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The Effect of Aging on Industrial Employment Share

Evidence from the European Union

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The effect of aging on industrial employment share --Evidence from the European Union

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Abstract

This paper addresses the issues related to the ageing phenomenon. In particular, it focuses on the effect of aging, which is indicated as the proportion of 65^{+} people in the total population in a certain country, on the employment rate share of 9 different industries. Two models will be used for this, the fixed and random effect model. The data of the employment rate shares were taken from the International Labor Organization between 1975 and 2005 and the data on the ages of the people in 20 countries[1] from Eurostat. The results show that the ageing effect will result in a shift from the manufacturing-like industries to the service-like industries. This has to do with the shifting demands when people are getting older.

Key words: Aging process, employment rate shares, labour market, policy

[1] *The chosen countries are: Austria, Belgium, Bulgaria, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Poland, Portugal, Romania, Spain, Sweden and the United Kingdom*

Content

Section1. Introduction

With the new technology development, advance in medicine, nutrition and feminization of work, the “new era” has arrived in Europe. The characteristics of this “new era” are: people living longer than before, women delaying or not giving birth to a baby and the growing proportion of elderly people in society. Since the advent of these phenomenons, the age structure of the society has been changing a lot. Without a doubt, the aging phenomenon has become a hot issue in recent decades. Although aging is a reflection of the success in human development process, it still has some negative impact on societies, which increasingly catches every policy maker’s eyes in the twenty first century.

When we look further, in the next 50 years, the EU countries will experience one of the most remarkable aging trends. It is getting closer to the trend in Japan, which is that people are getting older than before. Following this trend, the EU will face a lot of challenges in the future (OECD, 2006). Buslei et al. (2007) point out that aging affects the demand for goods and services and it can influences the reallocation of resources, in particular for the labor force. So in this perspective, the structure of the labor force in all the industries will be influenced by this changing trend. During this aging process, some sectors may be shrinked, on the contrary some sectors may be expanded. But of more interest is the question which kind of sectors will be shrinking or expanding. In which degree will the employment rate share change in each sector during this process? This has become more and more attractive in the research field of aging. For the purpose of answering these questions I plan to use the fixed and random effect econometric model to analyze the data, which are collected from nine different sectors of 20 EU countries and other factors conducted from the Eurostat, in the period from 1975 to 2005.

My expectation of estimation is that if aging is growing faster, the sectors like the financing related working field, public transportation and social and personal service, community will be expanded, because of increasing demand from the elderly people in these sectors. And the construction, mining and wholesale and retail trade will shrink instead of growing, due to the decreasing number of younger group among the society and also less demand from the elderly people. In the following part, I will check the result empirically.

The rest of the paper is organized as follows: Section 2 presents a short history about aging process during the past decades and compares the current situation and gives a brief prospect for the future. In section 3, I will discuss the aging performance in the past, present and future time .And the following section 4, I will show some evidences and discussed why the sectoral employment rate shares are link to the demographic changes. Section 5 describes the details about data and where it explains how we collect such large panel dataset. Section 6 provides the empirical model and basic assumption. Section 7, I will give a findings from our estimation result table. Section 8 try to gives some feasible proposals to balance the gap which caused by the aging. Section 9 presents a short conclusion.

Section2. Literature review

In this section, papers will be presented which examine what the aging phenomenon and what effects this has on society. In particular, aging plays an important role in shaping the current labor market employment share. Many literature related to aging have become increasing aware of the necessity to study the influence of this aging phenomenon.

The researches written by McMorrow, K. and W. Roeger (1999) and Emily Grundy (2006) have compared the age profile between several countries or continents. They suggest that the aging of the population in the EU, US and Japan is an inescapable fact. According to the latest demographic projections, the share of 65^{+} people in the whole population is almost double between now and 2050 in the case of EU and Japan. For the US, this is growing more modest. Because of this aging phenomenon, policymakers will be faced with the task of avoiding or cushioning the potential shock to peoples' living standards. For example, they will have to reform the current standards of the retirement policies.

Under the aging process, what other macroeconomic changes will there be? This question really attracts me to think about. Some papers state that the aging phenomenon has affected social economics in many aspects. The study of Bös, Dieter, and Robert K. von Weizsäcker (1988) has investigated the aging effect in the very early stages. They have found that aging will affect the size of the labor force, consumption patterns and generation saving. Börsch-Supan (2001) they believed that the aging will change the balance between capital and labour from a macroeconomic point of view, especially in industrialized countries. So they employ a multi-country overlapping generation model and combine it with long-term demographic projections for several world regions over a 50 year horizon. The result suggests that capital flows from fast-aging industrial countries to the world will be substantial. Börsch-Supan et al. ((2003), (2005), (2006), Denton 1988, McMorrow and Roeger 1999 and 2003)) Denton and Spencer (1998) address that aging of the population has raised concerns about the abilities to meet the increasing costs in health care, pension and other things related to the elderly. E Philip Davis (2006) researches the impact of demographic changes on financial asset volumes and financial market

structure more generally, as driven by age-related household savings and asset allocation decisions. Börsch-Supan (2002) they took Germany as an example, have found that demographic change will have a huge impact on the structure of consumption, production, and also alter international economic relations. All in all, these studies mostly find that the aging phenomenon has some significant impact on the society, especially on the markets which are labour market, the markets for goods and services, and capital markets.

Actually, there is not so much previous literature which has studied the change of the employment rate share in the different sectors. However, there are a couple of papers I have found addressing this topic. In the papers of Andrew J. Filardo (1997), Harrison and Bluestone's (1990), some economists have argued that the nature of work structure has changed. New jobs in well-paying countries tend to be occupied in the service sector rather than in the manufacturing sector. This is due to a much wider range of employment opportunities in the service sectors than in the manufacturing sectors, which attracts more people to work in that sector. The result of globalization, the greater role of ICT (Information Communication Technology) and the new economy also contribute to the employment shift from the manufacturing to the service sector in the labor market. At last, they concluded that this result has changed the workplace in a substantial way and it had just a little impact on the business cycle. Unlike existing research on how industrial and occupational shifts changes, David Elesh's (1999) paper offered a different perspective. In his paper, he compared the males' and females' experiences of the consequences of the industrial and occupational transformation restructuring of the 1980s for the cohorts in the labor force of US. They have found there were quite different consequences for the different gender and age cohort. For both man and woman in every age group, occupational restructuring

effects were larger than industry shift effects. And Ewa Orzechowska-Fischer (2004) has a very similar approach, but their samples are two countries, so they are using the comparison way to do the study which is the relationship between changes in the age structure and employment of particular age-sex groups within labour force as it ages. The question was addressed by means of one and two factor decomposition of employment rate. They have found that the employment rate of tertiary sector in Japan and Australia has increased by different degree, and the employment rates of secondary industries and primary industries have been declining in both countries. Among tertiary industries, the increasing trend are driven by the wholesale, retail and trade, services, finance, insurance, property and business and transport, storage and communication. In secondary sector, the strongest negative values of the age composition component were in manufacturing and construction in both two countries. Besides that, they also discussed the influence on sex group in these three industries by using the figure to shows that the changing trend. Other studies gave some clearly conclusions. Dale W. Jorgenson et al. (2008) have studied a U.S. case. They found that as the population aging in U.S. is becoming more and more dominant, the elderly households have different patterns of labor supply and consumption. These changes in labor demand and supply patterns are not wage and income effects, which are the consequence of population aging. In addition, they concluded that labor demand is driven by changes in new technology development. Labor-using technological change will play an important role in the reallocation of labor for different industries. In other words, it depends on whether the sector is labor-saving or labor-using.

There are many empirical approaches to understand how unobserved effects work. Here we want to compare two ways to estimate unobserved effects. One of those approaches is the fixed and

random effect linear model. This is different from the approach written in the paper of Ulrich Thießen (2008), in which he used the two step GMM framework. The disadvantage of using the GMM framework is that we need sufficient data for the model. In addition, the GMM estimator of Arellano and Bover (1995) involves the moment conditions among the first-differences and second –differences, which will make the model more complicated. The reason to use GMM is that the errors are heteroscedastic and GMM is most efficient when heteroscedasticity is appear, as addressed in the paper of Baum, Schaffer and Stillman (2003).

An additional contribution of this paper is the gender effect consideration, which we randomly pick from one of the EU members in the 20 countries. We will compare the result if we use the employment rate share in the whole population and if we take in to account the gender separately. And we also discuss the feasible policies that may be needed in the future to balance the employment gap.

Section3. Aging process in EU

In order to compare the aging development process in this section, we will discuss the aging performance in the past, present and future times. Meanwhile, we can get some enlightenment from these comparisons.

3.1 Past situation:

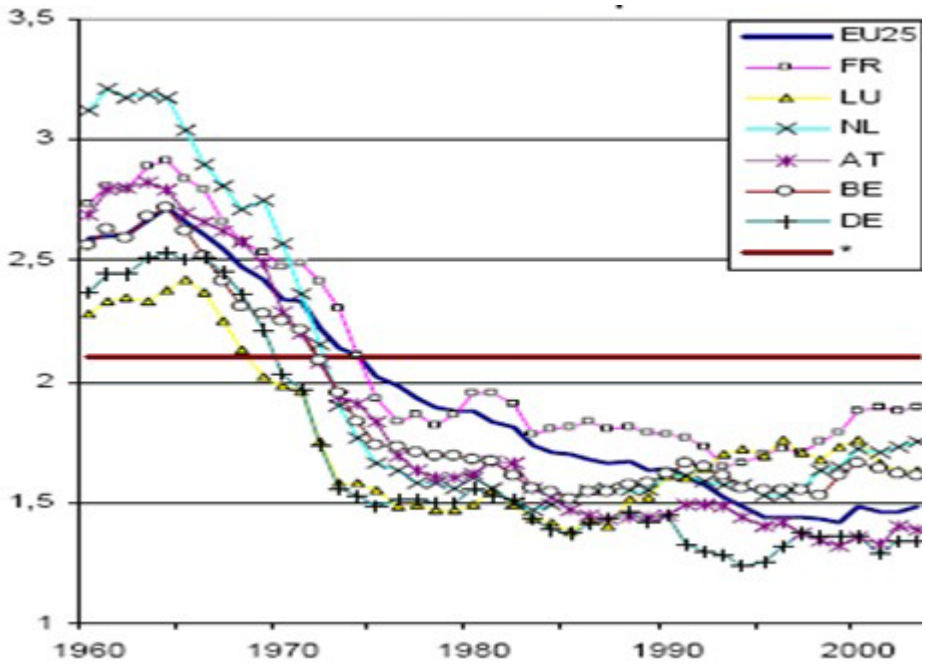
Looking at the past decades, EU countries have been experiencing a substantial progress of population aging in Europe. The population of Europe is aging faster than that of any other continent. This phenomenon is not a demographic problem only. It has become a social problem

according to the comment from the experts. Population aging has implied the governance, economy, good practice in public policy, social rights of all citizens and intergenerational solidarity. Indeed, public interest in aging in welfare states relates to labor market polices, retirement polices, health care policies, social benefits policies, long-term care policies, housing and environment policies, gender policies, and policies for the empowerment and more general social role for the elderly (Dragana Avramov and Miroslava Maskova (2003)). Some papers have stated that graying of Europe is characterized by a decline in fertility rate, a decline in mortality rate and an increase in life expectancy (Bovenberg (2008)). Since the fertility rate, which is the average number of children per women, has been one of the fundamental demographic trends behind aging, the total fertility rate (TFR) as an indicator will be used. Figure 1[2] shows that the total fertility rates in EU countries declined year by year, especially from 1960 to 1975. From 1975 to 1995, the changing trend is relative smoothly and from 1995 to 2005 there is a slightly increase. Because of the feminization of work and the better use of female human capital, the opportunity cost of women giving birth to a baby is higher than before (Bovenberg (2008)). As the fact that industrialization evolution appears everywhere, the human beings' living condition improved continuously. With people enhancing their own hygiene awareness considerably and the development of technology in medical care, diseases can be prevented from the people. Finally, it will result in a lower mortality and higher life expectancy. The most important indicator to define how a country has been suffering from aging is the percentage of elderly (above 65 years old) people relative to the whole population. In other words, it is the rising share of older people living in our societies, which will be accompanied by a shrinking population

[2] *This figure came from the paper named Grey new world: Europe on the road to gerontocracy? Bovenberg, A.L. (2008).*

overall. I will use this indicator as a method to analysis my research questions in the following parts.

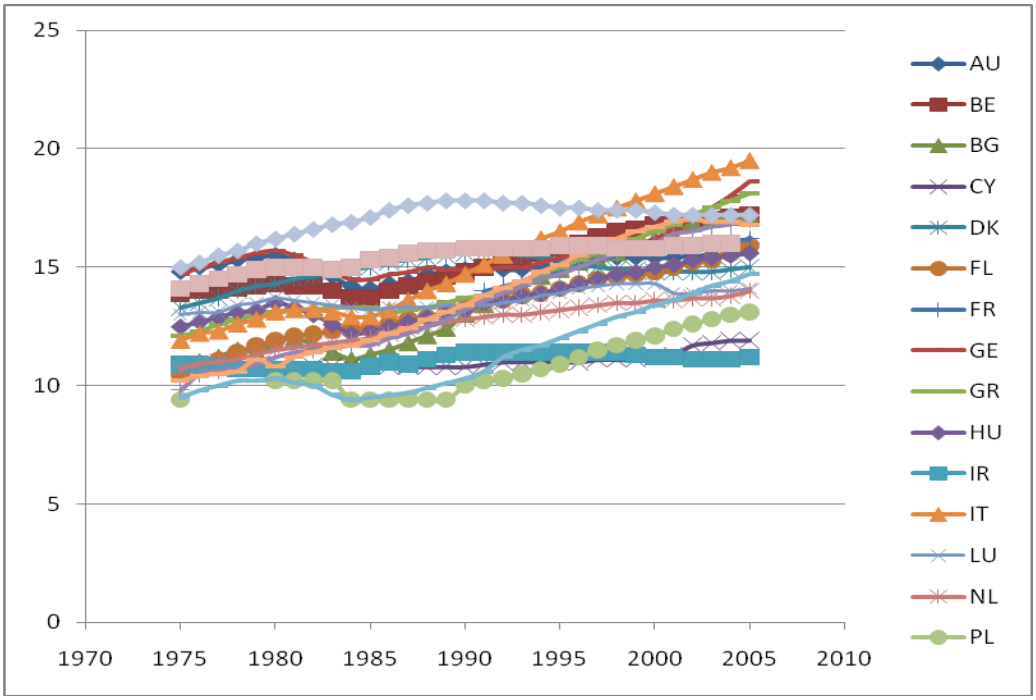
Figure 1: Total fertility rate-1960-2003 Central/Western Europe



Source: Eurostat

level needed for the replacement of generations

Figure 2: Percentage of elderly people to whole population



Source: Eurostat

3.2 Present situation

From figure 2 we can see the changing trend from selected EU countries. In recent years, the demographic division does not always consist with the traditional split between developed and developing countries according to the GDP per capita. (Table 1)

Table 1 :Distribution of the European countries according to the proportion of the elderly in the total population (2005)

Proportion of the population 65+ in total population (%)		
11-13.9	14-16.9	17.0 and more

Ireland	11.2	Netherlands	14.0	Portugal	17.0
Cyprus	11.9	Luxembourg	14.1	Bulgaria	17.1
Poland	13.1	Romania	14.7	Sweden	17.2
		Denmark	15.0	Greece	18.1
		Hungary	15.6	Germany	18.6
		Finland	15.9	Italy	19.5
		Austria	16.0		
		Belgium	16.0		
		UK	16.0		
		France	16.2		
		Spain	16.8		

Data source: Eurostat (2005)

The table shows that the aging degree in Italy is the most seriously one, with 19.5% of the elderly in the working age population at the end of 2005, followed by Germany (18.6%) and Greece (18.1%)[3]. Most countries of the European Union belong to the middle group (14-14.9). The countries in the lower group are less developed relative to other group members.

3.3 Changing trend in the future

[3] *Obtained from Eurostat*

Europe's current population has the highest median age of any other regions, which is 39 years according to UN (2005) and is projected to rise further to 48 by 2050.

With the current aging process, the policy makers have to respond to this challenge urgently. Although they have already done some treatment, the performance is still disappointing. The European commission predicted that the average ratio of the population over 65 years old among all EU member states will increase from 17.1% in 2008 to 30% in 2060. They state that the continuing low fertility rate and the increasing number of elderly people are the main causes for the growing aging trend. However, the decreasing number of successful marriages also can be a reason to some extent. We try to look ahead into the future of EU carefully with the prediction of table 2 from Eurostat below. In a trend perspective, the population aging process in EU is not spatially uniform, based on the fact that the differences between countries are significant. The most serious country of the aging process is Poland with 36.18(%) and the least serious one is Luxemburg with 23.57(%). By looking at the data within the country, the differences are even more significantly. Bulgaria, Poland and Romania will be suffering a dramatically change in the following 6 decades. By the end of 2060, these three countries will have the high proportions of 34.21(%), 36.18(%), and 34.96(%) respectively. Comparing the data with that of 2008, these three countries will increase 97.63%, 168.7% and 134.4% separately at the end of 2060. Under this projection table, we have found that the relative low proportion of elderly people in the society is less developed (central and east European countries) and a relative high proportion is more developed (west and north European countries).

Table 2: Share of the total population aged 65 years or over, for selected years

(%)	**2008**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**

EU27	17.08	17.38	20.06	23.55	26.85	28.81	29.95
AT	17.17	17.56	19.36	23.69	27.23	28.17	28.98
BE	17.04	17.22	19.51	22.87	25.03	25.70	26.52
BG	17.31	17.47	20.34	23.28	26.70	31.26	34.21
CY	12.39	12.65	15.03	17.95	19.97	23.23	26.17
DK	15.58	16.37	20.11	22.82	24.83	24.47	25.04
FL	16.52	17.06	22.41	25.52	26.21	26.81	27.82
FR	16.50	16.74	20.19	23.20	25.34	25.62	25.94
DE	20.05	20.57	22.79	27.61	31.06	31.71	32.47
EL	18.63	18.85	21.13	24.18	28.40	31.54	31.65
HU	16.17	16.61	19.82	21.95	24.96	29.35	31.93
IR	11.16	11.33	13.28	16.02	19.36	23.74	25.20
IT	20.08	20.34	22.68	26.15	30.82	32.62	32.71
LU	14.15	14.28	16.20	19.57	22.20	22.99	23.57
NL	14.72	15.33	19.80	24.10	26.89	26.65	27.25
PL	13.46	13.56	18.22	22.99	25.90	31.63	36.18
PT	17.42	17.79	20.08	23.25	26.83	30.12	30.85
RO	14.91	14.93	17.43	20.25	25.52	30.93	34.96
ES	16.61	16.69	18.18	22.13	27.66	32.11	32.34
SE	17.52	18.16	20.81	22.52	24.27	24.72	26.60
UK	16.10	16.38	18.29	20.55	22.45	22.95	24.74

Source: Eurostat, EUROPOP2008 convergence scenario

Section4 .Linking to the demand of labour market

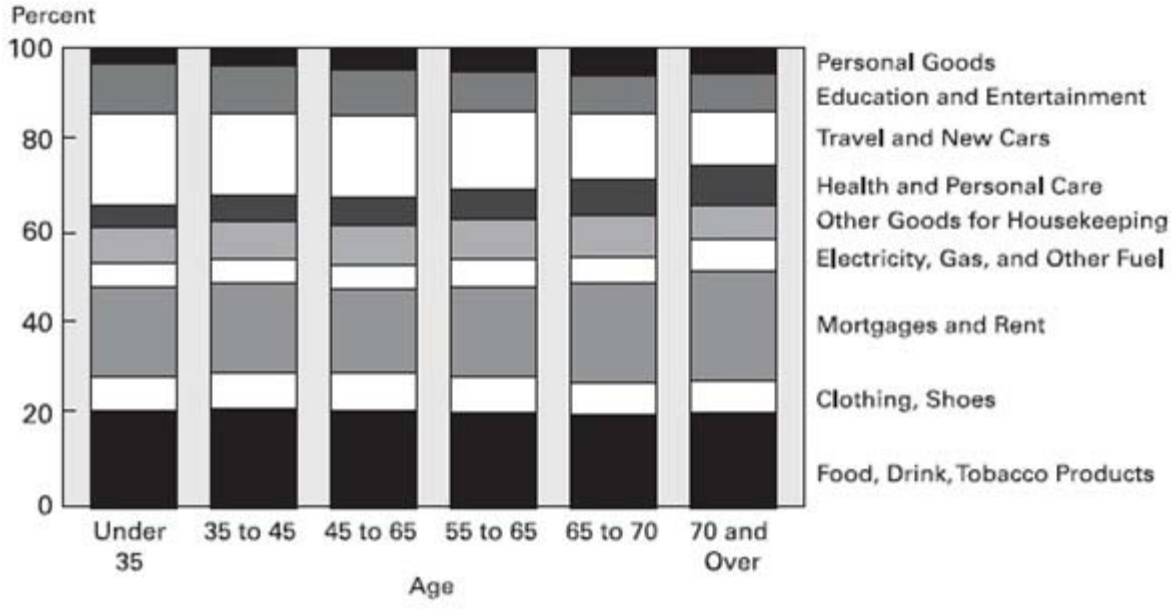
Demographic changes will have a huge impact on the structure of consumption due to the shifting demand from sector to sector. In the following part, I will motivate why aging would affect employment shares in different sectors and some evidence in Germany will be discussed by age cohort.

Demographic changes have implications for many aspects of economic life, including the consumption of goods and services. Especially the demand of labor market is affected by this. The dramatic changes of consumption range from sectors such as retail, financial services, healthcare, automotives, and real estates and so on.

In figure 3 of Axel H.Boersch-Supan (2001), which is shown below, shows age specific consumption patterns in Germany in the year 1993. It can be seen from this figure that the categories of food, drink, tobacco products, clothing, shoes and other goods for housekeeping (the two bottom areas of the figure) do not change that much according to the age cohort. That means no matter how old the people are, the consumption level on these categories is constant. This is not surprising, since these are the daily necessities of people's lives. They have to consume a certain amount at their different ages. Looking at the other categories, health and personal care, personal goods, mortgages and rent, electricity, gas and other fuel, the consumption in those sectors are slightly raised with the age groups getting older. Why did this happen? A lot of reasons can contribute to this. When people are getting older and older, (especially after their retirement) they will spend a lot of time at home, so the more energy will be needed and poor health (as a result of getting older) will induce more personal care as well.

On the contrary, some sectors like education and entertainment and travel, new cars drop manifestly. Compared to the other categories, it can be seen that the drop in the consumption pattern of travel and new cars increases a lot when people get older. The trend of increasing and decreasing indicates that these commodities here are more relevant with aging of people. The factors which can change their consumption behavior are such like disposal income, health condition constraint and leisure time.

Figure 3 Age-Specific distribution of consumer spending on goods and services

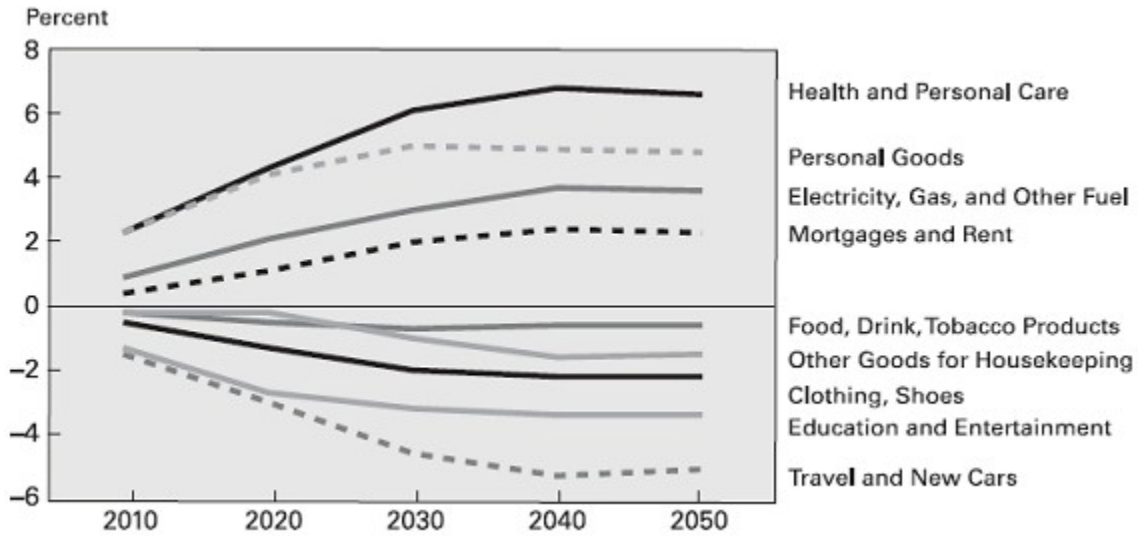


Source: Statisticsches Bundesamt (Federal Statistical Office), Series 15, Book 5, EVS 1993.

Structural changes in the market for goods will have a powerful influence on sectoral labor markets. To some extent, it will induce the employees shift from one sector to another. According to statistics in Germany, it is about one-fifth workforce that will be shifted within different sectors. Population aging also plays an important role in these labor market shifts. Due to the inflexible labor markets in Europe, the shift between sectors will not happen immediately

after the changes of consumption by age-specific groups. In other words, it takes some time for this shift to be achieved. Figure 4 is a projection trend calculated from figure 3, the figure has shown that some sectors have negative effect and some have positive effect by the consumption pattern's change. But it is no coincidence to find that the changing trend of sectoral labor demand is consistent with the changing trend of consumption on goods and services. The evidence shows that aging and sectoral employment rate shares have a strong relationship with each other and I will construct a model to discuss this deeply in the following paragraph.

Figure 4 Induced Sectoral shifts in demand for labor.



Source: Author's calculations on the basis of figure 3, population growth from forecast B2, and the Statistical Yearbook's "Sales per Employee," by sector.

Section5. Data description

My data set contains 20 selected countries according to the limited resources from EU 27. I will use the International Labor Organization (ILO) data for nine different economic activities and

the aging indicator (Proportion of population aged 65 years and more) which I used here was drawn from the Eurostat. The series covers 20 EU countries with historical estimates from 1975 to 2005.

This paper will investigate the impact of aging on the change of employment structure. The employment structure is how the workforce is divided up between the three main employment sectors: Primary (involves getting raw materials from the natural environment, the output of such primary production often needs further processing), Secondary (involves making things) and Tertiary (does not produce anything but involves work in the service of the economy)[4]. So I have chosen 9 different categories which belong to these three main industries as my dependent variables, which are 1) agriculture(ag), 2) construction(co), 3) wholesale, retail trade, restaurants and hotels(wh), 4) mining and quarrying(mi), 5) electricity, gas and water(el), 6) financial services, real estate and related services(fi), 7) transport, storage and communication(tr), 8) manufacturing(ma) and 9) community, social, and personal services (so)[5]. The labor force participation rates are reported by sex (male, female and both sexes), which is helpful for analyzing the gender effect in the following steps. For the reason of sufficient data sources I can collect, here I will take UK as a sample country. All the variables of UK are the same with the whole sample. The only difference is that the data will split into three groups, total population, man only and woman only.

[4] *As defined by the International Labor Organization*

[5] *It is classified according to either the ISCO-68 or ISCO-88, or to both versions side by side, in cases where the latest revision of this international classification has been adopted during the 10-year time series covered in the Yearbook*.

In reality, many factors (like income per capita, consumption level etc.) will influence the employment rate share, but I will only focus on the aging effect in this paper. So the proportion of 65^{+} people will be my explanatory variables.

In my research I want to measure the employment rate share of countries as a whole, but the data which I collected from ILO shows how many persons work in each category. For the sake of getting the employment share number, I have done this by dividing the employed people in each sector and the total number of employee in the society. And after obtaining the employment rate of different industries, I will use logarithmic transformation of the employment rate share as a percentage share.

Due to the long period and the 9 different sectors, missing years for at least some cross-sectional units in the sample are an unavoidable and considerable problem in the data set, which is also called an unbalanced panel data. There are many literatures related to this topic and it has become a hot issue for researchers and policymakers in the empirical field. But in my research, I will use STATA program to analyze the model. This regression package will make the appropriate adjustment for this loss automatically without any other activities. This unbalanced panel data does not change the basic story of the model.

Section6. Econometric model and issues

6.1 Theory and assumption of the fixed and random effect models

In the econometrics and statistics, random effects model means that is fluctuates over units in some population, and which particular unit is being observed, depends on chance. The precondition is that if there is no fixed effects (no individual effects) exist.

The basic unobserved effects model (UEM) can be written like below:

$$y_{it} = X_{it}\beta + \alpha_i + u_{it} \quad t=1,2,\ldots T$$

Where X_{it} is 1*K and can contain observable variables that change across t but not *i*, variables that change across *i* and t. In addition to unobserved effect, there are many other names given to α_i in applications: unobserved component, latent variable, and unobserved heterogeneity are common. Here *i* indicate individuals, then α_i we called an individual effect or individual heterogeneity, it can be applied to families, firms, cities, and other cross-sectional units. The u_{it} are called the idiosyncratic errors or idiosyncratic disturbances because these change across t as well as across *i*. Here, it must be have am important choice between treating α_i as either fixed or random, so in same case, it so-called mixed models. We may need to assume that u_{it} has a normal distribution with mean 0 and variance σ^2. So the typical linear model has both fixed and random components.

According to the statement in Wooldeige (2002, chapter 10), we summarized basic assumption for each effect. In the following result part, I will discuss the assumptions is violate or not.

Fixed effect:

1. We must have a random sample from the cross section.
2. Each explanatory variable changes over time (for at least some *i*), and no perfect linear relationships exist among the explanatory variables.

3. For each t, the expected value of the idiosyncratic error given the explanatory variables in all time periods and the unobserved effect is zero: E ($u_{it} \mid X_i, \alpha_i$) =0.

Random effect:

4. There are no perfect linear relationships among the explanatory variables.
5. The expected value of α_i given all explanatory variables is constant: E ($\alpha_i \mid X_i$) $=\beta_0$.
6. α_i is uncorrelated with all elements of X_{it}.
7. The variance of α_i given all explanatory variables is constant: Var($\alpha_i \mid X_i$)=σ_α^2.
8. The RE (random effect) estimator is consistent and asymptotically normally distributed as N gets large for fixed T.
9. zero correlation between the observed explanatory variables and the unobserved effect: Cov($\boldsymbol{X_{it}}$, α_i)=0,t=1,2,...T

In the methodological papers or in applications, they always discuss whether α_i will be treated as a random effect or a fixed effect. With a large number of random draw from the cross section, it almost always makes sense to treat the unobserved effects, α_i, as random draws from population, along with $\boldsymbol{y_{it}}$ and X_{it}, but sometimes not.

Fixed or random effects, which is better? It always depends on the objectives. Since the key consideration in choosing between a random effects and fixed effects approach is whether α_i *and* X_{it} are correlated, it is important to have a method for testing this assumption. Huasman(1978) proposed a test based on the difference between the random and fixed effects estimates. Since FE is consistent when α_i and X_{it} are correlated, but RE is inconsistent, a statistically significant difference is interpreted as evidence against the random effect assumption.

Statistically, Huasman test is a good way to distinguish which model is better for your research. Here our test hypothesis is Ho: difference in coefficients not systematic. If the result shows that the significant level is lower than10%, that means we will reject the null hypothesis and fixed effect model will be used, otherwise random effect model will be used.

6.2 Model application

I will employ the model for my research, which looks as follows:

$$emp_{it}=\gamma aging_{it}+D_{it}+\varepsilon_{it}$$

where $emp_{i,t}$ represents the employment share in the nine sectors, $aging_{i,t}$ represents how many elderly people there are in the whole society (aging indicator as a measure), γ is the coefficient measure of $aging_{i,t}$ (impact of the changing proportion of elderly people on the employment share in the different sectors), $D_{i,t}$ represents the fixed effects which are countries specific effects(20 countries) and period specific effects(31 years), and $\varepsilon_{i,t}$ represents the error term in the model. The basic summary of the data is in the appendix (Table3), it contains observations for each variable. From table it is very clearly to know the agriculture, hunting and forestry has less missing data compares to electricity, gas and water supply.

Besides the main model, it also has a sub-model to analysis the gender effect in UK, the model construct like a simple OLS model.

7. Estimate result

By summarizing the result from the Stata program, I have made results into one table and I will critically interpret the result and try to find out the truth behind these results.

From the table 4 and table 5 where it present the total information about fix and random effects, the last column it shows that all the p-value are under the 0.05,so all of the results are statistically significant. Then we look at the R-square of sector agriculture, mining and quarrying, financial services, real estate and related services and community, social and personal services are very high, that indicated these sectors are highly correlated with demographic change. Among the nine different sectors, community, social and personal services and agriculture are have extremely high R-square with 0.454 and 0.43.In statistics, there are almost 45% and 43% of these two sectors can be explained by this model respectively. The sector of electricity, gas, water supply and transport, storage and communication only can be explained 10% and 2% by this model respectively, which means it may not correlate with aging variable so much.

Stata have run the random and fixed effects both, according to the results I have to know which result for which sector is better. It is necessary to introduce a Hausman test to test the results. Table 6 shows that the results of Hausman test, as I mentioned before, if the significant level is lower than 10%, the null hypothesis will be rejected and fixed effect model will be better. Here the table 6 illustrates the sectors of “ag, ma, el, so” are rejected by this test, so the fixed effect model will be chose, the rest of sectors will choose random effect model. To get the better view of result table 4 and 5, the changing direction and degree is the most interested in. Firstly, we should look at the third column from the left hand side of the table 4 and 5, which is the coefficient of estimation results. Most of coefficients of sectors are negative except wholesale retail trade, restaurants and hotels and financial services, real estate and related services and

community, social, and personal services, and electricity, gas and water supply. The sector which has the positive sign means with the more and more elderly people in the whole society, the employment rate shares in those sectors will increase. There is a positive relationship between them. It is clearly to see that when the proportion of elderly people increase 1%, the employment rate share of community, social, and personal services is increase 1.4017%, in the same way, the financial services, wholesale is increase 0.7653%, but electricity, gas, water supply and wholesale retail trade, restaurants are not increase significantly with the coefficient of 0.0719 and 0.0474. According to the reality these several industries have expanded their demand of employees in the past decades are not difficult to explain. As the increasing number of elderly people in the society, compare to the young people the health condition of those elderly will decline in a fast rate, the probability of being sick are higher than other groups of people, so they will need more personal care and they will involve themselves in the community life more often. As we know that the wealth profile of old cohort is much higher than the younger age cohort, this theory is supported by the paper of Arie Kapteyn,Rob Alessie and Annamaria Lusardi (2003) ,from whom there is a strong association between wealth holding and age cohorts. So when they reach the retirement age, their wealth will begin draw down with a very fast rate, financial related services will be helpful for them in their rest of life. The other way around, some sectors are shrinking year by year according to the result from table, the changes of agriculture and manufacturing are relatively more significant, with the coefficient -1.5849and -1.7802. The less demand for agriculture sector is that the technology changes and development, some farm works by using the professional machine instead of human being, it is more efficient than the past days. Technology change is an important reason together with the population aging. For the manufacturing sector in EU, it may experience the saturated state, and elderly people are

not involving themselves in this sector very much. The employment rate shares of other sectors like mining and quarrying, construction, transport, storage and communication are slightly decreasing as the higher proportion of the elderly people. The common reason result in this consequence is that the less demand for those sectors, but they still have other multiple reasons. All in all, some economists have argued that the current structural change is shifting from manufacturing-like employment to service-like employment. This is in accordance with our result.

For checking the assumption of the model, I found there are independent secular trends for population aging and for shifts from the primary and secondary sectors to the tertiary sector. This could cause that both u and X increase over time. In this case, the third assumption for the fixed effects model is doesn't hold anymore.

In the next step, we have examined the specific country (UK), in this case we will know if the gender plays a role on the changing of employment rate shares. I have run the OLS[6] model to estimate the employment rate shares of total population and only males' and females'. In the table 7 we can see the three different columns from three sample groups, it is better and clearly to compare them. To observe their changing trend, the result clearly shows that all these three groups are changing in the same direction as a whole. That means the employment rate shares of different gender do not have their strong properties to against the changing trend of the total population in UK. When we look at the result table more deeply, although the changing direction

[6] *In statistics and econometrics,* ***ordinary least squares*** *(OLS) is a technique for estimating the unknown parameters in a linear regression model.*

of these three groups are the same, but there are still a little difference between the degrees. For example, the decline degree of construction sector for man is much higher than woman, which may caused by the gender discrimination of working, the employment rate shares of this sector for woman are lower at the basis point. Table 7 also reveals that the result of EU total (table 4 and table 5) can not apply for each specific country, because of the changing direction of “el” and “tr” in UK is totally going on the opposite way. It is not surprised that the result in UK is not in line with the main result in EU, there is the country specific reasons and different patterns effect, so the main result we have obtained is the general conclusion for EU area.

8. Policy implication

Demographic aging is both a challenge and an opportunity in European area. European commission comes into a new rule which called “active aging policy” which means encourage the older workers to leave the labour market later. This sounds like a good solution for the shortage of labour supply, but we could not see this political and economic environment without thinking the changing for the employment rate shares, this is becoming a truth and came into our view. To cope with this phenomenon, the policy makers should consider this situation seriously, here I trying to give some suggestions and feasible polices.

First of all, Due to the increasing demand of personal services, medical care and financial services, that means a lot of professional employees should work for these industries. This may be relate to the education when the people step into their college life ,the technical school or university may need to educate the plenty of talented person in these fields. To make it simple is prepare sufficiently which they need in the future.

Secondly, I think the employers of the related sectors which are expanded should be set their income higher to attract more people to work for them. Under this situation the gap of structural change will be covered.

Last but not least, I also want to mention something which may be not directly linked to the result, but it directly link to our prime problem—the global aging trend, so we are in an urgent time to against the aging crisis in EU. The most important thing is that we have to do some treatments to slow down the aging fact.

9. Conclusion and further study

This paper attempted to analyze the important effects of population aging on the structure change of European labour market and discussed some policies. I think my main research question have addressed through my whole procedure.

We conclude that the employment rate shares of mining and quarrying, construction, transport, storage and communication are slightly decreasing as the higher proportion of the elderly people, and some sectors like wholesale retail trade, restaurants and hotels and financial services, real estate and related services and community, social, and personal services, and electricity, gas and water supply are accelerated by the aging fact. These empirical results are broadly in line with the results from the previous literatures and recent report. We also can conclude that the manufacturing-like sectors are shifting to the service-like sectors. Through the specific case of

UK, I found the gender is not play a significant role of shaping the structural change of employment rate shares, the model analysis with the different gender effect are almost have the same changing trend with the model which do not have the gender effect analysis. And all of these results not only answered my research question, but also tell us the aging trend in Europe is a big problem, we have to pay more attention and do something for this serious social phenomenon.

Beyond these results we have obtained, I still found some limitations of my research which may have influence on the results to some degree. First of all, this result is a general results due to that there are different employment patterns within different countries and our sample data are mixed with the country and time specific effects. Secondly, there are some missing data do exist in my sample which may affect the accuracy of the result. Thirdly, the aging factor is not the only one factor to determine the sectoral change of labour market, it do have other interrelated variables such like income per capita and consumption level, etc, may be it can leave to the other researchers if the sufficient data are possible to access.

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Appendix:

Table 3: **Data summary**

Variable	Obs	Mean	Std. Dev.	Min	Max
Country	620	10.5	5.7709	1	20
Year	620	1990	8.9514	1975	2005
Elderly people	593	0.1381	0.0217	0.094	0.195
ag	527	0.1225	0.0968	0.0119	0.4272
mi	479	0.0075	0.0077	0.0007	0.0350
ma	528	0.2229	0.0518	0.1060	0.3536
el	459	0.0091	0.0035	0.0033	0.0216
co	524	0.0773	0.0165	0.0368	0.1258
wh	524	0.1509	0.0388	0.0550	0.2616
tr	524	0.0627	0.0103	0.0355	0.0963
fi	501	0.0641	0.0304	0.0027	0.1365
so	524	0.2599	0.0723	0.0958	0.4227

Table4: Estimate result of fixed effect

Variables	R-Square	Coef	SE	P>|t|
Agriculture	0.43	-1.5849	0.1079	0.000
Mining and quarrying	0.26	-0.1070	0.0086	0.000
Manufacturing	0.42	-1.7802	0.0939	0.000
Electricity, gas and water supply	0.10	0.0719	0.0101	0.000
Construction	0.047	-0.1669	0.0340	0.000
Wholesale and retail trade, restaurants and hotel	0.038	0.0424	0.0567	0.455
Transport, storage and communication	0.021	-0.0545	0.0189	0.004
Financial services, real estate and related services	0.30	0.7635	0.0412	0.000
Community, social, and personal services	0.454	1.4017	0.0830	0.000

Note: 5%significant level, Coef stands for coefficient ,SE stands for standard error

Table5: Estimate result of random effect

Variables	R-Square	Coef	SE	P>|t|
Agriculture	0.43	-1.6102	0.1075	0.000
Mining and quarrying	0.26	-0.1081	0.0085	0.000
Manufacturing	0.42	-1.7297	0.0934	0.000
Electricity, gas and water supply	0.10	0.0604	0.0097	0.000
Construction	0.047	-0.1657	0.0333	0.000
Wholesale and retail trade, restaurants and hotel	0.038	0.0474	0.0563	0.399
Transport, storage and communication	0.021	-0.0513	0.0187	0.006
Financial services, real estate and related services	0.30	0.7653	0.0408	0.000
Community, social, and personal services	0.454	1.4197	0.0825	0.000

Note: 5% significant level, Coef stands for coefficient, SE stands for standard error

Table 6 Result of Hausman test:

Hypothesis: Ho: difference in coefficients not systematic

Variables	Prob>chi2	Reject or not	which model will be used?
Ag	0.0070	reject	fixed
Mi	0.1536	accept	random
Ma	0.0000	reject	fixed
El	0.0000	reject	fixed
Co	0.8531	accept	random
Wh	0.4643	accept	random
Tr	0.2780	accept	random
Fi	0.7456	accept	random
So	0.0408	reject	fixed

Table 7: Estimate result of UK

Variable	Coef of total	Coef of man	Coef of woman
Ag	-0.717	-0.842	-0.336
Mi	-0.744	-1.139	-0.070
Ma	-7.502	-6.748	-7.330
El	-0.416	-0.529	-1.76
Co	0.695	1.641	0.340
Wh	0.878	1.871	0.235
Tr	0.263	0.468	0.541
Fi	5.035	5.416	4.444
So	5.415	4.591	3.449

Note: 5% significant level.