Academic Work Engagement, Resources and Productivity: Empirical evidence with policy implications

By

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Abstract

This paper analyzes the impact of job resources on academic productivity measured by publication and credit points in 53 departments in one large Norwegian university. The theoretical framework is the so-called conservation of resources theory (COR). The resources data came from the so-called ARK Intervention Program. The results showed that engagement and administrative and technical support for research and teaching stimulated research publications but had adverse effects on credit points from teaching, thus also contributing to the research-teaching nexus debate. To avoid adverse trade-offs between research and teaching, and to gain further positive effects on research productivity, targeted means and reward structures seem important.

Key words: academic productivity, research-teaching nexus, work engagement, university policies, COR-theory

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Introduction

Motivated academics are crucial for any university in meeting goals of high quality teaching and research (Gappa et al. 2007; MacFarlane and Hughes 2009; Dubbelt et al. 2016). Recent years have witnessed a large number of studies related to university productivity, often motivated by organizational and managerial changes, or changes in the funding system. Development of job resources and intrinsic motivation may increase the employees' ability to cope with such changes (Christensen et al. 2012). Research on various organisations from different countries suggests that employee well-being and the availability of various job resources are positively related to performance (Nielsen et al. 2015).

There are numerous studies examining academics' motivation and research productivity separately. However, very few are investigating the specific relationship between well-being and productivity (Horodnic and Zait 2015). Although evidence suggests that motivation and productivity are related, and that many of the factors also affecting motivation affect productivity (Demerouti and Cropanzano 2010; Visser-Wijnveen et al. 2012), there is a lack of empirical studies examining the direct relationship between these two.

In this study, we investigate the relationship between five variables of job resources assumed important for academics, and research and teaching productivity. The study extends previous studies mostly based on self-reported data by using job resources data collected separately from publicly recorded productivity data at the department level in more than 50 university departments. It also adds to the higher education literature on the research-teaching nexus debate initiated by Hattie and March (1996).

Theoretical framework

The theoretical underpinning is the conservation of resources theory (COR), which is a motivational theory that rests on the basic tenet that individuals strive to obtain, retain, foster, and protect their resources (Hobfoll 2001; Halbesleben and Wheeler 2015). The theory contributes to understanding the function of job resources in combination with productivity. Resources are defined as 'those objects, personal characteristics, conditions, or energies that are values by the individual or that serve as a means for attainments of these objects' (Hobfoll 1989, p. 516). These resources reduce the negative effect of daily demands, are functional in achieving goals and stimulate growth and personal development. This in turn leads to a gain

spiral where a reciprocal causal relationship between the resources increase motivation, well-being and work engagement (Hobfoll, 2001), and in turn productivity (Wright and Cropanzano 2007). We have chosen five resources variables in the present study, all regarded as highly significant for academics, and consequently for research and teaching.

Autonomy is by several authors referred as a core value for academics (Boyd et al. 2011; Fredman and Doughney 2012), because it is the capacity they have to influence their work. According to self-determination theory it is a basic human need leading to increased motivation and persistence (Deci and Ryan 2000), which has been shown to affect well-being and commitment among academics in a longitudinal study (Boyd et al. 2011). Esdar et al. (2016), based on motivational psychology theory and survey data from 534 junior academics in nine German universities, concluded that autonomy is important to reduce straining research and teaching goal conflicts. Edgar and Geare (2013), using self-reported data from universities in New Zealand, concluded that culture providing academics with autonomy and responsibility explains high research performance. Gappa and Austin (2010) argue that faculty member's essential needs today goes beyond academic freedom, shared governance, and job security.

Of additional importance are equity, collegiality, and professional growth. We therefore included *cohesion in work teams*, also regarded as basic human needs (Deci and Ryan 2000). Cohesion in work teams refers to how colleagues experience teamwork in their own department. Previous research has shown that social cohesiveness leads to better group performance (Mathieu et al. 2015; Xanthopoulou et al. 2008). A recent study on self-reported data from Australian universities concluded that 'collegiality' is positively associated with research performance and indirectly with teaching performance (Su and Baird 2017).

Administrative and technical support for academics in order to pursue and succeed with core activities is assumed important (Heijstra et al. 2016), and we therefore also explore how perceived support to teaching and research was related to academic productivity.

Work engagement is work-related well-being assumed to enhance productivity, defined as '… a positive fulfilling work-related state of mind, that is characterized by vigor, dedication and absorption' (Schaufeli et al. 2002, p. 74). Studies suggest that engagement is important for both the motivation process and for performance (Christian et al. 2011; Demerouti and Cropanzano, 2010). The concept of work engagement offers a task related

goal directedness, a willingness to spend effort, and positive emotions including resilience and enjoyment of work, which could broaden people's thought action repertoire and thereby facilitate high performance and coping with challenges at work (Dubbelt et al. 2016; Bakker and Oerlemans 2012; Sekerka et al. 2011). Dubbelt et al. (2016) found for example that academic females invested more time in activities relevant for performance on days where they were more engaged. In this study work engagement is measured by vigor and dedication. *Vigor* is described as having high levels of energy and mental resilience while working, and having a willingness to invest effort in work and persistence when meeting challenges. *Dedication* is to have a sense of significance, being proud and inspired, and experiencing strong involvement and identification with one's work (Bakker et al. 2014; Bakker and Demerouti 2007).

Based on the above, we hypothesized that there are positive associations between these five resources variables (a) job autonomy, (b) cohesion in work teams, (c) resources in terms of support for teaching and research and (d) work engagement, and productivity measured by publication points and credit points, respectively.

Methods

Design and sample procedure

Data on the job resources variables were collected from the ARK Intervention Program[1] survey conducted in one large university in Norway during the autumn of 2012, by using the corresponding KIWEST-questionnaire (Innstrand et al. 2015). This is a large comprehensive university with more than 10.000 students, equally oriented towards research and teaching, and covering all major research fields and study programs. The university is more than 50 years old, located in one of the country's largest cities, and organized in faculties and departments. The survey was administrated to all employees in the university by an electronic mail function, and with a cover letter stating the purposes of the survey, and ensuring confidentiality and anonymity. The response rate was 49.3% and the sample constitute 39% females and 61%. The age distribution of the sample was 17.5% below 30 years, 27.5% 30–39 years, 22.9% 40–49 years, 19.2% 50-59 years, and 12.9% above 59 years.

[1] ARK is a Norwegian acronym for 'Working Environment and Working Climate Surveys' developed for assessing psychosocial factors among employees in knowledge-intensive work environments.

The 53 units included in the survey had a distribution of 56.7% in permanent academic positions and 43.3% temporary appointed employees (adjunct professors, postdocs and PhD positions). Only responses from employees in academic positions are included in the statistical analyses.

Variables

The response alternatives ranged from 1 (*strongly disagree*) to 5 (*strongly agree*) for all the KIWEST variables. Cronbach's alpha (α_c) was used to measure internal consistency and reliability (Cronbach 1951). *Vigor* and *Dedication* were assessed by The Oldenburg Burnout Inventory (OLBI) (Demerouti et al. 2010). It includes both positively and negatively phrased items, and was used to assess work engagement by recoding the negatively phrased items. The OLBI includes two dimensions: from exhaustion to vigor, and from cynicism to dedication (Bakker and Demerouti 2008). The vigor scale consists of eight statements (e.g., 'I usually feel energized at work', α_c=0.87). The dedication scale also consists of eight items (e.g., 'I find my work to be a positive challenge', α_c=0.85). In line with Innstrand et al. (2011), the item 'I always find new and interesting aspects in my work', is changed to 'I am less interested in my job now than in the beginning'. *Autonomy* was measured by four items (e.g., 'I can make my own decisions on how to organize my work', α_c=0.85) by Näswall et al. (2010). The variable *Cohesion* in work teams was modified from Carless and De Paola (2000) by Christensen et al. (2012), and is based on three items (e.g., 'Our team is united in trying to reach its goals for performance', α_c=0.82). Administrative and technical *support* is constructed from a formative measurement model, and a high score implies perceived good support both for teaching and research. It is based on four items (e.g., 'I get the administrative support I need for my research', α_c =0.832).

The productivity variables *rate of publication points* (RPP_j) and *rate of credit points* (RCP_j) are constructed by dividing publicly recorded publication and credit points from each department *j* by the number of full time permanent academic staff (man year) in the corresponding department. Publication and credit points were obtained from the Norwegian Social Science Data Services (NSD),[2] which is the official system for scientific publications and credit points, also used by the government for budgeting purposes. Only publications satisfying certain criteria set by the national academic councils in Norway are included in this

[2] Source: http://dbh.nsd.uib.no/pub/ Last access: 5 May 2018.

system.[3] For a publication with several authors, the points are divided equally between the departments with which the authors are affiliated.[4] Credit points are measured by the number of exams or courses students pass every year, equivalent to the European Credit Transfer System (ECTS). A full time student following normal study progression will pass exams equal to 60 points, which is also our unit of measurement.

The data on scientific publication and credit points came from the year 2013 with the exception of 13 departments where 2012 figures were used because of divisions and mergers of units. Five units do not teach, and consequently do not produce credit points, so the number of observations in the RCP analysis is 48 (See panel A in table 1).

Statistical model

In order to assess the relations between productivity and the job resources variables, we estimate the following (*jxk*) equations by OLS:

$$ln\, p_j = const + \alpha\, Avg(X_k)_j \cdot \omega_j + \beta\, SD(X_k)_j \cdot \omega_j + Controls + \varepsilon_j,$$

where index *j* refers to department and *k* to resources variable (*k* = 1,…,5). The variable *ln* p_j denotes the log of the two productivity variables, RPP_j and RCP_j. Table 1 displays a lot of variation in these rates between the units. The table also shows heterogeneity among the units, as there are small and large units, and the mixture of academics is large with respect to rank, age and gender.

Table 1 about here

As the responses from the KIWEST survey are individual, we use department averages to represent the resources at the department level. These averages are denoted $Avg(X_k)_j$, where X_k represents each of the five variables. In order to best represent the resources dimensions at the unit level, we include the standard deviations of these variables, denoted $SD(X_k)_j$, which capture degree of consensus on the calculated average within each unit. However, this does not necessary apply if the response rate in a given unit is low and those who replied are not representative. To correct for this, the averages and their SDs were

[3] A description of the publication point system and an evaluation report by Aarhus University can be found at http://www.uhr.no/documents Last access: 5 May 2018.
[4] In case of co-authors from abroad, a proportional number of credit points are subtracted when calculating the number of points allocated to the national co-authors.

weighted by the respective unit's response rates in the KIWEST survey, i.e., units with low response rates are given lower weights than those with high rates. The response rate varied between 20.6 and 95 percent, with an average of nearly 50. The average of the response rate weight, ω_j, is normalized to 1 (See panel B in table 1).

The averages of the KIWEST covariates vary between 3.37 (*Vigor*) and 3.88 (*Autonomy*). The coefficients of variation ($SD(X_k)_j/Avg(X_k)_j$) give a clear picture of differences in views within each unit, as it lies between 0.17 (*Autonomy*) and 0.28 (*Support*). It is not surprising that academics regard themselves as having a high degree of autonomy but are more divergent regarding support for research and teaching.

The estimates of the αs are expected to be non-negative, and positive estimates are more reliably interpreted as effects according to the theoretical framework if it is accompanied with a non-positive estimate of β. A high SD means divergent views, which in case of a positive β may imply that a positive estimate of α captures other mechanisms. However, low SDs imply consensus within the unit, so the more consensus (lower SD) there is, the higher is productivity. Thus, positive α estimates with negative β estimates are more credibly interpreted as effects in line with our theoretical framework.

A crucial assumption behind the reasoning of the signs of α and β is that the two types of productivity are independent. If not, it may be the other way around: a high level of job resources may increase one productivity and reduce the other. Both productivity variables are endogenous and the statistical model consists of reduced form equations. This implies that the covariates are assumed exogenous so the error terms, ε_j, are uncorrelated with the covariates. However, causality may go *from* productivity *to* the resources variables, which gives biased estimators. It is reasonable to assume that the resources variables are predetermined, giving unbiased estimators, because it takes time to change them. For instance, degree of engagement in a department depends on the kind of people employed, turnover is low and it takes time before recruitment of new employees affects overall engagement in the department. Moreover, the productivity data are from the year 2013 for most of the units, whereas the KIWEST responses refer to 2012, and this data collection is independent of the collection of the productivity data, which reduces selection problems and strategic responses.

Number of credit and publication points are at the forefront in the universities' internal debates, strategic plans and annual reports. More credit and publication points increase government funding to the universities as both these variables are important performance

variables in the government's formula based funding model. This has become particularly important the last 10-15 years by the introduction of New Public Management (NPM) in Norwegian higher education institutions. In many European countries, including Norway, performance based funding have replaced traditional input based funding. Several universities, including the one in our analysis, have established their own formula based models for the internal allocation of the government funding, with performance variables identical to those used by the government, and directly related to research and teaching results at the department level.

The very dominant performance measure related to teaching is number of produced credit points, nearly 20 percent of the total budget for the higher education institutions in 2017.[5] Normal study progression for a full time student is 60 credit points per year. The average for Norwegian universities is around 40, and in almost all the study programs covered by our analysis, there is room for more credit points. Noticeable, a high level of credit points per student may also affect the university's future decisions on student enrollment in a given program. Hence, the funding incentives are significant, and the departments and their staff may increase the number of credit points through higher teaching quality, e.g., more effort in lectures, assessments and individual instructions. Number of publication points are not so important for government *funding*, but regarded as very important for reputation and external research funding. Equally important in our context, publication points are fundamental for individual advancement as only scientific publications count for promotion from for instance associate professor to full professor. The same applies to young academics, such as PhD candidates applying for their first job at the university. 'Academic freedom' and high degree of individual autonomy imply that academics decisively influence the level of credit points and publication points.[6]

[5] Prop. 1 S (2016-2017), p. 285 (in Norwegian) See: https://www.regjeringen.no/contentassets/20d6abbdd38446468cd7d24c4a87f4a3/nn-no/pdfs/prp201620170001_kddddpdfs.pdf Last access: 5 May 2018.

[6] In the EUA report 'University autonomy in Europe III. Country profiles' (April 2017), p. 137-143, Norway is classified as having 'high' academic autonomy. See: http://www.eua.be/Libraries/publications-homepage-list/university-autonomy-in-europe-iii-country-profiles.pdf?sfvrsn=8 Last access: 5 May 2018.

Results

Table 2 presents estimates of α and β from three different model specifications. Model 1 only includes faculty dummies to control for faculty specific differences regarding types and structures of study programs, research areas, teaching and research cultures, and management and leadership differences. In Model 2 is the number of permanent academic positions and PhD students added, whereas Model 3 extends the set of control variables much more, cf. the lower panel of table 2. With respect to sign of the estimated parameters, it is interesting to note that there are no qualitative differences between these three models. The estimated standard errors in the RPP relations are smaller in Model 2 as compared Model 1 and 3. Moreover, explanatory power increases a lot from Model 1 to Model 2 but not much from Model 2 to Model 3, taking into account that the number of variables included is much higher in the latter. Explanatory power of the RCP relations is much higher as compared to the RPP relations but does not increase from Model 1 to Model 2. This implies that discipline areas and study program structures within the faculties, are important factors behind the observed credit point rates. The estimated standard errors are similar in all the three model specifications for RCP, except for the vigor and dedication relations where these estimates are smaller in Model 3 than Model 2. However, the β estimates in the vigor and dedication relations are very similar across all three models. The differences between models 2 and 3, particularly regarding the RPP relations, may indicate biasness due to 'bad controls' (See, e.g., Angrist and Pischke, 2009). In the following, we therefore base our presentation on the results from Model 2.

Table 2 about here

Comparing results with weighted and unweighted KIWEST covariates, the parameter estimates are qualitatively the same but the estimated standard errors from the unweighted versions are larger. Thus, we follow Solon et al. (2015) and take these results as indications of misspecifications.

The results in table 2 show that there are no statistically significant relation between RPP and *Autonomy* and *Cohesion*, but there are significant positive relations to the engagement variables and *Support*. The estimates of the βs are all negative with the exception of *Autonomy*, where the parameter estimate is positive but far from statistically significant. However, only the estimates of the βs referring to *Vigor* and *Support* are statistically negative.

This indicates that units with a high degree of unanimous experience of engagement (low SD) in terms of energy and mental resilience (*Vigor*) and good administrative and technical support (*Support*), and to some degree also units with engagement characterized by enthusiasm and significance (*Dedication*), have higher productivity in terms of publication points per full time academic position.

From the RCP relations, it is interesting to note that it is the same two engagement variables, and *Support* and *Cohesion*, which have the strongest associations with this productivity variable, both in terms of the parameter estimates, and degree of statistical significance. The estimates all have, with the possible exception of *Autonomy*, the opposite sign from those in the RPP equations. This is surprising, as the implication is that more engagement and administrative and technical support within a unit, the less credit points per full time academic position.

In table 3 we illustrate the adverse relations in terms of elasticities, calculated at the averages of the two productivity variables, and *Vigor*, *Dedication* and *Support*. For instance, a one percent higher level of *Vigor*, keeping the its SD constant, corresponds to a 0.64% *higher* RPP but a 0.51% *lower* RCP. The same adverse relations apply for *Dedication* and *Support*. Furthermore, a one percent lower SD on *Vigor*, keeping the average level constant, corresponds to a 0.56% *higher* RPP but a 0.65% *lower* RCP.

Table 3 about here

Discussion

With respect to our hypotheses presented in the Introduction, the results are mixed. A positive relationship between work engagement and research productivity in terms of publication points is according to previous research (Christian et al. 2011; Rich et al. 2010; Halbesleben and Wheeler 2008; Demerouti and Cropanzano 2010; Salanova et al. 2005; Xanthopoulou et al. 2009). However, only the energy part of work engagement (vigor) was found to be important; the more vigorously engaged employees were, the more publication points they were likely to contribute to. Previous studies support that vigor seems to be the aspect of work engagement most crucial for performance (Demerouti and Cropanzano 2010).

The absence of clear positive relations between autonomy and cohesion in work teams, and both of the productivity outcomes is surprising in relation to other findings (Su and

Baird 2017; Esdar et al. 2016; Edgar and Geare 2013). The missing relations between *Autonomy* and *Cohesion*, and productivity, could possibly be explained by these variables initiating motivational processes whereby the work engagement variables mediate the relationship between these job resource variables and productivity (Bakker and Demerouti 2007).

Surprisingly and in contrast to our hypotheses, work engagement (vigor and dedication) had a negative association with credit points. This result is highly relevant for the so-called research-teaching nexus debate (Hattie and March 1996; Cadez et al 2015). Recent studies get similar results, e.g., Leišytė (2016) found a negative relation between 'weekly time spent on teaching' and 'articles published in reviewed journals.' Data in this study are self-reported, so there is a danger of self-selection bias as pointed out by the author. Similarly, based on interview data from Dutch and English academics Leišytė et al. (2009) also found a negative relationship between research and teaching. Horta et al. (2012) also found that research productivity correlates negatively with teaching, but academics teaching graduate students had higher research productivity. This contrast Galbraith and Merrill (2012), who on data from one business school in California found that research activity of the faculty is positively and significantly associated with teaching effectiveness.

Cadez et al. (2015) grouped the eight theories proposed by Hattie and Marsh (1996) of the relationship between research and teaching into three: negative, positive and no relation, and state that 'Empirical evidence supports the third' (*ibid*. p. 5). They made an important distinction between productivity and quality, and used archival data from one comprehensive university to best assess teaching quality in their own empirical analysis. They found that research productivity is unrelated to teaching quality, and that research quality relates positively to teaching quality.

Theoretically, a negative trade-off between research and teaching is consistent with faculty viewing research and teaching as substitutes, as discussed in Gautier and Wauthy (2007). However, it may also be explained by full resource utilization, i.e., that the units' effort levels are on the feasibility frontier. If engagement stimulates and increases research, teaching activities might decrease because the activity level is at the feasibility frontier.

This interpretation is consistent with empirical evidence suggesting that research, teaching and administration are different dimensions of academic work that often compete for time and are in conflict with each other (e.g., Mamiseishvili and Rosser 2011; Tight 2010;

Heijstra et al. 2016). Geschwind and Broström (2015) within a Swedish context point at stronger incentives for research than teaching. Consistently, research has become the most crucial work activity to increase status both nationally and internationally, and for successful promotion and tenure (Chen 2015). Academics who publish and work with graduate students are more likely to be recognized for their work and receive higher salaries as compared to colleagues who devote more time to undergraduate teaching and service (Fairweather 2005).

Explicit expectations from university management at all levels, and incentives towards publication and external research funding also related to job advancement, may explain that more engagement and vigor stimulate research at the cost of teaching. In line with this, the analysis in Benley and Kyvik (2013) of self-reported data from 13 countries from the so-called CAP database (See Teichler et al. 2013), shows that the only variable statistically significant in all the country specific regressions is 'research interest'. Moreover, Cummings and Shin (2014) show from the CAP data that of 19 countries, Norway stand out as being the country where preferences for research are most strongly expressed.

One may question if our productivity variables measure productivity properly. We refer to high rates of publication or credit points as high productivity. This is not necessarily the case if we consider the quality dimension, which obviously is important for a proper measure of productivity. With our measures, a journal article presenting results of great significance is evaluated the same as a paper with modest results. The same applies to teaching and educations, as some educations are more valuable in the labor market than other.

The Norwegian system for research publications awards points for three different types of *scientific* publications: monographs, book articles/chapters, and journal articles. The different publication channels are divided into two levels, level 1 and level 2, where the level 2 channels are assessed to present research of higher quality. For a publication to be included in this system, it has to satisfy certain criteria, and the national academic councils in Norway decide which publications are on the list. The list of level 2 publications is revised once a year while the base level 1 is revised continuously. To illustrate, an article in a level 2 journal gives three publication points in total and one point in a level 1 journal. A monograph classified as a level 2 channel gives eight points, and five points if it is a level 1 publication. The system was introduced in 2005, and is well known and incorporated within the institutions. It is interesting to note that Sandström and Besselaar (2016) on Swedish data show that *quantity* of

publications may be a good predictor for research *quality*. In our data set, the correlation between the total number of publication points and level 2 publication points is 0.95.

The statistically significant negative relations between RCP and resources were not according to expectations. As mentioned above, explanatory power is the same in Model 1 and 2 in table 2 for the RCP relations, saying that the main factor explaining differences in credit point rates is to which faculty the departments and study programs belong. The faculties are organized according to disciplines, such as the humanities, medicine, social sciences, science, and so on, thus the faculty dummies capture to a large extent differences between study programs. We tried alternative specifications of dummy variables to capture discipline differences without changing the results qualitatively. Moreover, vocational study programs, e.g., medicine, have much higher teacher/student ratios, and more administrative staff per student, than other studies. However, when we use a larger set of controls in Model 3, the results do not change much. As mentioned, there is also a trade-off w.r.t. 'bad controls'.

Some study programs contain courses from different departments. Allocation of credit points is according to the departments' contributions, and based on discretionary estimates by administrative staff. Because of the important role credit points play for funding, it is hard to see that this has created serious measurement errors that can explain the surprising results for credit points and resources.

The nature of academic work are viewed in different ways. One view suggests that devotion to work is self-imposed as academics love their work and spend much time on it. Another is more negative, suggesting that academics' work choices result from institutional demands. These views corresponds to the distinction between intrinsic and extrinsic motivation (See, e.g., Shin and Jung 2014 and Esdar et al. 2016). Our findings show that research (teaching) is positively (negatively) related to both extrinsic (*Support*) and intrinsic (*Vigor* and partly *Dedication*) motivation, thus inviting an important discussion on policy implications and interventions regarding incentives for teaching and for research.

In this study work engagement at the unit level is measured from individual assessments and represented both by the averages of these assessments, and degree of consensus measured by the standard deviations. By including this measure for consensus, we capture organizational and cultural aspects pointed out as important by Leišytė (2016). Performance in academia is the result of combined effort of many employees. Demerouti and

Cropanzano (2010) suggest that engagement exists at the unit level where team engagement may be an emergent group level phenomenon that has beneficial performance effects. Engagement could cross over and be contagious, and give positive impacts on the engagement of others (Bakker, Albrect and Leiter 2011). If colleagues influence each other's work engagement, they may perform better as a team. Our estimated effects of degree of consensus within each unit, the β's, give support to this suggestion.

Limitations

One advantage of the approach in this study is the collection of resources and productivity data in different settings, thus possibly reducing biases due to selection problems and self-reports on both sets of variables. Another is that it relates different dimensions of social interaction in academic units to productivity. However, there are some possible limitations to mention.

We use data from one single university, which may reduce the generalizability of the findings. However, as we use data from a large comprehensive university, we suggest that the results are representative for similar universities. In our analysis, high rates of publication or credit points means high productivity. Taking the quality aspect of research into account, this is not necessarily the case. We have pointed at this aspect above, and argued that our measures may by good indicators for productivity in the Norwegian setting.

We have argued that the job resources variables are exogenous to the chosen productivity measures. However, the possibility of two-way causality cannot be completely ruled out, neither can measurement errors in the covariates. Regarding two-way causality, Mamiseishvili and Rosser (2011) found that academics that were more productive in undergraduate teaching had significantly lower job satisfaction. Shin and Jung (2014) found that research support has a significant positive effect on job satisfaction, and Albert et al. (2016) that publication affects job satisfaction positively. Possible measurement error problems are handled by weighting the KIWEST variables with the units' response rates, as explained above.

Conclusion

Three main conclusions follows from this study. First, our results provide new knowledge on the role of job resources for academic productivity, to some extent opposite to our expectations expressed in the Introduction. Second, the results give support to those in the research-teaching nexus debate arguing in favor of a negative relationship between research and teaching. Third, the results have implications for policy, as intervention approaches should be considered carefully with a critical glance at possible adverse effects.

Means targeted towards increasing for instance the average level of administrative and technical support in a department without changing the spread (standard deviation) of the support, would according to our results increase research productivity. Alternatively, changing the distribution of support so those with less support get more, i.e., reducing the spread, but keeping the average level constant, would also increase research productivity. However, if this increase in the average support level also increases the spread of support, the effect on research productivity becomes ambiguous. Such changes in the average level and spread of administrative and technical support have the opposite effects on teaching productivity. Similar reasoning applies regarding engagement.

Performance based funding as part of New Public Management has been emphasized as effective means to improve productivity in higher education institutions. Related to our results, it is interesting to note that on data from the US there seems to be no effects of performance based funding on teaching productivity (Daugherty et al. 2014; Hillman et al. 2015; Shin 2010). However, positive effects on research productivity of performance based funding have been found from American and European data (Aghion et al. 2010), which according to our results strengthen the trade-off between research and teaching. If interventions with the aim of increasing scientific publications are undertaken, one must be aware that this may generate severe adverse effects on teaching output. Hence, targeted means, including carefully considered reward structures, could be very important.

References

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A. & Sapir A. (2010). The governance and performance of universities: evidence from Europe and the US. *Economic Policy*, January, 9-59. doi:10.1111/j.1468-0327.2009.00238.x

Albert , C., Davia, M.A. & Legazpe, N. (2016). Job satisfaction amongst academics: the role of research productivity. *Studies in Higher Education*, DOI: 0.1080/03075079.2016.1255937

Angrist, J.D. & Pischke, J.-S. (2009). *Mostly harmless econometrics* (pp. 64). Princeton, New Jersey, USA: Princeton University Press.

Bakker, A.B., & Demerouti, E. (2007). The Job Demands-Resources model: state of the art. *Journal of Managerial Psychology, 22*(3), 309-328. doi.org/10.1108/02683940710733115

Bakker, A.B., & Demerouti, E. (2008). Towards a model of work engagement. *Career Development international, 13*(3). 209-223. doi.org/10.1108/13620430810870476

Bakker, A., Albrecht, S,. & Leiter, M. (2011). Key questions regarding work engagement. *European Journal of Work and Organizational Psychology, 20*(1), 4-28. http://dx.doi.org/10.1080/1359432X.2010.485352

Bakker, A.B. & Oerlemans, W.G.M. (2012). Subjective well-being in organizations. In Cameron, K.S. and Spreitzer, G.M. (Eds), *The Oxford Handbook of Positive Organizational Scholarship*, Oxford University Press, New York, NY, pp. 178-189.

Bakker, A.B., Demerouti, Eva & Sanz-Vergel, A.I. (2014). Burnout and work engagement: the JD-R approach. *Annual Review of Organizational Psychology and Organizational Behavior, 1*(1), 389-411. https://doi.org/10.1146/annurev-orgpsych-031413-091235

Bentley, P.J. & Kyvik, S. (2013). Individual differences in faculty research time allocations across 13 countries. *Research in Higher Education, 54*(3), 329-348. doi:10.1007/s11162-012-9273-4

Boyd, C.M., Bakker, A.B., Pignata, S., Winefield, A.H., Gillespie, N., & Stough, C. (2011). A longitudinal test of the Job Demands–Resources model among Australian university academics. *Applied Psychology: An International Review, 60*, 112-140. DOI: 10.1111/j.1464-0597.2010.00429.x

Cadez, S., Dimovski, V. & Groff, M.Z. (2015). Research, teaching and performance evaluation in academia: the salience of quality, *Studies in Higher Education*, DOI: 10.1080/03075079.2015.1104659.

Carless, S.A. & Paola, C. (2000). The measurement of Cohesion in work teams. *Small Group Research, 31*(1), 17.

Chen, C.Y. (2015). A study showing research has been valued over teaching in higher education. *Journal of the Scholarship of Teaching and Learning, 15*(3), 15-32. DOI: 10.14434/ josotl.v15i3.13319

Christensen, M., Aronsson, G., Clausen, T., Hakanen, J., & Vivoll Straume, L. (2012). Building engagement and healthy organisations. A test of the Nordic questionnaire on Positive Organisational psychology (N-POP). In S.T. Innstrand (Ed.) *Health promotion – theory and practice* (pp. 25-36). Trondheim: Research Centre for Health promotion and Resources HiST/NTNU.

Christian, M. S., Garza, A. S., & Slaughter, J. E. (2011). Work engagement: A quantitative review and test of its relations with task and contextual performance. *Personnel Psychology, 64*, 89-136. doi: 10.1111/j.1744-6570.2010.01203.x

Cronbach, L.J. (1951). Coefficient apha and the internal structure of tests. Psychometrika, 16(3), 297-334.

Cummings, W.K. & Shin, J.C (2014). Teaching and research in contemporary higher education: An overview (pp.1-12). In Shin, J.C., Arimoto, A., Cummings, W.K & Teichler, U. (2014). *Teaching and research in contemporary higher education. Systems, activities and Rewards*, Springer.

Deci, E. L., & Ryan, R. M. (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268.

Demerouti, E., Mostert, K., & Bakker, A.B. (2010). Burnout and work engagement: A thorough investigation of the independency of both constructs. *Journal of Occupational Health Psychology, 15*(3), 209–222 http://dx.doi.org/10.1037/a0019408

Demerouti, E., & Cropanzano, R. (2010). From thought to action: Employee work engagement and job performance. In A.B. Bakker & M.P. Leiter (Eds.), *Work engagement: A handbook of essential theory and research* (pp. 147-163). New York: Psychology Press.

Dougherty, K.J., Jones, S.M., Lahr, H., Natow, R.S. & Reddy, V. (2014). Performance funding for higher education: forms, origins, impacts, and futures. *The Annals of the American Academy, 655*, 163-184.

Dubbelt, L., Rispens, S, & Demerouti, (2016). Work engagement and research output among female and male scientists. *Journal of Personnel Psychology, 15*(2), 55-65. DOI:10.1027/1866-5888/a000150

Edgar, F. & Geare, A. (2013). Factors influencing university research performance. *Studies in Higher Education*, 38(5), 774-792. doi.org/10.1080/03075079.2011.601811

Esdar, W., Gorges, J. & Wild, E. (2016). The role of basic need satisfaction for junior academics' goal conflicts and teaching motivation. *Higher Education*, 72, 175-190. doi:10.1007/s10734-015-9944-0

Fairweather, J.S. (2005). Beyond the rhetoric: Trends in the relative value of teaching and research in faculty salaries. *The Journal of Higher Education, 76*(4), 401-422. Doi.org/10.1353/jhe.2005.0027

Fredman, N. & Doughney, J. (2012). Academic dissatisfaction, managerial change and neo-liberalism. *Higher Education 64(1)* 41-58. doi:10.1007/s10734-011-9479-y

Gappa, J.M., Austin, A.E., & Trice, A.G. (2007). *Rethinking faculty work: Higher education's strategic imperative.* San Francisco, CA: Jossey-Bass.

Galbraith, C.S. & Merrill, G.B. (2015). Faculty research productivity and standardized student learning outcomes in a university teaching environment: a Bayesian analysis of relationships. *Studies in Higher Education*, 37(4), 469-480. doi.org/10.1080/03075079.2010.523782

Gautier, A. & Wauthy, X. (2007). Teaching versus research: A multi-tasking approach to multi-department universities. *European Economic Review*, 51, 273-295. doi:10.1016/j.euroecorev.2006.02.006

Geschwind, L. & Broström, A. (2015). Managing the teaching-research nexus: ideals and practice in research-oriented universities. *Higher Education Research & Development, 34*(1), 60-73. http://dx.doi.org/10.1080/07294360.2014.934332

Halbesleben, J. R. B., & Wheeler, A. R. (2008). The relative roles of engagement and embeddedness in predicting job performance and intention to leave. *Work & Stress, 22,* 242-256. http://dx.doi.org/10.1080/02678370802383962

Hattie, J. & Marsh, H.W. (1996). The relationship between research and teaching: a meta-analysis. *Review of Educational Research, 66*(4), 507-42. Doi: 10.12691/education-4-6-2

Heijstra, T.M., Steinthorsdóttir, F.S., & Einarsdóttir, T. (2016). Academic career making and the double-edged role of academic housework, *Gender and Education* http://dx.doi.org/10.1080/09540253.2016.1171825

Hillman, N.W., Tandberg, D.A. & Fryar, A.H. (2015). Evaluating the impacts of 'new' performance funding in higher education. *Educational Evaluation and Policy Analysis, 37*(4), 501-519. doi:10.3102/0162373714560224

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist, 44*(3), 513-524.

Hobfoll, S. E. (2001). The influence of culture, community, and the nested-self in the stress process: Advancing conservation of resources theory. *Applied Psychology, 50*(3), 337-421. doi:10.1111/1464-0597.00062

Horodnic, I.A., & Zait. A. (2015). Motivation and resesarch prouctivity in a university system undergoing transition. *Research Evaluation 24*(3), 282-292. DOI: https://doi.org/10.1093/reseval/rvv010

Horta, H., Dautel, V. & Veloso, F.M. (2012). An output perpective on the teaching-research nexus: an analysis focusing on the United States higher education system. *Studies in Higher Education*, 37(2), 171-187. http://dx.doi.org/10.1080/03075079.2010.503268

Innstrand, S. T., Christensen, M., Undebakke, K. G., & Svarva, K. (2015). The presentation and preliminary validation of KIWEST using a large sample of Norwegian university staff. *Scandinavian Journal of Public Health*, *43*(8), 855-866. doi:10.1177/1403494815600562

Innstrand, S.T., Langballe, E.M., Falkum, E., & Aasland, O.G. (2011). Exploring within- and between-gender differences in burnout: 8 different occupational groups. *International Archives of Occupational and Environmental Health, 84*(7), 813-824. doi: 10.1007/s00420-011-0667-y.

Leišytė, L., Enders, J. & de Boer, H. (2009). The balance between teaching and research in Dutch and English universities in the context of university governance reforms. *Higher Education, 58*, 619-635. doi:10.1007/s10734-009-9213-1

Leišytė, L. (2016). New public management and research productivity – a precarious state of affairs of academic work in the Netherlands. *Studies in Higher Education, 41*(5), 828-846. http://dx.doi.org/10.1080/03075079.2016.1147721

Macfarlane, B., & Hughes, G. (2009). Turning teachers into academics? The role of educational development in fostering synergy between teaching and research *Innovations in Education and Teaching International,46*(1), 5-14. DOI: 10.1080/14703290802646214

Mamiseishvili, K., & Rosser, V.J. (2011). Examining the relationship between faculty productivity and job satisfaction. *Journal of the Professoriate 5*(2), 100-132.

Mathieu, J. E., Kukenberger, M. R., D'Innocenzo, L., Reilly, G. (2015) Modeling reciprocal team cohesion–performance relationships, as impacted by shared leadership and members' competence. *Journal of Applied Psychology, 100(3),* 713-734. http://dx.doi.org/10.1037/a0038898

Nielsen, K., Lackmaker, J., Känsälä, M., Saari, E., Isaksson, K., B., & Nielsen, M. (2015) *Resource: A literature review on the relationship between resources, employees' well-being and performance with specific attention to Nordic issues.* TemaNord, Denmark. ISBN 978-92-893-3941-4.

Näswall, K., Låstad, L., Vetting, T-S., Larsson, R. Richter, A., & Sverke, M. (2010). *Job insecurity from a gender perspective: Data collection and psychometric properties report* (vol. 1). Stockholm: Stockholm University.

Rich, B.R., LePine, J.A., Crawford, E.R. (2010). Job Engagement: Antecedents and effects on job performance. *Academy of Management Journal, 53*(3), 617-635. Doi:10.5465/AMJ.2010.51468988

Salanova, M., Agut, S. & Peiró, J.M. (2005). Linking organizational resources and work engagement to employee performance and customer loyalty: The mediation of service climate. *Journal of Applied Psychology, 90*, 1217-1227. http://dx.doi.org/10.1037/0021-9010.90.6.1217

Sandström, U & van den Besselaar, P. (2016). Quantity and/or quality? The importance of publishing many papers. PLoS ONE, 11(11). DOI: 10.1371/journal.pone.0166149.

Schaufeli, W.B., Salanova, M., González-Romá, V., & Bakker, A.B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies, 3*, 71-92.

Sekerka, L. E., Vacharkulksemsuk, T., & Fredrickson, B. L. (2012). Positive Emotions: Broadening and Building Upward Spirals of Sustainable Enterprise. In *The Oxford Handbook of Positive Organizational Scholarship* Oxford University Press. DOI: 10.1093/oxfordhb/9780199734610.013.0013

Shin, J.C. (2010). Impacts of performance-based accountability on institutional performance in the U.S. *Higher Education, 60(1),* 47-68. DOI: 10.1007/s10734-009-9285-y

Shin, J.C. & Jung, J. (2014). Academics job satisfaction and job stress across countries in the changing academic environments. *Higher Education 67*(5), 603-620. doi:10.1007/s10734-013-9668-y

Su, S. & Baird, K. (2017). The impact of collegiality amongst Australian accounting academics on work-related attitudes and academic performance. *Studies in Higher Education*, 42(3), 411-427. http://dx.doi.org/10.1080/03075079.2015.1049142

Solon, G., Haider, S.J. & Wooldridge, J.M. (2015). What are we weighting for? *Journal of Human Resources*, 50(2), 301-316. DOI: 10.3386/w18859

Teichler, U., Arimoto, A. & Cummings, W. (2013). *The changing academic profession*. Springer.

Tight, M. (2010). Are academic workloads increasing? The post-war survey evidence in the UK. *Higher Education Quarterly*, 64(2), 200-215. DOI: 10.1111/j.1468-2273.2009.00433.x

Visser-Wijnveen, G.J., Stes, A. & Van Petegem, P. (2012) Development and validation of a questionnaire measuring teachers' motivations for teaching in higher education. *Higher Education, 64*(3) 421-436. doi:10.1007/s10734-011-9502-3

Xanthopoulou, D., Bakker, A.B., Demerouti, E., & Schaufeli, W.B. (2009). Work engagement and financial returns: A diary study on the role of job and personal resources. *Journal of Occupational and Organizational Psychology, 82,* 183-200. http://dx.doi.org/10.1348/096317908X285633

Xanthopoulou, D., Bakker, A.B., Heuven, E., Demerouti, E., & Schaufeli, W.B. (2008). Working in the sky: A diary study on work engagement among flight attendants. *Journal of Occupational Health Psychology, 13,* 345-356. dx.doi.org/10.1037/1076-8998.13.4.345, hdl.handle.net/1765/14496

Tables

Table 1 Summary statistics

Variables	N	Mean	SD	Min	Max
Panel A					
Rate of publication points (RPP_j)	53	2.04	1.08	0.10	5.26
Rate of credit points (RCP_j)	48	9.71	5.37	0.52	23.62
Employees in permanent academic positions (man-year)	53	28.00	16.48	6.2	85.86
Number of Ph.D. students	53	21.28	17.57	2	62
Share of employees in permanent academic positions (%)	53	56.69	14.07	31.45	84.86
Share of post.docs and adjunct professors (%)	53	8.45	4.53	0	17.55
Share of ph.d. students (%)	53	34.86	11.76	13.97	59.58
Number of Master candidates	48	51.52	39.08	1	158
Average age of persons in permanent academic positions and adjunct professors (man year)	53	49.24	3.65	40.34	57.82
Standard deviation of average age	53	10.52	1.70	6.11	13.96
Share of women of all permanent academic staff (%)	53	36.33	17.47	9.52	71.43
Share of employment in permanent administrative/technical positions	53	17.93	8.61	5.88	50
KIWEST response rate (percent)	53	49.32	16.61	20.63	95
Panel B					
Response rate weight (ω)	*53*	*1.00*	*0.34*	*0.42*	*1.93*
Avg(Vigor)·ω	*53*	*3.37*	*1.20*	*1.48*	*7.19*
SD(Vigor)·ω	*53*	*0.71*	*0.22*	*0.27*	*1.31*
Avg(Dedication)·ω	*53*	*3.85*	*1.35*	*1.62*	*7.91*
SD(Dedication)·ω	*53*	*0.68*	*0.22*	*0.29*	*1.25*
Avg(Autonomy)·ω	*53*	*3.88*	*1.30*	*1.76*	*7.92*
SD(Autonomy)·ω	*53*	*0.66*	*0.26*	*0.24*	*1.35*
Avg(Support)·ω	*53*	*3.56*	*1.30*	*1.60*	*7.33*
SD(Support)·ω	*53*	*0.98*	*0.37*	*0.30*	*2.38*
Avg(Cohesion)·ω	*53*	*3.42*	*1.17*	*1.59*	*6.84*
SD(Cohesion ·ω	*53*	*0.81*	*0.32*	*0.25*	*1.75*

Table 2 Estimated parameters of interest with different sets of control variables

Covariates		Publication rates, RPP (N=53)			Rates of credit points, RCP (N=48)		
		Model 1	**Model 2**	**Model 3[a)]**	**Model 1**	**Model 2**	**Model 3**
Vigor (Engagement)	α	0.25**	0.19**	0.15	-0.15***	- 0.15**	-0.07
		(0.12)	(0.10)	(0.13)	(0.06)	(0.06)	(0.06)
	β	-1.39***	-0.79**	-0.52	0.92***	0.92***	1.01***
		(0.57)	(0.46)	(0.49)	(0.30)	(0.31)	(0.22)
	R^2	0.40	0.55	0.56	0.85	0.85	0.92
Dedication (Engagement)	α	0.07	0.09*	0.06	-0.12***	- 0.10**	-0.02
		(0.08)	(0.07)	(0.09)	(0.05)	(0.05)	(0.06)
	β	-0.34	- 0.39	-0.27	0.77***	0.74***	0.76***
		(0.48)	(0.45)	(0.65)	(0.28)	(0.28)	(0.18)
	R^2	0.30	0.52	0.55	0.84	0.85	0.91
Autonomy	α	0.01	- 0.001	-0.03	-0.09**	- 0.07	0.04
		(0.08)	(0.09)	(0.09)	(0.05)	(0.07)	(0.07)
	β	0.29	0.41	0.59	0.45*	0.38	0.24
		(0.38)	(0.39)	(0.62)	(0.27)	(0.32)	(0.33)
	R^2	0.30	0.52	0.56	0.82	0.83	0.89
Support	α	0.23**	0.16**	0.22**	-0.11**	- 0.10**	-0.01
		(0.10)	(0.09)	(0.12)	(0.05)	(0.06)	(0.07)
	β	-0.65**	- 0.35*	-0.67**	0.44**	0.46**	0.37**
		(0.30)	(0.24)	(0.31)	(0.19)	(0.20)	(0.20)
	R^2	0.40	0.55	0.60	0.84	0.84	0.90
Cohesion	α	0.15	0.08	0.07	-0.12**	- 0.11*	-0.06
		(0.13)	(0.11)	(0.14)	(0.06)	(0.07)	(0.05)
	β	-0.40	- 0.10	0.07	0.38**	0.42**	0.56***
		(0.45)	(0.37)	(0.37)	(0.21)	(0.22)	(0.19)
	R^2	0.31	0.51	0.54	0.83	0.83	0.91

Model 1: intercept and faculty dummies. ***Model 2***: Model 1 plus log of permanent academic positions and log of number of PhD students. ***Model 3***: Model 1 plus log of number of master candidates, share of Ph.D.-students, share of permanent academic positions, share of women in all academic positions, average age of employees in all academic positions and its standard deviation, and share of employees in administrative positions.

Statistical significance: Robust standard errors in parentheses. One-tail tests: H_0: $\alpha=0$ against H_1: $\alpha>0$ and H_0: $\beta=0$ against H_1: $\beta<0$, or H_0: $\alpha=0$ against H_1: $\alpha<0$ and H_0: $\beta=0$ against H_1: $\beta>0$. Levels of significance: * = 10% ($t^* = \pm 1.30$), ** = 5% ($t^* = \pm 1.68$), and *** = 1% ($t^* = \pm 2.42$).

a) N=48 because number of master students are included, cf. table 1.

Table 3 Average elasticities of *Vigor*, *Dedication* and *Support* with respect to the productivity variables

Productivity variables:		*Vigor*	*Dedication*	*Support*
Rate of publication points	$AvgEl_{Avg}$	0.64	0.35	0.57
	$AvgEl_{SD}$	-0.56	-0.27	-0.34
Rate of credit points	$AvgEl_{Avg}$	-0.51	-0.38	-0.35
	$AvgEl_{SD}$	0.65	0.51	0.45