

# **On the Labor Market Placements of Postgraduate Degree Holders in Finland 1990-2004**

Susanna Stén

*Åbo Akademi University*

susanna.sten@abo.fi

Telephone +358-50-546 6011

In the past two decades the number of PhDs that graduated from Finnish universities grew from a yearly number of about 500 in 1990 to roughly 1,600 in 2009. In 2006, there were roughly 17,500 PhDs in the Finnish labor force, placing Finland in the lead of international statistics as one of the countries with the highest PhD intensity in the labor force. In this paper the labor market situation of Finnish PhDs and licentiates during the period 1990-2004 is studied. The focal point is on employment and wages and special attention is given to differences in outcomes between postgraduate degree holders in different fields of study. The data is rich longitudinal employer-employee data from Statistics Finland, containing one third of the Finnish population in 1990-2004. Descriptive analysis shows that although the supply of postgraduate degree holders more than doubled in 1990-2004, employment remained mainly good. However, there are remarkable differences between postgraduate degree holders in different fields of education. In the 2000s, the unemployment rate among PhDs increased, especially among PhDs in humanities and arts and natural science. On the other hand, holders of degrees in technology and health and welfare did better than the average in terms of both employment and wages. Nevertheless, regression analysis suggests that the private return to a postgraduate degree remained unchanged at about 15 percent compared to a master's degree in the period.

Keywords: PhD, Postgraduate education, employment, wages, returns to education.

This article is based on my Master's thesis that was accepted at Åbo Akademi University on May 22<sup>nd</sup> 2009 (Stén 2009). I want to thank Jonas Lagerström at Åbo Akademi University for his patience and guidance. I also want to thank the Research Institute for the Finnish Economy (ETLA) for all the help I have gotten during this process. I especially want to thank Rita Asplund and Edvard Johansson for their valuable comments.

## 1 Introduction

Since the beginning of the 1990s the yearly number of persons who graduate from Finnish universities with postgraduate degrees has increased at a rapid pace<sup>1</sup>. As can be seen in Figure 1, about 1,000 postgraduate degree holders graduated in 1990, while the number had doubled to 2,000 in 2009. The increase can mainly be accounted to the increase in PhD degrees. In 1990 about half of the postgraduate degrees were PhDs, but in 2009 they constituted roughly 80 percent of the postgraduate degrees, and the number of new PhDs that entered the labor market increased from 490 to 1,642. The total number of postgraduate degree holders in Finland increased from slightly more than 7,100 in 1991 (Husso 2004) to 30,900 in 2007 (Statistics Finland 2010).

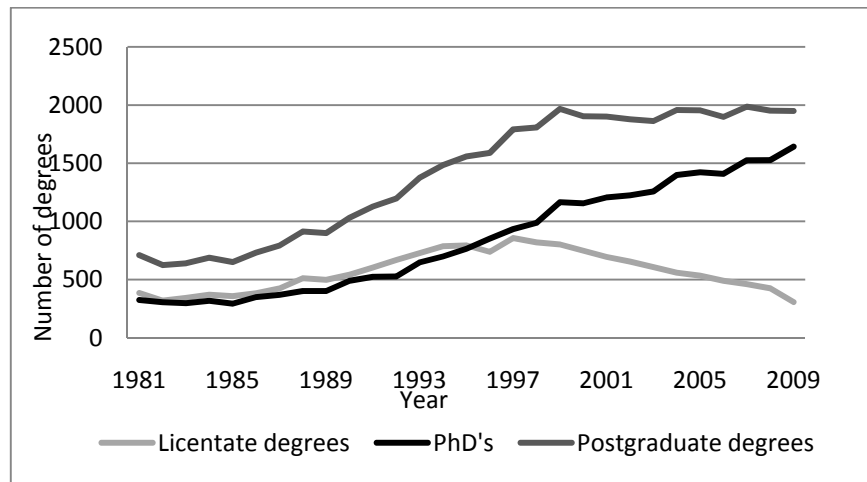


Figure 1 Number of licentiate and PhD graduates 1981-2009. Source: KOTA (2010).

This development is a result of a long political discussion, which resulted in a series of structural reforms of the postgraduate educational system in the 1990s. The most important reform was the establishment of graduate schools that resembled those in the United States in 1995. At the start there were 114 graduate schools covering all the important fields of science and encompassing about 720 postgraduate students (Husso 2005a). The reforms brought a clearer structure to the postgraduate education, including better financing and the possibility to focus on the research full-time. Another motivator for the changes was the national and international attitudes towards science and research. The political discussion focused on the transition of the Finnish economy into a knowledge-based economy. This development required

---

<sup>1</sup> There are two different postgraduate degrees in Finland, the PhD and the licentiate degree. The training leading up to both degrees is identical, intending to prepare the student for scientific work as researchers. However, the expected time to take a PhD degree is four years, while the expected time to take a licentiate degree is 2.5 years. In order to harmonize European education systems, it has been decided that the licentiate degree will be phased out. This is the reason for the drop in the number of licentiate degrees since the mid 1990s.

large-scale investments in the creation and diffusion of knowledge. To meet the increased demand for labor with research competence the postgraduate education system was improved and extended.<sup>2</sup>

The decision to expand the postgraduate education was an enormous investment of behalf of the Finnish government and the universities. Since 2007 there are 119 graduate schools with about 1,450 research scholarships financed by the Ministry of Education. Relative to the scope of the investment in postgraduate education, the follow-up of the outcomes and the returns to the investment has been quite modest.

Available research on the labor market situation has primarily focused on the transition from studies to work among recently graduated PhD (and to some extent licentiates). Typically the studies are based on surveys directed to students from certain universities, aiming at mapping out the transition into working life after the completion of the studies<sup>3</sup>. Thereby, the existing research fails to provide a more general view of how postgraduate degree holders (not only recently graduated) manage in the labor market, and whether the situation has changed in the long-term. An exception is a registry based study of the labor market placements of Finnish PhDs in the 1990s by Husso (2005b). It covers all Finnish PhDs in years 1990-1999. However, this study is getting out-of-date.

The aim of this article is to study the postgraduate degree holders in Finland in 1990-2004. In this time period, the number of postgraduate degree holders more than doubled in the Finnish labor market. Did the composition of the group change and how did their situation in the labor market change in terms of employment and wages? The study is undertaken in two steps. First descriptive statistics of the postgraduate degree holders are calculated for the years 1990-2004 using register data. This allows for a detailed analysis of personal characteristics such as field of education, gender and age, and labor market variables such as employment and wages. In the second part of the study, focus is sifted to a more econometric approach. To estimate the value of a postgraduate degree relative to other educational degrees, the private return to educational levels is estimated for 1990-2004. To account for the fact that observed differences in wages among the postgraduate degree holders in different fields of education in the descriptive analysis might be caused by other explanatory variables, such as gender or work experience, earnings equations for PhDs and licentiates in different fields of education are also estimated. Because of the large number of observations and the long time span, this study

---

<sup>2</sup> See Husso (2005a) for a review of the history of the doctoral education in Finland.

<sup>3</sup> The contribution of Haapakorpi (2008) is the most comprehensive. She studied PhDs who graduated from eleven of the 20 universities in Finland in 2004-2005, a total of 1,183 PhDs. Rather than examining the labor market placements, she focused on qualitative questions such as the motives for pursuing postgraduate education, the correspondence between education and work tasks and the utility of the education in the job searching process.

provides a broader overview of the labor market situation of PhDs and licentiates than has been available up to this point.

The paper is structured as follows. The data is presented in section 2. In section 3 the results from the descriptive analysis of the Finnish postgraduate degree holders as a group, as well as their labor market situation in 1990-2004 are reported. Firstly, attention is given to personal characteristics, and later focus is shifted to labor market variables as employment, wages and sector of employment. Sections 4 and 5 focus estimation of the private returns to postgraduate education. Section 4 covers theoretical and methodological aspects of estimation. The estimation results are presented in section 5 and section 6 concludes.

## 2 Data

The study is based on the Finnish Longitudinal Employer- Employee Data (FLEED) that is maintained by Statistics Finland. The data covers one third of the Finnish population aged 16-69 in years 1990-2004. Every year one third of the 16 year olds are added to the panel and are

Table 1. Observations in the data.

Year	Individuals			Branches of firms		Firms	
	Number of observations	Postgraduate degree holders	Postgraduate degree holders in the private sector	Number of observations	Branches with post-graduate degree holders	Number of observations	Firms with post-graduate degree holders
1990	1 173 727	4 161	990	91 065	404	93 296	329
1991	1 188 248	4 426	1 014	92 561	418	96 513	383
1992	1 203 530	4 678	1 100	92 308	400	98 034	375
1993	1 192 451	4 970	1 061	90 734	395	95 278	372
1994	1 206 808	5 289	1 160	104 767	441	95 963	413
1995	1 220 731	5 621	1 231	108 502	478	98 706	432
1996	1 195 274	5 886	1 317	114 516	510	103 354	466
1997	1 210 283	6 226	1 459	117 489	555	106 134	517
1998	1 198 459	6 477	1 562	120 819	611	107 970	546
1999	1 214 533	6 883	1 643	122 145	647	106 628	564
2000	1 229 771	7 271	1 771	122 945	696	106 865	629
2001	1 201 596	7 519	1 889	122 959	775	106 473	686
2002	1 201 863	7 851	1 960	120 802	777	104 895	670
2003	1 202 745	8 157	2 020	126 053	793	109 520	692
2004	1 205 345	8 521	2 076	124 440	796	108 231	701

thereafter followed until the age of 69. Consequently, there are roughly 1.2 million observations each year. The data also encompasses practically all firms and branches in the private sector. The employer data will only be used to a limited extent in the survey of labor market placements of postgraduate degree holders. Note that there is no data on the employers in the public sector.

FLEED contains detailed information on the individual level, with variables on family, education, employment, income, debt and pension. This allows for a thorough analysis of the postgraduate degree holders. However, the design of the data does not allow for distinction between PhDs and licentiates, but classifies them all as postgraduate degree holders.

The inability to tell the difference between PhDs and licentiates is a potentially serious restriction to the analysis. The preparation for the two degrees is essentially the same, but the licentiate degree takes only 2.5 years to fulfill while the expected time to take a PhD is four years. This would not necessarily have to be a problem if the proportions of licentiates and PhDs had remained constant in the time period studied. However, the share of PhDs increased from 46 percent in 1990 to 71 percent in 2004 (KOTA 2010). This implied that observed changes in studied variables might be caused by changes in the relationship between PhDs and licentiates rather than in changes in the actual variables.

Evidence from earlier surveys that cover both PhDs and licentiates suggests there are some differences in the labor market performance of the two groups. In the beginning of the 2000s, unemployment was higher among licentiates (4.8 percent) than among PhDs (1.5 percent) three years after graduation from the University of Helsinki (Manninen and Luukkainen 2006). The same study suggested that licentiates were more often employed on a permanent basis than PhDs (70 percent and 50 percent respectively). Also, PhDs were more likely to work in the public sector, and especially in the universities, than licentiates. Thus, it is not entirely clear what effect the lack of distinction between PhDs and licentiates has on the observed results. The results from this study are not likely to be misleading, but the reader is encouraged to keep this issue in mind when interpreting the results.

Comparing the number of postgraduate degree holders to official statistics on the Finnish population by the highest education completed<sup>4</sup> suggests that the data contains 26-32 percent of the postgraduate degree holders in Finland during the period 1990-2004 (Statistics Finland 1992, 1993, 1994, 2007, 2008a).

---

<sup>4</sup> Contains persons of at least 15 years of age, who have completed education at senior secondary schools, vocational education institutions or universities. Thus, the statistics also contain persons at an age older than 69, so the data is likely to contain a somewhat larger share of the postgraduate degree holder up to an age of 69 than the 26-32 percent specified above.

### 3 Descriptive analysis

In this section the results from the mapping of the postgraduate degree holders are presented. To begin with, the personal characteristics, such as age wage and field of study, of the postgraduate degree holders are studied. Thereafter focus is shifted to labor market variables such as employment, wages and employment sector.

#### 3.1 *Personal characteristics*

The structural changes in the 1990s made it easier to pursue postgraduate studies, through better financing and more well organized teaching and supervision for the students. Due to the improved conditions, postdoctoral education became more popular. Also, it attracted new types of persons to postgraduate education.

##### *Field of study*<sup>5</sup>

Figure 2 shows the number of postgraduate degree holders in the most common fields of science in 1990-2004. About 80 percent of the postgraduate degree holders were educated in one of the four most common fields of science, namely natural science, health and social science, engineering and business science, which were all about equally common. About 13 percent had education within the humanities and arts, while only a few percent had post gradual education in teacher education and educational science, agriculture and forestry or services (collected into one group).

In years 1990-2004, the number of persons with postgraduate degrees in every field of education increased at about the same pace with a few exceptions. The share of PhDs and licentiates that was trained in natural sciences dropped from 25 to 21 percent. The shares of postgraduate degree holders in the other large fields of science remained unchanged but the share of PhDs and licentiates that graduated in the smaller fields of education grew from six to 8.4 percent in 2004. The absolute numbers in these fields of education are small, but the relative increase is remarkable. For example, the number of persons with postgraduate degrees in educational sciences increased with about 300 percent in 1990-2004.

---

<sup>5</sup> FLEED distinguish between eight different fields of education: teacher education and educational science; humanities and arts; business and social sciences; natural sciences; technology; agriculture and forestry; health and welfare and services (Statistics Finland 2009). PhDs and licentiates with education in teacher education and educational science, agriculture and forestry and services, together with those whose field of study is unknown constitute no more than eight percent of the total number of postgraduate degree holders. For the sake of the clearness of the presentation, these minor fields of education are grouped into one group – “other fields of education”.

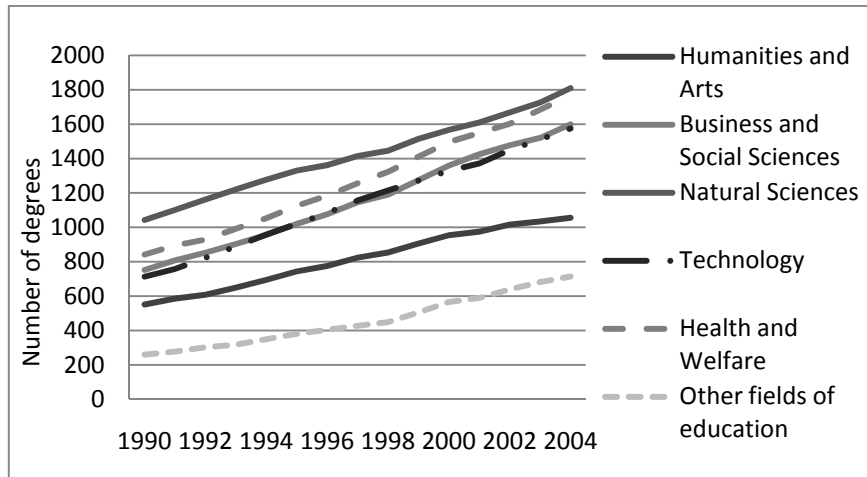


Figure 2 Licentiate and PhDs according to field of education 1990-2004.

### Gender

The gender distribution changed drastically during the period. In 1990 only every fourth postgraduate degree holder was female. In 2004, the share had increased to 37 percent. When studying only those who completed their postgraduate education, 46 percent were women in 2004, so the gender distribution was leveled out (KOTA 2010).

The gender distribution across fields of education was, however, very uneven. Within the humanities and teacher education and educational science the share of female PhDs and licentiate was the largest during the whole period, higher than 40 percent. In technology the gender distribution was the most uneven. However, technology was the field of science in which the share of female PhD and licentiate grew the most, from 8 to 17 percent. Also in the field of health and welfare there was a relatively large increase in the share of female postgraduate degree holders.

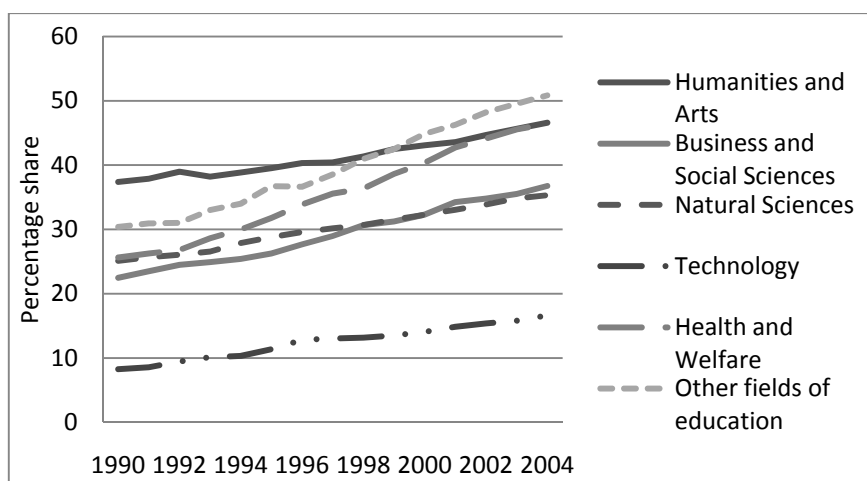


Figure 3 Share of female PhDs and licentiate according to field of education in 1990-2004.

## Age

Already in the mid 1980s it was stated that the mean age among those defending their licentiate and PhD theses should be lowered (OECD 1987). The main motives were to improve the employment possibilities of the postgraduate degree holders, but also to prolong the time that their knowledge could be utilized in the labor market. The data suggests that one have failed to lower the average age of graduates. In 1990 the average age of those who graduated was 36.4 years. In 2004 it had increased to 38.3 years. However, there an explanation for this that becomes clear when studying the graduates according to age groups. The share of licentiates and PhDs who graduate at an age below 35 has remained stable at about 45 percent throughout the period, while the share of persons graduating at an age older that 45 has increased from 11 percent in 1990 to 27 percent in 2004. This suggests that the educational system has failed to attract more young individuals to postgraduate education. Rather, the interest in pursuing postgraduate studies has increased among persons who are approaching the retirement age. These persons probably have motives like pure interest in the subject, rather than seeing the education as an investment, as is normally assumed by economic theory. As a consequence of the increased age of recently graduated PhDs and licentiates, the average age among all PhDs and licentiates also increased; from 45.3 to 48.2 years.

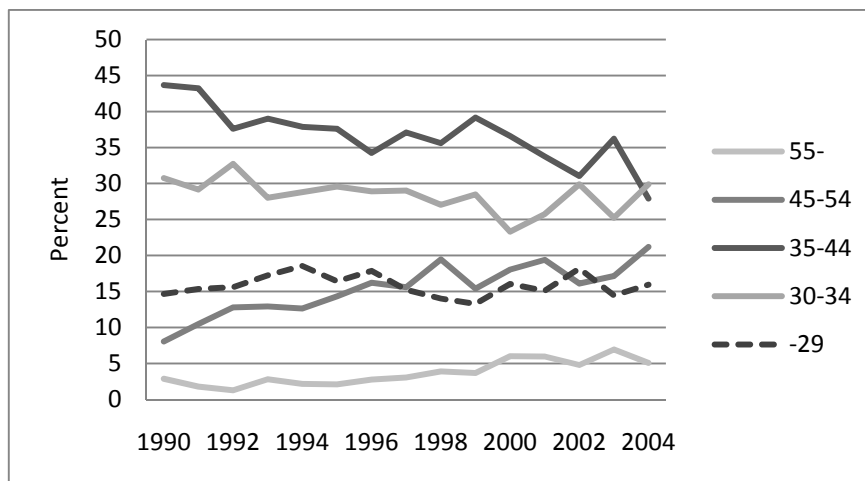


Figure 4 Recently graduated PhDs and licentiates according to age groups in 1990-2004.

However, there were remarkable differences in mean age between fields of education. During years 1990-2004, average age among graduating PhDs and licentiates in natural sciences and technology was about 34-36 years. The trend of increasing age was more apparent among persons in teacher education and educational science, business and social sciences and health and welfare. PhDs and licentiates in educational sciences graduated at an average age of almost



47 years in 2004, and persons graduating in humanities and business and social sciences had an average age of slightly more than 40 years.

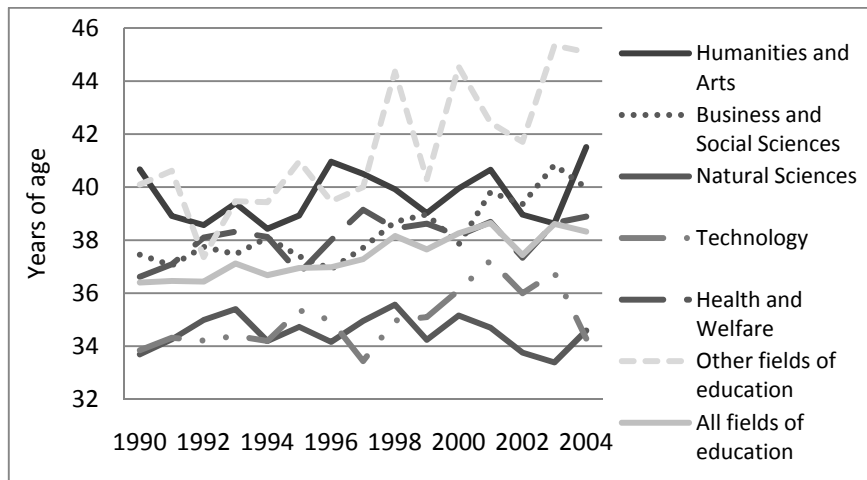


Figure 5 Mean age of recently graduated PhDs and licentiates according to field of education in 1990-2004.

### 3.2 Labor market performance

In the previous section it was shown that the composition of PhDs and licentiates in the Finnish labor force changed in 1990-2004. The most remarkable changes were the increasing share of women and the ageing of the group. When studying the labor market performance of the group, other factors are likely to affect the outcomes. However, this study does not try to explain the causes of changes in the labor market outcomes of PhDs and licentiates. For example, the demand for PhDs and licentiates in the labor market is not mapped out. Finnish policy makers argued for an expansion of the post gradual education system to meet the increased demand of highly educated workers. However, the demand for postgraduate degree holders has only been studied from a very superficial point of view (Academy of Finland 2003), and not much is known about the demand side of this labor market. Furthermore, the recession in the early 1990s hit Finland extremely hard, and this is likely to have affected the labor market in the 1990s, not only in terms of unemployment but also in terms of wage levels and employers. Thus, in the following the labor market situation of PhDs and licentiates in Finland in 1990-2004 is studied without further effort to explain the causes for observed changes.

#### Employment

In 1990-2004 the employment among PhDs and licentiates was high compared to the Finnish population as a whole. The employment rate remained at about 85 percent during most of the period after a drop from about 90 percent in the first years in the 1990s. The

unemployment rate increased in the period, but not as much as employment decreased. During the recession the unemployment rate increased from 0.5 percent in 1990 to the peak level of 2.3 percent in 1994. In the years following the recession, unemployment decreased, to increase again after year 2000. In 2004, the unemployment rate among postgraduate degree holders was 2.3 percent. The gap between employment and unemployment was explained by an increasing share of retired postgraduate degree holders. In years 1990-2004 the number of PhDs and licentiates in retirement increased from 4 to 9 percent.

There were remarkable differences in employment between licentiates and PhDs in different fields of education. In 1990-2004 about 90 percent of those with education in technology were employed. This applied to less than 80 percent on the PhDs and licentiates with education in humanities and arts. Among those with education in health and welfare and in humanities and arts, employment decreased in the beginning of the 1990s, while there was a remarkable drop in employment among natural scientists in the early 2000s.

On average, the unemployment was highest among those with degrees in humanities and arts (up to 3.7 percent), social sciences and business and natural science. On the contrary, only about 0.5 percent of the ones with postgraduate degrees in health and welfare and less than two percent of the holders of degrees in technology were unemployed. In the 2000s, unemployment increased most rapidly among degree holders in humanities and natural sciences.

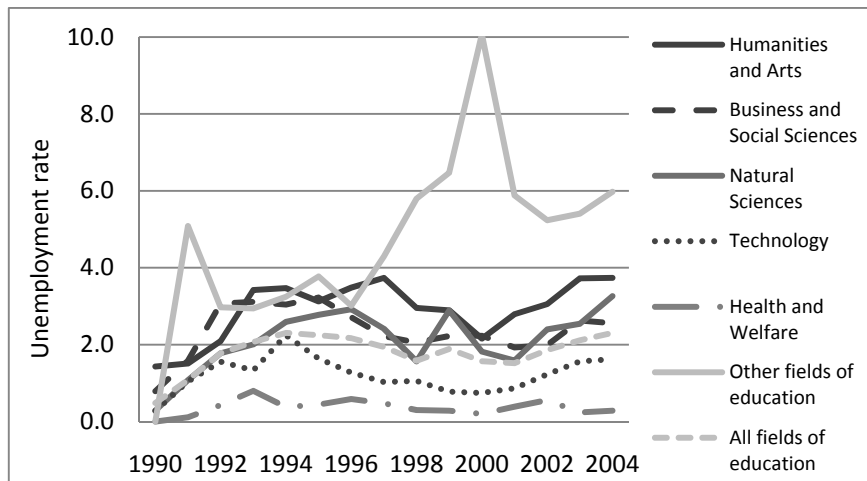


Figure 6 Unemployment rate among licentiates and PhDs according to field of education 1990-2004.

Employment patterns differed also across genders. About 86 percent of the female PhDs and licentiates were employed in 1990-2004, while the employment rate among men decreased from 92 to 84 percent. This was explained by an increasing share of retired male postgraduate degree holders. Unemployment was consistently somewhat higher among female PhDs and licentiates than among men.

Among recently graduated PhDs and licentiates, the employment rate was higher than the average, and it increased from 85 to 88 percent in 1990-2004. On the other hand, unemployment was much more common among the recently graduated than within the group as a whole. In 1993-1995 the unemployment was 4 percent among recently graduated. In the late 1990s it decreased to 2 percent, where after it started increasing quite rapidly to 3.6 percent in 2004.

### *Sector of employment*

Traditionally the universities have been the most important employer of PhDs. In the last decades, however, the personnel at the universities have increased at a slower pace than the work force of PhDs. Therefore, Finnish policy makers have hoped to increase the share of PhDs and licentiates that are employed in the private sector.

The data analysis shows that the share employed in the private sector increased, from 26.1 percent in 1990 to 28.8 percent in 2004. It seems like a modest increase, but the actual number of postgraduate degree holders employed in the private sector increased by 113 percent.

The distribution between employment sectors varied greatly across fields of education, however. Among those educated in technology or agriculture and forestry 50-60 percent was employed in the private sector. Among those with education in the humanities and arts, less than ten percent worked in the private sector. The share of privately employed increased the most among those educated in health and welfare (+55 percent) and natural sciences (+37 percent).

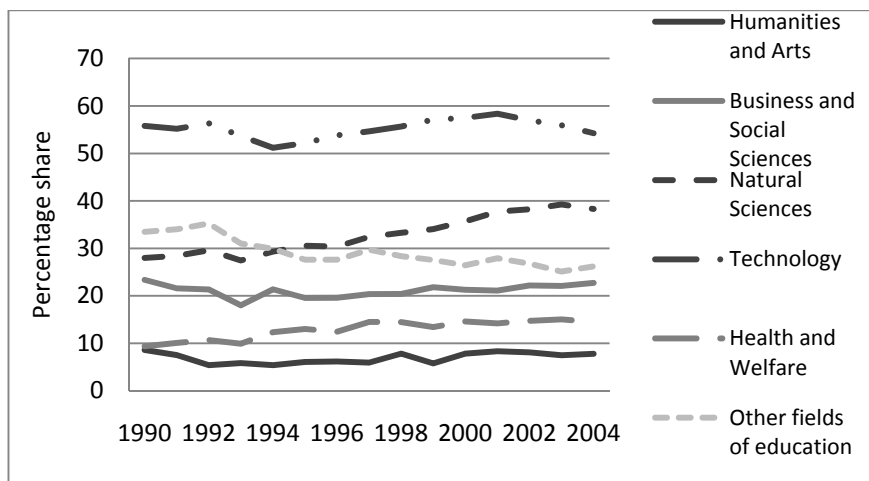


Figure 7 Employment sector of licentiates and PhDs according to field of education 1990-2004.

## Wages

The wages of the Finnish PhDs and licentiates will be more thoroughly studied in section 5, as part of the study of returns to postgraduate education. This section serves as a background for the forthcoming analysis.

In the data, only annual wage income is reported. To correct for months of unemployment etc., the annual wage converted to monthly wages using the number of months of work. For the sake of comparison, the wages were corrected for inflation to the price level year 2004. In the study of wages, PhDs and licentiates that were employed at the end of the year are included. Individuals with a yearly income higher than 200,000 € are truncated in FLEED. Furthermore, self employed were removed as their wage income is not reliable. However, self employed only constituted 4-6 percent of the postgraduate degree holders in the sample. Note also that the analysis focuses on wage levels rather than on wage trends.

The median wage level of the postgraduate holders follows a u-shaped pattern in years 1990-2004. In the first years in the 1990s the median wage level dropped from 4,030 Euros to 3,580 Euros in 1994, which is equivalent to a decrease of 11 percent. Thereafter the wage level increased at a steady pace to 4,150 Euros in 2004.

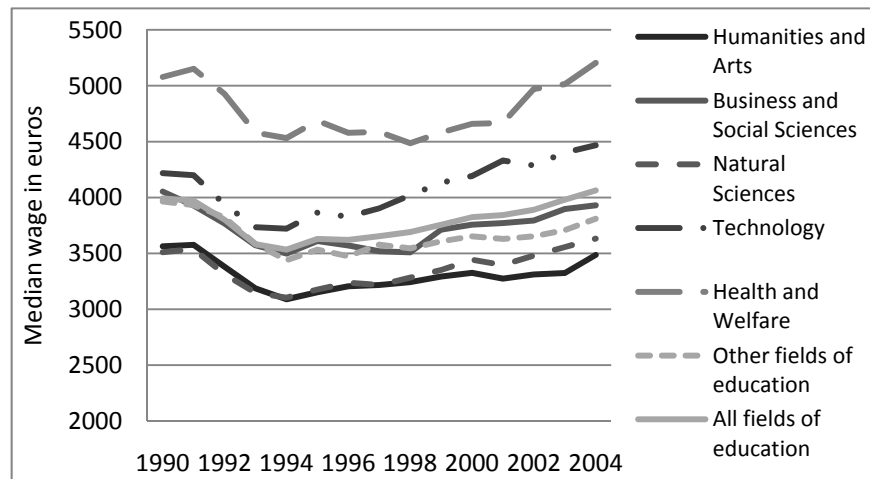


Figure 8 Median monthly wages of licentiates and PhDs according to field of education 1990-2004.

There were notable differences in wage levels within the group of postgraduate degree holders. The median wages according to field of education are depicted in Figure 8. PhDs and licentiates in health and welfare earned the highest wages throughout the period, and had a median wage of 5,200 Euros in 2004. Those with postgraduate degrees in natural sciences and humanities and arts earned the lowest wages, about 3,500 Euros in 2004. However, natural scientists, together with engineers, experienced the fastest increases in wage levels after the

recession. It is also noteworthy that holders of postgraduate degrees in health and welfare and technology are the only ones whose median wage level are above the average level for all fields of science.

Time elapsed since graduation also had an impact on the wage level. Throughout the period, the median wage among those who had graduated more than 20 years ago was about 2,000 Euros higher than that of those who graduated less than a year ago (median wage in 2004 was 5,270 and 3,070 Euros respectively). After five to nine years as a holder of a postgraduate degree, the median wage level was reached, on average.

The wage differences between employed in the public and private sector were, perhaps surprisingly, negligible. At most, the wage gap between the sectors was 200 Euros. This could be explained by the large share of PhDs (and licentiates) in health and social care that are employed in the public sector and, as shown earlier, have relatively high wages.

Gender seemed to affect the median wage levels. Male PhDs and licentiates earned on average 800 to 1,000 Euros more than their female counterparts. However, the gap was narrowed during the studied period as women's median wage increased by ten percent, compared to a four percent increase for men. In 2004 the median wage for a male PhD or licentiate was 4,470 Euros, compared to 3,570 Euros for a female.

#### **4 Returns to postgraduate education**

From the descriptive analysis it became evident that the postgraduate degree holders are a heterogeneous group, and that the differences are reflected in their wages. Up to this point, however, the analysis has been strictly descriptive. Nothing has been said about the correlation between the background variables. In order to broaden the analysis, regression analysis is utilized to study the relationship between the variables explaining the wage differences. To do this, simple earnings equations are estimated for the postgraduate degree holders. By repeating the estimations for each year in the time span 1990-2004, it is possible to estimate the impact of factors that explain the wage heterogeneity within the group, and whether the effects have changed over time. The relative value – in terms of predicted wages – of postgraduate degrees in different fields of education is studied by including dummy variables. Comparing the estimates over time gives an indication on whether there might be over- or underproduction of PhDs or licentiates in some fields of education.

Before estimating the earnings equations for PhDs and licentiates only, a related question is examined. As a reaction to the rapidly expanded post graduate education system, the question of excess supply of PhDs was raised in the early 2000s. Excess supply could give rise to a series of

negative effects on the labor market situation of the holders of postgraduate degrees. Firstly, it could lead to higher unemployment. Second, tougher competition for qualified positions could lead to reduced wage growth among PhDs and licentiates. Further, tougher competition could force holders of postgraduate degrees to accept jobs below their own competence level. This could also show up as lower wages.

Earnings equations have been widely used to estimate the return to schooling in a variety of settings. In this paper, earnings equations are used to estimate both the returns to levels of education, with primary focus on postgraduate education, and the returns to education in different fields of education. By comparing the estimates of returns to postgraduate education from 1990-2004, we get an indication of how the valuation of postgraduate degrees has developed relative to other degrees. In the following section, the econometric framework is presented in greater detail.

#### **4.1 *Methods***

There are several econometric problems related to the estimation of returns to education. One of the more serious problems is self-selection into higher education. Among others Griliches (1977) has proposed that innate ability affects the individual's choice of educational level. As ability is hard to measure, it is often omitted from the earnings equations, causing a bias in the coefficients from education as well as other included variables. Numerous approaches have been suggested to correct for this bias, among these the use of instrumental variables (see e.g. Angrist and Krueger 1991, Harmon and Walker 1995, Vella and Gregory 1996). Modeling the endogenous schooling decision has evident advantages over standard OLS estimation, but there is also serious criticism of the utilization of instrumental techniques. In the empirical literature, it has been hard to find good instruments for schooling. Weak instruments can in the worst case lead to IV estimates that approach the bias of OLS (Bound et al 1995). Because of the problems related to correction for self selection, selection into schooling is not corrected for in this study. Instead, an extended version of the Mincerian wage equation is used to estimate both the returns to postgraduate education and the wage differences between postgraduate degree holders.

##### **4.1.1 *Returns to postgraduate education***

Estimating the returns to postgraduate education relative to other educational levels can help indicating whether the increased supply of PhDs and licentiates has been met by an

increase in demand. The following equation is used to estimate returns to postgraduate education:

$$\ln W_i = \beta_0 + \beta_1 S_i + \beta_2 G_i + \beta_3 AGE_i + \beta_4 AGE_i^2 + \beta_5 COMP_i + \beta_6 COMP_i^2 + \beta_7 EMP_i + \beta_8 SEN_i + \beta_9 SEN_i^2 + u_i \quad (1)$$

The logarithm of the monthly wage is used as dependent variable. It is obtained by correcting the yearly income by correcting for the number of months of work. Wages are adjusted to the price level of 2004. Yearly wages over 200,000 Euros are reported as missing in the data. The educational levels, denoted in the equation by  $S_i$ , are upper secondary level education, past-secondary non-tertiary education<sup>6</sup>, lower-degree level tertiary education (bachelor level), higher-degree level tertiary education (master level) and postgraduate education (see Statistics Finland 2008b). Upper secondary education is left out from the regression equation and serves as reference group.

In most of the literature on returns to education, it is assumed that the individual complete all of his or her education before entering the labor market. This obviously does not apply to most PhDs and licentiates, as the mean age at graduation is well above 36 years, as was discussed in section 3.1<sup>7</sup>. The traditional approach of estimating experience with age, or age minus the age at which the education was completed (potential work experience), is therefore not consistent. Even if one could argue that the education lasts for about the same amount of time for everybody, experience obtained before completing the postgraduate degree might be valued differently than experience obtained after completion if the postgraduate degree in the wage setting. Therefore, three different measures of experience are used.  $AGE_i$  measures the general work experience of the individual, assuming that all individuals at a given educational level have spent the same amount of time on education.  $COMP_i$  denotes age minus the age at completion of the highest degree, and measures more specific experience that requires education at the highest completed educational level.  $SEN_i$  is the narrowest measure of work experience that measures the time the individual has spent at his current job.

This far in the research process, all three measures have been included in the wage equation simultaneously. The next step in the estimations is, however, to investigate further which of these measures of experience is optimal, excluding the other experience measures to

---

<sup>6</sup> Also known as lowest level tertiary education. These degrees are vocational degrees that are not polytechnic degrees, such as mechanics.

<sup>7</sup> Compulsory school attendance starts at age seven in Finland. The expected number of years of schooling to complete a PhD (licentiate) is 21 (19.5) years for women and 22 (20.5) for men due to military service. Thus, if all education was pursued continuously, PhDs should graduate at the age of 28-29 and licentiates would graduate at an age of about 27 years.

avoid the multicollinearity problem. In addition, another measure of work experience will be examined, namely age minus the expected duration of education, given the highest completed degree. This gives a measure of potential work experience, allowing for periods of work between periods of studies.

Finally, dummy variables for employment sector,  $EMP_i$ , and gender,  $G_i$ , are included. The public sector is used as reference group. The private sector is divided into two parts; the industrial and services sectors and the farming, forestry and fishing industry. It is possible that employment sector is correlated with education, but here it is assumed that the variables are uncorrelated.

To estimate the return to educational levels, the sample was extended to contain ten percent of all employed wage-earners in the data in years 1990-2004, resulting in sample size of about 30,000 to 45,500 observations, depending on the year.

#### 4.1.2 Wage differences among postgraduate degree holders

In section 3.2.3, it was shown that there are remarkable differences in wages among PhDs and licentiates in different fields of education. Thus, the return to a postgraduate degree estimated in equation (1) serves as a measure of the average return to a postgraduate degree. Still, this average estimate can be quite far from the true return of a postgraduate degree in natural sciences or engineering. To get a better perception of the wage gap between postgraduates in different fields of education, and how it has evolved in the last decades, the following wage equation is estimated for years 1990-2004:

$$\ln W_i = \beta_0 + \beta_1 S_i + \beta_2 G_i + \beta_3 AGE_i + \beta_4 AGE_i^2 + \beta_5 COMP_i + \beta_6 COMP_i^2 + \beta_7 EMP_i + \beta_8 SEN_i + \beta_9 SEN_i^2 + u_i \quad (2)$$

Again, the logarithm of the monthly wage is used as the dependent variable. In this setting the educational variable does not represent educational levels but rather fields of study. These are teacher education and educational science; humanities and arts; business and social sciences; natural sciences; technology; agriculture and forestry; health and welfare and services. Education in humanities and arts is used as reference group. Otherwise, the variables are the same as in equation (1).

The sample used for this estimation naturally consists only of holders of postgraduate degrees. Only wage earners that were employed at the end of the year were included. This results in samples that consist of 3,026 to 6,540 observations depending on the year.



## 5 Empirical results

When interpreting the estimates from the wage equations, it is important to remember that the group of postgraduate degree holders consists of both licentiates and PhDs, who might face different wage levels, leading to different returns to education. Particularly, it is important to remember that the relationship between PhDs and licentiates in the sample changed from 46 to 71 percent being PhDs. If the wage levels among PhDs and licentiates vary greatly, observed changes in the estimates might be affected by the changes in the share of PhDs over time. However, the differences are unlikely to be important as PhDs and licentiates face the same labor market to a great extent (see section 2).

### 5.1.1 Returns to postgraduate education

The complete estimation results of equation (1) are reported in table A1 in Appendix. In Figure 9, the estimated parameters of returns to level of education, or the education premium, are presented. The education premium is defined as the predicted wage relative to the predicted earnings of an individual who has completed upper secondary education only. Thus, the estimates take the background variables as gender, experience and employment sector into consideration. The estimates of the returns to higher levels of education show greater variation than those of the lower educational levels. This is, at least in part, due to the smaller number of individuals that complete higher degrees.

On average, the estimated coefficient for postgraduate education relative upper secondary education was 0.71<sup>8</sup> in 1990-2004. The estimate of 2004 was insignificantly lower than that of 1990. However, the estimates of 1996 and 1997 were statistically significantly lower than the estimate of 1990, suggesting decreasing returns to postgraduate education in the beginning of the 1990s. This is in line with the results of Eriksson and Jäntti (1997) and Uusitalo (1999), who found signs of decreasing returns to education in the first half of the 1990s.

From 1997 onwards, there was greater variation in the estimates of the education premium. Considering the whole period, however, it seems that the return to postgraduate education (as well as education on the other levels) relative upper secondary education has remained more or less unchanged. These results are in line with the ones of Asplund and Maliranta (2006), who found that the return to education remained unchanged in 1984-2001.

---

<sup>8</sup> The estimated coefficients can be expressed as percentages by performing an antilog operation. That is taking  $(e^b - 1) * 100$ , where  $b$  is the estimated coefficient. Thus, a coefficient of 0.71 corresponds to a wage premium of 103 percent.

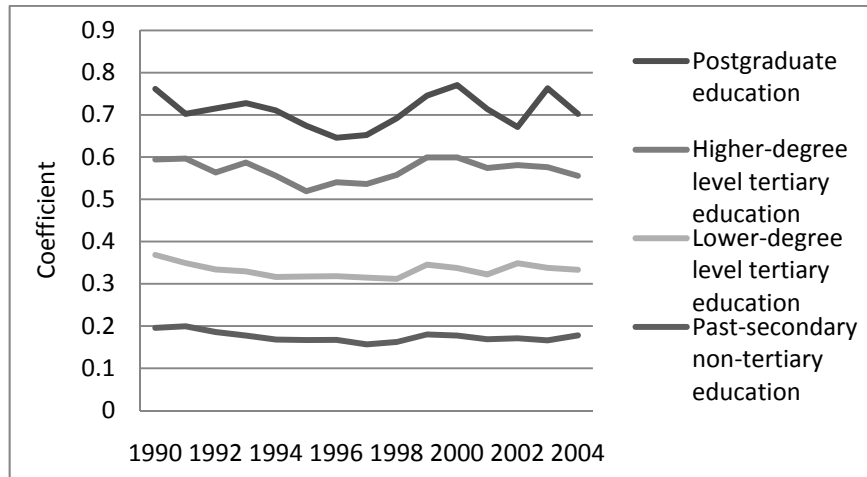


Figure 9 Estimated returns to educational levels in 1990-2004.

Note: results from estimation of equation (1). Full estimation results in Appendix. Upper secondary education is the reference group. All estimates are statistically significant on the 1 %-level.

The estimates of this study are higher than corresponding estimates from earlier studies. For example, Eriksson and Jäntti (1997) estimated that the coefficient of the education premium relative upper secondary education would be 0.56 in 1990 and Uusitalo (1999) estimated it to be 0.53 in 1989 and 0.50 in 1995. The change in the estimates over time, however, is similar, which suggests that the deviations are caused by the model specification. Further estimations will be performed to examine these differences further.

Estimating the return to education relative the lowest reported educational level is the standard approach in the literature, but comparing postgraduate education to upper secondary education is counter intuitive in the sense that an individual is never confronted with the choice between upper secondary education and postgraduate education. Therefore, a more practical approach is to study the postgraduate education premium relative to higher-degree tertiary education.

Figure 10 shows the returns to postgraduate education relative to higher-degree tertiary education in 1990-2004. The estimated coefficient varied between 0.08 and 0.18, but the deviations were not statistically secured. Instead, the wage premium of a postgraduate degree holder relative a master's degree fluctuated about 15 percent in the period.

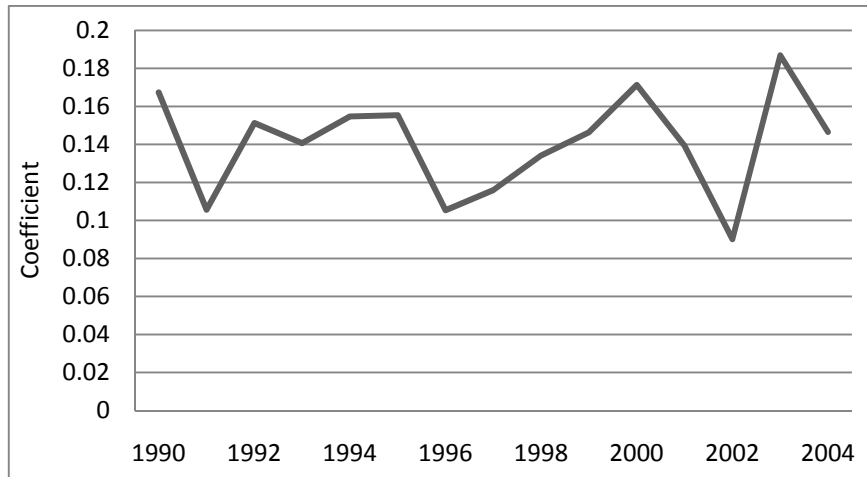


Figure 10 The education premium of postgraduate education relative higher-degree tertiary education. The coefficients are obtained from Table A1 in Appendix. The estimates are significant on 1 % level. The variation in the estimates over time is not statistically significant.

### 5.1.2 Wage differences among postgraduate degree holders

The wage premium for a field of education is defined as the predicted wage relative to the predicted wage of an individual with postgraduate education in humanities or arts. Background factors like gender and experience are thus taken in account. The full estimation results are reported in Table A2 in Appendix. The estimates for returns to field of education are reported in Figure 11.

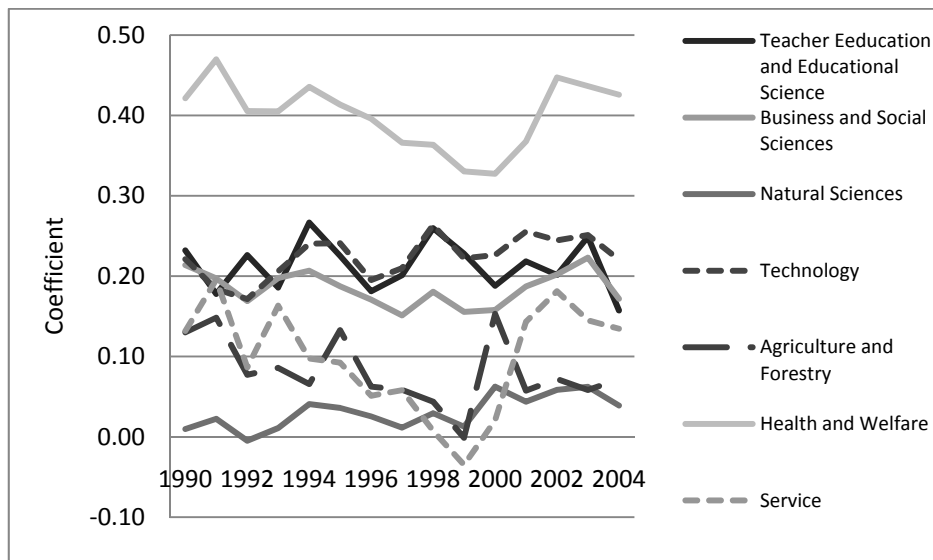


Figure 11 Estimated wage differences among postgraduate degree holders in 1990-2004.

Note: results from estimation of equation (2). Full estimation results in Appendix. Humanities and arts is the reference group. All estimates but the ones on natural sciences, agriculture and forestry and service fields are statistically significant on the 1 %-level.

Throughout the period, there were remarkable differences in wages among PhDs and licentiates in different fields of education. The reference group, postgraduate degree holders in humanities and arts, consistently earned the lowest wages, as every other group earned positive wage premiums. Postgraduate degree holders in health and welfare earned the highest wage premium, up to 50 percent more than their colleagues in humanities and arts. The coefficients for technology, teacher education and educational science and business and social sciences fluctuated at about 0.2 throughout the period. In the bottom, with only slightly positive wage premiums relative the humanities were natural science.

Despite some fluctuations in the estimates over time, the returns to degrees in the different fields of education relative a postgraduate degree in humanities remained at about the same level throughout the period. The only exception is natural science, whose wage premium relative the humanities increased from zero to about six percent.

Estimation of equation (2) also reveals other interesting results regarding the wage differences among postgraduate degree holders. The gender wage gap decreased in the studied period, and especially in the early 1990s. In 1990 the coefficient for female was -0.21, but it decreased to -0.16 in 1994. Since then, it has remained at a level of -0.17 until 2004, suggesting that female postgraduate holders earn about 18 percent less than their male colleagues.

In the descriptive analysis it was shown that the wage differentials between the sectors of employment were negligible. Statistical analysis, on the other hand, suggests a positive wage premium for PhDs and licentiates employed in the private sector. The wage premium decreased, however, from about 10 percent in the early 1990s to 4 percent in the 2000s. The deviation between the results from the descriptive analysis and regression analysis suggests that a larger share of the high-salary earners, postgraduate degree holders in health and social sciences for instance, are employed in the public sector.

## **6 Conclusions**

In the 1980s and 1990s Finnish policy makers strongly recommended an expansion of the postgraduate education system in order to increase the number of PhDs in the labor market. However, as the number of postgraduate degree holders increased rapidly in the 1990s, words of caution were raised. Some feared that there would be excess supply of PhDs in the Finnish labor market, which would impair the labor market situation of the PhDs.

This mapping of the labor market situation of Finnish licentiates and PhDs in 1990-2004 show that even though there has been changes in the labor market of postgraduate degree holders, these have been relatively small. The employment seemed to follow the business cycles

and the employment of the population as a whole. The return to post graduate education relative to other, lower educational levels remained unchanged throughout the period. The only sign of poorer labor market outcomes was the increased unemployment in the early 2000s, especially among recently graduated PhDs and licentiates. This increase was, however, neither high nor long lasting enough to be interpreted as a more permanent change in the labor market situation of the PhDs and licentiates. More recent statistics (Statistics Finland 2008a, 2010) show that the unemployment rate among postgraduate degree holders was 2.3 percent in 2006 and 2.8 in 2007. Hence, it seems that the increase in unemployment might have slowed down.

Considering the shock that the fast increase in the supply of PhDs was to the labor market of highly educated, research competent workers, the changes in the labor market situation of the PhDs are surprisingly small. This suggests that the demand for this type of personnel has indeed increased in Finland during this period. More thoroughly mapping out the demand for PhDs and licentiates is, nonetheless, an important question for future research in order to further improve match between supply and demand.

Despite the good overall performance of PhDs and licentiates in the labor market, there are some reasons for concern. There are enormous differences in labor market performance between PhDs and licentiates in different fields of education. Postgraduate degree holders in humanities and art, for instance, perform consistently worse than those in other fields of science. Thereto, their situation has developed less favorably than the others'. On the other hand, degree holders in technology and especially health and welfare performed better than the average in all aspects.

Therefore, it is legitimate to ask a) whether there is excess supply or demand for postgraduate degree holders within some fields of science and b) whether the admission into postgraduate education should be more closely governed to make sure that "the right kinds" of PhDs are produced.

## References

- Academy of Finland (2003). *Tohtoreiden työllistyminen, sijoittuminen ja tarve*. Publications of the Academy of Finland 4/03.
- Angrist, Joshua and Alan Krueger (1991). "Does Compulsory School Attendance Affect Schooling and Earnings." *Quarterly Journal of Economics*, 106, 979-1014.

- Asplund, Rita and Mika Maliranta (2006). Koulutuksen taloudelliset vaikutukset. Sitran Raportteja 60.
- Eriksson, Tor and Markus Jäntti (1997). "The Distribution of Earnings in Finland 1971-1990". *European Economic Review*, 41, 1763-1779.
- Griliches, Zvi (1977). "Estimating the Returns to Schooling: Some Econometric Problems". *Econometrica*, 45(1), 1-22.
- Haapakorpi, Arja (2008). Tohtorien varhaiset urat työmarkkinoilla ja tohtorikoulutuksen merkitys työelämässä. Aarresaari.
- Harmon, Colm och Ian Walker (1995). "Estimates of the Economic Return to Schooling for the United Kingdom". *American Economic Review*, 85, 1278-1286.
- Husso, Kai (2004). *Tohtoreiden liikkuvuus Suomen työmarkkinoilla*. In *Tiede ja teknologia 2004*. Statistics Finland, Tiede, teknologia ja tutkimus. 2004:5, s. 45-60.
- Husso, Kai (2005a). *Tohtorit, tiedepolitiikka ja työmarkkinat. Tutkijankoulutus Suomessa 1950-luvulta tutkijakoulujen aikaan*. Publications of the Ministry of Education, 2005:21.
- Husso, Kai (2005b). Tohtoreiden sijoittuminen Suomen työmarkkinoilla 1990-luvulla. In Husso, Kai (2005a). *Tohtorit, tiedepolitiikka ja työmarkkinat. Tutkijankoulutus Suomessa 1950-luvulta tutkijakoulujen aikaan*. Publications of the Ministry of Education 2005:21.
- KOTA (2010). The KOTA database, Ministry of Education.  
<https://kotaplus.csc.fi/online/Etusivu.do>
- Manninen, Jyri and Saara Luukannel (2006). *Tohtorit ja lisensiaatit työmarkkinoilla. Vuonna 2002 Helsingin yliopistosta valmistuneiden lisensiaattien ja tohtoreiden sijoittuminen työmarkkinoille kolme vuotta tutkinnon suorittamisen jälkeen*. Helsingin yliopiston hallinnon julkaisuja 21, Raportit ja selvitykset.
- OECD (1987). *Reviews of national science and technology policy: Finland*. OECD, Paris.
- Statistics Finland (1992). *Statistical Yearbook of Finland 1992*. Volume 87.
- Statistics Finland (1993). *Statistical Yearbook of Finland 1993*. Volume 88.
- Statistics Finland (1994). *Statistical Yearbook of Finland 1994*. Volume 89.
- Statistics Finland (2007). *Korkeasti koulutettu väestö (16-74-vuotiaat) pääasiallisen toiminnan mukaan vuosina 2000-2004*. Tieteen ja teknonologian henkilövoimavarat 2005 (Human resources of science and technology). [http://www.stat.fi/til/tthv/2005/tthv\\_2005\\_2007-01-17\\_tie\\_001.html](http://www.stat.fi/til/tthv/2005/tthv_2005_2007-01-17_tie_001.html)
- Statistics Finland (2008a). *Tieteen ja teknonologian henkilövoimavarat 2006 (Human resources of science and technology)*. [http://www.stat.fi/til/tthv/2007/tthv\\_2007\\_2008-12-11\\_tie\\_001\\_fi.html](http://www.stat.fi/til/tthv/2007/tthv_2007_2008-12-11_tie_001_fi.html)
- Statistics Finland (2008b). *Henkilöluokitukset, Koulutusaste (Social classifications, education)*. <http://www.stat.fi/meta/luokitukset/koulutusaste/versio.html>.

- Statistics Finland (2009). Classification of Education 2009, Fields of education.  
[http://www.stat.fi/meta/luokitukset/koulutusala/001-2009/index\\_en.html](http://www.stat.fi/meta/luokitukset/koulutusala/001-2009/index_en.html)
- Statistics Finland (2010). Tieteen ja teknonologian henkilövoimavarat 2007 (Human resources of science and technology). [http://www.stat.fi/til/tthv/2008/tthv\\_2008\\_2010-04-22\\_tie\\_001\\_fi.html](http://www.stat.fi/til/tthv/2008/tthv_2008_2010-04-22_tie_001_fi.html)
- Stén, Susanna (2009). *Förändrade arbetsmarknadsförhållanden för högre utbildade? – en studie av forskarutbildade i Finland 1990-2004*. Discussion Paper no. 1187, The Research Institute of the Finnish Economy (ETLA).
- Uusitalo, Roope (1999). Essays in Economics of Education. University of Helsinki, Research report no. 79:1999.
- Vella, Francis and R.G. Gregory (1996). "Selection bias and human capital investment: Estimating the rates of return to education for young males". *Labour Economics*, 3, 197-219.

## Appendix

Table A1. Estimated returns to educational level 1990-2004.

	1990	1991	1992	1993	1994	1995	1996	1997
Post-secondary non-tertiary education	0,1956 (0,007)***	0,1994 (0,007)***	0,1858 (0,007)***	0,1775 (0,007)***	0,1681 (0,007)***	0,1667 (0,007)***	0,1672 (0,006)***	0,1565 (0,006)***
Lower-degree tertiary education	0,3686 (0,011)***	0,3489 (0,011)***	0,3341 (0,011)***	0,3294 (0,011)***	0,3160 (0,011)***	0,3172 (0,011)***	0,3180 (0,009)***	0,3147 (0,009)***
Higher-degree tertiary education	0,5942 (0,010)***	0,5966 (0,010)***	0,5637 (0,010)***	0,5870 (0,010)***	0,5556 (0,010)***	0,5191 (0,010)***	0,5405 (0,009)***	0,5363 (0,008)**
Post graduate education	0,7616 (0,030)***	0,7022 (0,029)***	0,7150 (0,025)***	0,7277 (0,026)***	0,7103 (0,026)***	0,6745 (0,026)***	0,6459 (0,022)***	0,6523 (0,021)***
Female	-0,3039 (0,006)***	-0,2950 (0,006)***	-0,2908 (0,006)***	-0,2760 (0,006)***	-0,2643 (0,006)***	-0,2900 (0,006)***	-0,2672 (0,005)***	-0,2790 (0,005)***
Age	0,0417 (0,003)***	0,0500 (0,003)***	0,0500 (0,003)***	0,0612 (0,003)***	0,0652 (0,003)***	0,0660 (0,003)***	0,0579 (0,002)***	0,0583 (0,002)***
Age <sup>2</sup>	-0,0004 (0,000)***	-0,0005 (0,000)***	-0,0005 (0,000)***	-0,0007 (0,000)***	-0,0007 (0,000)***	-0,0007 (0,000)***	-0,0006 (0,000)***	-0,0006 (0,000)***
Years since completion of highest degree	0,0118 (0,001)***	0,0102 (0,002)***	0,0114 (0,001)***	0,0095 (0,002)***	0,0088 (0,002)***	0,0104 (0,002)***	0,0137 (0,001)***	0,0110 (0,001)***
Years since completion of highest degree <sup>2</sup>	-0,0003 (0,000)***	-0,0002 (0,000)***	-0,0003 (0,000)***	-0,0002 (0,000)***	-0,0002 (0,000)***	-0,0003 (0,000)***	-0,0004 (0,000)***	-0,0003 (0,000)***
Farming, forestry and fishing industry	-0,2242 (0,021)***	-0,1121 (0,021)***	-0,0880 (0,020)***	-0,0774 (0,021)***	-0,0751 (0,022)***	-0,2166 (0,021)***	-0,1943 (0,020)***	-0,1773 (0,020)***
Industrial and services sectors	0,0070 (0,007)	-0,0144 (0,007)**	-0,0147 (0,007)**	0,0010 (0,007)	0,0222 (0,007)***	0,0235 (0,007)***	0,0245 (0,006)***	0,0182 (0,006)***
Seniority	-0,0019 (0,001)	-0,0041 (0,001)***	0,0003 (0,001)	0,0059 (0,001)***	0,0093 (0,001)***	0,0041 (0,001)***	0,0131 (0,001)***	0,0133 (0,001)***
Seniority <sup>2</sup>	0,0003 (0,000)***	0,0004 (0,000)***	0,0003 (0,000)***	0,0001 (0,000)	-0,0001 (0,000)	0,0002 (0,000)***	-0,0001 (0,000)**	-0,0001 (0,000)**
Constant	6,5670 (0,046)***	6,3855 (0,047)***	6,3203 (0,048)***	6,0617 (0,051)***	5,9596 (0,050)***	5,9926 (0,049)***	6,1139 (0,042)***	6,1582 (0,039)***
Number of observations	30919	30085	29000	28002	29510	31401	33882	36215
Adjusted R <sup>2</sup>	0,2973	0,3194	0,3342	0,3193	0,3005	0,3003	0,3452	0,3426

Note: Reference group: upper secondary education, male, employed in the public sector. Equations estimated by OLS. The sample contains 10 % of the wage earners I FLEED at the end of each year. The dependent variable, the logarithm of the monthly wage, is obtained by correcting the yearly wage by the number of months of work. Standard errors in parentheses. \*\*\*, \*\* and \* denote statistical significance at the 1, 5 and 10-percent level.



Table A1. Estimated returns to educational level 1990-2004, continued.

	1998	1999	2000	2001	2002	2003	2004
Post-secondary non-tertiary education	0,1624 (0,006)***	0,1799 (0,007)***	0,1773 (0,007)***	0,1686 (0,007)***	0,1709 (0,006)***	0,1662 (0,006)***	0,1779 (0,006)***
Lower-degree tertiary education	0,3114 (0,009)***	0,3452 (0,010)***	0,3372 (0,010)***	0,3223 (0,009)***	0,3486 (0,008)***	0,3379 (0,008)**	0,3331 (0,008)***
Higher-degree tertiary education	0,5580 (0,009)***	0,5993 (0,009)***	0,5991 (0,009)***	0,5742 (0,009)***	0,5811 (0,008)***	0,5762 (0,008)***	0,5557 (0,008)***
Post gradual education	0,6922 (0,022)***	0,7457 (0,024)***	0,7704 (0,025)***	0,7136 (0,023)***	0,6712 (0,021)***	0,7631 (0,022)***	0,7022 (0,021)***
Female	-0,2885 (0,005)***	-0,2854 (0,006)***	-0,2887 (0,006)***	-0,3008 (0,005)***	-0,2967 (0,005)***	-0,2818 (0,005)***	-0,2992 (0,005)***
Age	0,0729 (0,002)***	0,0636 (0,003)***	0,0653 (0,002)***	0,0667 (0,002)***	0,0732 (0,002)***	0,0612 (0,002)***	0,0620 (0,002)***
Age <sup>2</sup>	-0,0008 (0,000)***	-0,0007 (0,000)***	-0,0007 (0,000)***	-0,0007 (0,000)***	-0,0008 (0,000)***	-0,0006 (0,000)***	-0,0006 (0,000)***
Years since completion of highest degree	0,0134 (0,001)***	0,0097 (0,001)***	0,0090 (0,001)***	0,0092 (0,001)***	0,0069 (0,001)***	0,0088 (0,001)***	0,0070 (0,001)***
Years since completion of highest degree <sup>2</sup>	-0,0004 (0,000)***	-0,0003 (0,000)***	-0,0002 (0,000)***	-0,0003 (0,000)***	-0,0002 (0,000)***	-0,0002 (0,000)***	-0,0002 (0,000)***
Farming, forestry and fishing industry	-0,1094 (0,022)***	-0,1260 (0,022)***	-0,1680 (0,023)***	-0,1155 (0,023)***	-0,0790 (0,022)***	-0,1402 (0,026)***	-0,0836 (0,025)***
Industrial and services sectors	0,0385 (0,006)***	0,0757 (0,006)***	0,0871 (0,006)***	0,0852 (0,006)***	0,0414 (0,006)***	0,0573 (0,006)**	0,0531 (0,006)***
Seniority	0,0165 (0,001)***	0,0168 (0,001)***	0,0132 (0,001)***	0,0139 (0,001)***	0,0180 (0,001)***	0,0131 (0,001)***	0,0129 (0,001)***
Seniority <sup>2</sup>	-0,0002 (0,000)***	-0,0003 (0,000)***	-0,0002 (0,000)***	-0,0001 (0,000)***	-0,0003 (0,000)***	-0,0001 (0,000)***	-0,0001 (0,000)***
Constant	5,8259 (0,040)***	6,0542 (0,044)***	6,0490 (0,041)***	6,0320 (0,040)***	5,8959 (0,037)***	6,1725 (0,038)***	6,1980 (0,038)***
Number of observations	39238	40505	42656	43565	45193	44302	45582
Adjusted R <sup>2</sup>	0,3475	0,2916	0,2854	0,2954	0,3263	0,2919	0,2866

Table A2. Wage differences among persons with postgraduate degrees in 1990-2004.

	1990	1991	1992	1993	1994	1995	1996	1997
Pedagogy and educational sciences	0,2320 (0,069)***	0,1778 (0,064)***	0,2261 (0,048)***	0,1858 (0,053)***	0,2667 (0,053)***	0,2252 (0,050)***	0,1812 (0,046)***	0,2010 (0,042)***
Business and social Science	0,2136 (0,036)***	0,1972 (0,033)***	0,1689 (0,026)***	0,1975 (0,030)***	0,2066 (0,031)***	0,1874 (0,030)***	0,1707 (0,027)***	0,1511 (0,025)***
Natural science	0,0096 (0,034)	0,0225 (0,032)	-0,0049 (0,025)	0,0109 (0,029)	0,0407 (0,029)	0,0359 (0,029)	0,0253 (0,027)	0,0115 (0,025)
Engineering	0,2209 (0,038)***	0,1838 (0,035)***	0,1714 (0,028)***	0,2059 (0,032)***	0,2404 (0,032)***	0,2409 (0,031)***	0,1952 (0,028)***	0,2099 (0,027)***
Agriculture and forestry	0,1300 (0,061)**	0,1484 (0,056)***	0,0771 (0,044)*	0,0858 (0,051)*	0,0657 (0,052)	0,1327 (0,053)**	0,0624 (0,047)	0,0585 (0,045)
Health and Social Services	0,4213 (0,035)***	0,4697 (0,032)***	0,4055 (0,026)***	0,4050 (0,030)***	0,4355 (0,030)***	0,4134 (0,030)***	0,3959 (0,027)***	0,3661 (0,025)***
Service fields	0,1318 (0,136)	0,1955 (0,127)	0,0863 (0,104)	0,1632 (0,126)	0,0976 (0,120)	0,0923 (0,119)	0,0510 (0,108)	0,0581 (0,100)
Female	-0,2111 (0,024)***	-0,2219 (0,021)***	-0,1949 (0,017)***	-0,1846 (0,019)***	-0,1640 (0,019)***	-0,1631 (0,019)***	-0,1753 (0,017)***	-0,1884 (0,015)***
Age	0,0755 (0,012)***	0,0887 (0,011)***	0,0912 (0,009)***	0,1143 (0,010)***	0,1530 (0,010)***	0,1303 (0,010)***	0,0898 (0,009)***	0,0941 (0,008)***
Age <sup>2</sup>	-0,0007 (0,000)***	-0,0009 (0,000)***	-0,0009 (0,000)***	-0,0012 (0,000)***	-0,0016 (0,000)***	-0,0014 (0,000)***	-0,0009 (0,000)***	-0,0010 (0,000)***
Years since completion of highest degree	0,0215 (0,004)***	0,0233 (0,004)***	0,0211 (0,003)***	0,0205 (0,004)***	0,0163 (0,004)***	0,0219 (0,003)***	0,0250 (0,003)***	0,0231 (0,004)***
Years since completion of highest degree <sup>2</sup>	-0,0004 (0,000)***	-0,0004 (0,000)***	-0,0004 (0,000)***	-0,0003 (0,000)***	-0,0002 (0,000)	-0,0004 (0,000)***	-0,0005 (0,000)***	-0,0003 (0,000)***
Farming, forestry and fishing industry	-0,5798 (0,176)***	0,0654 (0,132)	0,1790 (0,128)	0,1111 (0,150)	0,1658 (0,1839)	0,0899 (0,149)	0,1525 (0,137)	0,0942 (0,137)
Industrial and services sectors	0,0962 (0,024)***	0,0979 (0,022)***	0,0966 (0,018)***	0,0946 (0,021)***	0,0869 (0,021)***	0,0603 (0,020)***	0,0479 (0,019)**	0,0406 (0,018)***
Seniority	-0,0074 (0,004)*	-0,0114 (0,003)***	-0,0095 (0,003)***	-0,0110 (0,003)***	-0,0126 (0,003)***	-0,0071 (0,003)**	-0,0002 (0,004)	-0,0077 (0,003)**
Seniority <sup>2</sup>	0,0003 (0,000)*	0,0005 (0,000)***	0,0004 (0,000)***	0,0006 (0,000)***	0,0006 (0,000)***	0,0003 (0,000)**	0,0002 (0,000)	0,0005 (0,000)***
Constant	6,0406 (0,270)***	5,7912 (0,240)***	5,6940 (0,193)***	5,1820 (0,215)***	4,3153 (0,216)***	4,8609 (0,209)***	5,7308 (0,195)***	5,7232 (0,181)***
Number of observations	3026	3123	3665	3881	4049	4181	4597	4854
Adjusted R <sup>2</sup>	0,2218	0,2680	0,3077	0,2363	0,2390	0,2205	0,2539	0,2785

Note: Reference group: Humanities and arts, male, employed in the public sector. The model is estimated by OLS. The sample consists of all employed wage earning PhDs and licentiates at the end of each year. The dependent variable, the logarithm of the monthly wage, is obtained by correcting the yearly wage by the number of months of work. Standard errors in parentheses. \*\*\*, \*\* and \* denote statistical significance at the 1, 5 and 10-percent level.

Table A2. Wage differences among holders of postgraduate degrees in 1990-2004, continued.

	1998	1999	2000	2001	2002	2003	2004
Pedagogy and educational sciences	0,2596 (0,040)***	0,2279 (0,041)***	0,1880 (0,041)***	0,2184 (0,043)***	0,2014 (0,036)***	0,2490 (0,038)***	0,1573 (0,034)***
Business and social Science	0,1806 (0,025)***	0,1554 (0,025)***	0,1578 (0,027)***	0,1872 (0,028)***	0,2021 (0,024)***	0,2230 (0,025)***	0,1718 (0,023)***
Natural science	0,0294 (0,025)	0,0126 (0,025)	0,0625 (0,027)**	0,0438 (0,028)	0,0585 (0,024)**	0,0622 (0,025)**	0,0389 (0,024)
Engineering	0,2636 (0,026)***	0,2222 (0,027)***	0,2262 (0,028)***	0,2556 (0,029)***	0,2445 (0,025)***	0,2511 (0,026)***	0,2203 (0,025)***
Agriculture and forestry	0,0437 (0,044)	-0,0013 (0,044)	0,1532 (0,047)***	0,0575 (0,048)	0,0720 (0,041)*	0,0582 (0,043)	0,0716 (0,041)*
Health and Social Services	0,3634 (0,024)***	0,3304 (0,025)***	0,3274 (0,027)***	0,3676 (0,027)***	0,4473 (0,024)***	0,4366 (0,025)***	0,4258 (0,023)***
Service fields	0,0074 (0,095)	-0,0350 (0,094)	0,0203 (0,099)	0,1431 (0,103)	0,1811 (0,083)**	0,1450 (0,086)*	0,1345 (0,085)
Female	-0,1767 (0,015)***	-0,1786 (0,015)***	-0,1602 (0,016)***	-0,1627 (0,016)***	-0,1703 (0,014)***	-0,1872 (0,015)***	-0,1774 (0,013)***
Age	0,1055 (0,008)***	0,1094 (0,008)***	0,1003 (0,009)***	0,0991 (0,009)***	0,0932 (0,008)***	0,0929 (0,008)***	0,1027 (0,007)***
Age <sup>2</sup>	-0,0011 (0,000)***	-0,0012 (0,000)***	-0,0011 (0,000)***	-0,0011 (0,000)***	-0,0010 (0,000)***	-0,0010 (0,000)***	-0,0011 (0,000)***
Years since completion of highest degree	0,0248 (0,003)***	0,0200 (0,003)***	0,0252 (0,003)***	0,0336 (0,003)***	0,0279 (0,003)***	0,0302 (0,003)***	0,0253 (0,003)***
Years since completion of highest degree <sup>2</sup>	-0,0004 (0,000)***	-0,0002 (0,000)*	-0,0005 (0,000)***	-0,0007 (0,000)***	-0,0005 (0,000)***	-0,0006 (0,000)***	-0,0005 (0,000)***
Farming, forestry and fishing industry	0,1368 (0,144)	-0,1003 (0,133)	-0,0267 (0,156)	-0,1147 (0,145)	0,0982 (0,137)	-0,2382 (0,135)*	0,1138 (0,150)
Industrial and services sectors	0,0522 (0,017)***	0,0583 (0,017)***	0,0327 (0,018)*	0,0542 (0,018)***	0,0266 (0,016)*	0,0629 (0,017)***	0,0488 (0,016)***
Seniority	-0,0060 (0,003)*	-0,0016 (0,004)	-0,0095 (0,004)***	0,0069 (0,004)*	0,0173 (0,003)***	0,0051 (0,003)	0,0102 (0,003)***
Seniority <sup>2</sup>	0,0004 (0,000)***	0,0002 (0,000)	0,0005 (0,000)***	0,0000 (0,000)	-0,0004 (0,000)***	0,0000 (0,000)	-0,0002 (0,000)
Constant	5,4550 (0,177)***	5,4623 (0,181)***	5,6910 (0,190)***	5,6692 (0,198)***	5,8155 (0,168)***	5,8446 (0,177)***	5,6320 (0,162)***
Number of observations	5136	5361	5635	5761	6057	6235	6540
Adjusted R <sup>2</sup>	0,2365	0,2091	0,1556	0,1757	0,2026	0,1910	0,2094