Incentives, Hiring and Productivity: Evidence from Academia*

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Abstract

This paper investigates how incentives affect the productivity of innovative work. We present evidence from the German academia during 1990-2010 by exploiting a reform designed to uplift professors' incentives to publish. Collectively, productivity gains while dispersion among universities goes up. Analysis of detailed professor-level data reveals heterogeneous effects of the reform. Young professors who are better incentivized improve more. Increases in productivity, especially that of highly innovative work, i.e. top tier publications, are concentrated among previously outperforming professors. After the reform, high quality publications of an average professor rise with the number of outstanding co-located colleagues, suggesting the existence of positive spill-overs from star researchers. We further document an indirect productivity enhancing channel via better hiring decisions in the post reform era. Relationship hirings that impose detrimental impact on productivity become less prevalent.

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JEL Classification: J33, M51, M52

1 Introduction

Despite the fact that economists put forward ample evidence[1] suggesting the effectiveness of incentive pay in routine tasks, a large group of economists regard the research job itself they involve with as the source of true motivation. Academic workers tend to hold the view that their research requires exploration, creativity and long term commitment, and more importantly, is driven by their intrinsic, endless passion for knowledge, thus monetary incentives do not work well for them. Given the crucial role knowledge has played as an engine of economic growth, the question of motivating high quality research has taken on special importance. This paper exploits a unique reform in German academia, which tightens compensation closely with research performance, to address this question. Surprisingly, from our evidence, we have to admit that pay for performance does not necessarily lose its effectiveness when it comes to academic research.

The theoretical models and the empirical evidence largely go in line with each other when the task is simple, standard and easy to evaluate, corroborating that linking pay with performance indeed increases effort exertion and promotes average productivity. This line of studies ranges from exploiting quasi experiments using empirical data, to conducting laboratory studies or designing economic field experiments. Although there are concerns on the applicability of those experimental studies, the results are persuasive and mostly consistent across different studies. On the other hand, regarding less standard tasks, for example, innovative tasks, be it corporate R&D projects or academic research projects, where effort is not closely linked to observable output, or where the output is subject to randomness and hence hard to evaluate, the evidence is quite scarce. There are some early experimental and field studies in psychology documenting detrimental incentive effects in innovative tasks. For example, McGraw (1978) concludes that pay for performance motivates repeated jobs but not new unexplored approaches. Ederer and Manso (2013) argues that the combination of tolerance for early failure and rewards for long-term success, instead of standard pay-for-performance encourages innovation in a controlled laboratory setting. Recently there is also a growing literature investigating incentives and innovation under the corporate framework. Baranchuk, Kieschnick, and Moussawi (2014) shows that highly innovative newly listed firms are more likely to give their CEOs certain contracts. Those contracts usually contain unexercised options with long vesting periods and protection from takeover threats. However, non-experimental

[1]See Dickinson (1999), Fernie and Metcalf (1999), Lazear (2000), Shearer (2004) and Bandiera, Barankay, and Rasul (2007).

evidence on more general individuals remains thin. This paper intends to fill the gap by studying how changes in compensation scheme are directly linked to effort provision, and productivity of innovative tasks, and more importantly, under a non-experimental framework.

Our setting features an important reform of the remuneration system in German universities. The reform requires German universities to move from the old C-system, where professors receive essentially fixed pay determined by age, to a new W-system, where compensation is closely tied to research performance. The law was passed in 2002 and forced every state to adopt the new system by the end of 2004. Note that under the new system, total amount paid by each state remains unchanged, and a large bonus pool is created along with a reduced base salary. There are basically two important dimensions of the reform. Firstly it brings in long term incentives to do research since the professors now have the opportunity to freely negotiate their contracts based on their academic achievement. To quantify the effectiveness of individual incentives brought by the new system, we compare the pre- and post-reform research output of German business administration professors. Secondly the reform creates incentives on collective performance of the department as the ranking of the department is a key determinant of aggregate bonus size. For this reason, faculties are interested to hire excellent researchers under the new remuneration system. To explore the hiring channel, we examine how hiring decisions have altered with the reform.

Using a sample of German business administration professors from 1990 to 2010, we document a significant increase in average number of publications. Note that the publication output measure is adjusted both by the quality of papers and the number of coauthors. The rise is extremely large for publications in top journals. While the increase is around 40% if we count in all the journals, publications in top 64 journals (field As and high quality Bs) are more than doubled and those in top 15 journals (AER equivalent) are roughly tripled. So not only the reform encourages academic research in general, but also it tends to promote high quality research in particular. Accompanied by the average productivity growth, there seems to be a widen dispersion among universities. This is also consistent with the findings in Bandiera, Barankay, and Rasul (2007). Analysis of detailed professor-level data reveals heterogeneous effects of the reform. Young professors who are better incentivized improve more. Increases in productivity, especially that of highly innovative work, i.e. top tier publications, are concentrated among previously outperforming professors. After the reform, high quality publications of an average professor

rise with the number of outstanding co-located colleagues, suggesting the existence of positive spillovers from star researchers. The cross-sectional evidence is consistent with the dynamics of cost and benefit trade-off of effort when the reform takes place.

The other part of the analyses focuses on a less straightforward productivity enhancing channel. We start from a prevalent practice in German academia: hirings based on network, or relationship hirings, and evaluate the likelihood and outcome of those hirings before and after the reform. In addition to help identify a more subtle channel through which productivity may be affected, it can help us to better understand the role of social connections in employment decisions. Connections may help to achieve better hiring outcomes by improving screening and reducing information asymmetries. On the other hand, it may lead to biased decisions due to favoritism. Bandiera, Barankay, and Rasul (2009) documents favoritism from managers towards connected workers, which they argue to be detrimental for the firm's overall performance. We find a significant increase in the chance of getting hired if a candidate is connected to the hiring faulty. To better understand whether the positive association between connection and getting hired is driven by favoritism or better information, we examine the post-hiring performance of the connected versus non-connected candidates. We find that those connected candidates significantly under perform the non-connected ones after they get hired. However, the negative effects are largely mitigated after the reform. At the same time, we observe significantly fewer hirings of connected candidates. These findings are consistent with the notion that favoritism seems to drive network hirings. Hence when incentives to extend favoritism drop, at the extensive margin, such network hirings become less frequent, and at the intensive margin, they do not seem to have negative productivity implications.

Our paper is related to several strands of the literature. First, the incentive and productivity literature investigates how different features of compensation scheme work out for distinct types of tasks. The evidence is mostly experimental or drawn from field studies. Using a data set for the Safelite Glass Corporation, Lazear (2000) illustrates that the average productivity of windshield installers rises when their compensation scheme shifts from fixed wages to piece-rate pay. Dickinson (1999) and Fernie and Metcalf (1999) have similar findings among letter typers and Canadian tree planters. Regarding to innovative tasks, Azoulay, Graff Zivin, and Manso (2011), Ederer and Manso (2013) and Baranchuk, Kieschnick, and Moussawi (2014) all argue that tolerance for failure and rewards for long-term success, rather than standard pay-for-performance, encourage innovation. Their evidence supports a long line of theoretical models, such as Holmstrom (1989), Holm-

strom and Milgrom (1991), Manso (2011). Our contribution to the literature is twofold. First we document the effectiveness of pay-for-performance for a job that is mostly considered to be innovative and explorative. Secondly, our evidence is based on empirical data, thus adding to the existing experiment- or laboratory-based studies.

The analyses on hiring and post-hiring decisions illustrate the consequences of social connections. In that regard, the paper is related to a burgeoning literature on the interplay between social networks and individual/firm performance. Bandiera, Barankay, and Rasul (2005) studies how the workers response differently when their social connections with their co-workers at the same level of hierarchy changes. Bandiera, Barankay, and Rasul (2009) continues with the same field experiment framework and studies the effect of social connections across different levels of hierarchy, namely workers and managers, on productivity in the workplace. A lot of other papers discusses the bright and dark side of social connections, such as La Porta, Lopez-de Silanes, Zamarripa, et al. (2003) and Khwaja and Mian (2005) investigating lending outcomes. Our paper points out the dark side of social connections in academic hirings.

The rest of the paper is structured as follows. Section 2 describes the institutional environment of the renumeration reform and academic hirings in German. Section 3 presents and summarizes the data. Econometric methodology and results are discussed in Section 4. Section 5 concludes.

2 Institutional Background

2.1 Remuneration at German Universities before 2002: C-system

Until the year of 2005, associate and full professors in Germany were paid according to a highly rigid remuneration system—the so called "C-system". Each professor got a fixed salary which only depends on age. Pay for performance did not exist. There were regular salary raises after each two years. The final raise appeared at the age of 49. Professors could gain an extra salary increase via a job offer by another university; this increase, however, was not individually negotiated but known in advance[2]. For example, the first (second) post tenure job offer yields a salary increase per month of €485 (€761) if the

[2]Individual negotiations on salaries only took place after a professor had attained several job offers in the past. However, these cases were very rare since there exists a legal age restriction for changing universities.

professor leaves the current university. Retention offers were regulated as well. Given that the external job offer comes from a university located at a different federal state, the professor received 75 per cent of the salary increase as retention premium in case of staying. The retention premium was zero for switching professorships within the same federal state.[3] There was an agreement among the 16 states of the Federal Republic of Germany to limit fluctuation and salary increases of professors: having received a job offer as full professor automatically blocks further job offers for the next three years. All in all, a professor only had poor incentives to publish or to move. The incentive to move solely arose from vacant professorships that fit with one's own research interests – given that the professor is not blocked by a former job offer.

2.2 Senior Hiring in Germany

In Germany, associate and full professorships that become vacant have to be advertised publicly (e.g., in national newspapers), because internal promotions are typically forbidden. Together with the advertising decision, the searching faculty has to establish a hiring committee. The majority of this committee consists of associate and full professors from the searching faculty, but each of the other status groups (i.e., students, assistants, administration) also elects one member to join the committee. The hiring committee evaluates the professors and post-docs that have applied for the vacant position. Based on the applicants' CVs and publications, about six candidates are invited to give a talk at the searching faculty. After the talks, the committee meets to decide on the ranking of the candidates and to recommend a list of the best three to the faculty. The faculty formally decides on the ranking of the applicants and communicates it to the president of the university who then makes an offer to the first ranked candidate and starts negotiating with him or her. If negotiations fail, another offer is made to the second ranked candidate. At the end, either negotiations with one of the candidates are successful or the faculty has to advertise the vacancy again.

[3]The Federal Republic of Germany consists of 16 states. All universities of one state were governed by the same ministry. As a consequence, retention premiums were only paid to avoid fluctuations of professors to other federal states.

2.3 The Great Reform of the Year 2002: W-system

In 2002, the parliament of the Federal Republic of Germany opted for a radical change of professor remuneration while leaving the formal hiring procedure unchanged. The respective law (*Professorenbesoldungsreformgesetz*) forced each federal state to adopt the new system by the end of the year 2004. Thus, from January 01, 2005, each professor in Germany that is hired for the first time, changes the university, or renegotiates with the current employer must be paid according to the new system. The *Professorenbesoldungsreformgesetz* binds each federal state to pay out the same total amount of money as under the old system. However, the professors' base salary was reduced considerably[4] so that a huge bonus pool remains which should be distributed according to performance.

The remuneration reform was accompanied by a decentralization of decision rights. Under the new system, job offers directly come from the universities and no longer from the state ministries. Moreover, after a received offer from another university, the professor can freely negotiate his personal income with his potentially new employer and renegotiate a retention offer in case of staying with the current employer. Consequently, for negotiation and renegotiation purposes the state ministries have delegated the bonus pools to the universities, and the presidents of the universities have to decide on the distribution of these pools.

However, the president of a university faces a serious problem when evaluating the individual performance of his professors. Before starting to manage a German university, a president has been a full professor at the same or a different university. Thus, the president is able to evaluate the performance of other professors belonging to his field of research, but has difficulties in honoring the performance of all other professors. As the typical way out, a president ranks the different faculties of his university. This can easily be done based on public research rankings (e.g., the Tilburg University Economics ranking) and realized funding by the German Science Foundation. In a second step, the president typically decides to pay the predominant part of his bonus pool to the professors that belong to the top faculties. This practice provides not only incentives for a professor to pursue world-class research as an individual, but also incentives to improve collective performance of his faculty.

[4]The base salary was even so low that, in February 2012, the German Federal Constitutional Court decided that the remuneration reform was in parts unconstitutional.

More specifically, under the new system, the most common and important way for an individual professor to earn performance bonuses (out of the amount assigned to the faculty) is through attraction or retention offers. These bonuses are designed to attract a professor or prevent one from leaving. A professor's past academic achievement and qualifications are key factors to be considered. These bonuses are usually awarded permanently through (re)negotiation of contracts and have no upper limit, providing long-term incentives for the professors to do high quality research. The less common types of bonus are based on on-the-job-performance and take-up of management roles and tasks, which involve much lower amount and provide mostly short-term incentives.

To top other faculties and hence to be eligible for a larger piece of the bonus pie, faculties are interested in hiring excellent researchers under the new remuneration system. Such hiring policy improves the faculty's position in the research ranking of all faculties within the same field and leads to higher success in collective research funding. As a final consequence, hiring of excellent researchers improves the faculty's position within the university and, thus, results into higher personal incomes for the faculty's professors.

This radical reform provides an ideal setting for us to study how tightening pay with performance affects research output. Further, the presence of incentives on collective faculty performance intrigues us to explore the hiring channel. There are also several ideal features of the German senior academic job market. First of all, not allowing internal promotion leaves us with a reasonably high turnover rate so that we have a decent sample of new hirings to start with. Secondly it is a relatively closed market since it is not very open to non-nationals or foreign background academics. Thirdly and more importantly editorial and referring process of top journals does not take place inside the country so the endogeneity concerns are alleviated when we analyze the relationship between research productivity and connections. The question we want to ask is whether the reform provides incentives for hiring and in which direction it influences future research output of socially connected candidates. Our unique set-up will help to differentiate between the two underlying mechanisms of observed reliance on network hiring: screening based on more information or favoritism.

3 Data

Our sample comprises all 964 business administration professors that were employed at the 83 German universities between 1990 and 2010 (we do not include applied universities in this study). For each professor we collect the following information: the year and institution at which PhD was started as well as completed, the year and institution the Post-Doc (Habilitation - German equivalent to Assistant Professor) was started as well as completed, the year and institution where the professor obtained her/his first tenured hiring, the year and institution where the professor obtained her/his second tenured hiring (if applicable) and so on. Basically it contains the full academic history of professors.

To obtain this information we proceed as follows: First, we consult the webpages of all German universities to obtain the names of the professors currently employed at the business administration departments. In most cases (about 70 percent) professors provide their CV on their webpages that contain the information described above. Second, for all professors that do not provide their CV (or those that only provided incomplete information about their CVs on their webpages) we obtain the PhD thesis as well as the Post-Doc thesis from the German National Library or the respective university library where the PhD was completed at. From the foreword of the theses we obtain the university and year of the PhD (Post-Doc) completion. [5] Since in Germany PhD thesis have to be published and the German National Library keeps record of all German publications, we basically obtain the required CV information of all German business administration professors. Third, we repeat the exercise for those that are not currently employed at a German university[6]. By doing so, we also obtain CV information of business administration professors that are already retired (and therefore were not captured in the first step).

We then match our dataset with a database on publication outcomes from the German newspaper Handelsblatt (henceforth HB). This newspaper collects all publication of German business administration professors in order to provide a ranking of individual professors as well as faculties. Details of their methodology can be found on their webpage.[7] Importantly, the HB assigns points to several hundred academic journals according

[5] If the starting date of the PhD cannot be inferred from this information we assume that the starting date of the PhD was four years before the completion date.

[6] Their names may show up as the supervisor of current professors.

[7] See http://www.handelsblatt.com/politik/oekonomie/bwl-ranking/-bwl-ranking-2012-bwl-ranking-2012-methodik-und-zeitschriftenliste/6758368.html

to their impact factor.[8] For each publication (weighted by the number of coauthors) each professor gets assigned points based on the quality of the publication. The database comprises of the HB points obtained by each professor in each year. Furthermore, this database is also provided for HB points each professor obtained for publications only in the 64 or 15 international journals with the highest impact factor. We are especially interested in the HB points obtained in the high quality journals (top 64 and top 15) since the editorial as well as refereeing process of these journals generally takes place outside the German academic system.

Panel A[9] in Table 1 exhibits summary statistics of publication for all professor-years. In total, we have 9,733 observations with non-missing publication information, of which 2,823 professor-years are with positive HB points if all the journals are taken into account. The mean annual publication is quite low, only 0.092, which roughly means that an average business administration professor in Germany publishes one paper every three years if she constantly coauthors with three. Note that this one publication is quality-weighted, equivalent to one paper in Journal of Finance, but two papers in Journal of Corporate Finance, under the HB points system. The research productivity varies a lot with more than half of the population does not publish anything during a year to the top professors show up over three times in AER-equivalent journals with single authored papers[10]. When we turn to top journals, the number of professors who are able to put their names in quickly drops. Only for 278 professor-years we observe positive top 64 publications, which roughly means that every year less than 15 professors find their names there. The average per capita amount is extremely low, 0.017 for top 64 journals and 0.0059 for top 15 journals, which translates into around 32 papers and 9 papers[11] in top 64 and top 15 journals, respectively, assuming every paper is coauthored by *three*

[8]For the highest category of journals, such as the American Economic Review, 1 point is assigned. A publication in the lowest category of journals that is included in the list, such as the British Accounting Review, yields 0.1 points for a publication.

[9]Panel B shows the summary statistics for the connectedness measure between the candidate and the hiring committee, which we will define later.

[10]Note that we interpret the magnitude all in HB points equivalent sense. The maximum annual output is 3.9 HB points: which stands for 3.9 solo papers in the highest category (points weight=1), and 7.8 papers in the highest category if those papers are written with one coauthor, and 15.6 papers in the third category (points weight=0.5) if those papers are written with one coauthor

[11]Calculation for these two numbers is described below. For top 64 journals: $(9733 \times 0.017 \times 3/20)/0.77 \approx 32$. Multiplying by 3 is due to the assumption that each paper has three coauthors. Dividing by 20 converts the quantity to per year measure. We further divide by 0.77 since not every journal in the top 64 category earns 1 point. Only top 15 have a score of 1, while the remaining 49 journals are assigned only 0.7 points. Hence the average score for top 64 journals is $(15 \times 1 + 49 \times 0.7)/64 = 0.77$. For top 15 journals we have $9733 \times 0.059 \times 3/20 \approx 9$.

professors. Obviously aggregately those German professors are not on par with their US peers in terms of research output. As of 2010, when we count the total number of publications over their academic life, 781 out of 940 professors have ever published in some journal, while 190 and 71 of them have succeeded in grabbing pages of top 64 and top 15 journals, respectively. For a typical German business professor who is able to publish in top 64 (15) journals, his research output till 2010 is around 5.6 (3.9)[12] papers if he on average coauthors with two. It seems that the best group of German professors have done reasonably well in high quality research.

4 Empirical Strategy and Results

This section presents the econometric settings and the regression results. It is divided into two subsections. The first part studies how the reform motivates academic research directly. The second part explores a more subtle way that the reform may contribute to productivity: through the hiring channel.

4.1 Incentives and Productivity

Our major focus in this section is to directly evaluate the research output dimension of the reform. We are interested in quantifying the impact of the reform on publications and exploring the heterogeneity across professors.

4.1.1 Aggregate Evidence

Table 2 compares the average annual research output per professor before and after the reform. We can see that HB points increase significantly, especially when only top journals are counted. If all the journals are included, the HB points measure improves from 0.079 to 0.11, roughly 40% of the pre-reform level. More importantly, the presence in top 64 journals is more than doubled, and the presence in top 15 journals is almost tripled. All differences are significant at 1% level. Figure 1 confirms the substantial upward trend in publication after the reform took place. Before 2004, by the end of which all the

[12]Calculation: $(940 \times 0.29 \times 3/190)/0.77 \approx 5.6$ for top 64 journals; $940 \times 0.099 \times 3/71 \approx 3.9$ for top 15 journals;

universities are required to enter the new system, the average publication per professor does not seem to increase, while after 2004 the increase is both large and consistent.

Accompanied by the surge in aggregate productivity after the W-system is in place, disparity among different departments is another important issue to investigate. Figure 2 shows kernel density plots of average HB points obtained per year by professors across different business administration departments, pre and post W-system. There is a clear rightward shift of the distribution from pre to post-reform, further confirming the boost in aggregate productivity at the department level. However at the same time, the distribution corresponds to higher standard deviation of productivity per professor, especially for top publications. We find that the standard deviation is more than doubled for publication in top journals. Figure 3 is consistent with expanded disparity: we observe a clear upward trend after the reform in the research output of the top tercile of departments, but rarely any significant increase in the middle and bottom terciles.

Besides the descriptive evidence, to statistically estimate the overall effect of the reform on research productivity, we run the following regression:

$$Publn_{i,t} = \gamma_i + \beta_1 W_{u,t} + \phi X'_{i,t} + \delta X'_{u,t} + \mu_{i,t} \tag{1}$$

where i indexes for the professor, t for the year. Professor i's publication at year t is denoted by $Publn_{i,t}$. γ_i stands for professor fixed effects. $W_{u,t}$ is a university-specific dummy variable which equals to 1 post-reform, and equals to 0 pre-reform. $X_{i,t}$ is a set of professor level controls, including life-cycle effects[13] and past publication record as a proxy for professor's ability to publish, which could be time-varying. $X_{u,t}$ stand for university level controls, such as faculty size and average faculty age.

The estimation results are shown in Table 3. After controlling for fixed effects, the reform seems to considerably boost productivity. The rise stands for 20% of annual pre-reform mean publication if we count in all the publications (Column I to III). For top publication the rise is more pronounced: it stands for 60% for pre-reform publications in top 64 journals and almost 100% for pre-reform publications in top 15 journals. To better identify the underlying work force, we run several cross-sectional tests in the following section.

[13]We define six age groups according to years spent in academia since PhD: 1-10, 11-15, 16-20, 21-25, 26-30, 30+. We do this since there are evidence of productivity over the life cycle of the researchers, see Levin and Stephan (1991).

4.1.2 Cross-sectional Evidence

Different groups of professors receive heterogeneous levels of treatment from the reform. Some professors are likely to be affected more and thus improve more. To confirm our hypotheses, we run several cross-sectional tests, and the general regression model is as follows:

$$Publn_{i,t} = \gamma_i + \theta_t + \beta_1 W_{u,t} + \beta_2 W_{u,t} * C_{i,t} + \beta_3 C_{i,t} + \phi X'_{i,t} + \delta X'_{u,t} + \mu_{i,t} \qquad (2)$$

the notation is the same as in Equation 1. Additionally, θ_t stand for time fixed effects. $C_{i,t}$ denotes relevant variables splitting the sample. In the following context, we will specify several cross-sectional splits based on marginal cost and benefit of effort under the new system.

A professor's remaining academic life is closely related to the marginal benefit from exerting effort into research. If a top publication will help a professor to negotiate into a contract with a higher pay, a young professor gains more as he is likely to enjoy this incremental amount for a longer period than an old professor. As a result, the young professors are relatively more incentivized than the old under the new system. So the first cross-sectional test is based on age and the relevant variable is denoted as $Young$, which takes the value of 1 if the professor is below median age and 0 otherwise. Table 4 presents the regression results. Column I to III are specifications where we summarize HB points collected in all journals, we find that young professors improve significantly more under the new system than the old professors. The extra boost is equivalent to 30% of the annual post-reform mean publication. More interestingly, we find that the rise is even more pronounced in high quality research. More than 75% of increase in publications of top 64 journals can be accounted by the younger group. Although the results for top 15 journals are not significant, the direction and size is consistent.

Another important factor is the professors' cost of effort doing high quality research. For a professor who is able to publish in top journals before the reform, his cost of effort is likely to be low. Under the assumption that there are no rewards to publication, as in the pre-reform era, the amount of research produced by a professor is simply determined by his ability, or type, plus a random shock. Therefore, the research productivity prior reform can be considered as a proxy of ability, which is negatively related with cost of effort. The hypothesis is that if a professor already produces high quality research without pecuniary compensation, he will be more motivated under the W-system as his cost of effort is

low. Following this logic, the second cross-sectional test is based on past research output and the relevant variable is denoted as $High$, takes the value of one if the professor has obtained higher than average HB points for the past five years and zero otherwise. Table 5 shows the regression results. We can easily see that the high past productivity professors have a significantly higher rise post reform since the coefficients on the interaction term are all positive and highly significant. In terms of relative magnitude, they account for more than 75% of the increase in top 64 journals and close to 100% of the increase in top 15 journals. One may be worried that it is not the reform per se, but some concurrent event that is driving the results. Specifically, one major concern is that a lot of German professors may start to realize the existence and importance of top journals published in English-speaking countries around the same time when the reform took place. If this is indeed the case, those with little top publication previously shall improve more as they have higher unrealized potential compared to professors who were aware of and published in those journals already. We can exclude such an explanation based on the results in Table 5.

Each professor is not an isolated island. There might exist externalities from peers at work place. Having star researchers as colleagues may help in generating ideas, refining questions, delivering tips in the submission process, or in general, creating a more favorable research environment. We argue that with top researchers around, an average professor is likely to benefit from them and thus have lower cost of effort in producing better research. This leads to the third cross-sectional tests where the relevant variable *N_Star* counts the number of star colleagues. Stars are defined as those with top decile publication over the past five years. The corresponding regression results are reported in Table 6. In Column I to III the dependent variable is HB points achieved in top 64 journals. Comparing Column I and II we can see that the non-stars only benefit from their high quality colleagues after the reform. Results in Column III reassure that the increased spillover from star colleagues is statistically significant. In terms of economic magnitude, having an extra star as colleague helps an average quality professor to earn 0.002 more HB points in top 64 journals, which stands for almost 30% of the post-reform average productivity of non-stars. Comparing Column III to V indicates that the positive externalities on the productivity of an average professor is strongest for research output in top 64 journals while there is no significant effect for non-top publications. The results for top 15 journals are only marginally significant because non-stars seldom publish in top 15 journals.

The results of above cross-sectional tests are consistent with our hypotheses. Agents with lower cost of effort or higher benefit of effort indeed response more to the reform, corroborating the notion that the reform contributes to research productivity growth.

4.2 Incentives and Hiring Decisions

In this section, we investigate whether the reform provides incentives for hiring and in what manner are the hiring decisions affected. In particular, we focus on one prevalent phenomenon in German academia before the reform: relationship hirings. It used to be quite common for German universities to hire someone socially connected to the current faculty, but not necessarily the one with the highest credentials. Those hirings based on social connections obviously have their dark side, but they can also bring in benefits. On one hand, connected hirings hurt when favoritism is displayed towards relatively lower quality candidates that the hiring faculties are socially connected with. On the other hand, those hirings may be beneficial if they allow the faculties to provide non-peculiar incentives to those candidates or help reduce informational asymmetries. One natural question to ask is how such cost and benefits of social connections weigh against each other in an empirical setting. We are also interested in figuring out which factor, *favoritism* or *information*, is more likely to account for the reliance on network when it comes to academic hiring in Germany. With enhanced incentives under the new system, we are able to shed some lights on those issues.

More specifically, a professor's publication record or that of the department is mostly unrelated to her monthly income before the reform. Therefore, favoritism may be the driving force for relationship hirings as the incentive to collect and use information is low. Following the reform, colleagues might be motivated to hire someone to collaborate with or to raise the quality of the department. This could result in more resources being allocated to the respective department. Consequently, colleagues have incentives to use their soft information to identify a good candidate under the new system, or have less incentive to extend favoritism. If the above argument is indeed the case, we shall observe connected hirings end up with worse future performance and this detrimental effect shall be alleviated by the reform.

4.2.1 Connectedness Measure

To evaluate the role played by social connections in German academic hiring pre- and post-reform, we first construct measures for connections. From our database on CVs of German professors, we can calculate our measure for the network intensity between the respective candidate that obtained the offer as well as professors that were employed at the respective faculty when the offer was granted. To do so, we count the number of years a hired professor has spent together with the professors of the hiring department (and scale it by the number of years the professor has spent in academia since the start of his/her PhD). In our set-up there are basically two different possibilities that the network measure takes on a positive value that is best illustrated by examples. Example 1: Candidate I has done her PhD and Post-Doc at university A. As illustrated above, university A is not allowed to make a tenured offer to candidate I. Therefore, this candidate (if she wants to remain in academia) has to generate an outside offer, say from university B. If candidate I accepts a tenured offer from university A at a later stage, it is likely several faculty members at this point in time have also been faculty members during the PhD/Post-Doc period of candidate I. Therefore, our measure would indicate a positive value. Example 2: Again, candidate I has done her PhD and Post-Doc at university A. Faculty member(s) and/or senior Post-Doc(s) from university A became in the meantime faculty members of university B. If candidate I accepts an offer from university B, our network measure will take on a positive value in this case.

We take the baseline connectedness measure as the candidate's academic years spent with the hiring committee members. In addition, we develop variations of this measure. Firstly, we calculate pair-wise cosine similarity based on past working history. This measure is used widely in studies using textual analysis and social networks[14]. The basic process is to first build the full list of university-year pairs (assume there are N pairs) and then represent each professor as an N-vector summarizing her academic history. Each cell in this vector takes a value of 0 or 1, illustrating the presence of a certain professor in the corresponding university-year. Next we normalize each vector to unit length. The cosine similarity of the generated vectors has a upper bound of 1 and a lower bound of 0. Professors having more university years in common yield a higher similarity. In the end, we add up the candidate's cosine similarities with all the professors in the hiring department.

[14]See Hoberg and Phillips (2010) and Watts and Strogatz (1998).

Secondly, we build experience or publication weighted version of the baseline measure. The underlying motivation is straightforward: connections to certain members of the hiring department are simply more valuable than the others. In terms of making hiring decisions, senior professors or those who actively publish are likely to enjoy more power. To be more specific, we weigh each connection of the candidate by the connected professor's academic years (or publication score in the past five years) and then sum them up to yield a weighted measure of connectedness.

In the end, we also have a loosely defined measure, which only requires association with the same university, but not necessarily presence in that university at the same time. If candidate I and a faculty member at the hiring university both graduate from university A, and there is no overlap in their years at university A, candidate I is still considered as connected to that faculty member in this case.

The summary statistics of the connectedness measure are shown in Panel B of Table 1. Out of the 880 new hirings, 259 of them are connected to the hiring faculty to some extent. On average, a candidate spends 4.7 years together with a faculty member of the hiring faculty (or almost one year with 5 different faculty members). Since professors generate automatically more joint year with fellow faculty the longer they stay in academia, we scale the measure by the number of years one has spent in academia since the start of her PhD. This relative intensity measure is the baseline measure of network connectedness, or $Conn$. The other measures are constructed mainly for robustness checks, and they have similar distributional patterns as the baseline measure.

4.2.2 Connections and Chance of Get Hired

We start with examining whether the existence of a personal relationship of a candidate increases the probability that a candidate gets hired for a given job opening. To do so, we test whether the network intensity of a candidate increases the probability that a specific candidate obtains the offer. Unfortunately, we do not know the list of applicants for a given position. We, therefore, assume that all professors that have accepted an offer within the same subject area in the same year or in the year afterwards[15] are likely to be potential applicants. Empirically, we estimate the following regression model:

$$Prob(Hired) = \alpha_u + \lambda_s + \theta_t + \beta * Connected_{i,t} + \phi X_i' + \mu_i \tag{3}$$

[15]In unreported results, we also consider different intervals to determine the pool of applicants for a given position. The results largely sustain.

In Equation 3, *Hire* is a dummy variable that takes the value of one if candidate obtained position and zero otherwise. The key explanatory variable *Connected* is a dummy variable which takes the value of one if the candidate is connected with at least one member of the hiring faculty and zero if he has no connection at all. University, subject area and year fixed effects are denoted as α_u, λ_s and θ_t. To control for different levels of quality of the candidates we include the average of publication points the candidate has obtained per year in the past five years prior to the job opening. We further include life-cycle effects to control for the varying probability of getting hired for candidates with different levels of experience.

Panel A of Table 7 displays the results by running a probit regression without fixed effects in order to avoid the incidental parameters issue. We can see that unconditionally, if a certain candidate has a network relationship with the hiring faculty, the probability of obtaining an offer is significantly higher. Furthermore we split our sample in the period before and after the W-reform. The compassion of the relationships between the existence of a network relationship and hiring before and after the reform is striking: the coefficient is much lower after the reform and the difference is highly significant. In terms of marginal effects, which are not reported in this table, being connected increases a candidate's chance of being hired by more than 5%. However, the probability of being hired is around 7.6% higher before and only 3.3% higher after the reform if there is a network relationship.

Panel B of Table 7 reports regression results for Equation 3. Note that we run a fixed effects OLS regression as probit regression may suffer from the incidental parameters problem. The coefficients yielded in this setting are close to marginal effects from a probit regression. As shown in Column 1, moving from no connections to being connected with the hiring faculty increases the probability that a candidate obtains a certain position by about 5%, which is highly significant. Controlling for candidates' previous research output or academic experience does not affect this finding. Column II and III reports the results for the pre-reform and post-reform era, respectively. The benefit of being connected seems to drop substantially after the reform, from 0.072 to 0.030. The coefficient on the interaction term, as reported in Column IV, is highly significant. These findings illustrate two things. First, the existence of networks seems to play an important role in the hiring decision of senior faculties. Second, the introduction of the W-system seems to have lowered the reliance on networks between the candidate and the faculty when it comes to

recruitment. Next, we move on examining whether the important role networks play in the hiring decision can be explained by an information or rather a favoritism story.

4.2.3 Connections and Individual Future Performance

Hiring based on social networks allows the hiring faculty to take its decision under a larger information bundle. While all faculties have "hard information" on current publications, "soft information" on e.g. the future publication ability or citizenship should be more available for network hires. To test whether soft information are used, we cross sectionally compare how connections between the candidate and the hiring faculty affect the future performance of the candidate holding her publications at the point of hiring constant. We are also interested in how the reform changes association between connectedness and future performance. To do so, we estimate the following two equations:

$$Publn_{i,t_0-t_4} = \alpha_u + \lambda_s + \theta_t + \beta_1 Conn_{i,t} + \phi X'_{i,t} + \delta X'_{u,t} + \mu_i \quad (4)$$

$$Publn_{i,t_0-t_4} = \alpha_u + \lambda_s + \theta_t + \beta_1 Conn_{i,t} + \beta_2 Conn_{i,t} * W_{u,t} + \rho W_{u,t} + \phi X'_{i,t} + \delta X'_{u,t} + \mu_i \quad (5)$$

where i indexes for professors that get hired, t for the year of the hiring, u for university and s for the subject specialization of the respective professor. The dependent variable $Publn_{i,t_0-t_4}$ counts the average value weighted publications per year, or HB points, of a professor during the five years after she gets hired. University, subject and year fixed effects are denoted by α_u, λ_t and θ_s. $Conn_{i,t}$ is the proxy for network intensity, which is calculated by the cumulative number of years that the respective professor has spent with the faculty members of the hiring faculty divided by the academic age of the candidate. On top of the setup in Equation 4, we add the reform dummy $W_{u,t}$ and the interaction term between $W_{u,t}$ and $Conn_{i,t}$ into Equation 5. Furthermore we hold constant for the amount of hard information available to all faculty members by including the weighted number of previous five-year publications of the candidate by the year of hiring. $X'_{i,t}$ also includes another candidate specific variable: life-cycle fixed effects. Finally, we control for department specific characteristics X'_u, such as average faculty age and department size. We cluster all standard errors at the department level.

Our coefficients of interest are β_1 and β_2. β_1 captures how publication performance in the 5 years after the hiring is affected by the connectedness. β_2 shows how the reform changes the outcome of connected hirings. The results are presented in Table 8. In Column I and II we report results from running regressions in Equation 4 and Equation 5 with the dependent variable being HB points earned in top 15 journals in the next five

years. Our finding is striking: if a faculty hires a new faculty member who has spent time together with the current members, she will publish significantly less in high quality journals compared to someone who has not. The detrimental impact of relationship hirings is largely mitigated when the new W-system is in place as the coefficient on the interaction term is positive and significant. The magnitude is also economically large: consider a 10-year academic experience candidate that a member of the hiring faculty spent 2 years with during PhD, it will translate into a 69% drop[16] in publications of top 15 journals in the next 5 years if he is hired before the reform. However, if the recruitment takes place post-reform, the same level of connection does not have significant negative productivity implication. More interestingly, we note that the negative impact seems to be reversed when we turn to publications in lower tier journals. Column V to VIII show results with the dependent variable being HB points collected in any but the top 64 journals. In general, candidates hired with presence of connections also tend to under-perform in lower quality research. The magnitude is much smaller (only 1-2% of pre-reform output) than that of high quality research. Also note that this is mainly driven by post-reform under-performance (Column VI). The interaction term in Column VI is marginally negatively significant. But given the small economic magnitude, in terms of future lower-tier publications, being connected or not matters little.

In Column III (VII) and IV (VIII) we replicate the analysis of Column I (V) and II (VI) by changing the network intensity measure to the academic experienced adjusted one and the results are quite similar. We run additional tests with alternative measures of connectedness, namely, cosine similarity and publication weighted measure. The results are shown in Column I to IV in Table B2. They are very similar to results in corresponding columns in Table 8. Column V to VIII in Table B2 displays the results when the outcome variable looks at top 64 journals. Those results are qualitatively similar to that of top 15 journals, albeit in smaller magnitude, again suggesting that the major negative effect of relationship hirings is indeed concentrated in top journals and the reform helps in fixing the problem. Note that the evaluation of these journal publications is generally done by editors outside Germany. Therefore, endogeneity of network intensity and publication record (that would bias towards finding a positive relationship) is not much a concern in this specification.

A potential bias may arise if some candidates are biased towards their PhD school in which they are very likely to have connections by definition. If this is the case, the

[16]Calculation for top 15 journals: $(0.011 \times 2/10)/0.0032 = 68.75\%$

positive relationship between chance of getting hired and connections could be driven by back-flow of certain professors. There are a few such cases in our sample (around 3% of all cases), and we drop those cases and rerun all the tests in Table 7 and Table 8. The new results are gathered in Table B1 . We do not find any significant differences between the results out of the new sample and those achieved using the full sample.

Our findings here are not consistent with the argument that social connections can result in a better screening of the candidates. Instead, it confirms that the favoritism motive dominates the information advantage when agents have poor incentive to actively make use of their information.

5 Concluding Remarks

This paper investigates how incentives affect the productivity of innovative work. We present evidence from the German academia during 1990-2010 by exploiting a reform designed to uplift professors' incentives to publish. Collectively, we find that productivity gains while dispersion among universities goes up. Analysis of detailed professor-level data reveals heterogeneous effects of the reform. Young professors who are better incentivized improve more. Increases in productivity, especially that of highly innovative work, i.e. top tier publications, are concentrated among previously outperforming professors. After the reform, high quality publications of an average professor rise with the number of outstanding co-located colleagues, suggesting the existence of positive spill-overs from star researchers. We further document an indirect productivity enhancing channel via better hiring decisions in the post reform era. Relationship hirings that impose detrimental impact on productivity become less prevalent. We interpret this as evidence of the existence of favoritism in senior academic market. By comparing the declines of publications in journals of various qualities, we also find that the negative impact of network connections is more pronounced regarding extremely top quality research.

Overall our results suggest that pay-for-performance may work well for innovative tasks under settings where there is little incentive and a low productivity level to start with. This is to some extent contrary to our own perception of the nature of academic jobs or the view of Frederick Herzberg that the job itself is the source of true motivation.

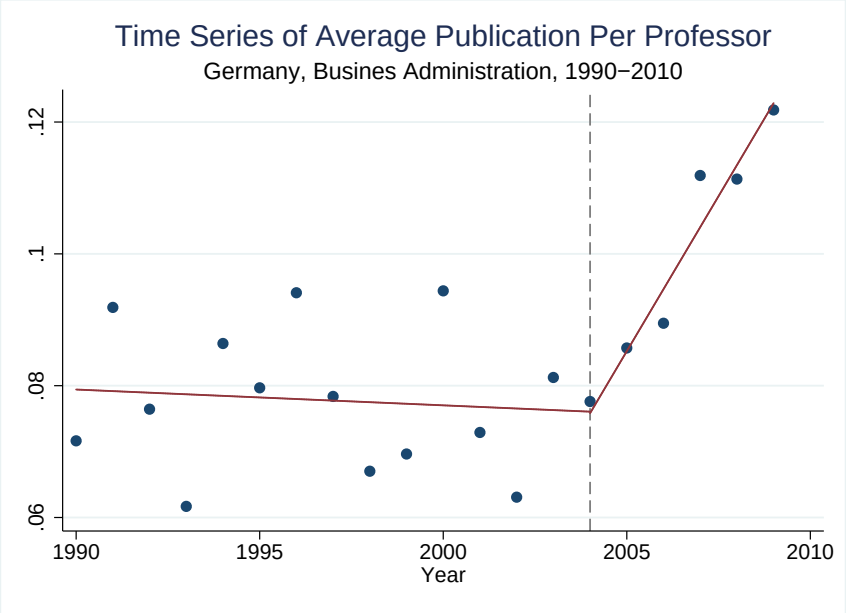

Figure 1: **Time Series of Average Per Professor Publication**. In this figure, we show the average publication HB points per German business administration professor over 1990 and 2010. The HB points account for both the quality of the journal and the number of co-authors. The horizontal line stands for year 2004, by the end of which all the universities are required to adopt the new W-system.

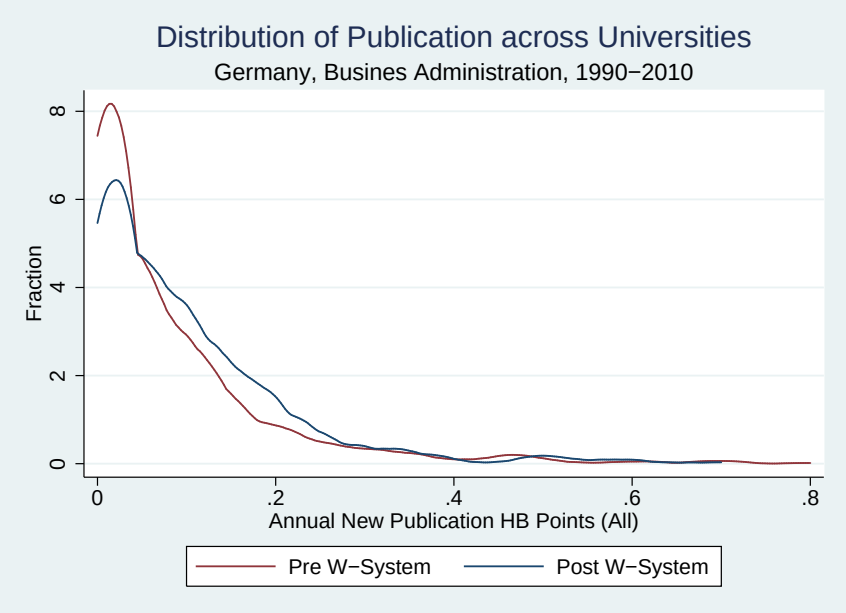

Figure 2: **Distribution of Average HB points across Universities**. In this figure, we show the distribution of average annual HB points obtained by business administration professors across German universities, with all the journals included. The HB points account for both the quality of the journal and the number of co-authors.

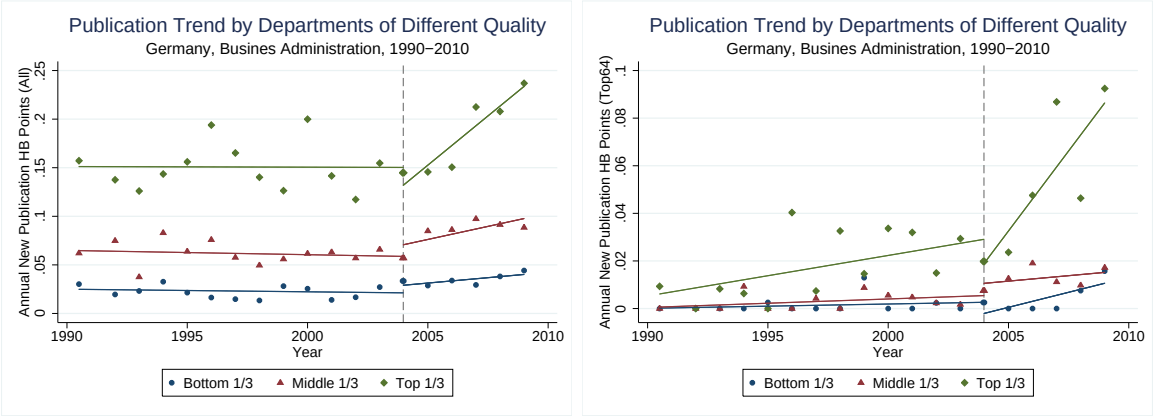

Figure 3: Publication Trend by Departments of Different Quality. In this figure, we plot the publication trend for universities which have their average publication per professor in the top tercile, middle tercile, and bottom tercile among all business administration departments. The left panel accounts for all the publications. The right panel accounts for only publications in top 64 journal. The horizontal line stands for year 2004, by the end of which all the universities are required to adopt the new W-system.

Table 1: Summary Statistics

This tables provides summary statistics for both research output and the connectness measures of German business adminidstration professors from 1990 to 2010. *Panel A* shows HB points obtained by the professors in our sample. Both per year and total HB points statistics are illustrated. HB points are calculated by weighting each publication by the impact factor of the journal (handelsblatt, or HB, assigns points to each journal according to its impact factor) and the number of coauthors. The second column, hence N(positive), displays the number of observations with positive values. We report statistics of HB points with *all* the journals included, with only *top 64* journals, and finally with only *top 15* journals. *Panel B* reports the statistics of the connected measures we construct. *# of Connected Faculty* counts the number of professors in the hiring faculty with which the job candidate has overlap (spent time at the same university in the same year) by the year of recruitment. *# of Years Spent with Hiring Faculty* counts the number of years the job candidate has spent with those connected professors in the hiring faculty. *Connectedness*, or *Conn*, is *# of Years Spent with Hiring Faculty* scaled by the number of years the job candidate has spent in academia. *Cos. Similarity* sums up pairwise cosine similarities with each hiring faculty member based on past working history. *Exp. Weighted* and *Publn. Weighted* is the experience weighted and publication weighted version of *Conn*, respectively.

	N	N (positive)	Mean	sd	Max
Panel A: Publication					
All obs					
(Annual) HB Points total	9733	2823	0.092	0.22	3.9
(Annual) HB Points top 64	9733	278	0.017	0.12	3.9
(Annual) HB Points top 15	9733	79	0.0059	0.074	2
As of 2010					
(Total) HB Points total	940	781	1.6	2.4	24
(Total) HB Points top 64	940	190	0.29	1	16
(Total) HB Points top 15	940	71	0.099	0.56	11
Panel B: Connectedness Measure					
# of Connected Faculty	880	259	1	2.9	24
# of Years Spent with Hiring Faculty	880	259	4.7	15	148
Connectedness (*Conn*)	877	259	0.38	1.4	17
Cos. Similarity	880	259	0.35	1.1	11
Exp. Weighted	877	259	0.42	1.6	19
Publn. Weighted	877	215	0.37	1.4	17

Table 2: Average Publication per Professsor Pre W-system and under W-system

This table shows the average research output per year, as measured by HB points, by German business administration professors *pre W-system* and *under W-system*. We show comparsion of pre- and post-reform statistics for publications in all the journals, in top 64 journals, and finally in only top 15 journals. The significance levels on the differences and standard errors are estimated from running the corresponding least squares regression. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	HB Points total			HB Points top 64			HB Points top 15		
	Pre W-system	W-system	diff	Pre W-system	W-system	diff	Pre W-system	W-system	diff
N	5152	4581		5152	4581		5152	4581	
mean	0.079	0.11	0.029***	0.01	0.025	0.016***	0.0032	0.009	0.006***
sd	0.19	0.26	(0.005)	0.085	0.15	(0.002)	0.05	0.093	(0.001)
max	2.5	3.9		1.4	3.9		1.3	2	

Table 3: Aggregate Evidence on Reform and Research Productivity

This table reports the results on the estimation of research output, as measured by HB points. In Column I to III the dependent variable is the average HB points obtained by each professor during the current year, aggregated over all the journals. In Column IV and V, the dependent variable is aggregated over top 64 and top 15 journals, repestively. The variable W-system takes the value of one if the observation is under W-system and zero if it is pre W-system. The control variables include the average HB points obtained per year over the previous five years and life-cycle effets. Information on fixed effects and clustering of standard errors are shown at the bottom of the table. Standard errors are reported in paraentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	I	II	III	IV	V
Dep. Var.	All Publn.	All Publn.	All Publn.	Top 64 Publn	Top 15 Publn
W-system	0.017***	0.018***	0.016***	0.007**	0.004*
	(0.006)	(0.006)	(0.006)	(0.004)	(0.002)
Contorls	Yes	Yes	Yes	Yes	Yes
Subject FE	No	Yes	No	No	No
Prof FE	No	No	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept	Dept
Adj. R^2	0.451	0.454	0.710	0.689	0.652
N	9696	9696	9696	9696	9696

Table 4: Cross-sectional Evidence—Young V.S. Old

This table reports the results on the estimation of young and old professors' research output, as measured by HB points. In Column I to III the dependent variable is the average HB points obtained by each professor during the current year, aggregated over all the journals. In Column IV and V, the dependent variable is aggregated over top 64 and top 15 journals, repestively. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. The variable *Young* takes the value of one if the professor is under median age before W-system and zero otherwise. The control variables include average faculty age, number of professors in the department, the average HB points obtained per year over the previous five years and life-cycle effets. Information on fixed effects and clustering of standard errors are shown at the bottom of the table. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	I	II	III	IV	V
Dep. Var.	All Publn.	All Publn.	All Publn.	Top 64 Publn	Top 15 Publn
Young*W-system	0.031***	0.032***	0.037***	0.016***	0.004
	(0.012)	(0.012)	(0.013)	(0.006)	(0.005)
Contorls	Yes	Yes	Yes	Yes	Yes
Subject FE	No	Yes	No	No	No
Year FE	No	No	Yes	Yes	Yes
Prof FE	No	No	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept	Dept
Adj. R^2	0.453	0.456	0.711	0.691	0.652
N	9696	9696	9696	9696	9696

Table 5: Cross-sectional Evidence—High V.S. Low Output

This table reports the results on the estimation of how the reform affects high and low productivity professors' research output, as measured by HB points. In Column I to III the dependent variable is the average HB points obtained by each professor during the current year, aggregated over all the journals. In Column IV and V, the dependent variable is aggregated over top 64 and top 15 journals, repestively. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. The variable *High* takes the value of one if the professor has obtained higher than average HB points for the past five years and zero otherwise. The control variables include average faculty age, number of professors in the department, the average HB points obtained per year over the previous five years and life-cycle effects. Information on fixed effects and clustering of standard errors are shown at the bottom of the table. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	I	II	III	IV	V
Dep. Var.	All Publn.	All Publn.	All Publn.	Top 64 Publn	Top 15 Publn
High*W-system	0.032***	0.032***	0.023**	0.016**	0.009**
	(0.009)	(0.009)	(0.011)	(0.007)	(0.004)
Contorls	Yes	Yes	Yes	Yes	Yes
Subject FE	No	Yes	No	No	No
Year FE	No	No	Yes	Yes	Yes
Prof FE	No	No	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept	Dept
Adj. R^2	0.453	0.456	0.711	0.691	0.653
N	9696	9696	9696	9696	9696

Table 6: Cross-sectional Evidence—Spillover from Star Colleagues

This table reports the results on the estimation of the spillover from star colleagues to an ordinary non-star professor' research output, as measured by HB points. In Column I to III the dependent variable is the average HB points obtained by each professor during the current year, aggregated over top 64 journals. In Column IV and V, the dependent variable is aggregated over all and top 15 journals, repestively. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. Star colleagues are defined as those with top decile publication over the past five years. The variable *N_Star* counts the number of star colleagues. The control variables include average faculty age, number of professors in the department, the average HB points obtained per year over the previous five years and life-cycle effects. Information on fixed effects and clustering of standard errors are shown at the bottom of the table. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	I	II	III	IV	V
Dep. Var.	Top 64 Publn	Top 64 Publn	Top 64 Publn	All Publn.	Top 15 Publn
	Pre W-system	W-system	All	All	All
N_STAR	0.000	0.002**	-0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)
N_STAR*W-system			0.002**	0.001	0.0004*
			(0.001)	(0.002)	(0.000)
Contorls	Yes	Yes	Yes	Yes	Yes
Subject FE	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes
Prof FE	Yes	Yes	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept	Dept
Adj. R^2	0.500	0.719	0.523	0.626	0.685
N	4479	3969	8448	8448	8448

Table 7: Connectedness and Probability of Getting Hired

This table reports the results on the estimation of probabilty of getting hired using probit regression. The dependent variable is a dummy variable which takes the value of one if the candidate is getting hired and zero if not. Column I and IV use the full sample while Column II and III use the pre-reform and post-reform subsamples, respectively. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. The variable *Connected* is a dummy variable which takes the value of one if the candidate is connected with at least one member of the hiring faculty and zero if he has no connection at all. The control variables in Panel B are the average HB points obtained per year over the previous five years and life cycle effects. Standard errors are in parentheses. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

Panel A: Probit Model with Control for Candidates' Quality				
	I	II	III	IV
Dep. Var.	Hired	Hired	Hired	Hired
Sample	All	Pre W-system	W-system	All
Connected	0.358***	0.465***	0.248***	0.465***
	(0.040)	(0.055)	(0.058)	(0.055)
W-system				-0.047
				(0.039)
Connected*W-system				-0.217***
				(0.079)
Pseudo R^2	0.012	0.020	0.006	0.015
N	13326	6662	6664	13326
Panel B: Linear Fixed Effects (close to to marginal effects)				
	I	II	III	IV
Dep. Var.	Hired	Hired	Hired	Hired
Sample	All	Pre W-system	W-system	All
Connected	0.051***	0.072***	0.030***	0.071***
	(0.008)	(0.012)	(0.010)	(0.012)
W-system				-0.001
				(0.014)
Connected*W-system				-0.040***
				(0.015)
Controls	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Dept FE	Yes	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept
Adj. R^2	0.016	0.005	0.013	0.017
N	9925	5137	4788	9925

Table 8: Connectedness and Future Output

This table reports the results on the estimation of post-hiring research output, as measured by HB points. The sample is newly hired business administration professors from 1990 and 2010. In column I to IV the dependent variable is the average HB points obtained in top 15 journals per year over the future five years. In column V to VIII the dependent variable is the average HB points obtained per year in any journal but the top 64 journals over the future five years. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. The variable *Network* is either *Conn* or *Exp. Weighted*. The variable *Conn* measures network intensity between the job candidate and the hiring committee while *Exp. Weighted* is the experience weighted network intensity. The control variables include average faculty age, number of professors in the department, average HB points obtained per year over the previous five years and life-cycle effects. Information on fixed effects and clustering of standard errors are shown at the bottom of the table. The control variable is the HB points obtained over the past five years. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

Dep. Var.	Top 15 Publn.	Top 15 Publn.	Top 15 Publn.	Top 15 Publn.	Low Tier Publn.	Low Tier Publn.	Low Tier Publn.	Low Tier Publn.
Network Measure	Conn	Conn	Exp. Weighted	Exp. Weighted	Conn	Conn	Exp. Weighted	Exp. Weighted
Network	-0.003*	-0.011***	-0.003**	-0.009***	-0.005**	0.003	-0.005***	0.003
	(0.002)	(0.004)	(0.001)	(0.003)	(0.002)	(0.005)	(0.002)	(0.004)
Network*W-system		0.009**		0.008***		-0.010		-0.009*
		(0.004)		(0.003)		(0.006)		(0.005)
Past 5-year Publn.	0.127**	0.127**	0.126**	0.127**	0.348***	0.348***	0.348***	0.348***
	(0.056)	(0.056)	(0.056)	(0.056)	(0.092)	(0.092)	(0.092)	(0.092)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dept FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept	Dept	Dept	Dept	Dept
Adj. R^2	0.230	0.233	0.230	0.234	0.233	0.233	0.233	0.233
N	854	854	854	854	854	854	854	854

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A Appendix: Selected List of Journals by Handelsblatt

Table A1 shows a selected list of journals as ranked by Handelsblatt (henceforth HB). The top 15 journals are all assigned one point. The next tier is assigned 0.7 points and there are 49 of them. Combined with the top 15 journals, this compose the top 64 journal list. The rest receive a score of 0.1 to 0.5. To save space, we list all top 15 journals and selectively list 15 0.7-point journals and 10 from the rest.

B Appendix: Additional Results

Table A1: Top Journals by HB

This table presents selected journals ranked by Handelsblatt. Panel A lists all the top 15 journals, each assgined with 1 points. Panel B selects 15 journals out of the top 64, but not top 15 journals, each assgined a score of 0.7. Panel C is a random list of the top 250 jouransl, exlcluding the top 64 journals, each assgined a score of 0.5 or 0.4. The list is from the 2009 version.

#	**Journal Name**	HB points
	Panel A: Top 15 journals by HB	
1	Review of Economic Studies	1
2	Quarterly Journal of Economics	1
3	Marketing Science	1
4	Management Science	1
5	Journal of Political Economy	1
6	Journal of Marketing	1
7	Journal of Financial Economics	1
8	Journal of Finance	1
9	Journal of Consumer Research	1
10	Econometrica	1
11	Information Systems Research	1
12	American Economic Review	1
13	Administrative Science Quarterly	1
14	Academy of Management Review	1
15	Academy of Management Journal	1
	Panel B: Selected Top 64 journals by HB	
1	Transportation Science	0.7
2	Strategic Management Journal	0.7
3	Review of Financial Studies	0.7
4	Review of Economics and Statistics	0.7
5	Review of Accounting Studies	0.7
6	Research Policy	0.7
7	RAND Journal of Economics	0.7
8	Production and Operations Management	0.7
9	Personnel Psychology	0.7
10	Organizational Behavior and Human Decision Processes	0.7
11	Organization Studies	0.7
12	Organization Science	0.7
13	Operations Research	0.7
14	MIS Quarterly	0.7
15	Journal of the Royal Statistical Society. Series B	0.7
	Panel C: Selected Top 250 journals by HB	
1	Economics Letters	0.5
2	Economic Theory	0.5
3	Decision Support Systems	0.5
4	Economic Journal	0.5
5	Decision Sciences	0.5
6	Entrepreneurship and Regional Development	0.4
7	Energy Economics	0.4
8	Economics of Transition	0.4
9	Economics and Philosophy	0.4
10	Economica	0.4

Table B1: Connectedness and Probability of Getting Hired, Excluding Hirebacks

This table reports the results on the estimation of probabilty of getting hired using probit regression. The sample exludes professors being hired back to the universities where they obtained PhD or hablitation. The dependent variable is a dummy variable which takes the value of one if the candidate is getting hired and zero if not. Column I and IV use the full sample while Column II and III use the pre-reform and post-reform subsamples, respectively. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. The variable *Connected* is a dummy variable which takes the value of one if the candidate is connected with at least one member of the hiring faculty and zero if he has no connection at all. The control variables in Panel B are the average HB points obtained per year over the previous five years and life cycle effects. Standard errors are in parentheses. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

Panel A: Probit Model with Control for Candidates' Quality				
	I	II	III	IV
Dep. Var.	Hired	Hired	Hired	Hired
Sample	All	Pre W-system	W-system	All
Connected	0.323***	0.433***	0.208***	0.433***
	(0.041)	(0.056)	(0.059)	(0.056)
W-system				-0.044
				(0.039)
Connected*W-system				-0.225***
				(0.081)
Pseudo R^2	0.010	0.017	0.004	0.012
N	12996	6487	6509	12996
Panel B: Linear Fixed Effects (close to to marginal effects)				
	I	II	III	IV
Dep. Var.	Hired	Hired	Hired	Hired
Sample	All	Pre W-system	W-system	All
Connected	0.046***	0.065***	0.027**	0.064***
	(0.009)	(0.014)	(0.012)	(0.014)
W-system				-0.005
				(0.009)
Connected*W-system				-0.036**
				(0.018)
Controls	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Dept FE	Yes	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept
Adj. R^2	0.036	0.041	0.054	0.037
N	9925	5137	4788	9925

Table B2: Connectedness and Future Output–Robustness Check

This table reports the results on the estimation of post-hiring research output, as measured by HB points. The sample is newly hired business administration professors from 1990 and 2010. In column I to IV the dependent variable is the average HB points obtained in top 15 journals per year over the future five years. In column V to VIII the dependent variable is the average HB points obtained per year in any journal but the top 64 journals over the future five years. The variable *W-system* takes the value of one if the observation is under W-system and zero if it is pre W-system. In column I to IV the variable *Network* is either *Cos. Similarity* or *Publn. Weighted*. In column V to VIII the variable *Network* is either *Conn* or *Exp. Weighted*. The variable *Cos. Similarity* measures the cosine similarity between the job candidate and the hiring committee while *Publn. Weighted* is the publication weighted network intensity. The variable *Conn* measures network intensity between the job candidate and the hiring committee while *Exp. Weighted* is the experience weighted network intensity. The control variables include average faculty age, number of professors in the department, average HB points obtained per year over the previous five years and life-cycle effects. Information on fixed effects and clustering of standard errors are shown at the bottom of the table. The control variable is the HB points obtained over the past five years. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	I	II	III	IV	V	VI	VII	VIII
Dep. Var.	Top 15 Publn.	Top 15 Publn.	Top 15 Publn.	Top 15 Publn.	Top 64 Publn.	Top 64 Publn.	Top 64 Publn.	Top 64 Publn.
Network Measure	Cos. Similarity	Cos. Similarity	Publn. Weighted	Publn. Weighted	Conn	Conn	Exp. Weighted	Exp. Weighted
Network	-0.004*	-0.010**	-0.003**	-0.009***	-0.007**	-0.015**	-0.006**	-0.012**
	(0.002)	(0.004)	(0.001)	(0.003)	(0.003)	(0.006)	(0.002)	(0.005)
Network*W-system		0.008**		0.008**		0.010*		0.008
		(0.003)		(0.003)		(0.006)		(0.005)
Past 5-year Publn.	0.127**	0.127**	0.127**	0.127**	0.387**	0.388**	0.387**	0.387**
	(0.056)	(0.056)	(0.056)	(0.056)	(0.148)	(0.147)	(0.147)	(0.147)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dept FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Dept	Dept	Dept	Dept	Dept	Dept	Dept	Dept
Adj. R^2	0.230	0.233	0.230	0.233	0.385	0.387	0.385	0.387
N	857	857	854	854	854	854	854	854