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The Effect of Permanent Employment on Research Productivity

A Study of Economists in Swedish Higher Education

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Abstract

This paper investigates whether research productivity declines once researchers become permanently employed. Using a unique panel dataset, describing research productivity over the career life cycle for Swedish economists, we present results indicating that permanent employment does not have a negative impact on research productivity. Furthermore, our report indicates that research productivity depends on career age, here defined as vintage of PhD. In previous research many have found a similar pattern, suggesting a decline in research productivity some six to eight years after the researchers receives their PhD. Several previous studies have explained that this decline is due to that the researchers become tenured around this time. Our results do however indicate that this might be a wrongly drawn conclusion. First, permanent employment appears not to affect research productivity negatively. Second, although the employment protection policies in Sweden differ from those of the US, with many researchers getting permanently employed early after their PhD, a similar publication pattern is observed. This implies that the decline in research productivity is due to other factors that are yet to be identified.

Keywords: Tenure, research productivity, Tobit model, permanent employment, life-cycle productivity

JEL Codes: C49, I23, J08, J24, J41, M51

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GLOSSARY

Tenure: A contractual form widely used in North America. Tenure is a senior academic's contractual right not to have his or her position terminated without just cause. Commonly a tenured researcher takes the title associate professor and can later be promoted to full professor.

Tenure track: An employment contractually guaranteeing the employed person to be considered for tenure status. Typically a junior researcher on tenure track is allowed a limited period of time (usually six to eight years) to establish a record of published research, academic visibility, teaching and administrative service and ability to attract funding before the tenure committee makes the up or out decision. A tenure track position does not guarantee tenure but the scholar is usually promised tenure as long as she fulfills certain requirements. Tenure track has recently started to be employed at some Swedish universities. A person on tenure track is commonly referred to as assistant professor (in Swedish: forskarassistent/biträdande lektor).

Permanent employment: Defined in this paper according to the definition of Swedish labor laws (in Swedish: tillsvidareanställning). It is an employment form where the employee is employed without an end date. The employment form is regulated in the Swedish Employment Protection Act (SFS 1982:80 Lag om anställningskydd). According to the law a temporary employment will automatically be transformed to a permanent employment after a specified amount of time.

Article submission: The first time a scholar submits a paper to an editor of a journal. Often the paper goes through a revision process before getting accepted.

Article accept: When the paper is accepted to be published in a journal.

Publication lag: The time between submission and publication of a paper.

1. INTRODUCTION

In higher education, a well-functioning organization with an appropriate career structure is of great importance in order to enable the employees to conduct effective research, innovation and education. It is also vital for the recruitment and retaining of prominent scholars in a world where academic institutions and private firms are competing to attract the most talented people. At many universities in the US it is more or less the norm to employ the well-known tenure track system. However, an increasing number of US universities have started to abandon the tenure track system, as they want to avoid having tenured staff (Feldman and Turnley 2004; Wikström 2008). At the same time, the trend in Sweden seems to be moving in the opposite direction, with a number of universities[1] recently starting to implement the system.

The tenure system, with the purpose of protecting the academic freedom and facilitating the process of attracting and retaining distinguished researchers, has frequently been subject to scrutiny in US educational debates. Amongst other things, it has been argued that the tenured researcher is offered a lifetime employment with limited contractual demands or incentives to exert high work effort. This claim has been fueled by several research papers presenting empirical evidence of significantly declining research productivity following the tenure decision. Thus, a central concern is: how do academic institutions create contracts that give the researcher incentives to exert high effort over a maximum period of time while, at the same time, protecting the academic freedom?

This paper falls within the field of economics of science, a discipline aimed at explaining the behavior of scientists and understanding the efficiency, or inefficiency, of scientific institutions. As science is commonly regarded to be a major driving force of technology, productivity and growth, the field is argued to be of substantial importance. In her 1996 *JEL* survey, Paula Stephan notes that remarkably few studies on research productivity have been written by economists investigating economic researchers.

The purpose of this paper is to investigate how a change to permanent employment affects the level of research productivity of Swedish academics. To the best of our knowledge this paper is the first with the intention of examining this question on

[1] Tenure system was implemented at Stockholm School of Economics in 2010 and is to be implemented at KTH Royal Institute of Technology and Karolinska Institute in 2014 and 2015 respectively.

Swedish higher education. A majority of previous research, mainly conducted in the US, suggests that productivity starts to decline some years following the tenure decision. This paper investigates if the same decline can be observed in Sweden when the researchers become permanently employed. Hence, the central research question of this paper is formulated as follows:

Does a change to permanent employment result in a decline in research productivity?

This paper presents a unique panel dataset that describes the research behavior of full professors currently employed at Swedish economics institutions. We analyze individual productivity throughout the career, testing whether faculty exert less effort after becoming permanently employed. We find no such evidence. We do however find results indicating that research productivity follows a hump-shaped pattern throughout the researchers' career.

The remaining part of this paper will unfold as follows. In section 2 we examine the previous research. In section 3 the method of analysis, and the collection of data, is demonstrated. Section 4 briefly presents the data sample and in section 5 the empirical results are presented. In section 6 the potential shortcomings of the chosen method are evaluated before turning to the discussion of the presented results in section 7. Finally, we present our concluding remarks in section 8.

2. Previous Research

In this section, we examine the previous empirical research, initially providing a brief overview of the studies made on the impact of employment protection on labor productivity in general. Next, we move to the world of higher education, examining the previous research exploring the impact of employment protection on research productivity. Finally, studies describing research productivity over the career life cycle of academics in higher education are presented.

Previous debates regarding the effect of tenure on research productivity have mainly had two issues in focus: (1) how the believed likelihood of permanent employment affects the motivation and productivity of scholars, and (2) how the tenure system influences academic freedom. The second issue is not within the scope of this paper. Nevertheless, we urge the readers of this paper to keep in mind the importance of the autonomy of thought and expression in higher education that is provided by academic freedom.

2.1 How Employment Protection Affects Labor Productivity

Employment protection legislation (EPL) regulates the conditions under which a firm is able to dismiss its employees. It includes court rulings, collectively bargained conventions and rules concerning both hiring, firing and dismissal compensation. The majority of previous research has targeted the effect of EPL on labor market flexibility, employee turnover, investments, firm productivity and the entry and exits of firms (Bjurgren 2013). Furthermore, some studies have aimed at understanding EPL's impact on labor effort and moral hazard behavior, the question being: how does job security affect worker performance? One could easily find intuitive arguments going both ways, and a common perception held by scientists and laymen alike is that making it difficult to lay off workers results in workers becoming unproductive. Consequently, from being forced to keep these workers, firms would suffer from inefficiencies. On the other hand, the outcome of a higher level of job security might also be increased worker satisfaction and greater loyalty to the company. This could result in employees investing more time and greater effort into their work.

Belot (2007) showed that higher job security may increase the employees' incentives to acquire additional firm specific skills. Ichino and Riphahn (2005) studied data from 858 workers and found that the number of days of absence per week increases significantly once employment protection is granted. Furthermore, Engellandt and Riphahn (2005) found that temporary employed personnel are 60% more likely to work unpaid overtime than permanent staff. Assuming work effort and moral hazard behavior being fundamental in determining worker productivity, the authors reached the conclusion that workers with temporary contracts exert greater effort compared to permanent staff. Dolado and Stucchi (2008) presented a panel dataset from Spanish manufacturing firms and found that temporary workers exert higher effort in firms with larger conversion

rates. Dolado and Stucchi concluded that temporary workers provide higher effort in light of a large enough probability of converting their temporary contracts into permanent ones. Bassanini (2008) rejected this theory, as he was unable to present any evidence that regulations regarding temporary contracts would affect productivity at all.

In sum, previous research is clearly multifaceted. However, a majority of the empirical findings suggests that high employment protection, in general, have a negative effect on labor productivity. In the ongoing debate on the issue of academic tenure, related arguments are presented. The empirical results of the previous research investigating this claim will be further examined in the following section.

2.2 How Tenure Affects Research Productivity

In his 1996 article "Why tenure works" William Cotter proclaimed the following:

> "In virtually every case, the granting of tenure has liberated that faculty member to become an even more productive and important contributor to the quality of academic and campus life, and her or his finest Scholary work is usually produced after the tenure decision, not before"

In this section we describe the research made on how tenure affects research productivity. Most of these studies have been done in the US, where the tenure system is widely employed. It should be noted that the Swedish employment protection legislations differ from those of the United States. As this paper will later demonstrate, many Swedish researchers become permanently employed much earlier than their American colleagues, often several years before the normal time of tenure in the United States.

In favor of removing academic tenure it has been argued that it demotivates faculty. Accordingly, a majority of the studies examining the relationship between job security and research productivity in higher education have found evidence supporting a decline in research productivity following the granting of tenure (Bell and Seater 1978; Goodwin and Sauer 1995; Hutchinson and Zivney 1995; Coupé et al. 2003; Backes-Gellner and Schlinghoff 2004; Leung 2009).

Coupé et al. (2003) argued that tenure probably is the most important promotion in academic life and that it may very well have a disincentive effect. The intuitive explanation brought forward was that an irrecoverable promotion to a supreme level of academic job security reduces incentives to put in great effort. Supporting this idea, Coupé et al. (2003, p.25) stated the following: "Our results are in line with Lazear (2003): promotions are used as sorting process and incentives provide an explanation for the Peter Principle, i.e. performance declines after promotion."

In their 1995 article "The Publication Profile of Economists," based on a sample of 1.600 US doctorial graduates in economics, Hutchinson and Zivney conclude their findings to be consistent with the ones found by Bell and Seater (1978), namely that "the granting of tenure seems to have negative effects on individual publishing performance." Similarly, using data of 112 economists in the US and 189 in Germany, Backes-Gellner and Schlinghoff (2004) found strong evidence of elevated publication outputs in time periods prior to a major promotion and significantly reduced publication productivity afterwards. Consequently, in explaining individual publication patterns, the authors concluded that promotions play a major role, both for German and US scholars. Goodwin and Sauer (1995) presented empirical evidence supporting a decline in productivity in the post-tenure period some six to eight years past PhD. The authors themselves stated, however, that they did not regard their findings to be unfavorable evidence against the tenure system. Rather, they called for caution when interpreting their results and stated that the results presented should not be considered as an isolated effect of tenure on research productivity.

Bess (1998) dismissed the idea of a general productivity decline as a result of the tenure decision. Presenting no new empirical data, the author mainly referred to the work of Blackburn and Lawrence (1986, 1995) where no apparent reduction in productivity following the tenure decision was found. He argued that: "the granting of tenure (…) does not alone influence productivity. It is a necessary, but insufficient condition for strong motivation." He continues by stating: "Tenure ensures that basic security needs are satisfied; it alone does not offer incentives (or disincentives) for performance. (…) In the terms of Herzberg (1959) tenure is a 'hygiene'. It only prevents dissatisfaction. It is not a motivator (or dismotivator)."

As with the research on how employment protection affects labor productivity, the research on the effects of tenure points in several directions. A majority of the studies mentioned in this section suggest that tenure would result in a decline in research productivity, but the research is not unilateral. Common among the studies in this field is however that the researchers all acknowledge that other factors are in play affecting research productivity. These factors are often explained as parts of the life cycle of research productivity, which we will explore next.

2.3 The Life Cycle of Research Productivity

As noted by Levin and Stephan (1991) there are two main hypotheses frequently advanced for scholars engaging in scientific research:

1. Research being investment-motivated
2. Research being consumption-motivated

Whilst the first hypothesis claims that scientists look to future financial rewards and engage in research because of it, the second downplays the role of financial rewards and instead targets scientists' fascination for the actual research puzzle. Note that the first hypothesis would, as a consequence of a finite time horizon, imply a decline in productivity over the research career. The second hypothesis, however, would not. In light of these hypotheses, previous research has studied the life cycle of research productivity, which is the area we aim to examine in the remaining part of this section.

Previous research is close to unanimous in their findings of a hump-shaped pattern of life-cycle research productivity. Reaching its peak some 6-10 years after PhD graduation, it slowly decreases from that point on (Levin and Stephan 1991; Zivney and Bertin 1992; Goodwin and Sauer 1995; Conley et al. 2013). On declining productivity over the career, Levin and Stephan (1991) presented a model of publishing productivity. From the model they concluded the following:

> "…there is evidence that, on average, scientists become less productive as they age. The ageing effect that is found is attributed to age per se and not to the possibility that, for some reason, older scientists in the sample have different attributes, values, or access to resources than younger members of the sample."

The authors described a pattern of productivity, which rose very sharply in the early stages of the researcher's career, with the peak of productivity around seven years after the scholars received their PhD. The authors then demonstrated how the decline in productivity commenced, although rather slowly. Looking in particular at the most able and productive researchers, there was "little or no tendency for productivity decline until about 20 years of experience." Observing at a sample of more than two hundred economists in top research institutions, Oster and Hamermesh (1998) concluded that productivity declines sharply with age. Conley et al. (2013) divided their dataset into cohorts based on vintage of PhD. They found a hump-shaped pattern of publishing productivity for all cohorts, generally rising until some six years past graduation, and then declining rather quickly to about 60% of the productivity peak. In an attempt of explaining the declining pattern, Goodwin and Sauer (1995) concluded their major finding to be that: "a permanent loss in research productivity is associated with an individual's accepting of an administrative position in academia."

Any randomly selected sample of researchers might consist of both investment-motivated and consumption-motivated researchers. However, even if the life cycle productivity pattern does differ between the two, any analysis made on the entire sample could very well offset the two patterns, making them undistinguishable. A common approach in previous research has consequently been to restrict the dataset in different ways. Aggarwal et al. (2006) studied a dataset comprised of a number of highly productive finance faculty. The authors found that this cohort of academics tend to start publishing early in their professional career and that their productivity increases considerably throughout the years before tenure, only to suffer a very slight decrease afterwards. However, their less productive colleagues have a more significant drop in publishing pace. Clemente (1973) argues that, out of the six factors he investigates,[2] only publishing record before PhD and the age of the researcher when she publishes for the first time have significant effects on research productivity.

[2] Clemente (1973) predicts research productivity in a regression with six independent variables: sex, age at PhD, years between bachelor's degree and PhD, age at first publication, publication before PhD, and quality of department of doctoral training.

Ellison (2002) brings the issue of increasing publication lags to the table in his article "The Slowdown of the Economics Publishing Process". In his study, he finds that the time to build (the time between submission until accept) has more than doubled between 1970 and 2000, increasing from about 9 months to around 24 months for a sample of the top economic journals[3].

In sum, previous research on publishing productivity has found a number of factors, supposedly independent of job security, which affects the productivity over the academic life cycle:

1. An independent negative age effect on publishing productivity over the course of a researcher's career.
2. That early high publishers tend to stay at high level of publications for a longer period of time compared to researchers launching their careers at a slower publication rate.
3. The time to build has increased from about 9 to 24 months over the last forty years.

3. METHOD

This section elaborates on how we empirically investigated our research question. It will unfold as follows: firstly, we define the scope of the data and secondly, the data collection processes. Thirdly, we describe a method of publication quality adjustment before lastly presenting the chosen statistical framework. Our research question was tested using a unique panel dataset. To study whether a change to permanent employment result in a decline in research productivity we formulated our hypothesis, in accordance with the results observed in previous research, as follows:

Hypothesis: When a researcher becomes permanently employed the research productivity of that person will decline.

The hypothesis was tested on the whole dataset with a grading system to add a quality measurement of the productivity. Moreover, the dataset was also divided into high productive and low productive cohorts, defined as the more and the less productive

[3] Ellison (2002) measures the publication lag for: *American Economic Review, Econometrica, Journal of Political Economy, Review of Economic Studies, Review of Economics and Statistics, and Quarterly Journal of Economics.*

halves up until the time of permanent employment. This was done in order to study whether the same patterns, observed for the whole dataset, also could be observed in the two subgroups with differing characteristics. Finally, to control the robustness of the results, the regressions were repeated with no quality measuring.

3.1 Scope of the Data

Studying the effect on research productivity from when a researcher becomes permanently employed will by necessity involve many omitted variables that, for practical reasons, are hard or impossible to quantify and include. To minimize this problem the sample should be as homogenous as possible, and it should contain individuals working under similar institutional characteristics. Moreover, the chosen measurement of research productivity, here published articles, should be appropriate.

This study addressed these concerns by limiting the scope of the data to full professors and professor emeriti registered at economics institutions at Swedish universities (see appendix 10.3 for the full list). Hence, the choice of sample was argued to be comparatively homogenous. It was a common view among those we interviewed for this paper that, compared to other fields of research, a large part of the research made in economics aims to result in published articles.

3.2 Collection of the Data

Data on when the professors received their bachelor's degree or similar, received their PhD, became permanently employment, and when they became full professors was collected directly from the individuals in the sample through email[4] and telephone.

Regarding the research output, data was also needed to be gathered about (1) in which journals the professors had published articles, (2) what year the articles were published, (3) and how many, if any, co-authors the professor had worked with on each article. For this, the professors' personal CVs together with information from the extensive article databases Scopus, Web of Science and Google Scholar were used. Scopus is a close to complete database for articles published after year 1995 (Falagas et al. 2008). It is still very extensive for older articles but there is a risk of older publications not being included in the database. The CVs and the other two databases were used to ensure that

[4] See appendix 10.1 for a copy of the email sent out.

all publications were included in our data. With very few exceptions, the databases and the CVs matched. In the rare cases where professors claimed a publication in their CV, which was not to be found in any of the databases, that publication was still added to the list. Publications of shorter comments, editorship, conference papers, working papers, monographs, publications in an international handbook or encyclopedia, articles in peer reviewed books, dissertations, and other unpublished texts were not accounted for. The reason for this was that the databases and the personal CVs only sporadically included these types of works.

3.3 GRADING OF PUBLICATIONS

If productivity was to be measured solely by counting the total number of articles published each year, there would be good reasons to argue that the quality of the work would be overlooked.

At Lund University, which has one of the largest economics institutions in Sweden, a grading system is used to give bonuses to the professors based on their publications.[5] The grading system grades between 0 and 10 depending on what standard and reputation they are considered to uphold. By using an extensive list of journals, compiled and graded by the Norwegian Social Science Data Services, they ensure that also publications in journals in other fields are included. The grading is very similar to that of the Association of Business Schools (ABS) but is far more extensive in terms the number of academic fields. In this paper, the grading of journals has been based on the framework provided by Lund University. To measure productivity, the scholars in our data therefore received different scores depending on where they had been published. Also, in accordance with the bonus system of Lund University, the score was divided by the number of authors behind the article.[6] All publications during a certain year were summed for each researcher giving her a total "productivity score" for each year.

Another quality measurement typically employed when studying research productivity is a count of article citations. In this paper, we choose not to consider citations. Rauber and Ursprung (2008) present two main reasons to exclude citations:

[5] See appendix 10.2 for a summary of the grading system.
[6] If for example a professor had published an article in American Economic Review (a ten point journal) together with three other authors, she would have received 2.5 "productivity points".

1. Citations are subjects of manipulation (citation cartels).
2. Only a minor proportion of economic journal articles are cited often enough to function as a non-random indicator.

3.4 Statistical Analysis

An issue that needs to be considered when choosing a statistical model is the presence of a limited dependent variable as the data on the number of publications per year is truncated at zero[7]. Evidently, the reason for this is that there are certain years in which the professors in our sample do not publish at all. In an OLS regression, this truncation would lead to the parameter estimates being biased and inconsistent. This is commonly referred to as the zeros-problem, an issue that has previously been handled mainly in two different ways. Goodwin and Sauer (1995), faced with a dataset containing values clustered at and around zero, approached this issue using a Poisson regression model. This was not appropriate for the current study, however, as the Poisson model requires the data to be positive integers, so called count data. With the scoring system used in this paper the productivity points for any given professor can, for any year, be any non-negative real value, not only integers. Consequently, we turned to the second alternative: the censored regression model, commonly and hereafter referred to as the Tobit model.

This paper analyzes how the research productivity of each individual changes over the researchers' careers. The comparisons of different cohorts, for instance not permanent employed and permanent employed, therefore contain the same individuals in different stages of their careers.

3.4.1 General Formulation of the Tobit Model

Following Greene (2012), the general formulation of the Tobit model is typically specified in terms of an index function:

[7] As can be seen in figure A3 in appendix 10.4 the dataset contains a high number of zeros.

$$y_i^* = x_i'\beta + \varepsilon_i,$$

$$y_i = 0 \; if \; y_i^* \leq 0,$$

$$y_i = y_i^* \; if \; y_i^* > 0.$$

Here, y_i^* is the latent variable (index variable) depending on x_i' through the parameter β, which similarly to a linear model determines the relationship between the independent and the latent variable. If the latent variable is above zero the observable y_i is defined to be equal to the unobservable y_i^*, and zero otherwise. For the latent variable, $E(y_i^*|x_i)$ is $x_i'\beta$. There are two basic assumptions underlying the Tobit model:

1. The underlying disturbances (error terms) are assumed to be normally distributed, $\varepsilon \sim N\,(0, \sigma^2)$.
2. The underlying disturbances are assumed to be homoskedastic.

These assumptions and their implications on the current study will be further discussed in section 3.4.4.

3.4.2 Application of the Tobit Model to Our Data

The distribution of the error term, ε_{it}, is here assumed to have a varying variance over time. Due to the assumption that the error term is not stationary we turned to a random-effects version of the Tobit model. Hence, the general set-up of the regression model used in this paper can be written as,

$$y_{it} = \beta x_{it} + v_i + \varepsilon_{it}$$

with $i = 1 \ldots n_i$ rows and $t = 1 \ldots n_t$ columns. In this model the random effects, v_i, are assumed to be independent and identically distributed, and normally distributed ($v_i \sim N\,(0, \sigma_{v_i}^2)$). Similarly, the error terms, ε_{it}, are assumed to be independent and identically distributed, and normally distributed ($\varepsilon \sim N\,(0, \sigma_\varepsilon^2)$). In this paper, the regression model was,

$$prod_{it} = \beta_{0it} + \beta_{1it}t1 + \beta_{2it}t2 + \beta_{3it}t3 + \beta_{4it}t4 + \beta_{5it}t5 + \beta_{6it}perm + \; v_i + \varepsilon_{it}$$

where $i = 1 \ldots n_i$ individuals, $t = 1 \ldots n_t$ time periods, $prod_{it}$ is the dependent variable estimating the research productivity. The independent dummy variables were defined according to the table below.

Vintage of PhD (years)	$t1 = \begin{cases} 1 & if\ vintage < 1 \\ 0 & otherwise \end{cases}$
	$t2 = \begin{cases} 1 & if\ vintage\ 1-5 \\ 0 & otherwise \end{cases}$
	$t3 = \begin{cases} 1 & if\ vintage\ 6-10 \\ 0 & otherwise \end{cases}$
	$t4 = \begin{cases} 1 & if\ vintage\ 11-15 \\ 0 & otherwise \end{cases}$
	$t5 = \begin{cases} 1 & if\ vintage > 15 \\ 0 & otherwise \end{cases}$
Permanent Employed	$perm = \begin{cases} 1 & if\ permanent\ employed\ at\ year\ t \\ 0 & otherwise \end{cases}$

Table 1: The definitions of the dummy variables used in the regressions made in this paper.

Apart from the permanent employment variable, which is the main interest of this paper, a step function with five more dummies was included. These variables grouped the data depending on the vintage of PhD according to table 1. As the all the variables are dummies they will never take on negative values no matter if, as in the case of $t1$, the years for which a variable is equal to 1 are negative.

The inclusion of vintage of PhD as independent variables was done by for instance Goodwin and Sauer (1995) and Levin and Stephan (1991). Levin and Stephan presented several reasons for including these variables. Amongst other things, they argued that the researchers' ability changes with age and thereby with the time after PhD. They also pointed out that the research productivity could be affected by the state of the job market when the researchers receive their PhD. A researcher that graduates when available positions in the top academic sector are few might then turn out to be less productive compared to when the prospects of promotion are good. Furthermore, Levin and Stephan continued by pointing out several additional factors that might change over time and therefore argued that the inclusion of cohorts with different vintage of PhD is appropriate. In this study, the inclusion of the vintage of PhD variables helped limiting any omitted variables that might have biased the estimated coefficient, explaining the effect of permanent employment, away from its true value.

3.4.3 Interpretation of the Tobit Model Betas

The main purpose of this study is to examine the effect of permanent employment on research productivity. Accordingly, in this paper we examined the marginal effect of how a discrete change (from 0 to 1) in the dummy variable $Perm$ altered the observable variable, holding all other variables fixed at their means. Following Cong (2000), the marginal effect on the observable variable is computed as follows,

$$\frac{\partial E(y^*|x)}{\partial x_k} = \beta_k \Phi\left(\frac{x\beta}{\sigma}\right)$$

where $\Phi\left(\frac{x\beta}{\sigma}\right)$ is the estimated probability of observing an uncensored observation within the selected boundaries. In the current study, this would be the probability of observing a negative real value. With fewer censored observation, this ratio approaches one and becomes less important. At one, with zero censored observations, the coefficient β_k provides the marginal effect at their particular values of the independent variables.

3.4.4 Discussions About the Underlying Assumptions of the Tobit Model

In order to use the Tobit regression model in the form as suggested above, some assumptions about the properties of the data were made. These are briefly discussed in this section.

If the distribution of the error terms are normally distributed and homoskedastic, as assumed in this paper, the derivation and maximization of the likelihood function is fairly straightforward providing consistent and approximately normal estimators of the coefficients of the independent variables (Chay and Powell 2001). If these assumptions do not hold, the estimators, of the independent variables, risk becoming inconsistent. In this paper, no statistical test was carried out to try whether the assumption of homoscedasticity was appropriate. However, Greene (2012) pointed out that in the Tobit model the marginal effects in the heteroskedasticity model are, in general, very similar to those computed from the model assuming homoscedasticity. If zero observations are censored the marginal effects will, as explained in section 3.4.3 be equal to the coefficients themselves. This implies that if zero observations are censored, as in this study, the results become relatively heteroskedastic robust.

Many researchers using the Tobit model have struggled with the question of whether the error terms are normally distributed or not. Greene (2012) gave a short account of different methods of making the estimators robust to changes in distribution, for instance the least absolute deviations (LAD) method developed by Powell (1981, 1984). However, the computations required for this method are of a very complex nature. Consequently, for practical reasons, we have settled with assuming that our error terms follow a normal distribution.

Most research on the Tobit model applied on panel data seems to have been focused on the fixed effects version of the model (Greene 2012). However, according to Greene, the choice of a fixed- or random-effects version of the Tobit model is not a straightforward one. He referred to Greene (2004) where the MLEs[8], in several of the tests conducted, were not biased away from zero in the same manner that would have been expected if the fixed effect model was appropriate. Hence, in the current study, a random effects model was argued to be more suitable. The software[9] used for the statistical analysis in this paper only handles the random-effects version of the model, why it was more practical for us to assume random-effects. We believe also that this could be intuitively supported. The error term could be viewed as comprising of, for example, changes in the researchers' individual-specific and immeasurable abilities. These are factors that are not related to vintage of PhD or the employment situation. Assuming that these abilities are randomly distributed and uncorrelated with vintage of PhD and employment situation, a random-effects model would be appropriate.

[8]Maximum-likelihood estimation (MLE) is a method used to estimate parameters of a statistical model.
[9] Stata 12.1

4. DATA

4.1 DATA DESCRIPTION

The collected data contains the following information about the professors registered at an economics institution at a Swedish university:

1. When they received their bachelor's degree or similar.
2. When they received their PhD.
3. When they became permanently employed.
4. When they became full professors.

Furthermore, the data collected contains information on all individual publications regarding:

1. The year of publication.
2. The journal in which the article was published
3. The number of co-authors.

A number of previous studies have limited their samples to scientists that are relatively active in research. As noted by Rauber and Ursprung (2008) the exclusion of inactive researchers could be motivated by two main reasons. First, it would be easier to draw conclusions regarding productivity when the individuals in the sample seem to have made research their main career focus. Second, the steadier stream of data provided by active researchers is better suited for standard econometric approaches. The current study did, however, not exclude any professor regardless of their publishing activity. This is partly due to the fact that a sample, restricted by very specific characteristics, risks limiting the conclusions that can be drawn. Furthermore, the total number of researchers at Swedish economics institutions was, at the time of this study, already quite small. Further limiting the sample would have resulted in a sample potentially too small for any econometric analysis.

In total 109 professors, including emeriti, were registered at the time of our data collection. Out of those we got in contact with 102 of which 98 were willing to answer our questions, giving us a response rate of approximately 90%.[10] As the employment

[10] When the professors excluded due to their age or other reasons, the total number of professors that would have been "relevant" for our study was 90 increasing the response rate to approximately 92%.

conditions, as well as publishing policies, have changed over time, the data was further limited by excluding the professors that received their bachelor degree or equal before 1970. This was also motivated by the fact that the universities seemed to follow different procedures on when to list emeriti and not. The risk of overlooking active emeriti was ruled out by excluding those that had received their bachelor's degree before 1970. The final dataset contained observations from 83 professors.

4.2 SCREENING OF THE DATA

The data was recorded into a panel dataset, describing individual research productivity scores on a yearly basis. The panel dataset was then normalized around the year when the professors became permanently employed.

The larger the timespan around the year of permanent employment, the larger is the risk of including irrelevant observations. Hence, we limited the observations to a time span of 25 years, ranging from 8 years before permanent employment until 16 years after. It is safe to assume that the professors would not have published any article before they received their bachelor's degree or similar. A professor might not even have graduated from high school twenty years before she became permanently employed or might, for that matter, have retired twenty years after. The number of observations will also decrease with time as some professors became permanently employed quite recently. If a professor became permanently employed in 2003 there will logically not be any data available for years later than 10 years after that professor's permanent employment. The number of professors in our dataset, where it is possible to make observations, decreases after the year of permanent employment as follows:

Year (0 = perm.)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Number of observations	81	79	78	77	74	74	70	69	68	60	58	53	51	49	44	41	32	30	30	26	23

n = 83

Table 2: Shows how the number of professors from which it is possible to make observations decreases with time after employment. This is because some professors in the sample have not been permanently employed longer than a few years. Note that two observations are already missing year 0 due to that two of the professors in the dataset became permanently employed 2014 and our data is limited to the end of 2013 meaning that no observations are available for those two professors after the year before year 0.

5. EMPIRICAL RESULTS

In this section we present the results from the six regressions that were made. The regression of main interest is that made on the complete dataset with the publications graded as a quality measurement. The regressions made on the productive and unproductive cohorts are also presented to displaying whether the results on the complete dataset also are valid for the cohorts with their different characteristics. Finally the results from the three regressions with no grading, as a quality measurement, are presented displaying if and how the results are affected by a quality measurement.

5.1 THE EFFECTS OF PERMANENT EMPLOYMENT ON RESEARCH PRODUCTIVITY

In table 3 the results of the Tobit regression made on the complete dataset are presented. With the z stat value approximately equal to 1.91 for the $perm$ coefficient the alternative hypothesis that the coefficient is significantly negative could be rejected with a one-sided left tailed test at a 5 % significance level. In fact, as the coefficient was slightly positive and a one-sided right tailed test, with the alternative hypothesis that the coefficient is positive, would have resulted in a rejection of the null hypothesis that it is zero. That permanent employment would have had a negative effect on research productivity was in any case not supported by these empirical results.

Prod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t1	-1.090	.356	-3.06	0.002	-1.787	-.393
t2	.883	.298	2.96	0.003	.298	1.467
t3	.484	.272	1.78	0.075	-.049	1.017
t4	.075	.272	0.27	0.784	-.458	.607
t5	0	(omitted)				
perm	.386	.203	1.91	0.056	-.011	.783
_cons	1.645	.346	4.75	0.000	.966	2.324
/sigma_u	1.143	.110	10.44	0.000	.928	1.358
/sigma_e	2.486	.043	57.28	0.000	2.401	2.571
rho	.174	.028			.125	.235

Table 3: Regression results from the regression made on the complete dataset with the journals graded as a quality measurement

The same regression was made on a dataset differing from the first set only in that the researchers received the same "productivity score" regardless of in which peer-reviewed journal the article was published in. The regression results can be seen in table A1 in appendix 10.4. The coefficient estimates were similar to those in the regression taking our quality measurement into account with a statistically positive $perm$ coefficient at a 5% significance level. This indicated that the results are fairly robust to changes in the grading system.

Regressions were also performed on two cohorts created by dividing the dataset with one cohort with productive researchers and one cohort with less productive researchers based on how much the researchers had produced up until the year they received permanent employment. The results of these regressions are presented in appendix 10.4 (see table A2, A3, A4 and A5). The coefficients are summarized below:

Cohort	Coef.	z	P>|z|
Unproductive cohort with quality measurement	.803	2.65	0.008
Productive cohort with quality measurement	.046	0.13	0.893
Unproductive cohort without quality measurement	.330	4.54	0.000
Productive cohort without quality measurement	.270	2.01	0.044

Table 4: Summarizes the coefficients of the perm variable for the regressions made on the two cohorts: unproductive and productive. Also includes the observed z-value and P>|Z| which gives the significance level at which the null hypothesis that the coefficient is zero can be rejected against a two-tailed alternative hypothesis.

As can be seen none of the subgroups showed a decline in research productivity after permanent employment. This result was valid both for the data with the quality measurement and for the data without the quality measurement. All cohorts showed a significant increase in productivity, with the exception of the productive cohort with quality measurement.

The ρ (in the tables marked as "rho") is relatively small for all the $perm$-coefficients, the largest being $\rho \approx 0.22$ which was that of the regression on the total dataset with no quality measurement. When ρ is low, the panel estimator is close to the Tobit estimator. Had ρ been large, the random-effects model used here would have become unidentified.

5.2 THE EFFECTS OF VINTAGE OF PHD ON RESEARCH PRODUCTIVITY

As seen in section 2, a majority of previous studies on research productivity have observed a hump-shaped productivity life cycle. In the regressions made in this paper, the coefficients of the vintage of PhD cohorts' variables represented the changes in research productivity over the researchers' careers. The regression results for these variables can be found in table 3 in section 5.1 and in appendix 10.4 in table A1, A2, A3, A4 and A5. As discussed in section 3.4.3 the marginal effects of the coefficients in the Tobit model becomes equal to the coefficients themselves when no observations are censored. In our case any negative number would have been censored but as the dataset only contained non-negative numbers the marginal effects of the coefficients and the coefficients themselves were the same. Plotting the marginal effects gave the following results:

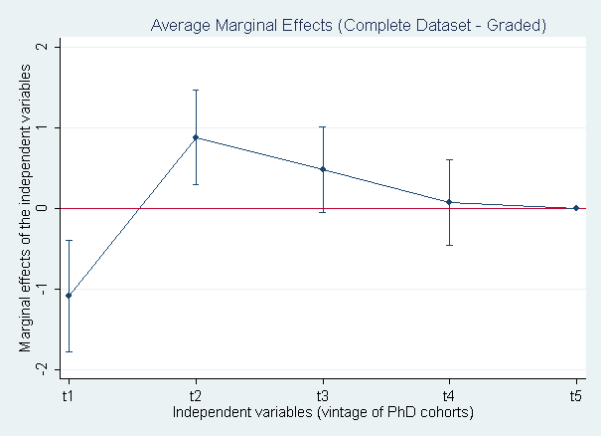


Figure 1

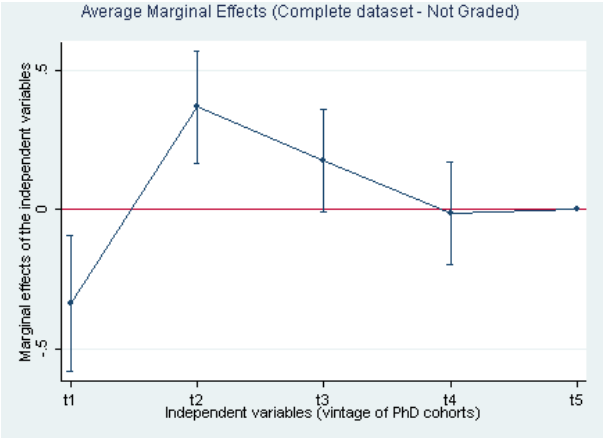


Figure 2

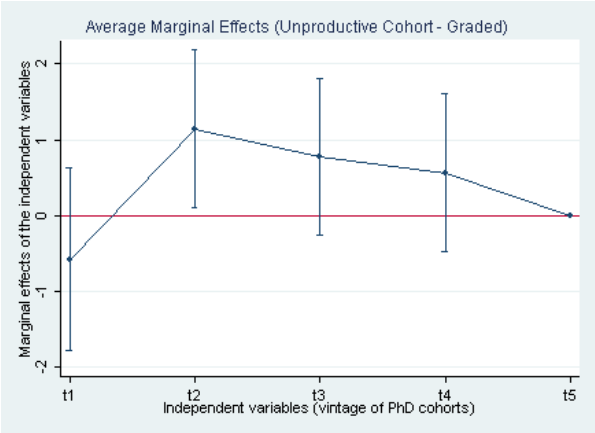


Figure 3

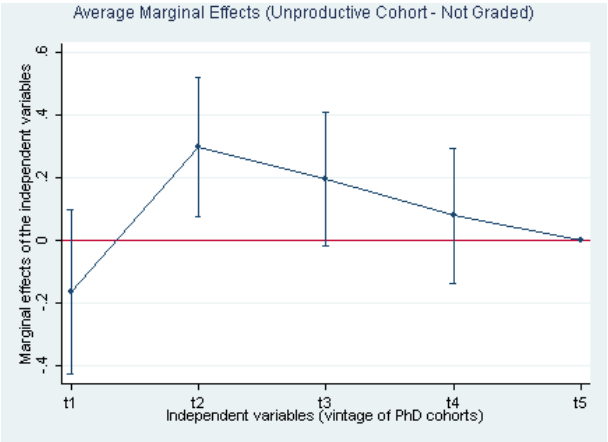


Figure 4

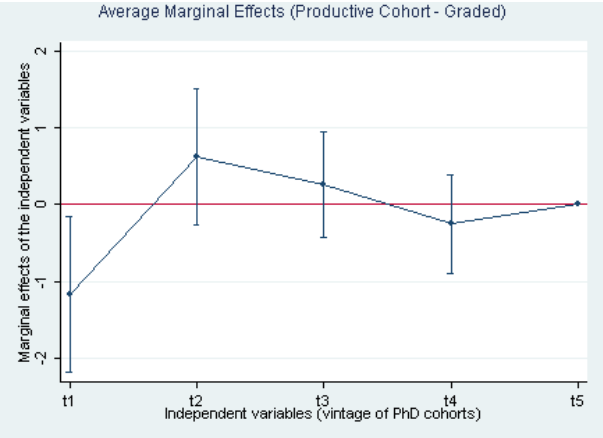


Figure 5

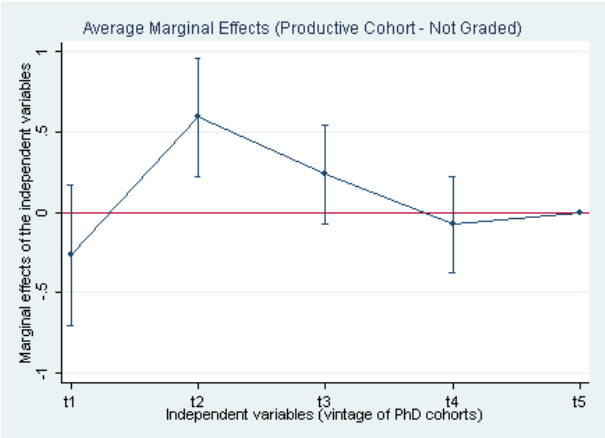


Figure 6

Figures 1-6: The graphs show how the marginal effects of the independent vintage of PhD variables for the six regressions that were made in this paper. The marginal effects are in this study equal the coefficients themselves. The exact values of the coefficients (and thereby the marginal effects) can be found in table 3 in section 5.1 for figure 1 and in tables A1-A5 in appendix 10.4 for figure 2-6.

The standard errors were too large allow us to make any statement concerning whether the coefficients were actually different from each other. In five of the six regressions a peak, positively different from the total average marginal effect, was found for the $t2$ vintage cohort, at a 5% significance level for. However, the sixth regression, which was that of the productive cohort with quality measurement, no marginal effect could be said to be positively different from zero.

In sum, this provided some empirical support that the researchers in our study showed the, from previous research observed, hump-shaped productivity pattern. However, it seemed as if the decline in research productivity 6 to 10 years after PhD, previously explained by the granting of tenure, was not due to that the researchers became permanently employed.

6. Reflections on the Limitations of the Study

In this section, we discuss the potential shortcomings of the methods used in this paper. We evaluate the concerns and the implications of the data collection, the chosen scope, and the assumptions made.

First, as the data was manually collected, there is a potential risk of human errors. This issue was addressed by pairwise data entry and frequent spot checks during the collection process. Furthermore, all double entries were automatically highlighted and erased. In total, we argue that the risk of human errors has been significantly reduced.

Second, there is a risk that the professors answering the survey (se appendix 10.1) used in the data collection interpreted the question regarding the year of permanent employment wrongly. Even though they were few, a number of replies were sent back asking for clearer definitions of the term permanently employed, implying that misinterpretations could have occurred. An example would be a person who referred back to a year when she was promoted to a certain position in the academia, that she considered being of permanent nature, when she in reality was already permanently employed due the Swedish Employment Protection Act.

Next, in order to limit the presence of omitted variables, we argued that it would be preferable for this type of study if the data sample was homogenous in other aspects than those the study investigated. This motivated the choice of limiting the scope of the data to professors at Swedish economics institutions, whom had received their bachelor's degree in 1970 or later. It would also make any estimates easier to analyze, as the potential sources of explanation of the results would be fewer in comparison to a more heterogeneous sample. However, the sample still comprised of individuals starting their research career in very different times. This is obviously an issue, given that the general employment conditions and the norms and requirements of publishing pace could have differed over time changing the publishing pattern in general. Also, the regressions made in this paper grouped the publications into those made before and after permanent employment was granted. Should the average time between PhD and permanent employment been generally changed over time, so would hypothetically also the publication patterns.

Rauber and Ursprung (2008) discussed the problem that people in different stages of their career life cycles are included in the same cohorts. They point out the separation of career age and cohort effects as one of the major challenges when studying life cycles in research productivity. Furthermore, they argue that the resulting estimates of a regression analysis, where this separation is not perfect, will yield biased estimates. In our study, the separation between real age and career age was not made, why this study could potentially contain biased estimators. The reason for not separating actual age and career age was that the inclusion of more variables would risk a too large loss in degrees of freedom, given the fairly small dataset.

In this paper we assumed a publication lag of two years over the whole dataset. However, as mentioned in section 2.3, Ellison (2002) found that the average lag, for the top six journals, increased from around 9 months in year 1970 to approximately 24 months in year 2000. We recognize that only a very small part of the data consists of points scored through publishing in any of journals investigated by Ellison. Nonetheless, we argue that although it is probable that the publication lag of lower ranked journals differ from the highest ranked ones, the general trend of increasing lags is likely to be the same. The fact that the actual average lag has increased with time, while this paper has

assumed it to be constant, could very well result in a bias of the estimates. The size of the impact on the estimates has not been tested in this paper.

On the same topic, a critical aspect of this study is that the quality and reputations of the journals might very well have changed over time, while the current study has kept them constant. This could result in the quality measurement being biased when scoring older publications in the dataset. Nevertheless, it should be noted that Ellison (2002) demonstrates how the top six journals have kept their high status over the entire investigated time period of this study. Other, less known journal, might however have improved, or for that matter, worsened their reputation with time, resulting in unfair scores given in the quality control.

Lastly, the journal grading system, used as a quality measurement of the publications, is derived from the one used at Lund University. As this system is tied to compensation and used as part of the evaluation material when assessing a researcher for promotion, it is likely that this has affected the publication scores at Lund University. Fortunately, this study does not compare publication levels of individuals or between schools. Rather, we examine publication patterns, why the risk of this issue should be significantly reduced. Moreover, the grading system at Lund University is very similar to that of the widely recognized ABS grading, although more extensive. The risk that this paper's use of the Lund system as a quality assessment would misgauge researchers at other universities' productivity patterns, as they were working with other incentives, is therefore argued to be very low. This statement is further supported by the fact that the quality controlled coefficient estimates and the visible trends were very similar to those were no grading was done.

7. DISCUSSION

In this section, we describe how our findings differ from previous studies. We then make an effort to examine why this is the case. The section will unfold as follows. First, we briefly summarize our findings and discuss them in light of previous studies. Second, we make an effort to examine why our results partly differ from previous research. Third, we discuss potential reasons for the hump-shaped pattern of research productivity

that is observed. Lastly, we present some potential implications of the findings in this paper and suggest areas for future studies.

7.1 FINDINGS: NO DECLINE IN PRODUCTIVITY BUT A HUMP-SHAPE PATTERN OBSERVED

Research question:

Does a change to permanent employment result in a decline in research productivity?

In light of the formulated research question this paper investigated whether a change to a permanent employment results in a decline in research productivity. The empirical findings, reported in section 5, suggest that such a decline does not exist. This is a result contrasting a majority of the previous empirical studies made (Bell and Seater 1978; Goodwin and Sauer 1995; Hutchinson and Zivney 1995; Coupé et al. 2003; Backes-Gellner and Schlinghoff 2004; Leung 2009). As the regressions were made on not only the employment situation, but also the vintage of PhD variables, the potential bias of the $perm$ coefficient due to omitted variables is in this paper argued to be limited but it cannot be discarded.

Studying the results of the marginal effects of the vintage of PhD coefficients, in this paper we observe a hump-shaped pattern of research productivity over the academic career, similar to previous studies presented (Levin and Stephan 1991; Zivney and Bertin 1992; Goodwin and Sauer 1995; Conley et al. 2013). Apart from the regression on the productive cohort with quality measurement, all regression indicated that research productivity peaked around 6-10 years of vintage of their PhD. That the regression of the productive cohort with quality measurements did not show a significant decline in productivity with time supports the findings of Clemente (1973) and Aggarwal et al. (2006) discussed in section 2.3.

In total, our estimates suggest that the research productivity patterns of full professors currently employed at economics institutions at Swedish universities is inconsistent with the hypothesis of declining research productivity as the researchers become permanently employed. The decline following the peak of the hump-shaped pattern has in several previous studies been explained by the tenure-decision, which normally occurs around six to eight years after the PhD. Consequently, previous studies have concluded that the shift from a temporary to a permanent employment contract, through the tenure

decision, has a negative effect on research productivity. In the data sample used in this study the time between PhD and permanent employment widely varies between different individuals (see appendix 10.4, figure A2). Thus, as the hump-shape pattern of research productivity still is observed, we argue similar to Bess (1998) that other factors, unidentified in this study, are in play.

7.2 Explaining Contrasting Results

As earlier touched upon, there are several differences between the general institutional characteristics of Swedish and American universities, the latter being where the main part of the previous research has been performed. Hence, it could be argued that, for instance, dissimilar incentive structures, organizational matters, or cultural differences, to some extent explain why the estimates - and thus the conclusions - in the current study differ from a majority of previous research. In this section, we will discuss and elaborate further on a number of those aspects.

First and foremost, this paper investigates research output using the explanatory variable permanent employment. Clearly, this is not perfectly substitutable with tenure, which has served as the benchmark for previous studies. Bess (1998) notes that, in the US, tenure carries with it an implicit assumption of guaranteed lifetime employment. An American researcher probably perceives the shift to the protected employment, which tenure provides, as a larger change than her Swedish colleague perceives a permanent employment that, in any case, is automatically granted to her after a few years. This implies that any attempts on comparing results should be performed with some degree of caution.

The publication patterns of scientists from both national systems could easily be argued to be determined through the very same mechanism, namely that incentives to produce research are provided by different types of promotions. However, the incentive structures between the two university systems obviously differ to some extent. As observed by Wikström (2008), the academic career paths in the US are much more clearly defined, than those of the Swedish system, with its widely used tenure track. In general, young scientists undergoing the around six to eight year evaluation period of the tenure track work under clearly formulated demands on both the quantity and the quality of published research that is expected to be produced in this finite time period. In the

promotion decision that follows the evaluation period, demonstrating a strong record of published research is often argued to be the single most important assessment factor. In total, around 55-60% of those that undergo the tenure track become tenured (Wikström 2008). Considering this, we argue similar to Backes-Gellner and Schlinghoff (2004) that US scholars are subjects of a higher concentration of incentives during the early years of their careers. This could result in the ratio of productivity output in the early years over output later in the career, being higher for American researchers than for their Swedish colleagues. A study on an American sample of researchers would consequently be more likely to confirm the hypothesis that was rejected in this study.

7.3 An Effect of Career Age

While dismissing the idea of permanent employment as an explanatory factor for declining research productivity, the results of the current study indicates the existence of general career age effects. Similar to the results presented by amongst others Levin and Stephan (1991) and Baser and Pema (2004), the estimates presented in this paper suggest that career age effects have a negative impact on research productivity. Thus, the estimates provided in the current study support the investment model of scientific productivity.

However, it is apparent that research output only represents one aspect of the total work effort of an academic. In a fully specified model, other activities such as teaching, administrative duties and applying for research funding should be taken into account. As noted in section 2, Goodwin and Sauer (1995) find the acceptance of an administrative position in the academia to correlate with a permanent loss in research productivity. With no direct observations on how researchers allocate their time between these tasks over different stages in the academic career, this paper is unable to differentiate the potential explanations regarding the declining age-productivity relationship in higher education.

In his 1979 article "Age and Scientific Performance", Stephen Cole discuss that numerous essential scientific discoveries have been made by rather young scientists. Cole argues that it is a public perception as well as a popular belief held by researchers that science is a young person's game – with many believing age to be negatively correlated with scientific productivity and creativity. Cole notes that for instance Karl F. Gauss

developed the least squares at age 18, Charles R. Darwin was 29 years old when he developed the concept of natural selection and Albert Einstein formulated the theory of relativity at age 26. The latter once even proclaimed that: "a person who has not made his great contribution to science before the age of thirty will never do so." Unlike athletes, where the reduction in productivity clearly is a consequence of age-correlated diminishing physical ability, few intuitive arguments explain why a researcher at age 50 should not be as productive as a researcher at age 30. On the contrary, with experience comes knowledge and the scholars might even enjoy the opportunity of building new research on top of their previous. One might also believe that the publication process itself should be facilitated by years of experience and a stronger reputation. In light of the investment model of scientific productivity, Backes-Gellner and Schlinghoff (2004) argue however that a sharp increase of publications early in the career is likely to be succeeded by a balanced decline. Young researchers publish to invest in their reputation, which, as observed by Levin and Stephan (1991) pays off through higher income opportunities in later years.

7.4 POTENTIAL IMPLICATIONS

The results of this study suggest that a change to permanent employment, in fact, does not result in a decline in research productivity. Being the first study of its kind in Sweden, further studies are required to support or dismiss the findings of this paper. If similar results are found by future studies made on academics in Sweden, or in countries with similar employment protection legislations and university policies as Sweden, it would be of great interest for the ongoing debate on how to best organize and manage institutions of higher education.

If safer employment is beneficial for the academic freedom, it seems to us that giving academics this safety would be beneficial for the scholars as well as for society as a whole. There are certainly many other arguments for and against the employment protection of scholars, but at least the argument that permanently employed scholars would be less productive could be discarded.

The results in this paper suggest that the hump-shaped pattern of research productivity over time, also observed in studies made in for instance the US, would exist in Sweden. It has, however, been more difficult to find the underlying reasons for this pattern. Even though vintage of PhD as a measurement of career age seems to explain the pattern, the underlying factors are not yet identified. To understand why career age explains changes in research productivity further research needs to be made. We therefore encourage further research in this area as it seems to be essential to enable well-informed decisions on how to best organize and manage an organization of higher education.

8. CONCLUSION

This paper has been aimed at answering the question whether a change to permanent employment results in a decline in research productivity. The question was to be investigated for full professors registered at institutions in economics at Swedish universities.

By creating a unique dataset containing information about the publications made by the professors in the dataset and information about when the professors had become permanently employed, this study analyzed whether a change in research productivity could be observed.

The results indicated that a change to a higher level of job security did not result in a decline in research productivity. This was true both for the complete dataset but also when the data sample was divided into two cohorts; one with the researchers that were the more productive half before they became permanently employed, and one with those that were the less productive half. A grading of the journals was included to add a quality measurement to research productivity. Subsequent control regressions, without the grading, still confirmed that no decline in research productivity could be observed.

In addition, the effects of career age, measured in vintage of PhD, on productivity were examined. The results indicated that a hump-shaped pattern in research productivity over the career existed, something which has been observed by several previous studies. The time of permanent employment, in the US closely tied to the time of tenure, occurs at approximately the time of the peak of the hump-shaped pattern. Because of this

several researchers have concluded that it is likely that permanent employment has a negative effect of research productivity.

What our study indicates, however, is that this might be a conclusion drawn on false basis. Even though the employment protection policies are different for many of the individuals in the dataset used in this study compared to the data used in a majority of US studies the same publication patterns are observed. This indicates that there are factors, other than the level employment protection, that play a more important role in determining the research productivity of a researcher.

While potential factors explaining the pattern have been discussed in this paper, it is apparent that future studies are needed on which of these factors that actually affects research productivity and in what way.

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10. APPENDIX

10.1 THE QUESTIONS EMAILED TO THE PROFESSORS

This is the English version of the email we sent out to all professors at Swedish institutions in Economics. In the Swedish version a short description of our planned research was also included as many were curious about the subject of our thesis.

Hello,

We are two students from the Stockholm School of Economics who are writing a thesis in economics during spring 2014. In the thesis we want to investigate how the quantity and quality of published articles, of scholars from economic institutions, changes throughout the academic career.

The only thing we need your help with is to answer the four questions below:

1) What year did you graduate from university/college?
2) What year did you receive your PhD?
3) What year did you get permanent employment at a university/college? *
4) What year did you become professor? *

* *Does not need to have been at your current university/college.*

As the number of active professors at economic institutions in Sweden is limited our thesis is dependent on that everybody answers these four questions. Of course all information will be treated as confidential.

10.2 Publication Policy for the Department of Economics (Lund University)[11]

1. To earn points the affiliation of the author at Lund University must be clearly stated in the publication *and* the publication must have been reported into Lund University's publications database LUP by 31 January the year after publication (the year printed or, for e-journals, the year published on-line).
2. The lists of the A*, A and B journals and Recognized Publishers will be updated at least every two years.
3. A peer reviewed journal that does not appear in the department's lists will be classified as category B if it is classified as category 2 in Norwegian model. Journals that have category "-" in the Norwegian model will not give points. Other journals will be classified as category C. See http://dbh.nsd.uib.no/kanaler/.
4. A publisher that does not appear in the department's list will be added to the list if it is classified as category 1 or 2 in the Norwegian model.
5. For jointly authored articles, books *etc.*, the number of points will be divided by the number of authors.
6. Points can be converted into extra research time and/or compensation for conference expenses. The scale for this will be determined in the department's budget each year. Points not used within two years will be automatically converted into research time.

Definition and Valuation of Categories

Category A* (10 points)

- Article in A*-journals according to the Department's list

Category A (5 points)

- Article in A-journals according to the Department's list

Category B (3 points)

- Article in B-journals according to the Department's list

[11] Revised 2013-03-12

- Monograph published by a recognized publisher according to the Department's list
- Full-length article (10.000+ words) in an international Handbook/Encyclopedia

CATEGORY C (1 POINT)

- Article in other international peer reviewed journals
- Shorter refereed article (3000 words +) in an international Encyclopedia
- Peer reviewed article in an edited book by a recognized publisher
- Editorship of a book published by a recognized publisher

NOTES

- The following lists are compiled by the Department and revised at least once every two years
- Category A* journals in economics
- Category A journals in economics
- Category B journals in economics
- Recognized publishers.
- Current lists will be shown on the Department's web pages.

10.3 The Swedish Universities from Which Data has Been Collected

- Dalarna University
- Linköping University
- Linnaeus University
- Luleå University of Technology
- Lund University
- Mälardalen University Sweden
- Mid Sweden University
- Örebro University
- Södertörn University
- Stockholm University
- The Stockholm School of Economics
- University of Gothenburg
- Umeå University
- Uppsala University

10.4 TABLES AND GRAPHS

REGRESSION RESULTS

Prod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t1	-.339	.124	-2.73	0.006	-.582	-.100
t2	.366	.103	3.55	0.000	.164	.569
t3	.174	.094	1.86	0.063	-.009	.358
t4	-.013	.093	-0.14	0.887	-.196	.170
t5	0	(omitted)				
perm	.205	.070	2.90	0.004	.067	.343
_cons	.541	.123	4.40	0.000	.300	.782
/sigma_u	.458	.042	10.96	0.000	.376	.540
/sigma_e	.850	.015	57.26	0.000	.821	.880
rho	.225	.033			.166	.293

Table A1: Regression results from the regression made on the complete dataset with no grading of the journals

Prod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t1	-.575	.616	-0.93	0.350	-1.782	.631
t2	1.147	.534	2.15	0.032	.099	2.194
t3	.775	.525	1.48	0.140	-.253	1.803
t4	.565	.532	1.06	0.288	-.477	1.608
t5	0	(omitted)				
perm	.803	.304	2.65	0.008	.208	1.398
_cons	.995	.638	1.56	0.119	-.255	2.245
/sigma_u	1.255	.160	7.84	0.000	.941	1.568
/sigma_e	2.452	.057	42.90	0.000	2.340	2.564
rho	.208	.043			.134	.301

Table A2: Regression results from the regression made on the unproductive cohort with the journals graded as a quality measurement

Prod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t1	-1.174	.517	-2.27	0.023	-2.188	-.160
t2	.621	.451	1.38	0.168	-.262	1.505
t3	.260	.348	0.75	0.455	-.422	.941
t4	-.253	.329	-0.77	0.441	-.898	.391
t5	0	(omitted)				
perm	.046	.340	0.13	0.893	-.621	.712
_cons	2.003	.454	4.42	0.000	1.114	2.892
/sigma_u	.996	.153	6.52	0.000	.697	1.295
/sigma_e	2.511	.066	37.94	0.000	2.381	2.640
rho	.136	.037			.076225	.222

Table A3: Regression results from the regression made on the productive cohort with the journals graded as a quality measurement

Prod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t1	-.165	.134	-1.23	0.218	-.427	.097
t2	.297	.113	2.62	0.009	.075	.519
t3	.197	.108	1.81	0.070	-.016	.409
t4	.079	.110	0.72	0.471	-.136	.294
t5	0	(omitted)				
perm	.330	.073	4.54	0.000	.187	.472
_cons	.247	.135	1.83	0.067	-.017	.512
/sigma_u	.279	.037	7.45	0.000	.205	.352
/sigma_e	.634	.015	42.63	0.000	.605	.663
rho	.162	.037			.099	.245

Table A4: Regression results from the regression made on the unproductive cohort with no grading of the journals

Prod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
t1	-.267	.224	-1.19	0.234	-.707	.173
t2	.590	.187	3.15	0.002	.223	.956
t3	.237	.157	1.51	0.130	-.070	.544
t4	-.074	.152	-0.49	0.627	-.372	.224
t5	0	(omitted)				
perm	.270	.134	2.01	0.044	.007	.534
_cons	.597	.208	2.87	0.004	.189	1.004
/sigma_u	.530	.072	7.32	0.000	.388	.672
/sigma_e	1.053	.028	38.22	0.000	.999	1.107
rho	.202	.045			.125	.302

Table A5: Regression results from the regression made on the productive cohort with no grading of the journals

THE DIFFERENCES IN SPREAD BETWEEN CAREER EVENTS

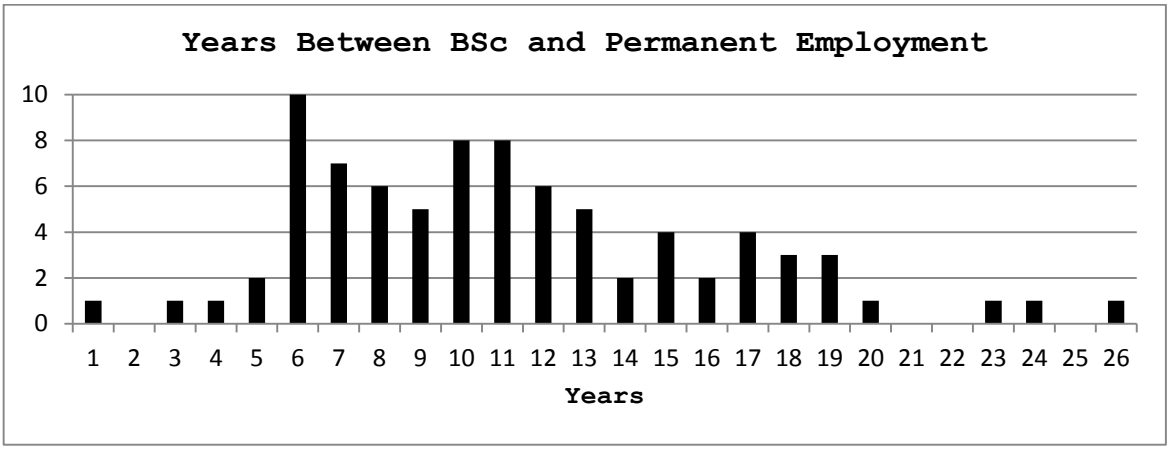


Figure A1: Differences of the time between BSc graduation (or similar) to permanent employment for the professors in the sample. The figure shows the number of professors (vertical axis) that had a certain spread (horizontal axis) between the two career events.

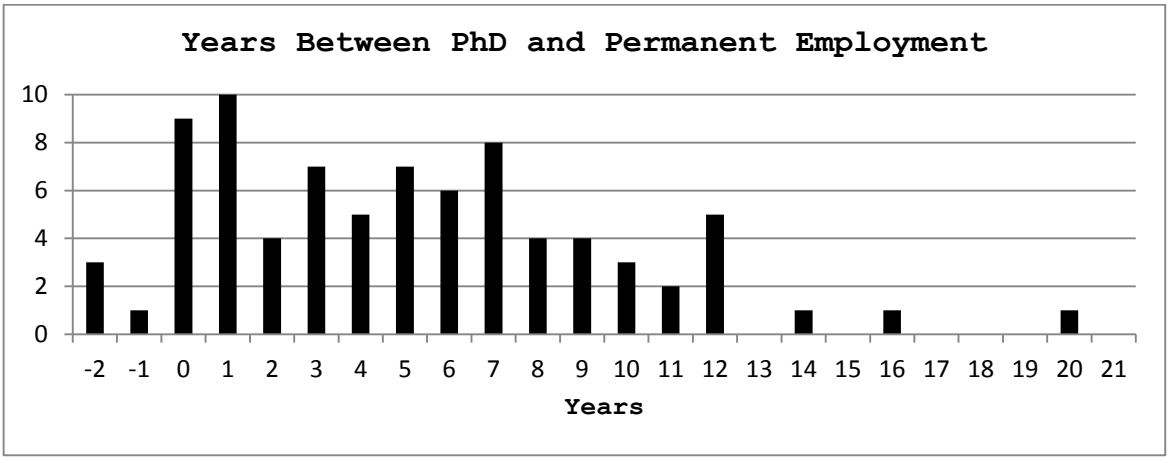


Figure A2: Differences of the time between PhD Graduation to permanent employment for the professors in the sample. The figure shows the number of professors (vertical axis) that had a certain spread (horizontal axis) between the two career events.

OBSERVED NUMBER OF PUBLICATIONS PER YEAR BY A CERTAIN PROFESSOR

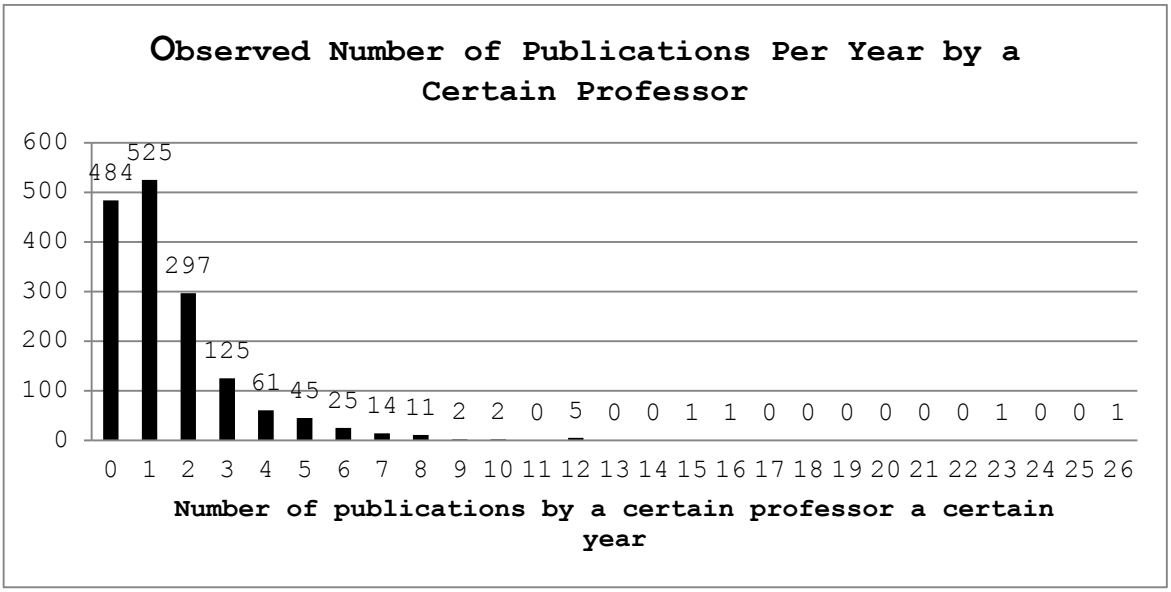


Figure A3: The observed number of times (vertical axis) a certain number of publications made during the same year by the same professor (horizontal axis) has been observed.