.5455**	
	(-1.3492)	(2.132)		
Mining				
ΔER_t	-0.1088	-0.2973***	12.5752***	
	(-0.3511)	(-3.5462)		
				0
ΔNR_t	-0.1824	-0.1975*	3.4454*	
	(-0.4635)	(1.8562)		

Numbers in parenthesis are t-statistics.

* (**) *** denotes significance at 10% (5%) 1% respectively, refer to Ericsson & MacKinnon (2010).

p denotes the lag of VAR model selected based on AIC.

If we look into the Table 4.6, A negative error correction terms (α_{11}) in the equation (9) ensures that ΔER_t decreases; at the same time, the positive error correction terms (α_{21}) in the equation (10) ensures ΔNR_t increases thereby

correcting the error. From the Table 4.6, we can see that the error correlation coefficients (α_{11}) are all significant at 5%. The results suggesting that deviations from equilibrium are corrected at approximately 42%, 28%, and 29% annually for agriculture, construction and mining industries respectively. On the other hand, the error correction terms (α_{21}) for the equation (10) of the construction and mining industries is significant at 5% and 10% respectively. The results suggesting that deviations from equilibrium are corrected at approximately 25% and 20% annually for construction and mining industries respectively.

Importantly, In order to examine the hypothesis of multiplier (competition) effect is the dominant force of firms' exit (entry), we relies on the signs and magnitude of the coefficients after we adjusted the firms' exit and entry in order to restore the long-run equilibrium between them. In other words, we rewrite the VEC model into VAR form (Refer to Equations (f), (g), (h), (i), (j), and (k) in Appendix 4.2) in order to see the real estimate sign and magnitude of the coefficients for previous exit and previous entry for exit and entry equation.

Table 4.7 Coefficients of VEC model in VAR from

Industry/Sector	Constant	ER_{t-1}	NR_{t-1}
Agriculture			
ER_t	4.9808	0.5794	0.0008
NR_t	-1.3871	0.9642	0.9998
Construction			
ER_t	2.9477	0.7179	0.0704
NR_t	-2.9833	0.2523	0.9370
Mining			
ER_t	0.1296	0.7057	0.2666
NR_t	-0.3519	0.2093	0.8104

Unsurprisingly, the estimated result in Table 4.7 also shows that the coefficients are all positive signed, which are exactly similar to the result in Table 4.3. However, by observing the estimated sign of coefficient from this result only able

to conclude that the competition effect and multiplier effect are both explaining the exit rates and entry rates, which forces are predominant is left unexplained so far. Therefore, refer to previous chapter; we had discussed the identification of dominant forces regarded to the magnitude of coefficients.

From the estimated results in Table 4.7, in explaining the exit (ER_t) equations we find that the magnitude of all the coefficients for previous exit (ER_{t-1}) is greater than the coefficients for previous entry (NR_{t-1}). This finding support the hypothesis saying that the multiplier effect is the dominant force in explaining firms' exit; which suggesting that the exit of firms are response greater to the previous firm's exit compare to previous firms' entry.

In explaining the entry (NR_t) equations we find that the magnitude of all the coefficients for previous entry (NR_{t-1}) is larger than the coefficient for previous exit (ER_{t-1}). This result however is contrary with the hypothesis which saying the competition effect is the dominant force in determining the firms' entry. The firms' entry has a greater response on the previous firm's entry compare to previous firms' exit. Thereby, the entry of firms is also determined by the multiplier effect.

From Table 4.8, we can conclude that the agriculture industry, construction industry, and mining industry are having the multiplier effect as the more dominant force in explaining both exit and entry patterns of each industry.

Table 4.8 Results from comparison of variables' coefficients

	Agriculture	Construction	Mining
	Dominant Forces		
Exit (ER_t)	Multiplier Effect	Multiplier Effect	Multiplier Effect
Entry (NR_t)	Multiplier Effect	Multiplier Effect	Multiplier Effect

Agriculture industry, construction industry and mining industry can be characterized as labor intensive industry in United States, for example a startup of new agriculture firms will significantly increase the incomes in the area via jobs creation, and thus to higher demand of agriculture products such as vegetable oil,

processed food, and timbers, which in turn stimulate further entrants of new agriculture firms. In contrast, when an agriculture firm exits from the area, it will induce the likelihood of other agriculture firms to exit because the demand of agriculture products decrease as the incomes of the area greatly reduced.

Besides, the formation of mining firms, for instance, an establishment that extracts crude petroleum in the area will attract the potential new entrants to set-up a similar firms since they aware of market opportunities, which mean the discovery of new sources of crude petroleum in the nearby area. Similarly, when a crude petroleum extraction firms close indicates that the area is already running out of crude petroleum, thereby discourages the new entrants of similar firms and the other similar existing firms will also soon close down as the sources of petroleum is running out.

4.4 Conclusion

By used the Vector Autoregressive (VAR) framework to examined the interdependencies of entry and exit rates for manufacturing sector, retail trade industry, services sector, and wholesale trade; and for the agriculture sector, construction sector, and mining industries, we are using the Vector Error Correction Model (VECM) which superior to the VAR framework to estimate the non-stationary series. The results above have convincingly accepted the hypothesis that support the presence of interdependencies between entry and exit is undeniable.

By observing the estimated sign and magnitude of coefficients in both exit and entry equation, we can draw down our major findings in the study in Table 5.1. for the agriculture industry, manufacturing industry, mining industry, construction industry, services industry and wholesale trade industry are having the multiplier effect as the determinants of both exit and entry patterns.

Interestingly, we found out that the retail trade industry are having competition effect as the dominant force in the determinants of retail firms' entry; and multiplier effect as the dominant force in explaining the retail firms' exit, this finding is consistence with the findings in Johnson and Parker (1994) in this particular industry.

However, the above finding has revealed some drawbacks in using the pure time series method to study the dynamic links between exit and entry, and we will discuss about it in following chapter.

Chapter 5. Discussion, Conclusion and Implications

5.0 Introduction

The paper aimed to examine the dynamic linkages between firms' entry and exit rates in the context of the United States major industries, namely agriculture, construction, manufacturing, mining, retail trade, services and wholesale trade at the NAICS 2-digits level and using time series data of total 35 years. By understanding the existence of the two opposing forces (multiplier effect and competition effect) that are influential to the interrelationships between firm's entry and exit for the industries under study, we further study the mentioned interrelationship with the aid of pure time series approach. Specifically, our aim is to determine whether the multiplier effect or competition effect forces has much stronger influence that is present in the entry and exit of firms to the industry.

5.1 Summary of statistical analysis

As the preliminary analysis, we investigate the stationarity of the variables by using the Augmented Dickey Fuller (ADF) unit root test. We thenused the Vector Autoregressive (VAR) framework to examine the interdependencies of entry and exit rates for manufacturing industry, retail trade industry, services industry, and wholesale trade industry which is the stationary series. While for the agriculture industry, construction Industry, and mining industry, we used the Vector Error Correction Model (VECM) which is superior to the VAR framework to estimate the non-stationary series. We found that optimal lag length of 1 for each industry which in turn can be expressed as the effect of previous exit and entry on future exit and entry will take place in one year. We also found that, in related to non-stationary series, we found that the exit rates and entry rates for agriculture

industry, construction industry and mining industry are having a long run relationship as the tested variables are cointegrated.

By assessing the dynamic linkages between exit and entry by using the lagged variables; the result, unsurprisingly supports the hypothesis saying that the exit and entry are interdependence and the findings also favor the hypothesis saying that the prevalence of multiplier effect and competition effect are two opposing forces in the interdependencies of exit and entry.

By observing the estimated signs and size of the coefficients in the exit and entry equation from VAR model leading us to examined the hypothesis competition (multiplier) effect is the dominant force to explain the firms entry (exit) patterns. We found that all the estimated coefficients are positive signed, and the size of coefficients which led us to assert that the presence of multiplier in explaining both firms' entry and exit for all the industries except retail trade industry.

5.2 Major Findings

Besides, follow the Johnson & Parker (1994), based on our empirical analysis, we recognized the presence of multiplier effect and competition effect as the opposing forces in the interrelationship of firms' entry and exit and these forces can simultaneously exist. Thereby the second hypothesis saying that the multiplier and/or competition effect are explaining the firms' exit and entry patterns is accepted.

More importantly, conclusion we can draw down from the empirical findings is that, for the agriculture industry, construction industry, manufacturing industry, mining industry, services industry and wholesale trade industry are having the multiplier effect as the dominant force in explaining both firms' exit and entry patterns. We have therefore accepted the fourth hypothesis which saying that multiplier effect is the dominant force to explain the firms' exits. But this finding

is somehow contrary with the third hypothesis that competition effect is more dominant force in explaining the patterns of entry. However, the result is much convincing because one might expect the multiplier effect taking place to determine the firms' entry pattern if the same effect is explaining the firms' exit patterns.

Besides, we found that the retail trade industry is having multiplier effect as the determinant of firms' exit, and competition effect as the determinant of firms' entry; expectedly, this result is consistence with the study of Johnson and Parker (1994) in this particular industry. The empirical results in the retail trade industry have led us to accept the third and fourth hypothesis. This might because of retail trade industry is much smaller compare to other industries with lower operating cost and can easily substitute employees because of no special skills is needed. Thus firms in this industry may enter and exit freely. We summarize our major findings which identified which forces are act as a determinants of firms' exit and entry patterns into the Table 5.1.

Table 5.1 Summary of Major Findings

Sectors / Industries	Determinants of Exit	Determinants of Entry
Agriculture	Multiplier Effect	Multiplier Effect
Manufacturing	Multiplier Effect	Multiplier Effect
Mining	Multiplier Effect	Multiplier Effect
Construction	Multiplier Effect	Multiplier Effect
Services	Multiplier Effect	Multiplier Effect
Wholesale Trade	Multiplier Effect	Multiplier Effect
Retail Trade	Multiplier Effect	Competition Effect

5.3 Implications of Study

For our implications of study, our research paper will act as a reference for policymakers that want to attain greater levels of new firm formation and minimize firms' failure. For example, we found that the equation of exit is

dominated by the multiplier effect which means that current exit of firms will lead to more exit of firms in the future. Policymakers that emphasize on higher rate of new firm's formation can come out with policies that provide incentives to stimulate potential entrants or maintain incumbent firms. For example, provide subsidies or benefits to potential entrants and incumbent firms. While on the other hand, the equation of entry that is dominated by multiplier effect and competition effect will continue to encourage entry of new firms.

Next, entrepreneurs will also benefit from our study as they will get to know a little bit more on the structural change in an industry with underlying forces of competition and multiplier effect. Thus, they can use it as a proxy to help them to make decision on whether to enter or exit an industry.

Furthermore, this study not only provides a link between exit and entry of firms over the time; according to Johnson & Parker (1994) and Dejardin (2004), recommended policies cannot be instantly dispersed to each independent industry because of differences across industries. Therefore, by including 7 different industries in our study have an important implication for the assessment and evaluation of policies designed accordingly to the particular industry.

5.4 Limitations of Study

We carried out our study based on strict endogenous assumptions in our regression modeling which is more to microeconomic scope. Thus, we can test the competition and multiplier effects by assessing the effect of coefficients related to lagged variables of entry and exit rates. However, we do not consider any exogenous factors that affect firm's entry and exit rates such as common economic shocks and productivity dynamics that link competition and multiplier effects. For example, the inflation and interest rate of the United States. We do not study the relationship of how common economic shocks and productivity dynamics that may or may not affect firm's entry and exit rate.

5.5 Recommendation for future research

Recommendation for future research is to include the assessment of exogenous underlying forces that link productivity dynamics to competition and multiplier effects which influence firm's exit and entry rates in the United States. For instance, future researcher can examine the "market availability"; specifically, the conditions of market after the adjustment of net entry, whether the market is saturated or unsaturated in the major industries of United States, and how does that attracts potential entrants as well as creates barriers to potential entrants.

Secondly, investigating the effects of previous net entry on unemployment and incomes at industry level are able to influence the demand in the United States, which in turn affects the future new entrants and also incumbents. In other words, we suggest the linkages of number of labor and income distributions with productivity dynamics that affects competition and multiplier effect, and hence firms' entry and exit rates.

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Appendix 4.1

Table 4a. Lag length for Entry and Exit equations

Lag	LogL	LR	FPE	AIC	SC	HQ
Manufacturing						
0	-99.2433	NA	1.9194	6.3277	6.4193	6.3581
1	-67.6627	57.2400*	0.3428*	4.6039*	4.8787*	4.6950*
2	-64.4625	5.4003	0.3618	4.6539	5.1119	4.8057
3	-62.3526	3.2968	0.4109	4.7720	5.4133	4.9846
Retail Trade						
0	-111.5357	NA	4.1382	7.0960	7.1876	7.1263
1	-91.5551	36.2148*	1.5258*	6.0972*	6.3720*	6.1883*
2	-87.8274	6.2903	1.5583	6.1142	6.5723	6.2660
3	-86.0602	2.7613	1.8083	6.2538	6.8950	6.4663
Services						
0	-95.1702	NA	1.4880	6.0731	6.1647	6.1035
1	-81.7906	24.2505*	0.8288	5.4869*	5.7617*	5.5780
2	-76.3525	9.1768	0.7607*	5.3970	5.8551	5.5489*
3	-73.3720	4.6570	0.8182	5.4608	6.1020	5.6733
Wholesale Trade						
0	-100.0956	NA	2.0244	6.3810	6.4726	6.4113
1	-86.7786	24.1370*	1.1320*	5.7987*	6.0735*	5.8898*
2	-84.1845	4.3775	1.2410	5.8865	6.3446	6.0384
3	-81.8167	3.6998	1.3870	5.9885	6.6298	6.2011
Agriculture						
0	-126.825	NA	10.7601	8.0516	8.1431	8.0819
1	-99.9368	48.73493*	2.5764*	6.6210*	6.8959*	6.7121*
2	-97.2607	4.515848	2.8100	6.7038	7.1618	6.8556
3	-95.5446	2.681433	3.2712	6.8465	7.4878	7.0591
Construction						
0	-152.5353	NA	53.6640	9.6585	9.7501	9.6888
1	-106.6931	83.08904*	3.9301*	7.0433*	7.3181*	7.1344*

2	-105.0141	2.833249	4.5621	7.1884	7.6464	7.3402
3	-100.6976	6.744538	4.5142	7.1686	7.8099	7.3812
Mining						
0	-160.8886	NA	90.4522	10.1805	10.2721	10.2109
1	-129.4284	57.0214*	16.2750*	8.4643*	8.7391*	8.5554*
2	-127.8724	2.6258	19.0379	8.6170	9.0751	8.7689
3	-121.9908	9.1900	17.0823	8.4994	9.1407	8.7120

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Appendix 4.2

Rewrite the VEC model in VAR form.

In long run equilibrium,

$$ER_t = ER_{t-1}$$

and,

$$NR_1 = NR_{t-1}$$

therefore,

$$ER_{t-1} = \beta_0 + \beta_1 NR_{t-1} + e_{t-1}$$

$$ER_{t-1} - \beta_0 - \beta_1 NR_{t-1} = e_{t-1} \qquad \text{(a)}$$

where, $$e_{t-1} \sim IID(0, \sigma^2)$$

Meanwhile, VEC models:

$$\Delta ER_t = \alpha_{10} + \alpha_{11}(ER_{t-1} - \beta_0 - NR_{t-1}) + e_{1t} \qquad \text{(b)}$$

and

$$\Delta NR_t = \alpha_{20} + \alpha_{21}(ER_{t-1} - \beta_0 - NR_{t-1}) + e_{2t} \qquad \text{(c)}$$

Subsequently, we substitute equation (a) into equations (b) and (c); we have VEC model in VAR form as shown below:

$$ER_t = (\alpha_{10} - \alpha_{11}\beta_0) + (\alpha_{11} + 1)ER_{t-1} - \alpha_{11}\beta_1 NR_{t-1} + e_{1t} \qquad \text{(d)}$$

and

$$NR_t = (\alpha_{20} - \alpha_{21}\beta_0) + \alpha_{21}ER_{t-1} - (\alpha_{21}\beta_1 - 1)ER_{t-1} + e_{2t} \qquad \text{(e)}$$

The rewrite equations are represented as below:

Agriculture:
$$ER_t = 4.980814 + 0.579436ER_{t-1} + 0.000775NR_{t-1} \qquad \text{(f)}$$
$$NR_t = -1.387110 + 0.9642134ER_{t-1} + 0.999822NR_{t-1} \qquad \text{(g)}$$

Construction:
$$ER_t = 2.947652 + 0.717876ER_{t-1} + 0.070433NR_{t-1} \qquad \text{(h)}$$
$$NR_t = -2.983285 + 0.252257ER_{t-1} + 0.937024NR_{t-1} \qquad \text{(i)}$$

Mining:
$$ER_t = 0.129598 + 0.705675ER_{t-1} + 0.26660NR_{t-1} \qquad \text{(j)}$$
$$NR_t = -0.351942 + 0.209344ER_{t-1} + 0.810376NR_{t-1} \qquad \text{(k)}$$