WESTERN SYDNEY UNIVERSITY

SKILL-BIASED TECHNOLOGICAL CHANGE IN VIETNAM

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MASTER OF RESEARCH

WESTERN SYNEY UNIVERSITY

JUNE 2018

DEDICATIONS

I would like to dedicate this thesis to my parent, Nguyen Thanh Nong and Nguyen Thi Thuong. There is no doubt in my mind that without their loves and continued support I could not have completed this process.

I also dedicate this thesis to my wife and my children, Thuy Van Le, Anna Vu, Brian Vu, and William Nguyen, for all their love.

Sydney, 22 June 2018

Con kính tặng luận án này cho ba má, không có tình yêu và sự ủng hộ của ba má con không thể hoàn thành luận án này.

Tôi dành tặng luận án này cho vợ và các con thân yêu của tôi.

Sydney, ngày 22 tháng 6 năm 2018

ACKNOWLEDGEMENTS

I would like to thank to all those who helped me with the completion of this thesis. Most of all, I would like to thank my supervisors, Dr. Dilupa Nakandala and Associate Professor Maria Estela Varua, for their guidance, great support and kind advice throughout my thesis. They have invested endless time and energy into my thesis. I have learned so much from working with them.

STATEMENT OF AUTHENTICATION

I hereby declare that the work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. The material, either in full or in part, has not been submitted earlier for a degree at this or any other academic institution.

Thanh Thong Nguyen

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ABBREVIATIONS

MOLISA	Ministry of Labour, Invalids and Social Affaris
ILO	International Labour Organization
OECD	Economic Cooperation and Development
GDP	Gross Domestic Product
GSO	Vietnam General Statistics Office
NTP-NRD	National Target Programme for New Rural Development
R&D	Research and Development
VHLSS	Vietnam Household Living Standards Survey
SBTC	Skill-Biased Technological Change
TFP	Total Factor Productivity
UK	United Kingdom
USA	The United States of America

ABSTRACT

Previous research has found evidence for the existence of skill-biased technological change in both the USA and Europe. However, similar studies are still limited in developing countries. There has not been any previous research that measured skill-biased technological change in Vietnam. The research question that this study aims to answer is if there is a skill-biased technological change in Vietnam. Based on data collected from the Vietnam Household Living Standards Survey from 2004 to 2014, this thesis measures the skill-biased technological change in Vietnam by measuring relative skill productivity. Relative skill productivity is calculated using the elasticity of substitution between skilled and unskilled workers, skill premium, the respective factor augmenting technology term of unskilled workers, and the respective factor augmenting technology term of skilled workers. The thesis developed a regression model for estimating wage as informed by the Mincer (1974) wage equation. The findings provided evidence that skill-biased technological change occurred in Vietnam during the period 2004 to 2008. It also provided empirical evidence of the wage gap between skilled and unskilled workers, between male and female workers, and between urban and rural areas. This thesis provides policy recommendations to improve the wage differential and the skill of the workers in Vietnam.

Keywords: Skill-Biased Technological Change, Skill Premium, Mincer Wage Equation, Wage Differential

CHAPTER 1: INTRODUCTION

This chapter provides an introduction to the thesis including an overview of technological change and skill-biased technological change (SBTC), followed by a discussion of technological change in Asia and Vietnam. It also identifies research objectives and the organisation of chapters.

1.1 BACKGROUND

The term technological change has been widely used in the literature since 1935 (Weintraub 1937; Weintraub & Kaplan 1938; Magdoff et al. 1938; Gill 1940; Gourvitch 1941). Kuznets (1929) recognized technological change as the most important factor in the manufacturing and extractive sectors. Maclaurin (1953) defined technological change as a process that starts with basic research and ends at the way a firm generates technological change. Brozen (1951) defined technological change as any change in production function in an enterprise or industry and identified the social impact of technological change. By reviewing two decades of studies on technological change, Ruttan (1959) redefines the term "technological change" in a functional sense. According to his definition, the practical application of innovation in technology and economic organization is the reason for the change in the coefficients of a product function. President's Commission on National Goals (1960) of USA mentioned technological change as the cause of real displacement in the working population. Mansfield (1968) considers technological change as the change in technology and technological changes are used reciprocally. In 1972, based on a review of technological process, Kennedy and Thirlwall (1972) emphasised the effects of technological change on economic growth.

Marx (1967) points out the concerns on the effects of innovation, especially in the development of machinery instead of labour. Various studies on the effects of technological change on the labour market, particularly labour composition and wages, have been considered. Welch (1970) hypothesizes that technology will raise the demand for skilled labour. Malthus (1978) indicated that the displacements of labour were an effect of the introduction of machinery. "Creative destruction", as introduced by Schumpeter (1975) in explaining technological change, will create new jobs and industries, as well as destroy some current jobs.

In recent years, wage inequality has been the focus of studies on technological change. Some studies have argued that technological change is skill-biased along with the development of investment in machinery (Lynch & Osterman 1989; Bartel & Lichtenberg 1990; Davis & Haltiwanger 1991; Berndt, Morrison & Rosenblum 1992; Kruger 1993; Mishel & Bernstein1994). The main reason for this skill-bias is the introduction of new technologies, which increases the demand for skilled workers who have the knowledge and ability to adapt to new technologies. According to Berman, Bound, and Machin (1998), wage premium has increased in the Organization for the Economic Cooperation and Development (OECD) countries. This means the economy favours workers with higher levels of education and skill over those with lower levels. Their research also attributed that the recent increase in unemployment was an impact of technological change on the labour market. They argued that technological change in the OECD countries has been skill-biased.

1.2 TECHNOLOGICAL CHANGE IN ASIA AND VIETNAM

A large number of studies argued that technological change, particularly labour-saving technological change, played an important role in fuelling the extraordinary economic growth in Asia (Freeman 1995; Nelson & Pack 1999; Krueger et al. 2000). However, some research stated that the main reason for economic growth in Asia was a result of the heavy capital investment, and the role of technological change was unimportant (Krugman 1994; Collins & Bosworth 1996). Thus, the role of technological change in Asian countries is controversial.

In Vietnam, this controversy is shown by low total factor productivity (TFP) growth rates. According to the Ministry of Labour Invalids and Social Affairs Vietnam and International Labour Organization (2010), the contribution of total factor productivity increases when gross domestic product (GDP) growth is about 26% (in TFP, growth does not include increased labour quality), but the contribution of capital investment is over 60% of GDP growth in Vietnam. The evidence of the impact of technological change on both the economic and labour markets have not been explored in Vietnam. Sakellarious and Patrinos (2003) indicated that skill premiums have been rising in their study on the impact of computer use on wages in Vietnam. Sakellarious and Patrinos (2003) concluded that the recent technological change changed demand for educated, skilled labour. Moreover, Konstadakopulos (2005) found that information and communications technology has penetrated to export-oriented sectors based in areas where the internet connection is higher in

Vietnam. Shillabeer (2013) indicated that Vietnam is an attractive destination for outsourcing due to its relatively young workforce, as well as low wages. Thus, the

import of high-tech machines and equipment is the reason for increasing wages of skilled workers. Moreover, the young workforce in Vietnam has been increasing their technological and language skills, causing the inevitable consequence of high-tech capital investment and a transition to higher value-added activities (Thangvelu 2013). These previous studies indicate that technological change in Vietnam could be skill-biased.

1.3 RESEACH OBJECTIVES

There has not been any previous research on skill-biased technological change (SBTC) in Vietnam to the author's knowledge. Therefore, this thesis aims to investigate SBTC in Vietnam in the period 2004 to 2014 using the datasets collected from the Vietnam Household Living Standards Survey from 2004 to 2014. The analysis of this thesis is conducted in two phases. First, the thesis developed a regression model for estimating wage as informed by the Mincer (1974) wage equation. Based on the wage regression in Vietnam for the period 2004 to 2014, the annual skill premiums are calculated. Then the relative skill productivity is calculated by using an estimated value for the elasticity of substitution of skilled workers and unskilled workers, skill premium the respective factor augmenting technology term of unskilled workers and the respective factor augmenting technology term of skilled workers.

1.4 ORGANIZATION OF CHAPTERS

The remainder of the thesis is organized as follows:

Chapter 2 provides a review of the literature on SBTC. It includes a historical review of the concept of SBTC and its importance and also identifies that the previous research on SBTC has been limited. This chapter also provides a review of the literature on wage differential. Methods adopted in previous studies are reviewed and an empirical model to measure SBTC is identified. A review of the literature on the elasticity of substitution of two labour factors (skilled workers and unskilled workers) is also presented.

Chapter 3 presents the method adopted in this study that aims to measure the SBTC in Vietnam. It consists of three sections. The first section describes the data sets obtained from the Vietnam Household Living Standards Survey in the period 2004 to 2014. The second section presents the descriptive statistics of the data including the geographic, gender, age, and skill distribution. The third section presents the two-phase method adopted to measure the SBTC in Vietnam from 2004 to 2014. The first phase reviews the skill premium and Mincer (1974) wage function in order to build an extended Mincer wage regression function to calculate the skill premium in Vietnam. In the second phase, relative skill productivity is calculated using the total number of skilled and unskilled workers and the elasticity of substitution between skilled and unskilled workers.

Chapter 4 presents the results, and discusses the findings. It includes (1) Results of Phase 1 on the calculation of the skill premium, and (2) Results of Phase 2 regarding the skill relative productivity.

Chapter 5 discusses the theoretical and practical implications of this study including implications to policy, limitations of the study and suggestions for future research.

CHAPTER 2: LITERATURE REVIEWS

This chapter provides a review of the literature on skill-biased technological change (SBTC). It includes a historical review of the concept of SBTC and its importance and also identifies that the previous research on SBTC has been limited. This chapter also provides a review of the literature on wage differential. Methods adopted in previous studies are reviewed and an empirical model to measure SBTC is identified. A review of the literature on the skill premium and the elasticity of substitution of two labour factors (skilled workers and unskilled workers) is also presented.

2.1 SBTC OVERVIEW

Since Griliches (1969), the idea that skilled workers have become more important than unskilled workers has emerged in many studies. However, the idea that technological change favours skilled workers was not common in the 19th century. It was seen as skill-replacing rather than skill-biased. Indeed, along with technological development, new machines that assist with production have been released. New weaving, spinning, and threshing machines were the reason for the fear that it would replace them in their jobs (Acemoglu 2002). Their fears are also the reason for destroying such machines in the Luddite and Captain Swing riots (Acemoglu 2002). What happened later showed that their fears were justified; the shops filled with artisans were replaced by technology-assisted assembly lines.

In the 20th century, the idea that technological change favours skilled workers has become popular. Goldin and Katz (1998) wrote that beginning with the 20th century, technology-skill and capital-skill complementarities appeared, and examples of these

complementarities are the widespread adoption of technologically-enabled production methods. In the 1960s, a variety of studies on technology-skill complementarity was conducted. The decade of 1960-1970 has been called the decade of "human capital revolution" in economic theory and inspired much literature about investments in education, especially as pertains to technology-skill complementarity. Nelson and Phelps (1966) put forward models based on the theory that "educated people make good innovators, and education speeds up the process of technological diffusion." Griliches (1969) gave evidence that skilled labour was more complementary with capital than unskilled labour. Schultz (1975) argued that education is critical to the tasks of dealing with economic upheaval caused by technology. Tinbergen (1975) put forward a supply and demand framework to explain wage inequality and called it the race between technology and education. Goldin & Katz (2008) have extensively discussed the notion of a race between technological development and access to education. According to Goldin & Katz (2008), this notion related to the SBTC's consequences on income inequality and the important role of education in mediating the relationship between SBTC and income inequality.

The 1980s and 1990s saw the skill premium in the USA and UK increase dramatically. In the USA, the wages of college graduates increased by over 25% between 1979 and 1995 relative to the wages of high-school graduates (Acemoglu 2002). Later, a wide array of studies tried to link the evolution of wage structure and SBTC. The role of the computer and internet was the main focus in investigating the relationship between wage structure and SBTC. For example, Berman, Bound, and

Griliches (1994) studied the composition of employment in US manufacturing from 1979 to 1987 and found that the demand for white-collar workers was strongly associated with investments in R&D and computers. However, they also indicated that there were other possibilities for the wage inequality, such as trade liberalization, de-unionization, and immigration, but the technological change was the main cause.

Moreover, Bound and Johnson (1992) contributed to this debate by investigating in the structure of wages in the USA in the 1980s. They concluded that SBTC played a larger part in the increase of wages of highly educated workers than factors relating to trade and unions. Goldin and Katz (2008) investigated both skill premium and wage inequality in the US from 1915 to 2005 and found that the growth of the supply of educated workers can explain most of the educational wage differentials. However, Acemoglu and Autor (2012) did not agree with Goldin and Katz (2008). Acemoglu and Autor (2012) stated that the wages of the top and bottom wage earners had not grown faster than in the middle tier of the distribution of wages. They proposed a task framework that theorized that capital invested in technological change could replace some tasks previously performed by workers. Acemoglu and Autor (2012) concluded that increases in job polarisation were caused by the growth of high-skilled, high-wage occupations at the expense of low-skilled, low-wage occupations. Hence, they noted that technological change in the USA over the 20th century was partially skill-biased.

2.2 PREVIOUS RESEARCH ON SBTC

Early studies about the bias of technological change in the 19th century indicated that technological change was having disproportionate effects on skilled and unskilled workers (Nelson & Phelps 1966; Griliches 1969; Griliches 1970; Welch 1970; Bartel & Lichtenberg 1987). More specifically, early research on the non-neutrality of technological change by Nelson and Phelps (1966), Griliches (1969), Griliches (1970), and Welch (1970) found out that the value of education encouraged the companies to approach new technologies easily, and therefore, the rate of return to education is enhanced by the technological change. The study on the bias of technological change in the USA by Bartel and Lichtenberg (1987) affirmed that skilled workers were more advantageous than unskilled workers because they are capable of solving problems, as well as approaching new technologies. By researching the percentage of labour cost devoted to hiring educated workers, Bartel and Lichtenberg (1987) also confirmed that skilled workers were more likely to adapt to change in the work environment than unskilled workers.

Since Bartel and Lichtenberg (1987), there have been several studies to discover whether technological change is non-neutral in the USA that indicated that there was an increase in wage inequality and demand for highly educated workers in the USA (Lynch & Osterman 1989; Bartel & Lichtenberg 1990; Davis & Haltiwanger 1991; Berndt, Morrison & Rosenblum 1992; Kruger 1993; Mishel & Bernstein 1994; Berman, Bound & Griliches 1994; Dunne & Schmitz 1995; Dunne, Haltiwanger & Troske 1997; Autor, Katz & Krueger 1998; Siegel 1997; Bartel & Sicherman 1999). Moreover, Davis and Haltiwanger (1991) showed that there was a difference

between the income of production and non-production workers in the 1980s. Dune, Haltiwanger, and Trosker (1997) reported a positive correlation between technological usage and levels of wage and education. These authors indicated that non-neutral technological change is the reason for increasing the income of skilled workers (Groshen 1990). Such results indicated the wage and employment implications of SBTC.

Previous studies on the bias of technological change have been dominated by the empirical studies in developed countries and have reported similar findings (Chennells & Van Reenen 1995). Channels and Van Reenen (1995) reported that there is a positive association between wages and technology usage for skilled and unskilled workers in the United Kingdom. Entorf and Kramarz (1998) reported a positive correlation between technology usage and wages in France. Berman, Bound, and Machin (1998) determined that technological change is the main reason for wage and employment shift in eight OECD countries. Betts (1997) found out that there was a non-neutral technological change in 16 out of 18 industries in Canada. Haskel (1999) and Haskel and Heden (1999) found that there was an increase in the demand for skilled workers in the United Kingdom manufacturing industry in the 1980s.

Recent studies have focused on the implications of SBTC for overall inequality and labour market. A large number of economic models in the literature provide a foundation for SBTC (Acemoglu 2002; Aghion 2002; Hornstein, Krusell & Violante 2005). In a review of the literature on technological change and labour market inequalities, Hornstein, Krusell and Violante (2005) stressed that a distinctive feature

of the SBTC is the development of a very wide variety of a different theoretical. Goldin and Katz (2007) provided a unified framework for interpreting how the demand and supply of human capital have shaped the distribution of earnings in the USA labour market over the 20th century. Focusing on the skill premium, they concluded that the educational wage differentials can be well explained by changes in the growth of the supply of educated workers. Acemoglu and Autor (2012) have suggested that the framework proposed by Goldin and Katz (2008) needed some amendments since it could not sufficiently account for the deceleration in the skill premium since the early 1990s. They proposed that the growth of employment in high-skill, high-wage occupations and low-skill, low-wage occupations are the reasons for job polarization. Hence, they considered technological change to be only partially skill-biased. Card and DiNardo (2002) provide evidence in favour of the SBTC hypothesis that a burst of new technology caused a rise in the demand for highly skilled workers that, in turn, led to a rise in earnings inequality. Weiss and Garloff. (2011), in a study on the effect of the SBTC on unemployment, has shown that SBTC leads to increasing unemployment of the unskilled when benefits are endogenous and linked to the evolution of the average income.

Despite the differences in methodology and data collection methods, as well as the scope of SBTC studies in the USA and other developed countries, such studies generally indicated that technological change was positively correlated with wages and shifts labour composition in favour of the skilled workers. Two main methods have been adopted in the previous studies on SBTC: 1) the production or cost function framework based on an estimation of a reduced form model (Berndt,

Morrison & Rosenblum 1992; Berman, Bound & Griliches 1994; Mishel & Bernstein 1994; Park 1996; Siegel 1997; Haskel 1999). 2) The standard approach to labour economics: the estimation of wage equation (Bartel & Lichtenberg 1990; Krueger 1993; Reilly 1995; Autor, Katz & Krueger 1998).

Several studies presented the results of industry-level regressions of changes in employment shares or wages on representatives for technological change such as R&D, computers, and the adoption of advanced manufacturing technologies. By using the regression of change in non-production, worker's share in total wage on computers, and R&D, Berman, Bound, and Griliches (1994) indicated that skill upgrading has occurred in most of the industries in the USA and demonstrated, in effects, through presenting a positive connection between investments in computers and R&D and changes in the non-production worker's share in employment and wage. By using the regression of change in employment and the share for five educational classes of workers on technology proxies, Mishel and Bernstein (1994) found a positive association between technology proxies and the proportion of educated workers. Using similar methods, Berndt, Morrison, and Rosenblum (1992) indicated the positive correlation between the share of high-tech office equipment and employment share of non-production.

Moreover, Siegel (1997) found the positive correlation between the indicator of labour quality and investment in computers. In developed countries, Berman, Bound, and Machin (1998) used the cross-country correlations of within-industry changes in the proportion of non-production workers in nine OECD countries. Betts (1997) used an estimation of the translog cost function in studying Canada manufacturing

industries. In a study on the United Kingdom, Haskel (1999) used a regression of changes in the relative wages of skilled and unskilled workers on computers. Haskel and Heden (1999) used a regression of changes in wage bill share for four classes of workers on computers and R&D. In developing countries, Park (1996) indicated a positive correlation between labour productivity growth and the proportion of multi-skilled workers in Korean manufacturing industries. Regev (1998) constructed a firm technology index at the firm level based on the quality of labour, capital, and R&D investment. He reported that technology-intensive firms pay above-average wages and are consistently more productive than other firms in the same industry.

Besides, using the estimation of wage equation, Bartel and Lichtenberg (1990) have inversed the relationship between the age of technology and the wage of skilled workers. By using the data collected from the Current Population Survey, Krueger (1993) linked technological changes to the wage structure at the micro level of technology and reported that workers who used a computer on the job earned a wage premium of 10-15%. Reilly (1995) found that Canadian workers with access to computers earned a 13% wage premium. Moreover, Autor, Katz, and Krueger (1998) showed that the wage premium had increased in the last decade to approximately 17% in the USA. They pointed out that investments in computers could account for as much as 35-50% of the increase in the growth in demand for highly skilled workers. It should be noted that industry-level studies could be subject to aggregation bias. Hence, it is more desirable to examine the impact of technology on wages and labour composition at the plant or firm level. This is because there could be a substantial variation in the technological effects within industries.

There have been several firm-level studies on SBTC reported in the literature. Lynch and Osterman (1989) estimated the labour demand curve for ten occupational classes of workers and reported that technological innovations stimulated an increase in the demand for technical and professional workers. By regressing the change in non-production, worker's share in employment on the number of AMT's adopted, Dunne & Schmitz (1995) indicated that plants with a high rate of technology adoption paid higher wages and employed a larger percentage of skilled workers. Van Reenen (1996) examined panel data on wages and innovation for a sample of British firms whose shares were publicly traded for at least five years between 1976 and 1982.

The data on innovations were derived from the Science Policy Research Unit (SPRU) database, which contains detailed information on successful commercial innovations in Great Britain. Using both static and dynamic instrumental variables estimation to control for the endogeneity of innovations, Van Reenen (1996) concluded that innovative firms paid above-average wages.

One of the main requirements of the data commonly used in the research on SBTC is to have information of both workers and their workplace. Several US researchers have used a dataset of Worker-Establishment Characteristic Database that combines three datasets (Demographic data from 1990 Decennial Census; data on establishments from the Census of Manufactures and the Annual Survey of Manufacturers; detailed information on advanced manufacturing technology usage from the data collected from the Survey of Manufacturing Technology) (Dunne, Haltiwanger & Troske 1996; Doms, Dunne & Troske 1997). Lynch and Osterman (1989) used the data collected from the USA Survey of Manufacturing Technology.

In the United Kingdom, several researchers have used the data collected from a plant-level survey called Workplace Industrial Relations Survey (Chennells & Van Rennen 1995; Machin 1996). In France, an employee-employer panel dataset with detailed measures of labour composition and technology usage was used (Entorf & Kramarz 1998). Regev (1998) estimated a simple production function model for a panel dataset of 2,500 Israeli firms. The complex requirements of research data are one of the reasons for limiting the number of studies about SBTC in developing countries. This study examines the SBTC in Vietnam, a developing country, using the datasets obtained from the Vietnam Household Living Standards Survey from 2004 to 2014. That data contain basic demographic information, employment, and income on all members of households that were selected to represent both rural and urban areas in Vietnam.

2.3 PREVIOUS RESEARCH ON SBTC IN VIETNAM

There have been a few studies on the impact of technological change on employment in Vietnam. The impact of increased information technology investment has relatively benefited Vietnam's young population, who see the opportunity for relatively high wages and a heightened social status due to working for an international company (Shillabeer 2013). Nguyen (1999) explored the impact of technological change on the opportunities for female workers in the process of economic change in Vietnam and found that despite Vietnam has made significant progress in the economy, women's opportunities have not improved. Abbott et al. (2017) used data for seven aggregated sectors and the overall Vietnamese economy to examine the roles played by structural transformation, technical change, and

institutional bias towards capital-intensive development and found that a majority of the difference between GDP and employment growth is because of technical change. Poole et al. (2017) showed that technological change was not the main driver of the demand of skilled workers in Vietnam by indicating that trade was one of the reasons for an increase in the demand for both skilled workers and unskilled workers in Vietnam. However, there has been no study that measured SBTC in Vietnam.

2.4 PREVIOUS RESEARCH ON WAGE DIFFERENTIAL

Studies of wage differentials started in the twenties of the last century (Edgewort 1922) and became more common in the 1950s, especially after Becker's (1957) study. For example, Dunlop (1957) identified the existence of wage differentials across sectors in a study that found the wages of unionised Boston-area truck drivers varied by a factor of two depending on what the load was in the driver's truck. These preliminary studies, such as Dunlop (1957) and Becker's (1957), not only showed the existence of the wage gap but also provided a model for the study of wage differential. Slichter (1950) found a high correlation between occupation and wage differentials in the US economy. They focused on the demand function in the labour market for analysing the effects of industry characteristics on wage structure. Studies on wage differences during the 1960s and early 1970s followed that direction. Thomas and Leonard (1967) focused on estimating the impact of sectoral characteristics (such as profitability, market dominance, union participation, and firm size) on the average wage. In the 1970s, the development of human capital models made research on wage differential more directional forward by analysing the importance of individual career skills, experience, and human capital variables.

The development of human capital models and data analysis tools resulted in a series of new studies of wage differentials during the 1970s and 1980s. These studies used wage as a dependent variable to test the significant level of the slope of the independent variables in the wage equation, including differences in the individual characteristics of workers. Mincer (1974) introduced earnings as a function of potential earnings net of human capital investment costs, where potential earnings in any time period depended on investments in previous time periods. The Mincer model focuses on the life-cycle dynamics of earnings and the relationship between observed earnings, potential earnings, and human capital investment, both regarding formal schooling and on-the-job investment. The Mincer earnings function is the cornerstone of the well-developed literature in empirical economics. It is used as the framework to estimate returns to schooling (Psachoropoulus 1981; Willis 1986; Ashenfelter & Krueger 1994; Ashenfelter & Rouse 1998; Smith & Welch 1989; Krueger 1993), returns to schooling quality (Behrman & Birdsall 1983; Card and Krueger 1992), and to measure the impact of work experience on male-female wage gaps (Mincer & Polachek 1974).

2.5 PREVIOUS RESEARCH ON WAGE DIFFERENTIAL IN VIETNAM

In Vietnam, the income and wage differential have been studied in recent years. These studies focus on understanding the variability of time differentials and the causes of these differentials. Previous studies on income differential from 1993 to 1998 were often based on the Gini coefficient. This is a measure of income inequality, which has a value from 0 to 1. Vietnam's Gini coefficient is calculated by

the Institute for Social Studies (VASS) and has risen from 0.34 in 1993 to 0.35 in 1998 and to 0.43 in 2010. In subsequent studies, the trend focused on examining the correlation between income and wage differential and household characteristics (Gallup 2004; Glewwe et al. 2002; VASS 2007; Molini & Wan 2008; Litchfield & Justino 2004). Another study by Nguyen et al. (2007) analysed the effects of income and poverty on the key explanatory variables of infrastructure, characteristics of household heads, and non-agricultural occupations.

Moreover, Nguyen (2005) followed the method in Juhn-Murphy-Pierce (1993). They found out that the average wage gap between male and female workers tended to increase from 0.094 in 2002 to 0.1103 in 2004. Liu (2004) used the results of the Vietnam Living Standards Survey 1993 and Vietnam Living Standards Survey 1998 to examine wage differentials in Vietnam for workers who were aged 18 to 60 and were working. He used the Mincer (1974) wage equation, which was expanded by adding field of work, ethnicity, and marital status variable. In his equation, the dependent variable is the logarithm of the hourly wage. Independent variables include potential experience variable, which is calculated by the age minus the number of years of schooling and the subsequent deduction for six; dummy variables for occupation; migration; marital status; ethnicities; urban-rural residence; and economic sectors. He found that there is wage inequality between male and female workers. According to Liu (2004), in 1993, for each additional year of study, male workers received 5% more wages than female workers and the wage differential between male and female workers was 39.1% in 1998.

Furthermore, Bui et al. (2001) estimated non-farm income in Vietnam according to educational variables and found the wage differential between urban and rural workers. Hoang et al (2001) conducted a wage regression model using region, household size, religion, ethnicity, education level, sex, occupation, and domain variable and confirmed the wage differential between urban and rural workers in 2001 in Vietnam. Gallup (2004) also got the same results in 2004.

Besides, Nguyen (2006) used the data collected from the Vietnam Household Living Standards Survey 2002 to determine the wage differential between the public and private sectors, as well as the gender gap in each region in Vietnam. He found that workers in the public sector were paid less than those working in the private sector. Hung et al. (2007) researched the wage differentials among ethnic groups in Vietnam by using the data collected from the Vietnam Living Standards Survey 1993, the Vietnam Living Standards Survey 1998, and the Vietnam Household Living Standards Survey 2002 and found that there were wage differentials between Kinh-Hoa ethnic groups and other ethnic groups. In this study, an expanded Mincer (1974) wage equation is used to calculate the skill premium using the datasets obtained from the Vietnam Household Living Standards Survey from 2004 to 2014.

2.6 MEASURING SBTC

Despite the importance of investigating the bias of technological change, the number of studies on SBTC in developing countries is scarce. The main reason for that scarcity may be due to the lack of suitable data in developing countries. SBTC in Vietnam is measured in this thesis by calculating the ratio of factor-augmenting technology term of skilled workers and factor-augmenting technology term of

unskilled workers factor. That ratio is calculated by measuring skill premium and an elasticity of substitution of two labour factors (skilled workers and unskilled workers).

2.6.1 EMPIRICAL METHOD TO MEASURE SBTC

Solow (1957) introduced the way of residually quantifying factor-neutral technical change from the measures of aggregate output, capital and labour and an estimate of the elasticity of output to capital. According to Solow (1975), the technological change could be estimated residually using the production function below:

$$Y = ZK^{\alpha}L^{1-\alpha} \tag{2.1}$$

where: Y: aggregate output

K: aggregate capital

L: aggregate labour

α and β: the two inputs' respective shares of output

A: a change in technology

Measuring aggregate total factor productivity (TFP) is the traditional way to measure technological change at the macro level. As per definition of Solow (1975), a change in TFP is a form of factor-neutral technological change. This means an increase in TFP leads to a rise in output that leaves marginal rates of transformations unchanged for the given inputs. According to my knowledge, there were five constant elasticity of substitution (CES) production functions since 2002 that have been developed based on the Solow (1957) framework (Klump & Harald 1960; David & Klundert 1965; Arrow et al. 1962; Barro & Martin 1995; Acemoglu 2002). According to

Acemoglu (2002), the elasticity of substitution of the CES production function for the aggregate economy has provided a more general view of Solow's (1957) framework. The CES production function of Acemoglu (2002) is as follows:

$$Y(t) = [(A_l(t)L(t))^{\rho} + (A_h(t)H(t))^{\rho}]^{\frac{1}{\rho}} \tag{2.2}$$

where: *L(t)*: the number of unskilled workers at time t

H(t): the number of skilled workers at time t

$A_l(t)$: the respective factor augmenting technology term of unskilled workers at time t

$A_h(t)$: the respective factor augmenting technology term of skilled workers at time t

In addition, the elasticity of substitution between elasticity of substitution between skilled and unskilled workers is defined as follows: $\sigma = 1/(1-\rho)$. With competitive input markets, the skill premium formula can be as follows:

$$\frac{w_h}{w_l} = \left(\frac{A_h}{A_l}\right)^{\frac{\sigma-1}{\sigma}} \left(\frac{H}{L}\right)^{\frac{-1}{\sigma}} \tag{2.3}$$

The relative skill productivity formula is generated by taking the log of both side (2.3). Thus, the relative skill productivity calculates as follows :

$$\ln\left(\frac{A_h}{A_t}\right) = \frac{\sigma-1}{\sigma}\left[\ln\left(\frac{w_h}{w_l}\right) + \frac{1}{\sigma}\ln\left(\frac{H}{L}\right)\right] \tag{2.4}$$

where: *L*: the number of unskilled workers

H: the number of skilled workers

A_l: the respective factor augmenting technology term of unskilled workers

A_h: the respective factor augmenting technology term of skilled workers

w_h/w_l: the skill premium

σ: the elasticity of substitution between elasticity of substitution between skilled and unskilled workers

Based on the equation (2.4), a change in the ratio A_h/A_l is a form of factor-biased technical change since it modifies the marginal rates of transformation at a given input ratio. In particular, under the empirically plausible parametric assumption $\sigma > 0$, technical change is skill-biased if A_h/A_l increases. In this thesis, SBTC will be measured using the formula given in the equation (2.4) with an elasticity of substitution between skilled and unskilled workers, the number of skilled workers, the number of unskilled workers, and skill premium.

2.6.2 THE ELASTICITY OF SUBSTITUTION BETWEEN SKILLED WORKERS AND UNSKILLED WORKERS

The elasticity of substitution between skilled and unskilled workers (σ) has been used widely in research on education and wage inequality since 1970 (Behar 2010). Bowles (1970) reported some evidence on the elasticity of substitution among different types of education labour. Beside, σ can be used to inform the potential for skill biasing effect of trade (Teulins & van Rens 2008; Acemoglu 2003). Also, σ can be used to calculate the effect of a change in relative factor prices on relative factor

demand (Hamermesh 1993). In this thesis, σ is used to calculate the relative skill productivity in Vietnam from 2004 to 2014 using the equation (2.4). These relative skill productivities will be compared together in order to examine the SBTC in Vietnam in the period 2004 to 2014.

There have been several studies to calculate σ in developed countries (Behar 2010). Freeman (1986) introduced a range between 1 and 2 for the elasticity of substitution between college and non-college workers. Katz and Murphy (1992) introduced an estimate of 1.4 for that elasticity. However, even after reviewing about 40 previous studies, Hamermesh (1993) was not prepared to offer a summary range of values for that elasticity. Moreover, the recent work on a panel of US states by Ciccone and Peri (2005) estimate of 1.5 was used for. By considering 47 observations going back to as far as 1915, Goldin & Katz (2008) preferred an estimate of 1.67. Acemoglu and Autor (2010) estimated that it would be between 1.6 and 1.8. These authors estimate the elasticity in the US by regressing the change in the log skill premium on the change in the log of college-educated workers relative to non-college educated workers and a time trend that captures changes in relative factor demands.

Using a full sample of developing countries, the Psacharopoulos and Hinchliffe (1973) study generates an elasticity of 1.5 when people are skilled. In another estimation, Tinbergen (1974) has offered a value of 0.6 to 1.2 for developing countries based on education data of a cross section 18 countries collected by Bowles (1969).

Finally, this thesis considers the elasticity of the situation between unskilled and skilled to be 1.5 based on Psacharopoulos and Hinchliffe (1973) because it's the estimate that the study of Psacharopoulos and Hinchliffe generated with a sample of developing countries such as Mexico, Chile, Columbia, Nigeria, Kenya, India, and the Philippines. Vietnam is a developing country that has the same context as countries in that sample.

CHAPTER 3: METHODOLOGY AND THE DESCRIPTION OF DATA

This chapter presents the method adopted for this study to measure the Skill-Biased Technological Change (SBTC) in Vietnam. The chapter is divided into three sections. The first section describes the various datasets obtained from the Vietnam Household Living Standards Survey (VHLSS) for the period 2004 to 2014. The second section presents the descriptive statistics of the data which includes the geographic, gender, age, and skill distribution of the respondents. The third section presents the two-phase method employed to measure the SBTC in Vietnam from 2004 to 2014.

3. 1 THE DATA

This section presents the adoption of national surveys in the literature on wage followed by the description of data and the processes to ascertain the final data used for the analysis

National survey data is used widely in research about wage. For example, Nestic (2010) analysed the gender wage differential in Croatia using the wage function proposed by Mincer (1974) and using the Labor Force Survey in Croatia for the years 1998 and 2008 conducted by the Croatian Bureau of Statistics. Also, the study by Bhattarai and Wisniewski (2002) used data from the UK Living Standard Survey to study factors affecting UK wages. They found that school years, work experience, vocational training, gender, language, and occupational and area characteristics are significant factors that affect employees' wages.

In this thesis, datasets obtained from the VHLSS conducted from 2004 to 2014 is used with the aim of measuring the SBTC in Vietnam. Between 2004 and 2014, the Vietnam General Statistics Office (GSO) conducted biennial surveys regularly for the purpose of instituting policies, socio-economic development planning, monitoring and managing the standard of living for diverse population groups in Vietnam, as well as evaluating the poverty situation and inequality in the nation (GSO 2004).

Vietnam is divided into three administrative tiers with different types of administrative units on each tier. On the first tier, Vietnam is divided into 64 provinces. On the second tier, Vietnam is divided into 713 units, including urban districts, towns, and rural districts. On the third tier, Vietnam is divided into 1,581 wards, 603 townships, and 8,978 communes (GSO 2004). The GSO survey sampling method was designed in consultation with and was under the supervision of the Institute for Statistical Sciences, United Nations Development Programme, and the World Bank in order to ensure inclusive representation of the selected sample. Data was collected by the GSO in two phases. In stage 1, the selection of communes and wards independently in urban and rural areas were independently determined using the probability method and taking into consideration the proportion of the number of households in each ward. More specifically, communes and wards are selected from urban districts (13.11%), towns (13.16%), and rural districts (22.68%) (GSO 2010). In stage 2, from each ward, three geographic areas were selected for the survey according to the probability method, taking into account the number of households in each area.

The VHLSS 2004 questionnaires were designed to suit a population of 75,000 households as a representative of the entire country's population, considering rural and urban areas in the 64 provinces (GSO 2004). The survey respondents of 2004 were divided into two types: household survey and commune survey. Data collected in the household surveys contain basic demographic information, employment, and income on all household members. Thus, it was the reason whey it was used in this thesis. The survey for 2004 was undertaken in two time periods: the first one in May 2004 and the second in September 2004.

The VHLSS 2006 surveys were sent to 45,900 households as representatives of the whole country, both in rural and urban areas in 64 provinces (GSO 2006). The surveys were divided into two groups: 36,720 homes were studied based on their income while the other 9,180 homes were reviewed based on their income and expenditures. Since the thesis is only concerned with income, the data collected from 45,900 households were used in this thesis. As in previous survey, the data collection was just done in May 2006 and then again in September 2006.

Likewise, the VHLSS 2008 was undertaken on a population size of 45,945 households that representing both rural and urban areas in 64 provinces (GSO 2008). The income survey was completed by 36,756 homes on income, and 9,189 households were further interviewed regarding their income and expenditure. Similarly, the survey was undertaken in May 2008 and in September 2008. The official interviewers and key officials in communes collected the survey data during these periods in 2008.

Furthermore, the VHLSS 2010 was conducted countrywide on a population of 69,360 households quarterly (GSO 2010). It started in the second quarter of 2010 and was completed in the first quarter of 2011. In addition, the VHLSS 2012 was undertaken countrywide on a population of 69,360 homes quarterly (GSO 2012).In contrast in 2014, the VHLSS was only conducted countrywide on a population of 46,995 homes quarterly (GSO 2014).

Using the definition of working age population from the Vietnam labour code (1992), this thesis defines the working age population for male employees to be 18 to 60 years old and for female employees to be 18 to 55 years old. The data used in this thesis were filtered two times from the data collected from the VHLSS survey. First, the data collected from the VHLSS surveys from 2004 to 2014 were filtered based on the working age population definition and were eliminated. Then, the data collected from the VHLSS surveys from 2004 to 2014 were further filtered based on availability of information on socio economic variables regarding wage, ethnicity, marital status, gender, occupation, industry, and the type of enterprise a respondent is employed in.

3.2 DESCRIPTIVE STATISTICS

The number of observations of data collected from the VHLSS 2004, 2006, 2008, 2010, 2012, and 2014 were 21,896, 21,898, 21,916, 18,693, 20,217, and 20,819 respectively. However, after filtering the data, only 4,736 observations of data collected from VHLSS 2004 have data on wages and other related information that is needed for this thesis. Thus, the sample size included in this thesis for 2004 is 4,736. Similarly, the number of observations used in this thesis for 2006, 2008, 2010, and

2012 are 5,424, 4,789, 5,904, 5,352, and 6,613 respectively. The final data set includes information regarding demographics, employment, and income on all household members. This section presents basic summary statistics of the geographical, gender, age, and skill distribution of the VHLSS datasets from 2004 to 2014. These are the main variable models to conduct the regression analysis in this thesis.

3.2.1 GEOGRAPHICAL DISTRIBUTION

When examining the geographical distribution of the sample in 2004, it reveals that there were 1,874 observations in urban areas, which account for 39.56% of the sample observations, and the remaining 2,862 located in the rural areas account for 60.44%. Similarly, there were 2,283 observations in urban areas, which account for 42.09% of the sample observations, and the remaining 3,141 located in the rural areas account for 57.91% in 2006. In 2008, the geographical distribution was 1,974 observations in urban areas (41.21%), and 2,815 (58.79%) observations in rural areas. There were 2,336 observations in urban areas, which account for 39.56% of the sample observations, and the remaining 3,568 located in the rural areas account for 61.44% in 2010. In 2012, the geographical distribution was 2,122 observations in urban areas (39.64%), and 3,230 (61.36%) observations in rural areas. Finally, there were 2,670 observations in urban areas, which account for 40.37% of the sample, and the remaining 3,943 located in the rural areas account for 59.63% in 2014. Figure 3.1 shows the geographical distribution of the included respondents for the period 2004 to 2014. It can be seen from the diagram that the number of workers in rural areas was always higher than the number of workers in urban areas. This result

is in line with Vietnam's current geographical distribution, noting that agriculture is still the primary sector that employs the most number of workers (GSO 2004).

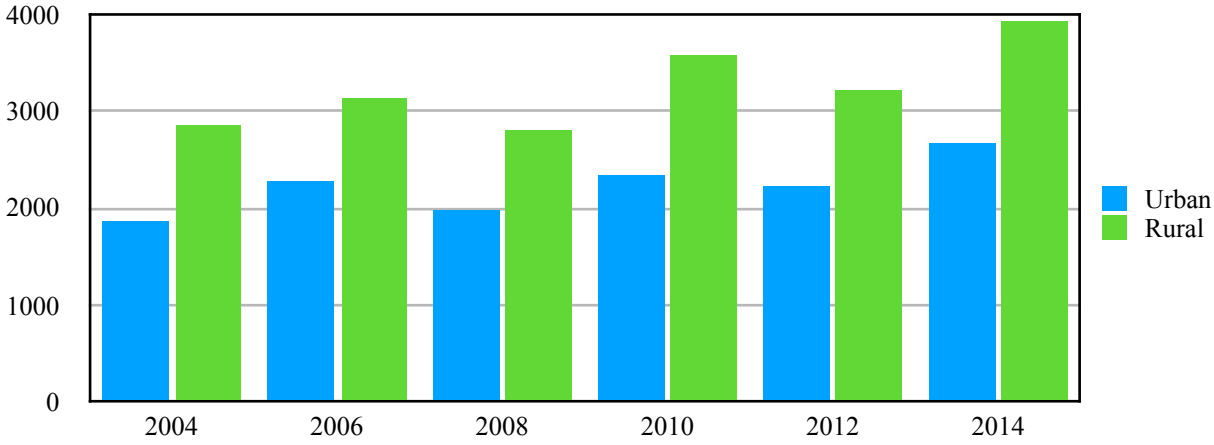

Figure 3.1 The geographical distribution of the sample in the period 2004 to 2014

3.2.2 GENDER DISTRIBUTION

When considering the gender distribution of the sample in 2004, 1,730 observations were females (36.52%) while 3,006 were males (63.48%). Similarly, 2,090 observations were females (38.54%) while 3,334 were males (61.46%) in the sample in 2006. In the sample in 2008, 1,826 observations were females (38.12%) while 2,963 were males (61.88%). In addition, 2,303 observations were females (39%) while 3,601 were males (61%) in the sample in 2010. Similarly, 2,199 observations were females (41.08%) while 3,153 were males (58.92%) in the sample in 2012. In 2014, 2,748 observations were females (41.55%) while 3,865 were males (59.45%). Figure 3.2 shows the gender distribution of the sample in the period 2004 to 2014. It can be seen that the number of male workers was always higher than the number of female workers in the period 2004 to 2014. It also can be seen that the percentage of female workers has increased and the percentage of male workers has decreased in the period 2004 to 2014.

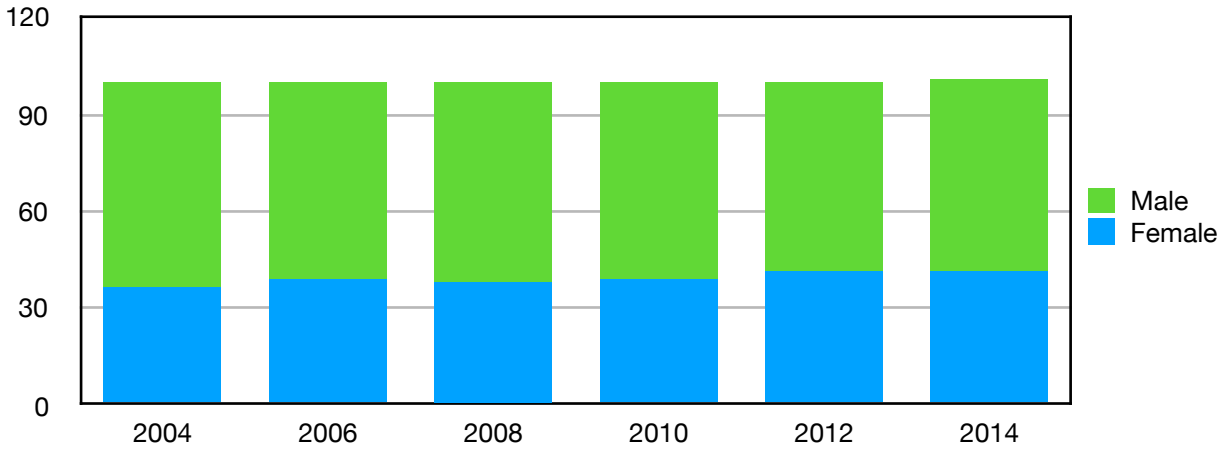

Figure 3.2 The gender distribution of the sample in the period 2004 to 2014

Moreover, Table 3.1 shows the gender distribution in urban and rural areas of the sample in the period 2004 to 2010. It can be seen that the number of male workers was always higher than the number of female workers in both urban and rural regions. The number of workers in rural areas was always higher than the number of workers in urban areas. These results are in line with Vietnam's current economic conditions, where the male workers represent the main labour force and agriculture is the main economic sector in Vietnam (GSO 2004).

	2004	2006	2008	2010	2012	2014
Percentage of female workers in urban areas. (%)	42.42	42.88	43.41	44.17	43.73	45.80
Percentage of male workers in urban areas. (%)	57.58	57.12	56.59	55.83	56.27	54.20
Percentage of female workers in rural areas. (%)	32.66	35.37	34.42	35.62	34.35	38.67
Percentage of male workers in rural areas. (%)	67.34	64.63	65.58	64.38	65.65	61.33

Table 3.1 The gender distribution in urban and rural areas of the sample in the period 2004 to 2014

3.2.3 AGE DISTRIBUTION

The median age of the thesis sample of 2004, 2006, 2010, 2012 and 2014 was 33.92 years, 34.19 years, 34.77 years, 34.65 years, 35.14 years, and 34.94 years respectively. Based on the age distribution of the sample collected from all the datasets, the age distribution was somewhat similar, as shown in Figure 3.3. It is evident that workers aged between 25 years and 34 years accounted for the highest proportion: 33.29% in 2004, 32.98% in 2006, 34.24% in 2008, 38.31% in 2010, 36.84% in 2012, and 39.34% in 2014. The second highest age group was between 25 years and 34 years of age. The over 55 years working age group that had the lowest rate.

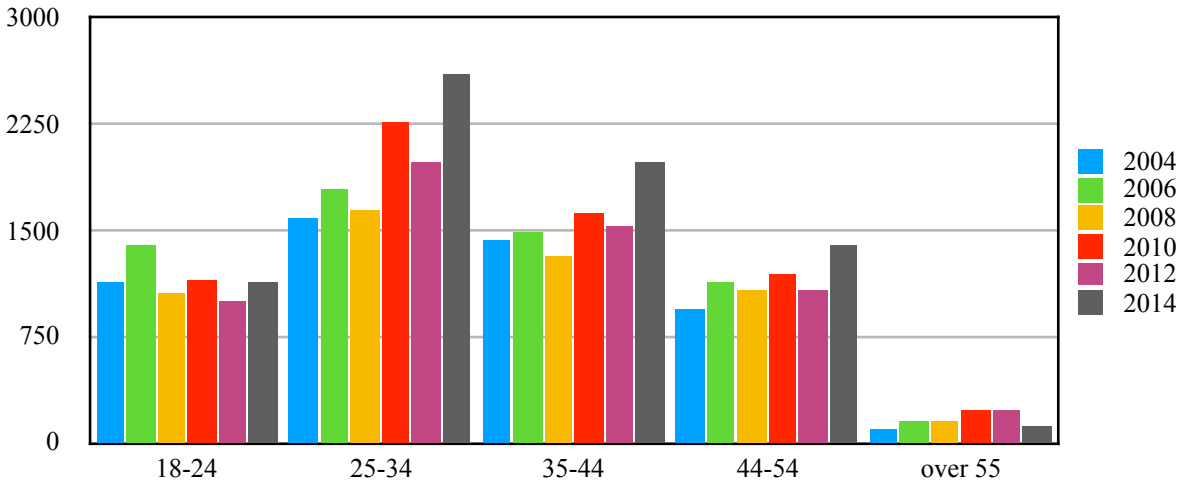

Figure 3.3 The proportion of age groups in the sample

3.2.4 SKILL DISTRIBUTION

According to the data collected from the VHLSS surveys, in 2004, the percentage of skilled workers was 36.69%. In 2006, the percentage of skilled workers was 38.51%. In 2008, the percentage of skilled workers was 39.19%. In 2010, the percentage of skilled workers was 37.02%. In 2012, the percentage of skilled workers was 37.48%.

And in 2014, the percentage of skilled workers was 38.63%. Figure 3.4 shows the percentage of skilled workers from all datasets. It can be seen that the percentage of skilled workers has increased in the period 2004 to 2008. It decreased from 2008 to 2010, but it has increased again in the period 2010 to 2014. The percentage of the skilled worker is the highest in 2008. The percentage of skilled workers is lowest in 2004. The definition of SBTC from Violante(2016) states SBTC is a shift in the production technology that favours skilled workers. The rise in the percentage of skilled workers in the period 2004 to 2008 and in the period 2010 to 2014 forecast the exist of SBTC in the period 2004 to 2010.

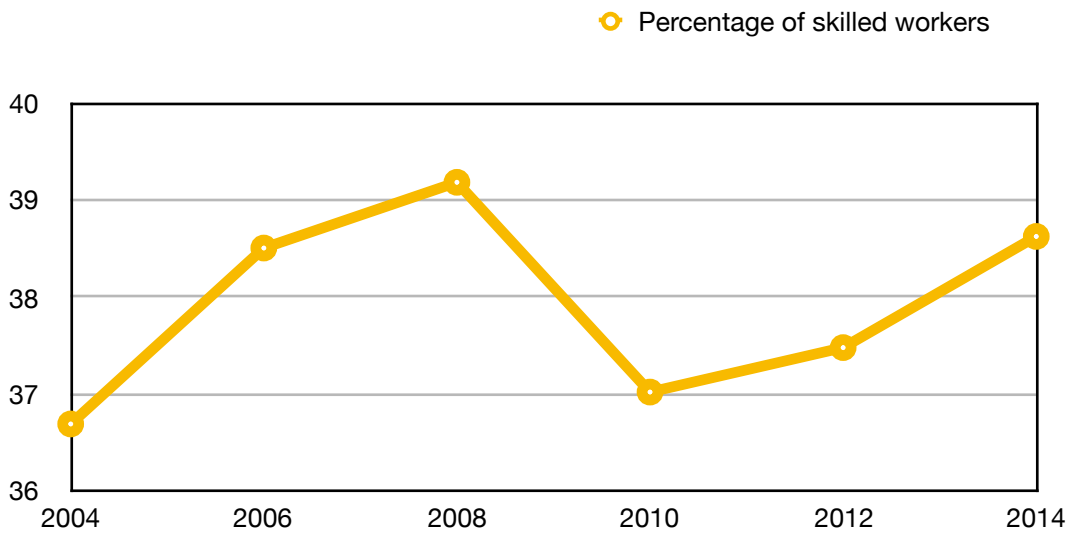

Figure 3.4 The percentage of skilled workers in the period 2004 to 2014

3.3 PHASE 1: SKILL PREMIUM

Mincer (1974) introduced wage equations that showed the relationship between natural logarithm of wages, or earnings, with factors such as the number of years of schooling, work experience, and the square of the work experience based on the argument that the amount of money paid to an individual partly depends on the level

of human capital investment previously spent. In this section, the Mincer (1974) wage function and it's extension adopted in this thesis is discussed.

3.3.1 THE MINCER WAGE FUNCTION (1974)

Following Mincer (1974) model, investments in training can be expressed as a fraction of potential earnings invested: $C_t = k_t E_t$, where k_t is the fraction invested at time t and E_t is potential earnings at time t. Let r_t be the return to training investments made at time t. Then potential earnings E_t is expressed as:

$$E_t = E_{t-1}\left(1 + r_t k_t\right) \tag{3.1}$$

where: t = 0, 1, 2…

In turn, by substituting E with previous periods according to the recursive formula, we get:

$$E_t = \left[\prod_{j=0}^{t-1}(1 + r_j k_j)\right] E_0 \tag{3.2}$$

Taking the logarithms of two sides, we obtain:

$$\ln E_t = \ln E_0 + \sum_{j=0}^{t-1} \ln(1 + r_j k_j) \tag{3.3}$$

Assuming that:

- The number of years of schooling (s) is the number of years spent in full-time employment ($k_0 = k_1 = \ldots = k_{s-1} = 1$ (year))
- The effect of the number of years of schooling on potential wages is constant over time ($r_0 = r_1 = \ldots = r_{s-1} = \beta$)
- The effect of investing in school after graduation on a potential wage is constant over time ($r_s = \ldots = r_{t-1} = \lambda$)

Then the wage equation can be rewritten as follows:

$$\ln E_t = \ln E_0 + s\ln(1+\beta) + \sum_{j=s}^{t-1} \ln(1+\lambda k_j) \tag{3.4}$$

As we know ln (1 + x) and x are equivalent infinitesimal when x = 0.

Therefore, when the value of β, λ is relatively small, we obtain:

$$\ln E_t \approx \ln E_0 + \beta s + \sum_{j=s}^{t-1} k_j \tag{3.5}$$

In order to build a relationship between potential wages and experience, Mincer (1974) assumed that the investment in post-graduate education decreases over time expressed as:

$$k_{s+z} = \eta\left(1 - \frac{z}{T}\right) \tag{3.6}$$

Where: $z = t - s >= 0$; η (0, 1) and T is the last number of years of work be considered.

Integrating (3.5) and (3.6) into (3.4), results to:

$$\ln E_t \approx \ln E_0 + \beta s + \left(n\lambda + \frac{n\lambda}{2T}\right)z + \left(\frac{n\lambda}{2T}\right)z^2 \tag{3.7}$$

Thus, the net wage earned from the investment in education after graduation is specified as:

$$\ln E_t - \eta\left(1 - \frac{z}{T}\right) \approx \underbrace{\ln E_0 - \eta\lambda - \eta}_{\alpha} + + \underbrace{\left(\eta\lambda + \frac{\eta\lambda}{2T} + \frac{\eta}{T}\right)}_{\delta} z + \underbrace{\left(-\frac{\eta\lambda}{2T}\right)}_{\phi} z^2 \tag{3.8}$$

Or, it could be written in another way:

$$\ln E_t - \eta\left(1 - \frac{z}{T}\right) \approx \alpha + \beta s + \delta z + \phi z^2 \tag{3.9}$$

where: $\alpha = \ln E_0 - \eta\lambda - \eta$

$$\delta = \eta\lambda + \frac{\eta\lambda}{2T} + \frac{\eta}{T}$$

$$\phi = -\frac{\eta\lambda}{2T}$$

Finally, assuming the actual wage is equal to the net potential wage at any time t:

$$\ln w_t = \ln E_t - \eta\left(1 - \frac{z}{T}\right) \tag{3.10}$$

The Mincer's wage equation becomes:

$$\ln w_t = \alpha + \beta s + \delta z + \phi z^2 \tag{3.11}$$

where: $z = t - s$

3.2.2 AN EXTENSION OF THE MINCER WAGE FUNCTION

Equation (3.11) is known as the static Mincer wage equation which is used in many wage and wage differential studies. Card (1994) focused on the average effect of school years on wages by using the least squared regression method. Based on Card (1994), the wage form can be written as follows:

$$\ln w_t = \alpha + \beta s + \delta z + \phi z^2 + \gamma X + u \tag{3.12}$$

where:

- s: number of years of schooling
- z: years of experience up to time t with $z = t - s$
- X: other independent variables affecting wages such as gender, occupation, type of work …

Several studies have expanded Mincer's wage equation after Card's study (1994). Those studies have not been limited to the study of average wages and the analysis of average wage disparities but have extended to the study of other statistical parameters of the wages function, such as Buchinsky (1998) and Bhattarai (2017). Buchinsky (1998) built a wage function for female workers for the period from 1968 to 1990 by using the wage function proposed by Mincer (1974). Bhattarai (2017) studied the factors of wage and labour supply in the UK by using an extension wage function based on Mincer (1974) wage function and the data from the UK Living Standard Survey. They showed that school years, work experience, vocational training, gender, language, and occupational and area characteristics affect employee's wages. The wage function used in that study is as follows:

$$\ln w_i = \beta_0 + \beta_1 S_i + \beta_2 Age_i + \beta_3 Age_i^2 + \beta_4 VC_i + \beta_5 Sex_i + \beta_6 E2L_i + \beta_7 RGSC_i + \beta_8 Region_i + \varepsilon_i \quad (3.13)$$

where :

- S: number of years of schooling.
- Age: represents the number of years of work experience.
- VC: the variable represents the level of vocational training.
- Sex: a dummy variable representing gender (equals 1 if male, 0 if female).
- $E2L$: a dummy variable, equal to 1 if English is not the first language.
- $RGSC$: seven dummies representing RG social class on the most recent job.

- *Region*: region variable to see the influence of different regions to predicate.
- ε_i: denotes the disturbance term.

Zhou (2002) showed that human capital was an important determinant of youth income, along with the number of years of schooling and the highest educational attainment in Harare. The results indicate that college-educated individual can earn 46% more than non-college graduates. However, in that same study, demographic and socio-demographic variables and work experience variables were not statistically significant.

Using the VHLSS datasets from the period 2004 to 2014 and employing the Mincer wage function used in previous studies, this thesis develops an extension of Mincer (1974) wage equation. The dependent variable in the regression equation is the natural logarithm of the hourly wage of employees. Nominal hourly wages are calculated by dividing the employee's total annual wage by the total number of hours worked during the year. By choosing the hourly wages, the analysis ignores the difference in wages due to the nature of the work being full-time or part-time. It should be noted that the analysis ignores the factors that may affect the working time of workers, such as housework or childcare. The explanatory variables included in the regression function are divided into two groups: (i) variables related to individual labour productivity and (ii) variables related to job characteristics.

(i) Group of variables related to individual labour productivity include:

- **Age:** Following the definition of working age population from the Vietnam labour code (1992), this variable is measured by filtering respondents to include only age groups for male workers to be 18 to 60 years old and for female workers to be 18 to 55 years old.

- **Year of schooling:** The characteristics of the educational system of Vietnam are used to calculate the number of years of schooling. It will be determined as follows:

    - The school starting age is 6 years old. When the school attendance is continuous at the end, a student is progressed to the next level each year.
    - The number of years of attended for elementary, secondary, and high school are the number of classes attended by individuals.
    - The number of years of vocational training is calculated based on the highest vocational qualification information and the actual number of years of studying in the Vietnamese vocational education system. The number of years of vocational training is as follows:

	Number of years
Short-term vocational training	0.5
Long-term vocational training	1
Professional high school	1.5

Table 3.2 Number of years needed to complete vocational training or professional high school

    - The college degree is completed in three years; the bachelor degree is completed in four to five years depending on the discipline of training; the master's degree is completed in two to three years for people with

university degrees, and the doctorate degrees is completed in two to three additional years. Since there is no industry information for the above mentioned education system, the following durations are applied:

	Number of years
College degree	2
Bachelor degree	4
Master degree	2
Doctoral degree	4

Table 3.3 Number of years needed to complete college, bachelor, master and doctoral degree

- **The highest educational qualification of the worker is used to indicate the employee's skill:** according to the VHLSS datasets, categories of degree, elementary, secondary, high school, vocational training, college or university, and postgraduate degree, are used for educational qualifications. This thesis uses a dummy variable (unSkilled_Skilled) to indicate educational qualifications in the regression model. According to the VHLSS surveys, the worker who has completed vocational training or attained a higher degree is defined as a skilled worker. This definition was also used on the augmented Mincer regression pioneered by Katz and Murphy (1992). The first three educational qualifications groups (elementary, secondary, and high school) are regarded as the educational qualifications group representing the unskilled worker. The other educational qualifications are regarded as the qualified group representing the skilled worker. This variable has a value of 1 if the worker is a skilled worker. It has a value of 0 if the worker is an unskilled worker.

- **Marital status**: this variable is expressed by a dummy variable with a value of 1 if the worker is married, or a value of 0 if the worker is not married (including divorced or widowed/widower).

- **Ethnicity**: this variable is represented by a dummy variable with a value of 1 if the worker is of "Kinh-Hoa" ethnicity, or a value of 0 if the worker belongs to another ethnic group. Specifically, Vietnam is a multi-nationality country with 54 ethnic groups (GSO 2014). The Viet ("Kinh") people account for 87% of the country's population. Among ethnic minorities, the largest ones are "Tay," "Thai," "Muong," "Hoa," "Khmer," and "Nung" with a population of around 1 million each, while the smallest are "Brau," "Roman," and "Odu," with several hundred people each (GSO 2014).

- **Gender**: this variable is represented by a dummy variable with a value of 1 if the worker is a male, or a value of 0 if the employee is a female.

(ii) **Groups of variables related to job characteristics include:**

- **Type of occupation**: according to the VHLSS surveys, there are six types of occupations: army force and leader; top-level and mid-level expert in all fields; elementary professional and white-collar technical personnel; skilled worker in all fields; and service and ales, and unskilled workers. Five dummy variables were used: Armed_force&Leader_staff; Service&Sale_staff; Expert_staff; Office_staff; and Technical_staff. Unskilled workers occupation type is the reference category.

- **Type of industry:** according to the VHLSS surveys, there are three types of industries: agriculture, sylviculture, and aquaculture; manufacturing; and service. Two dummy variables were used: Manufacturing_industry and Service_industry. Agriculture, sylviculture, and aquaculture industry type is the reference category.

- **Type of enterprise:** according to the VHLSS surveys, there are four types of enterprise: state-owned, private, foreign-invested, self-employed, household, and collective. Three dummy variables were used: state_owned_enterprise_type, private_enterprise_type, Foreign_invested_enterprise_type. Other types of the enterprise are the reference categories.

- **Domain:** this variable is represented by a dummy variable with a value of 1 if the worker comes from an urban area, or a value of 0 if the worker comes from a rural area.

- **Region:** according to the VHLSS surveys, there are six regions: Red River Delta; North East and North West; Northern and Coastal Central; Central Highlands; North East South; and the Mekong River Delta. Five dummy variables were used: Red_River_Delta_region; Northern&Coastal_Central_region; Central_Highland_region; South_Eastern_region; and Mekong_Delta_region. North East and North West is the reference category.

In summary, the quantitative variables included in the wage regression function are: the numerical variables of age and age squared. Also, the qualitative variables are education, gender, marital status, type of occupation, type of industry, type of

enterprise, ethnicity, domain, and region. Therefore, the regression equation for estimating the skill premium is as follows:

$$\begin{aligned}
&\ln w = \beta_0 + \beta_1 Unskilled_skilled + \beta_2 Age + \beta_3 Age^2 \\
&+\beta_4 Schooling + \beta_5 Gender + \beta_6 Marital + \beta_7 Ethnicity + \beta_8 Domain \\
&+\beta_9 Armed_force \,\&\, Leader_staff + \beta_{10} Expert_staff + \beta_{12} Office_staff \\
&+\beta_{13} Sale \,\&\, Service_staff + \beta_{14} Skilled_staff \\
&+\beta_{14} Manufacturing_industry + \beta_{15} Service_industry \\
&+\beta_{16} \Pr ivate_enterprise_type + \beta_{17} State_enterprise_type \\
&+\beta_{18} Foreign_invested_enterprise_type + \beta_{19} Red_River_Delta_region \\
&+\beta_{20} Northern \,\&\, Coastal_Central_region \\
&+\beta_{21} Central_Highland_region + \beta_{22} South_Eastern_region \\
&+\beta_{23} Mekong_Delta_region \\
&+u_i
\end{aligned} \tag{3.14}$$

Variables in (3.4) is described in the following table.

Variable	*Description*
Unskilled_skilled	A dummy variable that represents the educational attainment of the worker. This variable has a value of 1 if the worker has completed a vocational training degree or obtained a higher degree. Otherwise, this variable has a value of 0.
Age	Worker's age
Age²	Square of worker's age
Schooling	The total number of years of schooling at the levels of general education, vocational training and higher education.
Gender	The dummy variable concerns the gender of the workers. This variable has a value of 1 if the worker is male. Otherwise, this variable has a value of 0.
Marital	A dummy variable that represents the marital status of the workers. This variables has a value of 1 if the worker is married. Otherwise, this variable has a value of 0.

Variable	*Description*
Ethnicity	A dummy variable that represents the ethnicity of the worker. This variable has a value of 1 if the ethnicity of the worker is of "Kinh-Hoa". Otherwise, this variable has a value of 0.
Domain	A dummy variable concerns the region of the worker. This variables has a value of 1 if the worker comes from an urban area. Otherwise, this variable has a value of 0.
Armed_force&Leader_staff	The dummy variable concerns the type of occupation. This variable has a value of 1 if the worker is an armed force or leader staff. Otherwise, this variable has a value of 0.
Expert_staff	The dummy variable concerns the type of occupation. This variable has a value of 1 if the worker is an expert staff. Otherwise, this variable has a value of 0.
Office_staff	The dummy variable concerns the type of occupation. This variable has a value of 1 if the worker is an office staff. Otherwise, this variable has a value of 0.
Sale&Service_staff	The dummy variable concerns the type of occupation. This variable has a value of 1 if the worker is a sale or service staff. Otherwise, this variable has a value of 0.
Technical_staff	The dummy variable concerns the type of occupation. This variable has a value of 1 if the worker is a technical staff. Otherwise, this variable has a value of 0.
Manufacturing_industry	The dummy variable concerns the type of industry. This variable has a value of 1 if the worker's company is relevant to the manufacturing industry. Otherwise, this variable has a value of 0.
Service_industry	The dummy variable concerns the type of industry. This variable has a value of 1 if the worker's company is relevant to the service industry. Otherwise, this variable has a value of 0.

Variable	*Description*
Private_enterprise_type	The dummy variable concerns the type of enterprise. This variable has a value of 1 if the worker is working in a private company. Otherwise, this variable has a value of 0.
State_owned_enterprise_type	The dummy variable concerns the type of enterprise. This variable has a value of 1 if the worker is working in a state company. Otherwise, this variable has a value of 0.
Foreign_invested_enterprise_type	The dummy variable concerns the type of enterprise. This variable has a value of 1 if the worker is working in a foreign-invested company. Otherwise, this variable has a value of 0.
Red_River_Delta_region	The dummy variable concerns the region of the worker. This variable has a value of 1 if the worker comes from the Red River Delta region. Otherwise, this variable has a value of 0.
Northern&Coastal_Central_region	The dummy variable concerns the region of the worker. This variable has a value of 1 if the worker comes from the Northern and Coastal Central region. Otherwise, this variable has a value of 0.
Central_Highland_region	The dummy variable concerns the region of the worker. This variable has a value of 1 if the worker comes from the Central Highland region. Otherwise, this variable has a value of 0.
South_Eastern_region	The dummy variable concerns the region of the worker. This variable has a value of 1 if the worker comes from the South Eastern region. Otherwise, this variable has a value of 0.
Mekong_Delta_region	The dummy variable concerns the region of the worker. This variable has a value of 1 if the worker comes from the Mekong Delta region. Otherwise, this variable has a value of 0.

Table 3.4 The descriptions of variables in formula (3.14)

3.4 PHASE 2: CALCULATE THE RELATIVE SKILL PRODUCTIVITY

In this phase, relative skill productivity is calculated using the total number of skilled and unskilled workers and the elasticity of substitution between skilled and unskilled workers.

As Violante (2016) pointed out, SBTC induces an increase in the relative productivity of skilled labour that raises its relative demand and the skill premium. The relative skill productivity in Vietnam from 2004 to 2014 is calculated using the formula (2.4). Following the formula (2.4), relative skill productivity is calculated from the skill premium $\ln(w_h/w_l)$, the total number of skilled workers, the total number of unskilled workers, and the elasticity of substitution between high and low-education workers (σ).

The skill premium $\ln(w_h/w_l)$ is calculated using the method applied in Phase 1. Following Katz and Murphy (1992) for the definition of skilled workers who have completed a vocational training or attained a higher degree as being skilled, the total number of skilled and unskilled workers in the data collected from VHLSS datasets in the period 2004 to 2014 are shown in table 3.5.

	2004	2006	2008	2010	2012	2014
Number of unskilled workers (L)	1738	2089	1877	2186	2006	2555
Number of skilled workers(H)	2998	3335	2912	3718	3346	4058

Table 3.5: The total number of skilled and unskilled workers in the samples from 2004 to 2014

There is a broad consensus in the literature that the elasticity of substitution between high and low-education workers, σ, ranges between 1.4 and 2 (Freeman 1986). Katz and Murphy (1992), for instance, have found a value of $\sigma \approx 1.4$ for US data, whereas Angrist's (1995) results on Palestinian skill premia imply $\sigma \approx 2$. Focusing on developing countries, Psacharopoulos and Hinchliffe (1973) have estimated values of $\sigma \approx 1.5$. For the purpose of this study, the value from Psacharopoulos and Hinchliffe (1973) is the best estimate for the elasticity of substitution between high and low education workers in Vietnam available so far.

CHAPTER 4: ANALYSIS & RESULTS

This chapter presents the results, and discusses the findings. It includes (1) Results of Phase 1 on the calculation of the skill premium, and (2) Results of Phase 2 regarding the skill relative productivity.

4.1 RESULTS OF PHASE 1: SKILL PREMIUM

In this study, an extended form of the Mincer wage function specified in equation (3.14) is used. Regression analysis were performed with the natural logarithm of hourly wage as the dependent variable, and with the following as independent variables:

Unskilled_skilled, Age, Age^2, Schooling, Gender,Marital, Ethnicity, Domain, Armed_force&Leader_staff, Office_staff, Service&Sale_staff, Technical_staff, Manufacturing_industry, Service_industry,

Private_enterprise_type, State_enterprise_type, Foreign_invested_enterprise_type,

Red_River_Delta_region, Northern&Coastal_Central_region,

Central_Highland_region, Central_Highland_region,

Southeastern_region,Mekong_Delta_region.

This section discusses the results of the regression model using the data collected from the VHLSS survey for the period 2004 to 2014. This section will also present the results of the wage differential, with regards to age, gender and domain in Vietnam, as well as the skill premium in Vietnam from 2004 to 2014.

4.1.2 REGRESSION RESULTS FOR 2004

The results of the regression model using the VHLSS 2004 survey data are as follows:

Independent variables	Estimated Coefficients β	Robust Std. Error	p-value	VIF
Unskilled_skilled	0.1747	0.0245911	(0.000)***	2.28
Age	0.0357	0.0057753	(0.000)***	58.68
Age²	-0.0003	0.0000778	(0.000)***	53.63
Schooling	0.0354	0.004014	(0.000)***	2.50
Gender	0.2224	0.0169033	(0.000)***	1.14
Marital	0.0317	0.0212442	0.135	1.85
Ethnicity	0.1082	0.0367879	(0.003)**	1.23
Domain	0.1650	0.0174901	(0.000)***	1.28
Armed_force&Leader_staff	-0.2331	0.0471647	(0.000)***	1.49
Expert_staff	0.1029	0.0331751	(0.002)**	2.85
Office_staff	0.0774	0.0452675	(0.087)*	1.36
Service&Sale_staff	0.0478	0.0426499	0.262	1.16
Technical_staff	0.1641	0.020272	(0.000)***	1.53
Manufacturing_industry	0.4715	0.033999	(0.000)***	3.80
Service_industry	0.3940	0.032349	(0.000)***	3.89
Private_enterprise_type	0.2902	0.0267404	(0.000)***	2.42
State_enterprise_type	-0.1910	0.0627028	(0.002)**	1.06
Foreign_invested_enterprise_type	0.1507	0.0258775	(0.000)***	1.24
Red_River_Delta_region	-0.1443	0.029082	(0.000)***	2.16
Northern&Coastal_Central_region	0.0179	0.026481	0.498	2.13
Central_Highland_region	0.1246	0.0412783	(0.003)**	1.29
Southeastern_region	0.4974	0.0282093	(0.000)***	2.22
Mekong_Delta_region	0.1483	0.027719	(0.000)***	2.14
Constant	6.866	0.1050626	(0.000)***	
$R^2 = 0.4386$				

Number of observations : 4736	
***, **, * represent 1%, 5%, and 10% level of significance respectively	
Diagnostic Test	**Test Result**
F-statistics	0.0000
Ramsay RESET Test	0.0580
Skewness/Kurtosis tests for Normality	Pr(Skewness) = 0.0718 Pr(Kurtosis) = 0.1235

Table 4.1 Regression results of the regression analysis using the VHLSS 2004 survey data

The results in Table 4.1 show that all variables in the function are statistically significant at the 5% except for the following variables:

Marital (p_value = 0.135), *Office_staff* (p_value = 0.087), *Service&Sale_staff* (p_value = 0.262), and *Northern&Coastal_Central_region* (p_value = 0.498).

The value of R^2 is 0.4386, meaning that the independent variables explain around 43.86% of the variance of the dependent variable in the model. Moreover, apart from two variables (*Age* and *Age2*), other independent variables do not have multi-collinearity (VIF < 10). The result of the Ramsay RESET Test further indicates that the function has no omitted variables (p_value = 0.0580 > 0.05). The result of the Skewness/Kurtosis tests for Normality shows that the residuals are normally distributed (pr(Skewness) > 0.05 & pr(Kurtosis) > 0.05).

According to the results in Table 4.1, pertaining to the age, for a worker´s one year increase in age, their wage will increase by 3.57%. As for skilled or unskilled, when a worker changed from being unskilled to skilled, their wage is increased by 17.47%. The result also revealed that there was a large wage differential between urban and rural workers. The wage of a worker increased by16.50% if the worker moved from a rural to an urban area. In addition, when a worker moved to the Southeastern

region, their wage increased by 49.74%. As for the industries, in 2004, if a worker changed their job from agriculture, forestry, or aquaculture industry to the service or manufacturing industry, their wage increased by 39.40% and 47.15% respectively. As for the enterprise type, in 2004, if a worker changed their job to a company that was a private or foreign-invested enterprise type from stage and others enterprise type, their wage increased by 29.02% and 15.07% respectively.

Moreover, as the results in Table 4.1 demonstrate, the wage differential between male and female workers in Vietnam was significant in 2004. The results further illustrate that there are wage differentials between "Kinh-Hoa" and other ethnicities. Likewise, the results also indicate that the wage differential exists between married and unmarried workers.

4.1.2 REGRESSION RESULTS FOR 2006

The results of the regression model using the VHLSS 2006 survey data are as follows:

Independent variables	Estimated Coefficients β	Robust Std. Error	p-value	VIF
Unskilled_skilled	0.1892	0.0226445	(0.000)***	2.40
Age	0.0539	0.0054559	(0.000)***	68.73
Age^2	-0.0006	0.000073	(0.000)***	63.11
Schooling	0.0306	0.0036902	(0.000)***	2.68
Gender	0.2118	0.0143778	(0.000)***	1.11
Marital	0.0412	0.0189642	(0.003)**	1.80
Ethnicity	0.1072	0.0319313	(0.001)**	1.23
Domain	0.2083	0.014597	(0.000)***	1.21

Armed_force&Leader_staff	-0.0614	0.0470041	0.191	1.47
Expert_staff	0.2229	0.0285799	(0.000)***	2.91
Office_staff	0.0510	0.0404868	0.207	1.32
Service&Sale_staff	0.0316	0.0368668	0.391	1.16
Technical_staff	0.1513	0.0177027	(0.000)***	1.54
Manufacturing_industry	0.4042	0.0327632	(0.000)***	4.24
Service_industry	0.3372	0.0315158	(0.000)***	4.29
Private_enterprise_type	0.1539	0.0230275	(0.000)***	2.39
State_enterprise_type	-0.1379	0.0611694	(0.024)*	1.06
Foreign_invested_enterprise_type	0.1636	0.0206799	(0.000)***	1.24
Red_River_Delta_region	0.0108	0.0252087	0.666	2.51
Northern&Coastal_Central_region	-0.0104	0.0253736	0.680	2.22
Central_Highland_region	0.1128	0.037781	(0.003)*	1.33
Southeastern_region	0.3949	0.0261748	(0.000)***	2.21
Mekong_Delta_region	0.1068	0.0268798	(0.000)***	2.18
Constant	6.9037	0.1019645	(0.000)***	
$R^2 = 0.4236$				
Number of observations: 5424				
***, **, * represent 1%, 5%, and 10% level of significance respectively				
Diagnostic Test	**Test Result**			
F-statistics	0.000			
Ramsay RESET Test	0.1177			
Skewness/Kurtosis tests for Normality	Pr(Skewness) = 0.7903 Pr(Kurtosis) = 0.1324			

Table 4.2 Regression results of the regression analysis using the VHLSS 2006 survey data

The results in Table 4.2 show that all variables in the function are statistically significant at the 5% except for the following variables:

Armed_force&Leader_staff (p_value = 0.191), *Service_sale_staff* (p_value = 0.207), *Office_staff* (p_value = 0.391), *Northern&Coastal_Central_region* (p_value = 0.68), and *Red_River_Delta_region* (p_value = 0.666).

The value of R^2 is 0.4236, meaning that the independent variables explain around 42.36% of the variance of the dependent variable in the model. Moreover, apart from two variables (*Age* and Age^2), other independent variables do not have multi-collinearity (VIF < 10). The result of the Ramsay RESET Test indicated that the function has no omitted variables (p_value = 0.1177 > 0.05). The result of the Skewness/Kurtosis tests for Normality indicated that the residuals were normally distributed (pr(Skewness) > 0.05 & pr(Kurtosis) > 0.05).

According to the results in Table 4.2, pertaining to age, for a worker´s one year increase in age, their wage increased by 5.3%. In addition, pertaining to skilled or unskilled, when a worker changed from being unskilled to skilled, their wage increased by18.92%. The wage of a worker increased by 20.83% if the worker moved from a rural to an urban area. In addition, when a worker moves to the Southeastern region, their wage increased by 39.49%. As for the industries, in 2006, if a worker changed their job from agriculture, forestry, or aquaculture industry to the service or manufacturing industry, their wage increased by 33,72% and 40.42% respectively. As for the enterprise type, in 2006, if a worker changes their job to a company that was a private enterprise or foreign-invested type from stage and others enterprise type, their wage increased by 15.39% and 16.36% respectively.

Compared with the estimated coefficient of the *Unskilled_skilled* variable in 2004, there is an increase in 2006. This shows that the change from unskilled to a skilled worker has a real effect on the wage in 2006. The model also shows that there is a large wage differential between urban and rural workers. The estimated coefficient of the *Domain* variable shows that the worker´s domain really affects the wage in

2006, compared to 2004. Similarly to 2004, pertaining to the results in Table 4.2, the wage differential between male and female workers was significant in 2006 in Vietnam. The results show the wage differential between "Kinh-Hoa" and other ethnicities. The results also show the wage differential between married and unmarried workers.

4.1.3 REGRESSION RESULTS FOR 2008

The results f the regression model using the VHLSS 2008 survey data are as follows:

Independent variables	Estimated Coefficients β	Robust Std. Error	p-value	VIF
Unskilled_skilled	0.2201	0.0260188	(0.000)***	2.44
Age	0.0490	0.0060626	(0.000)***	65.98
Age²	-0.0005	0.0000807	(0.000)***	61.63
Schooling	0.0484	0.0040801	(0.000)***	2.88
Gender	0.2248	0.0172036	(0.000)***	1.08
Marital	0.0828	0.0207717	(0.000)***	1.67
Ethnicity	0.1546	0.0339347	(0.000)***	1.21
Domain	0.1839	0.0176875	(0.000)***	1.25
Armed_force&Leader_staff	-0.1426	0.0539062	(0.008)**	1.58
Expert_staff	0.2460	0.0358161	(0.000)***	3.31
Office_staff	0.1155	0.0509596	(0.023)**	1.32
Service&Sale_staff	0.0972	0.0435903	(0.026)**	1.24
Technical_staff	0.2264	0.0218556	(0.000)***	1.75
Manufacturing_industry	0.1702	0.0336729	(0.000)***	3.58
Service_industry	0.1288	0.0362667	(0.000)***	3.98
Private_enterprise_type	0.1923	0.0287633	(0.000)***	2.52
State_enterprise_type	0.0111	0..0563218	0.843	1.08
Foreign_invested_enterprise_type	0.2062	0..0256448	(0.000)***	1.21
Red_River_Delta_region	-0.1508	0..0325489	(0.000)***	1.86

Northern&Coastal_Central_region	-0.0255	0..0274039	0.351	2.08
Central_Highland_region	0.1419	0.0384116	(0.000)***	1.27
Southeastern_region	0.4341	0.0281072	(0.000)***	2.17
Mekong_Delta_region	0.0747	0.0288405	(0.010)*	2.08
Constant	7.2789	0.1159854	(0.000)***	
$R^2 = 0.4506$				
Number of observations: 4789				
***, **, * represent 1%, 5%, and 10% level of significance respectively				
Diagnostic Test	**Test Result**			
F-statistics	0.000			
Ramsay RESET Test	0.0642			
Skewness/Kurtosis tests for Normality	Pr(Skewness) = 0.0531 Pr(Kurtosis) = 0.0505			

Table 4.3 Regression results of the regression analysis using.the VHLSS 2008 survey data

The results in Table 4.3 show that all variables in the function are statistically significant at the 5% except for the following variables:

State_enterprise_type (p_value = 0.843), *Northern&Coastal_Central_region* (p_value = 0.351).

The value of R^2 is 0.4506, meaning that the independent variables explain 45.06% of the variance of the dependent variable in the model. Moreover, apart from two variables (*Age* and Age^2), other independent variables do not have multi-collinearity (VIF < 10). The result of the Ramsay RESET Test indicated that the function has no omitted variables (p_value = 0.0642 > 0.05). The result of the Skewness/Kurtosis tests for Normality indicated that the residuals were normally distributed (pr(Skewness) > 0.05 & pr(Kurtosis) > 0.05).

According to the results in Table 4.3, pertaining to age, for a worker´s one year increase in age, their wage increased by 4.9%. In reference to skilled or unskilled, when a worker changed from being unskilled to skilled, their wage increased by 22.01%. When a worker changed their location from a rural to an urban area, their wage increased by18.39%. In addition, when a worker moved to the Southeastern region, their wage increased by 43.41%. As for the industries, in 2008, if a worker changed their job from agriculture, forestry, or aquaculture industry to the service or manufacturing industry, their wage increased by 12.88% and 17.02% respectively. Pertaining to the enterprise types, the regression result can not indicate the wage differential between stage enterprise and other enterprise in 2014 due to the *State_enterprise_type* variable being not statistically significant at the 5%.

The estimated coefficient of the *Age* variable has increased, compared to 2004, but decreased compared to 2006. In reference to skilled or unskilled, the estimated coefficient of the *Unskilled_skilled* variable has increased compared to 2004 and 2006. This shows that the wage gap between skilled and unskilled workers has increased in the period of 2004 to 2008. The model also shows that there is a large wage differential between urban and rural workers in 2008. Although the estimated coefficient of this variable has fallen compared to 2006, the decrease is negligible. Similarly to 2004 and 2006, as per the results in Table 4.3, the wage differential between male and female workers was significant in 2008 in Vietnam. The results show the wage differential between “Kinh-Hoa” and other ethnicities. The results also show the wage differential between married and unmarried workers in 2008 in Vietnam.

4.1.4 REGRESSION RESULTS FOR 2010

The results of the regression model using the VHLSS 2010 survey data are as follows:

Independent variables	Estimated Coefficients β	Robust Std. Error	p-value	VIF
Unskilled_skilled	0.1812	0.0221014	(0.000)***	2.44
Age	0.0609	0.0049901	(0.000)***	66.29
Age²	-0.0007	0.0000663	(0.000)***	61.92
Schooling	0.0241	0.0030569	(0.000)***	2.82
Gender	0.2441	0.013979	(0.000)***	1.08
Marital	0.0369	0.0163365	(0.024)***	1.65
Ethnicity	0.1556	0.0265746	(0.000)***	1.21
Domain	0.2005	0.0138476	(0.000)***	1.22
Armed_force&Leader_staff	0.3709	0.0492926	(0.000)***	1.47
Expert_staff	0.3302	0.0308641	(0.000)***	2.59
Office_staff	0.07781	0.0405414	(0.055)*	1.19
Service&Sale_staff	0.1413	0.0305941	(0.000)***	1.17
Technical_staff	0.2241	0.0181181	(0.000)***	1.64
Manufacturing_industry	0.1814	0.0274515	(0.000)***	4.00
Service_industry	0.1175	0.0295139	(0.000)***	4.29
Private_enterprise_type	0.2665	0.0181392	(0.000)***	2.27
State_enterprise_type	0.1632	0.0248784	(0.000)***	1.06
Foreign_invested_enterprise_type	0.3490	0.0278553	(0.000)***	1.21
Red_River_Delta_region	0.0275	0.0239583	(0.000)***	2.51
Northern&Coastal_Central_region	0.1159	0.0233183	0.250	2.15
Central_Highland_region	0.11598	0.0306718	(0.021	1.46
Southeastern_region	0.3287	250556	(0.000)***	2.24
Mekong_Delta_region	0.0066	0.0271809	0.786	2.13
Constant	7.6909	0.1015918	(0.000)***	
$R^2 = 0.4741$				

Number of observations: 5904	
**, **, * represent 1%, 5%, and 10% level of significance respectively	
Diagnostic Test	**Test Result**
F-statistics	0.000
Ramsay RESET Test	0.1436
Skewness/Kurtosis tests for Normality	Pr(Skewness) = 0.0635 Pr(Kurtosis) = 0.3025

Table 4.4 Regression results of the regression analysis using the VHLSS 2010 survey data

The results in Table 4.4 show that all variables in the function are statistically significant at the 5% except for the following variables:

Office_staff (p_value = 0.391) and *Northern&Coastal_Central_region* (p_value = 0.25), and *Mekong_Delta_region* (p_value = 0.786).

The value of R^2 is 0.4741, meaning that the independent variables explain around 47.41% of the variance of the dependent variable in the model. Moreover, apart from two variables (*Age* and Age^2), other independent variables do not have multi-collinearity (VIF < 10). The result of the Ramsay RESET Test indicated that the function has no omitted variables (p_value =.0.1436 > 0.05) The result of the Skewness/Kurtosis tests for Normality indicated that the residuals were normally distributed (pr(Skewness) > 0.05 & pr(Kurtosis) > 0.05).

According to the results in Table 4.4, in reference to age, for a worker´s one year increase in age, their wage increased by 6.09%. Pertaining to skilled or unskilled, when a worker changed from being unskilled to skilled, their wage increased by 18.12%. In addition, if a worker moved from a rural to an urban area, their wages increased by 20.5%. In addition, when a worker moved to the Southeastern region, their wage increased by 32.87%. As for the industries, in 2010, if a worker changes

their job from agriculture, forestry, or aquaculture to the service and manufacturing industry, their wage increased by 11.75% and 18.14% respectively. Pertaining to the enterprise types, in 2010, if a worker changed their job to a company that is a private, stage, or foreign-invested enterprise type from other enterprise types, their wage increased by 26.65%, 16.32%, 34.49% respectively.

The estimated coefficient of the *Age* variable has increased compared to 2004, 2006, and 2008. This shows that the wage differential, with regards to age, has increased in the period 2004 to 2010. The estimated coefficient of the *Unskilled_skilled* variable variable has decreased compared to the period 2006 to 2008. This shows that the wage gap between skilled and unskilled workers has increased in the period of 2004 to 2008 but decreased in the period 2008 to 2010. Similarly to the period 2004 to 2008, as the results in Table 4.4 demonstrate, the wage differential between male and female workers was significant in 2010 in Vietnam. The results show the wage differential between "Kinh-Hoa" and other ethnicities. The results also show the wage differential between married and unmarried workers in 2010 in Vietnam.

4.1.5 REGRESSION RESULTS FOR 2012

The results of the regression model using the VHLSS 2012 survey data are as follows:

Independent variables	Estimated Coefficients β	Robust Std. Error	p-value	VIF
Unskilled_skilled	0.1514	0.0239471	(0.000)***	2.61
Age	0.0697	0.0054422	(0.000)***	60.46

Age²	-0.0008	0.0000716	(0.000)***	57.47
Schooling	.0218	0.003027	(0.000)***	3.05
Gender	0.2404	0.0149982	(0.000)***	1.09
Marital	0.0360	0 .018907	(0.057)*	1.44
Ethnicity	0.1793	0.0319489	(0.000)***	1.30
Domain	0.1680	0.01531	(0.000)***	1.24
Armed_force&Leader_staff	0.2693	0.0544994	(0.000)***	1.54
Expert_staff	0.3793	0.0332271	(0.000)***	3.72
Office_staff	0.0687	0.0500893	0.170	1.45
Service&Sale_staff	0.1191	0.0332863	(0.000)***	1.60
Technical_staff	0.1195	0.0214676	(0.000)***	2.07
Manufacturing_industry	0.2446	0.0282887	(0.000)***	3.51
Service_industry	0.1135	0.0303023	(0.000)***	4.06
Private_enterprise_type	0.1069	0 .019583	(0.000)***	1.46
State_enterprise_type	0.1738	0.0261334	(0.017)**	2.63
Foreign_invested_enterprise_type	0.0624	0.0266346	(0.000)***	1.33
Red_River_Delta_region	0.2551	0.0262496	0.729	2.76
Northern&Coastal_Central_region	-0.1041	0.0265605	(0.000)***	2.64
Central_Highland_region	-0.0231	0.038483	0.548	1.39
Southeastern_region	0.1832	0.0271554	(0.000)***	2.57
Mekong_Delta_region	-0.0730	0.0292998	(0.013)**	2.52
Constant	7.8826	0.0995333	(0.000)***	
$R^2 = 0.4035$				
Number of observations : 5352				
**, **, * represent 1%, 5%, and 10% level of significance respectively				
Diagnostic Test	**Test Result**			
F-statistics	0.000			
Ramsay RESET Test	0.0545			
Skewness/Kurtosis tests for Normality	Pr(Skewness) = 0.3231 Pr(Kurtosis) = 0.0524			

Table 4.5 Regression results of the regression analysis using the VHLSS 2012 survey data

The results in Table 4.5 show that all variables in the function are statistically significant at the 5% except the following variables:

Marital (p_value = 0.391), *Office_staff* (p_value = 0.017), *Red_River_Delta_region* (p_value = 0.729), and *Central_Highland_region* (p_value = 0.548).

The value of R^2 is 0.4035, meaning that the independent variables explain around 40.35% of the variance of the dependent variable in the model. Moreover, apart from two variables (*Age* and Age^2), other independent variables do not have multi-collinearity (VIF < 10). The result of the Ramsay RESET Test indicated that the function has no omitted variables (p_value = 0.0545 > 0.05). The result of the Skewness/Kurtosis tests for Normality indicated that the residuals were normally distributed (pr(Skewness) > 0.05 & pr(Kurtosis) > 0.05).

According to the results in Table 4.5, pertaining to age, for a worker´s one year increase in age, their wage increased 6.97%. As for skilled or unskilled, when a worker changed from being unskilled to skilled, their wage increased by15.14%.. When a worker changed their location from a rural to an urban area, their wage increased by16.80%. As for the industries, in 2012, if a worker changed their job from agriculture, forestry, or aquaculture industry to the service or manufacturing industry, their wage increased by 11.35% and 24.46% respectively. As far as the enterprise types, in 2012, if a worker changed their job to a company that was a private, state, or foreign-invested enterprise type, their wage increased by 10.69%, 17.38%, 6.24% respectively.

The estimated coefficient of the *Age* variable has increased compared to the period 2004 to 2012. This shows that the wage differential, with regards to age, has increased in the period 2004 to 2012. The results in table 4.5 shows that the wage

gap between skilled and unskilled workers has decreased in the period 2010 to 2012. It also shows that the wage gap between urban and rural workers decreased compared with the period 2008 to 2010. Similarly to the period 2004 to 2010, as the results in Table 4.5 demonstrate, the wage differential between male and female workers was significant in 2012 in Vietnam. The results show the wage differential between "Kinh-Hoa" and other ethnicities.

4.1.6 REGERSSION RESULTS FOR 2014

The results of the regression model with the VHLSS 2014 survey data are as follows:

Independent variables	Estimated Coefficients β	Robust Std. Error	p-value	VIF
Unskilled_skilled	0.0783	0.014731	(0.000)***	2.85
Age	0.0366	0.0038039	(0.000)***	71.55
Age²	-0.0004	0.0000507	(0.000)***	68.10
Schooling	0.0146	0.0020056	(0.000)***	3.23
Gender	0.1783	0.0094858	(0.000)***	1.15
Marital	0.0646	0.0116503	(0.000)***	1.43
Ethnicity	0.0354	0.0194098	(0.068)*	1.27
Domain	0.0683	0.0094576	(0.000)***	1.21
Armed_force&Leader_staff	0.4036	0.0365402	(0.000)***	1.44
Expert_staff	0.3677	0.020563	(0.000)***	3.75
Office_staff	0.1385	0.0268192	(0.055)*	1.45
Service&Sale_staff	0.0099	0.0203886	0.627	1.60
Technical_staff	0.1717	0.0124208	(0.000)***	2.02
Manufacturing_industry	0.1098	0.014757	(0.000)***	2.66
Service_industry	0.1341	0.0159607	(0.000)***	2.04
Private_enterprise_type	0.1162	0.0119952	(0.000)***	1.54

State_enterprise_type	0.1056	0.016769	(0.000)***	2.92
Foreign_invested_enterprise_type	0.1933	0.0155546	(0.000)***	1.46
Red_River_Delta_region	-0.0349	0.016374	(0.033)**	2.66
Northern&Coastal_Central_region	-0.0720	0.0167125	0.250	2.54
Central_Highland_region	-0.0239	0.0267163	0.370	1.36
Southeastern_region	0.0965	0.0171064	(0.000)***	2.40
Mekong_Delta_region	-0.0920	0.0174604	(0.000)***	2.41
Constant	6.8036	6.8036	(0.000)***	
$R^2 = 0.3997$				
Number of observations : 6613				
**, **, * represent 1%, 5%, and 10% level of significance respectively				
Diagnostic Test	**Test Result**			
F-statistics	0.000			
Ramsay RESET Test	0.4603			
Skewness/Kurtosis tests for Normality	Pr(Skewness) = 0.3011 Pr(Kurtosis) = 0.1636			

Table 4.6 Regression results of the regression analysis using the VHLSS 2014 survey data

The results in Table 4.6 show that all variables in the function are statistically significant at the 5% except the following variables:

Service&Sale_staff (p_value = 0.627), *Office_staff* (p_value = 0.055), *Central_Highland_region* (p_value = 0.37), *Ethnicity* (p_value = 0.68), and *Northern&Coastal_Central_region* (p_value = 0.250).

The value of R^2 is 0.3997, meaning that the independent variables explain around 39.97% of the variance of the dependent variable in the model. Moreover, apart from two variables (*Age* and Age^2), other independent variables do not have multi-collinearity (VIF < 10). The result of the Ramsay RESET Test indicated that the function has no omitted variables (p_value = 0.4603 > 0.05). The result of the

Skewness/Kurtosis tests for Normality indicated that the residuals were normally distributed (pr(Skewness) > 0.05 & pr(Kurtosis) > 0.05).

According to the results in Table 4.6, pertaining to age, for a worker´s one year increase in age, their wage increased 3.66%. As for skilled or unskilled, with an increase of one level of employee's skill, their wage had increased by 7.83%. When a worker changed their location from a rural to an urban area, their wages increased by 6.83%. As for the industries, in 2014, if a worker changed their job from agriculture, forestry, or aquaculture industry to the service or manufacturing industry, their wage increased by 13.41%, 10.98% respectively. As far as the enterprise types, in 2014, if a worker changed their job to a company that is a private, state, or foreign-invested enterprise type, their wage increased by 11.62%, 10.56%, 19.33% respectively.

The estimated coefficient of *Age* variable has decreased compared to the period of 2004 to 2012. This shows that the wage differential, with regards to age, has decreased in the period 2012 to 2014. The estimated coefficient of the *Unskilled_skilled* variable has decreased compared to the prior 2010 to 2012. This shows that the wage differential between skilled and unskilled workers has decreased in the period 2010 to 2014. The estimated coefficient of the *Domain* variable has decreased in the period 2010 to 2014. Similarly to the period 2004 to 2012, as the results in Table 4.6 demonstrate, the wage differential between male and female workers was significant in 2014 in Vietnam. The results also show the wage differential between married and unmarried workers in 2014 in Vietnam. However, the regression result can not indicate the wage differential between "Kinh-Hoa" and

other ethnicities in 2014 due to the *Ethnicity* variable being not statistically significant at the 5%.

4.1.7 THE WAGE DIFFERENTIAL IN AGE, GENDER, AND DOMAIN IN VIETNAM FOR THE PERIOD 2004 TO 2014

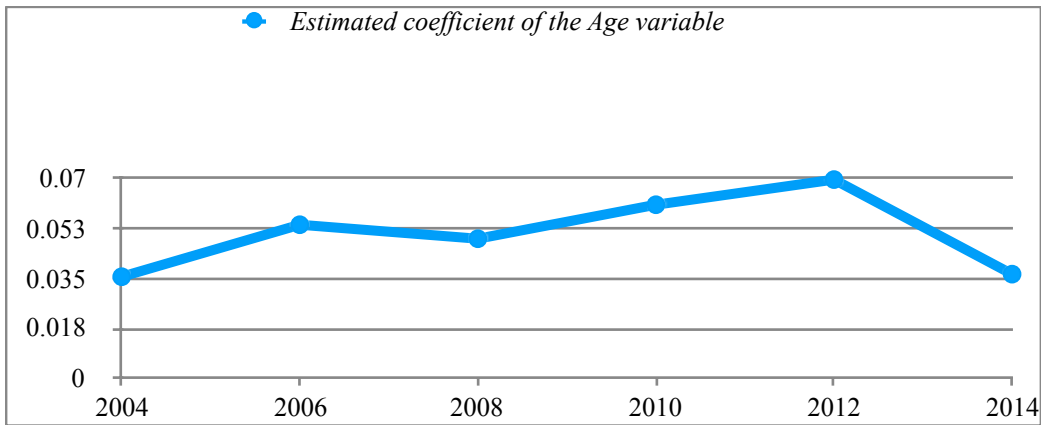

Figure 4.1 The change of the estimated coefficient of the Age variable

From the results of the multiple regression analysis carried out for the period 2004 to 2014, the estimated coefficient of the *Age* variable for the period 2004 to 2014 are summarised in Figure 4.1. The results show that the wage differential, with regards to the age variable, is the highest in 2012. It increased from 2004 to 2012 and decreased from 2012 to 2014. However, the change in the estimated coefficient of the *Age* variable is small, as the gap between the highest and lowest estimated coefficient is 0.031.

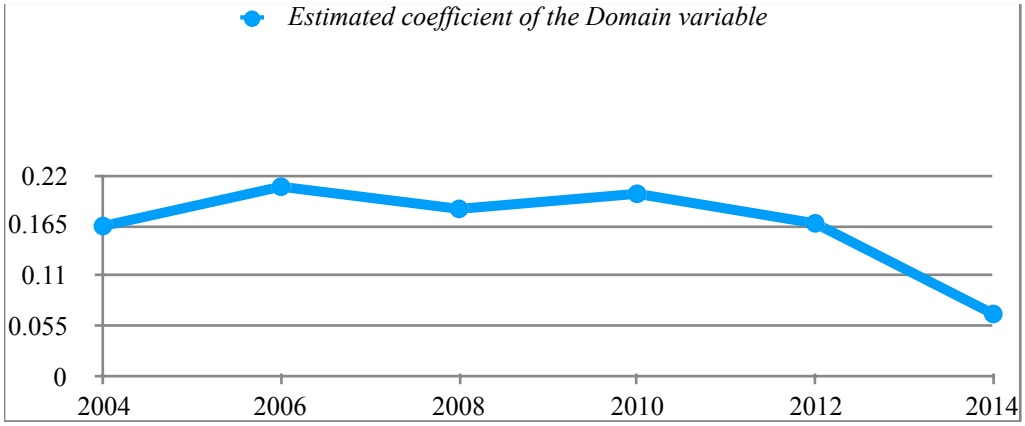

Figure 4.2 The change of the estimated coefficient of the Domain variable

Similarly, the estimated coefficients of the domain variable for the period 2004 to 2014 are presented in Figure 4.2. The results show that the wage differential, in regards to the domain, is the highest in 2006 and tends to decline until 2014. The high value of the estimated coefficient of the *Domain* variable shows that there is a large wage differential in regards to the domain variable in Vietnam. These results are in line with previous research on the wage differential between urban and rural areas in Vietnam mentioned in section 2.5 such as Bui et al. (2001), Hoang et al (2001) and Gallup (2004).

The wage differential between rural and urban areas occurs in most developed countries (Waugh et al. 2016). As revealed by the descriptive statistics with regards to the domain distribution in chapter 3, in Vietnam, the number of workers in rural areas is always higher than the number of workers in urban areas.Moreover, a large number of workers in rural areas work in agriculture, silviculture, and aquaculture decor and received a low income (GSO 2004). However, the estimated coefficient dramatically decreased from 2006 to 2014. This result shows that the current government's policies to increase the income of rural workers have had a significant

effect on the wage differential between rural and urban areas. Continued implementation of rural development policies may further reduce the wage differential. The government launched the Nation Target Programme on New Rural Development in 2009. This program was developed on the assumption that agricultural and rural areas (and farmers) are the fundamental pillars of the industrialization and modernization of Vietnam, at least until 2020 (Vietnam Government 2008).

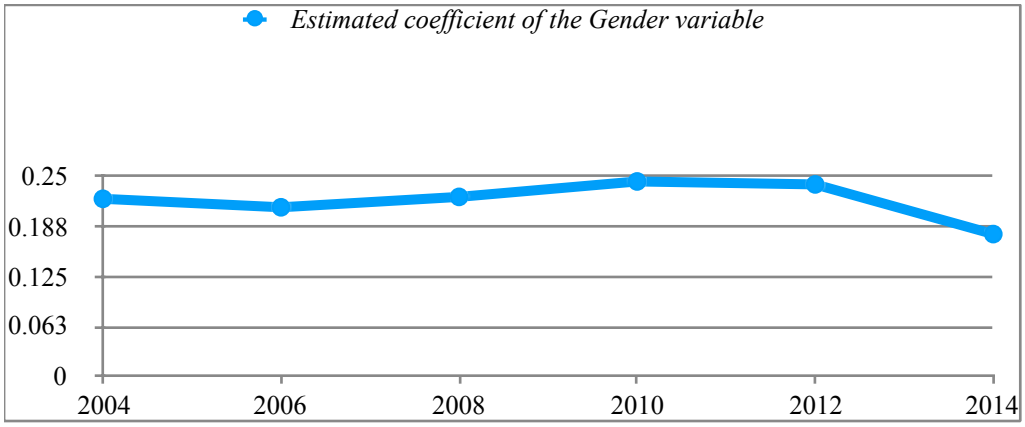

Figure 4.3 The change of the estimated coefficient of the Gender variable

Likewise, the estimated coefficients of the gender variable during the period 2004 to 2014 are presented in Figure 4.3. The results indicate that the wage differential based on gender was slightly trending upwards from 2004 to 2010 but decreased significantly from 2010 to 2014. In Vietnam, female workers are burdened with heavier workloads due to the additional work they have to do at home (Chowdhury et al. 2018). Moreover, women have fewer job opportunities and often focus on low-wage job positions or sectors (Chowdhury et al. 2018). Besides, there still exists male chauvinism in Vietnamese society (Duong 2001). These are some of reasons why a high wage differential exists between men and women.

Compared with previous research on the wage differential between male and female workers in Vietnam as mentioned in section 2.5, the wage differential between male and female workers in the period 2004 to 2014 has decreased compared with the result from Liu (2004) for the wage differential between male and female workers in 1998 (39.1%).

4.1.8 THE SKILL PREMIUM IN VIETNAM FROM 2004 TO 2014

From the results of the multivariable regression analysis conducted for the period 2004 to 2014, the effect of skilled or unskilled variables on the dependent variable of natural logarithm of the hourly wage is summarized in Table 4.7.

	2004	2006	2008	2010	2012	2014
$\ln(w_h/w_l)$	*0.1747*	*0.1892*	*0.2201*	*0.1812*	*0.1514*	*0.0783*

Table 4.7 Skill premium in Vietnam from 2004 to 2014

As shown in Table 4.7, in 2004, when a worker changed from being unskilled to skilled, the wage increased by 17.47%. In 2006, this was estimated to be 18.92%, while in 2008, it was calculated to be 22.01%. In 2010, the increase is found to be 18.12%. And in 2012, the increase is 15.14%. However, the resulting wage increases are only increased by 7.83% in 2014. As shown in Table 4.7, skill premium was rising from 2004 to 2010 and started to decrease in 2010 until 2014. This result is in line with the result of descriptive statistics regarding skill distribution in chapter 3. The number of skilled workers has increased in the period 2004 to 2010 but started to decrease in the period 2010 to 2014. To my knowledge, there has not been any previous research conducted that measure the skill premium in the period 2004 to

2010 in Vietnam. Autor (2014) indicated that the reasons for increasing skill premium are technological change, de-unionisation, and globalisation. The demand for educated, skilled labor is associated with recent technological developments that are contributing to a rising skill premium (Sakellarious & Patrinos 2003). Pertaining to the rising of number of skilled workers in the period 2004 to 2010, the reason for the change of the skill premium in the period 2004 to 2014 could be technological change.

4.2 RESULTS OF PHASE 2: RELATIVE SKILL PRODUCTIVITY

Following the formula specified in equation (2.4), relative skill productivity is calculated from the skill premium ln(wh/wl), the total number of skilled workers (H), the total number of unskilled workers (L), and the elasticity of substitution between high and low-education workers (σ) where σ is the estimated value from Psacharopoulos and Hinchliffe (1973). The relative skill productivity is calculated by using the equation (2.4) and the results are presented in Table 4.8. The skill premium ln(wh/wl) in Vietnam from 2004 to 2014 is calculated in the section 4.1, and the results are presented in Table 4.7. The total number of skilled workers (H) and the total number of unskilled workers (L) of the VHLSS survey data from 2004 to 2014 are specified in Table 3.5. Following the formula specified by equation (2.4), Ah/Al is the relative skill productivity.

	2004	2006	2008	2010	2012	2014
$\ln(w_h/w_l)$	*0.1747*	*0.1892*	*0.2201*	*0.1812*	*0.1514*	*0.0783*
H	1738	2089	1877	2186	2006	2555
L	2998	3335	2912	3718	3346	4058
σ	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*
$\ln(A_h/A_l)$	*-0.0629*	*-0.0409*	*-0.0242*	*-0.0767*	*-0.0632*	*-0.0763*
Relative skill producitivity	*0.9390*	*0.9599*	*0.9760*	*0.9440*	*0.9387*	*0.9265*

Table 4.8 Relative skill productivity in Vietnam from 2004 to 2014.

According to Violante (2016), a change in the relative skill productivity is a form of a factor-biased technical change because it modifies the marginal rates of transformation at a given input ratio. The results in Table 4.8 demonstrate that the relative skill productivity increased from 2004 to 2008 and decreased from 2008 to 2014. It can be concluded that the technological change is skill-biased in the period from 2004 to 2008. However, the decrease in relative skill productivity from 2008 to 2014 is small as the gap between highest and lowest relative skill productivity is 0.0495. The relative skill productivity in 2010 is still higher than the relative productivity in 2004. This shows that the effect of technological change still had not changed much in the period 2008 to 2014, compared to the period 2004 to 2008. Furthermore, the decrease of relative skill productivity from 2008 to 2014 indicates the need to investigate the effects of the SBTC on relative skill productivity, wage structure, and the labour market in Vietnam for the period 2010 to 2014 by considering other factors such as globalization and trade.

CHAPTER 5: CONCLUSION

This chapter discusses the theoretical and practical implications of this study including implications to policy, limitations of the study, and suggestions for future research.

5.1 CONTRIBUTIONS OF THE STUDY

Taking into account the results of the analysis in sections 4.1 and 4.2, the contribution of this thesis to the empirical knowledge on the SBTC and wage differential in Vietnam are as follows:

- Firstly, this thesis contributed to empirical knowledge on the SBTC by applying the formula of measuring the SBTC to VHLSS datasets which has not been done before. This thesis also provided empirical evidence of the SBTC in Vietnam. More specifically, the thesis found that the relative skill productivity has increased in the period 2004 to 2008, but decreased in the period 2008 to 2014. Thus, the findings indicate that SBTC has occurred in Vietnam during the period 2004 to 2008. It also identifies the need to incorporate other factors such as globalisation and trade to further investigating the effects of SBTC on relative skill productivity, wage structure and the labour market in Vietnam for 2008 to 2014.

- Secondly, this thesis developed an extension of the Mincer (1974) model which determines the influence of various factors such as skilled or unskilled, ethnicity, domain, age, gender, type of enterprise, occupation, industry, and region on wage of employees. This extended model was also

used to calculate the skill premium and in the examination of wage differential in term of age, domain, gender.

- Thirdly, this thesis provided empirical evidence of the existence of wage gap between skilled and unskilled workers, between male and female workers, and between urban and rural areas. The findings reveal that the wage gap between skilled and unskilled workers has increased in the period 2004 to 2008 and decreased in the period 2008 to 2014. The findings also show that wage gap between urban and rural workers was slightly trending upward from 2004 to 2010, but decreased in the period 2010 to 2014. Moreover, the results reveal that the change in the wage gap between male and female workers in the period 2004 to 2010 is insignificant. However, the wage gap between male and female workers decreased from 2010 to 2014.

5.2 POLICY IMPLICATIONS

This thesis confirmed that SBTC occurred in Vietnam in the period 2004 to 2008. However, this thesis failed to confirm that SBTC occurred in Vietnam in the period 2008 to 2014. Further investigation suggests that the latter might be due to changes in policy. The succeeding section presents the difference in policy between the period 2004 to 2008 and the period 2008 to 2014 in Vietnam followed by the proposed policy recommendations that can be applied in the context of Vietnam.

5.2.1 POLICY CHANGES IN THE PERIOD 2004 TO 2014.

Vietnam's education policies in the period 2004 to 2010 were discussed in chapter three of the Constitution of the Socialist Republic of Vietnam in 1992 and

Constitution of the Socialist Republic of Vietnam in 2013. Furthermore, the education law was enacted in 1998 and revised in 2005 and 2009 (Vietnam Government 2005; Vietnam Government 2009). The more difference in education policy before and after 2008 is the change in the number of articles of the Education Law. The major purpose of the amendments and supplements in Education Law 2009 are to create a profound impact on improving the quality of educational institutions, activities contributing to the renovation of education, and a basic legal basis for the promotion of management reform to improve the quality of education. (Ministry of Education and Training 2009) However, according to the decrease of skilled premium in the period 2008 to 2014, the effect of these changes in reducing the wage differential between skilled and unskilled workers is negligible and do not provide evidence for skill-biased technological change in the country.

The main difference in rural development policies between the period 2004 to 2008 and the period 2008 to 2014 is the National Target Programs for New Rural Development. The National Target Programme for New Rural Development (NTP-NRD), launched in 2009, is one of the national target programs designed for the period of 2010 - 2020 (Vietnam Government 2008). This program was developed based on the assumption that agriculture and rural areas (and farmers) were the fundamental pillars of the industrialization and modernization of Vietnam at least until 2020 (Vietnam Government 2008). The purpose of this program is to build new rural areas with a modern socio-economic infrastructure; create economic structure and rational production forms, linking agriculture with the fast development of industry and services; attach rural development to urban planning; create a

democratic rural society, with a stable cultural identity; protect the ecological environment; make sure the material and spiritual life of the people has been improved; and create a Socialist orientation (Vietnam Government 2008).

Until 2014, The National Target Programme for New Rural Development has improved the quality of living for rural people by some measures. According to a report by the Central Steering Committee for NTP-NRD, by the end of 2014, there had been 785 communes meeting new rural area criteria (accounting for 8.8% of all the communes nationwide), increasing by 600 communes compared to the figure recorded in May 2014 (Chung 2015). According to GSO (2014), the average income of rural people increased 1.9 times compared to 2010, and the rate of poor households decreased 1.65% per year from 2010 to 2014 to 10.1%. Thus, NTP-NRD could be one of the reasons for decreasing the wage differential in the domain from 2010 to 2014 as was the result in section 4.1.7.

5.2.2 POLICY RECOMMENDATIONS

This thesis confirmed that SBTC occurred in Vietnam between 2004 and 2008. Moreover, according to the results of the wage regression, the workers' wage will increase rapidly if the workers changed from being unskilled to skilled. As per the definition of skilled worker, as there is strong evidence that shows the role of education, namely qualifications for both wages and finding the job. Therefore, the solutions to improve the educational level of workers in Vietnam are appropriate and necessary. In addition, as the results in the section 4.1.8, the skill premium has decreased in Vietnam in the period 2008 to 2014. Hence, this thesis recommends that

the incentive policies offered by the state should be reviewed to understand the decrease in skill premium. In general, education improvement policies can lead to improved workers' wages and the economic growth in the long term.

This thesis found that a wage gap exists between male and female workers. According to United Nations Development Program (2013), gender inequality in wages occurs in many countries, especially in developing countries. In the case of Vietnam, the cause of this situation is known to be derived from the traditional viewpoints that have long existed in the society (Duong 2001). Employers often believe that male labour productivity is higher than women's; hence, men are more likely to receive higher wages than women (Liu 2004). The result of the analysis in the section 4.1.7 shows that the change in the wage gap between male and female workers in the period 2004 to 2010 is insignificant. However, the wage gap between male and female workers decreased from 2010 to 2014. The Law on Gender Equality in Vietnam, passed by the National Assembly in 2006, clearly regulates equal treatment between men and women (Vietnam Government 2006). From the analysis above, combined with the obtained regression results, this thesis recommends that the state needs to improve legal normative documents to reduce inequalities in wages between male and female workers. Although the law cannot regulate stereotypes and ideologies of discrimination between men and women, strict rules of law will limit the fact that these discriminatory ideas are actualized into inequalities in the women's pay. The regulations of the state should be more practical and focused on low-wage workers. The state may also organize, encourage, or

sponsor sociology studies so as to restrict gender discrimination in the workplace, particularly in employment, promotion, and pay raise.

This study finds the evidence of wage inequality between urban and rural workers. The wage differential, in regards to domain, occurs in most developed countries (Waugh et al. 2016). As descriptive statistics in domain distribution in chapter 3, in Vietnam, the number of workers in rural areas are always higher than the number of workers in urban areas. Moreover, a large number of workers are in rural areas and work in agriculture, silviculture, and aquaculture with a low income (GSO 2004). Moreover, technical infrastructure, science, and technology in rural areas are very limited when compared to urban areas (GSO 2004). The rural labour force is simple labour with low technical content (ILO 2010). In addition, the living standards of rural areas are lower than the urban areas. The rural areas do not have many opportunities for finding jobs (ILO 2010). Salaries of workers in urban areas are higher than in rural areas at the same job position; thus workers always tend to move from rural to urban areas (Cu 2005). Therefore, to improve the urban-rural wage gap in a positive direction, the following solutions were proposed by this thesis:

- The state needs to continue improving rural development policies that were implemented in the past years, such as a poverty reduction policy and loans from social policy funds. The result in section 4.1.7 shows that the urban-rural wage gap has decreased in the period 2010 to 2014. Hence, policy complementation during that period has produced positive results.

- Earning higher salary is one of the main reason for the migration of workers from rural to urban areas (Cu 2005). Thus, the state needs to strengthen economic measures to keep qualified workers in the rural areas using economic measures, not administrative ones. Possible economic measures could be: increasing the level of remuneration in rural areas, creating the opportunity to improve their levels, opportunities for promotion, improving the wages of the workers, etc.

5.3 LIMITATIONS AND FUTURE RESEARCH DIRECTION

Besides the contribution of this thesis to the analysis and presentation of empirical evidence on the SBTC and wage differential in Vietnam in the period 2004 to 2014, there are known limitations of this study.

Firstly, this thesis followed Violante (2016) developing a method to calculate the SBTC in Vietnam. There has been some empirical research that measured the SBTC in developed countries. For example, Katz and Murphy (1992) used the same formula to measure the SBTC in the USA and Hutter and Weber (2017) used it to measure the SBTC in Germany. However, to my knowledge, there has been no empirical research that used this formula to measure the SBTC in developing countries. Moreover, the elasticity of substitution between skilled and unskilled workers ($\sigma = 1.5$) in formula (2.4) was estimated from the research of Psacharopoulos and Hinchcliffe (1973). This value has not been calculated in the context of Vietnam. In addition, this value is estimated using the data in 1973, with

changes in technology and market structure, this value is maybe not acceptable in the current context of Vietnam.

Secondly, the skill premium in formula (2.4) is calculated from an extended Mincer (1974) wage function. The number of years of schooling (schooling) is one of the variables in the extended Mincer (1974) wage function. The number of years of schooling for each individual is the total number of years of schooling at the levels of general education, vocational training, and higher education. It did not take into account individuals who attend school or work, or short-term courses, and similar activities. Moreover, the wage function did not consider additional factors such as teamwork skills, working environment, and interaction among individuals that have an impact on an individual willing to accept a lower wage in a friendly, comfortable, work environment.

Thirdly, this thesis used the data collected from the VHLSS survey which doesn't collect information specifically for this research. The sample for each year may not represent the division of skilled and unskilled workers of the entire population. A more focused survey could have resulted in more robust results.

The results of this study offer some guidance for future research. Further research can develop a more accurate estimate of the elasticity of substitution between skilled and unskilled workers for the context of Vietnam. If the elasticity substitution between skilled and unskilled workers can be calculated for each economic sector, the SBTC can be measured in each sector.

The decrease of relative skill productivity from 2008 to 2014 indicates that the SBTC from 2004 - 2008 did not continue to. the need to 2008 - 2014. Further research can focus on the effect of internal and external factors that caused the decline of relative skill productivity in Vietnam from 2008 to 2014.

In recent years, the Vietnam government has been faced with problems of high inflation, unemployment rates, and budget deficits (Nguyen et al. 2017). In 2016, the General Statistics Office of Vietnam reported that the youth unemployment rate is around 7.86%. For 2017, the main mission of the Ministry of Labour, Invalids and Social Affairs of Vietnam was to promote job creation for youth workers (ILO, 2018). Hence, further research can investigate the impact of SBTC on youth employment in Vietnam.

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