This document is the Accepted Manuscript version of a Published Work that appeared in final form in Studies in Higher Education. To access the final edited and published work see https://doi.org/10.1080/03075079.2024.2307965.

Explaining academic researchers' performance from the Ability–Motivation–Opportunity (AMO) perspective

Claudia Benítez-Núñez
University of Las Palmas de Gran Canaria
Institute for Technological Development and Innovation in Communications (IDeTIC)
claudia.benitez@ulpgc.es
https://orcid.org/0000-0001-9144-5299

Nieves Lidia Díaz-Díaz
University of Las Palmas de Gran Canaria
nieves.diaz@ulpgc.es
https://orcid.org/0000-0002-8752-6157

José Luis Ballesteros-Rodríguez
University of Las Palmas de Gran Canaria
Institute for Technological Development and Innovation in Communications (IDeTIC)
joseluis.ballesteros@ulpgc.es
https://orcid.org/0000-0002-3934-2679

Petra de Saá-Pérez
University of Las Palmas de Gran Canaria
Institute for Technological Development and Innovation in Communications (IDeTIC)
petra.desaaperez@ulpgc.es
https://orcid.org/0000-0002-3945-5454

Explaining academic researchers' performance from the Ability–Motivation–Opportunity (AMO) perspective

ABSTRACT

Drawing from the Ability–Motivation–Opportunity (AMO) framework, this paper aims to study the influence of academic researchers' ability, intrinsic and extrinsic motivation, and opportunity on their performance. We conducted an empirical analysis using a sample of 607 academic researchers to examine the relationships between the three AMO dimensions and scientific performance. The findings reveal that academic researchers' ability, intrinsic motivation, and opportunity are positively associated to their scientific performance, whereas extrinsic motivation has a negative nonlinear association. The results also show two- and three-way interactions between ability, motivation, and opportunity. This paper makes an essential contribution to the literature by showing the linear and nonlinear effects of AMO dimensions on academic researchers' performance. Thus, the study highlights the importance of each AMO dimension in the academic context, offering broad-scale guidance about which decisions on employee relations will advance scientific performance at universities.

Keywords: AMO model, research performance, higher education

1. Introduction

Universities worldwide have changed considerably due to the intense competitive pressures of performance evaluation (Wang et al., 2018). National research assessments, international rankings, and changes in funding patterns, such as the incentives for research impact (Horta, 2022; Mudrak et al., 2018), have led universities to pay more attention to the quality and quantity of research and to expect an increase in the number of active researchers (Brew et al., 2016, Nygaard, 2017). Degn et al. (2018) coined the term "academic capitalism" for this new context, which affects researchers because they face increasing pressure to obtain measurable results in a competitive environment, where they must cooperate and compete with other colleagues to achieve better scientific results (Le Roy & Fernandez, 2015). As Horta and Li (2022) point out, "doctoral students commonly viewed their peers both as competitors and as benchmarks for measuring their chances in the academic labour market" (p. 13). Furthermore, due to the multidimensional nature of scientific outputs, the importance of analysing researcher

performance remains a topic of great interest (Goel & Göktepe-Hultén, 2020; Jørgensen & Hanssen, 2018).

Previous studies reveal that academic researchers' performance depends on multiple internal or external factors, such as individual ability, work experience, motivation, formal alliance network, resources, environmental characteristics, and strategic research agendas (e.g., Albert et al., 2018; Christensen et al., 2020; Horta & Santos, 2016; Jørgensen & Hanssen, 2016; Kyvik & Aksnes, 2015; Stupnisky et al., 2023). Nevertheless, few studies have analysed how these dimensions can simultaneously influence academic researchers' performance from the Ability–Motivation–Opportunity (AMO) perspective.

Thus, in line with authors who suggest bringing theories of organisational behaviour to understand the scientific context (De Frutos-Belizón et al., 2019; Walsh & Lee, 2015), this paper considers that the AMO perspective can be appropriate for analysing academic researchers' performance by focusing on aspects such as the skills they possess (Corley et al., 2019; Ulrich & Dash, 2013; Van Iddekinge et al., 2018), the motivation they present (Kyvik & Aksnes, 2015; Olaya-Escobar et al., 2017), and the opportunities they are given (Lawson et al., 2021; Ulrich & Dash, 2013). Therefore, taking into account the lack of studies analysing researchers' performance considering the dimensions of the AMO model and their interactions, the present study focuses on the following research question: How can we explain the performance of academic researchers from the AMO perspective, and what are the critical interactions among ability, motivation, and opportunity factors in the Spanish academic research context?

By using the AMO perspective, this article makes a novel contribution to how universities should direct their efforts to obtain better researcher performance because it reveals the importance of each AMO dimension (ability, motivation, opportunity) as substitute or complement factors in explaining academics' performance. An important contribution of this paper is to describe how

academic researchers' ability, motivation and opportunity interact to improve scientific performance in a nonlinear way. This study therefore contributes to the literature by addressing the interactions between variables in contemporary AMO research in line with Kellner et al. (2019) suggestion. Moreover, the divergence of our results from past research highlights the importance of considering the research context in studying the AMO model as other authors have stated (Bos-Nehles et al., 2013; Kellner et al., 2019; McDermott et al., 2019). The results of our study not only advance research into the AMO model but also could offer policymakers broad-scale guidance on the decisions regarding employee relations to prioritise investments in academic researchers' ability, motivation, and opportunity that would enhance scientific performance at universities (Pak et al., 2019).

The paper is structured as follows. After the introduction, the following section summarises the theoretical background that justifies the hypotheses based on a review of the AMO literature adapted to the higher education context. The third section addresses the characteristics of the Spanish university context. Then, the fourth section describes the methodological aspects of the study, including the sample, the questionnaire's design, and the scales' validation. The fifth section shows the results, and the sixth section presents the main conclusions and discussions, practical implications, limitations, and future research lines.

2. Theoretical background

2.1. The proposed AMO model

The AMO model is a perspective for studying employees' behaviours that highlights the role of their abilities and motivation from a psychosocial perspective. It also considers the opportunities in the group and organisational context as elements that determine employee performance (Beltrán-Martín & Bou-Llusar, 2018). The ability dimension refers to the psychological and

cognitive capabilities of a person to carry out a task (Wang et al., 2019) and, therefore, encompasses what is known as human capital, which refers to "the internal capacity derived from individual endowments or investments" (Corley et al., 2019, p. 683). Motivation is the psychological characteristics that lead an individual to perform a task (Wang et al., 2019). It depends on the internal and external factors that determine a person's actions and can result in negative or positive performance. Thus, it is frequently conceptualised as intrinsic or extrinsic motivation, based on whether the psychological mechanisms that explain the behaviour are intrinsic (e.g., personal satisfaction and self-realisation) or extrinsic (e.g., economic rewards and promotion) to the individual (Deci & Ryan, 2008). Finally, opportunities refer to the resources organisations make available to employees to carry out their work and that make it possible to perform tasks (Marin-Garcia & Martinez-Tomas, 2016).

Although the literature on the AMO model shows a consensus in assuming that employees' performance depends on their ability, motivation, and opportunity (Boxall & Purcell, 2003), how these dimensions and their interactions are related to performance remains unclear (Kim et al., 2015; Wang et al., 2019). In this vein, the classic perspective of the AMO model proposes a mutual relationship between the three dimensions so that if one dimension were absent or scarce, it would neutralise or reduce the effect of the others on performance (Bos-Nehles et al., 2013). This is a more extreme position because, to perform, individuals must have a certain level of research abilities, be motivated, and have opportunities to carry out their tasks (Kim et al., 2015). However, along with the traditional vision that justifies the complementary nature of the three dimensions of the AMO model, other proposals highlight the independent role of each one. In this case, each dimension has a direct effect, irrespective of the rest of the model's dimensions. Fostering any of them would increase the employee's performance levels. Those who support the direct model believe this proposal is reasonable because when one of the dimensions is absent, the others can still positively affect performance (Boxall & Purcell, 2003). Finally, according to

other authors, ability is the critical dimension in explaining an employee's performance, whereas motivation and opportunity alone cannot directly influence performance but only increase or decrease the effect of ability (Bos-Nehles et al., 2013). Therefore, the relationship between the AMO model dimensions is a complex issue that requires further research (Kellner et al., 2019; Kim et al., 2015; Wang et al., 2019).

2.2. The AMO model in the academic research context

2.2.1. Academic researchers' performance

The study of academic researchers' performance is a topic of great interest that has been explored in the literature from different perspectives (Ballesteros-Rodríguez et al., 2022). Academic researchers' performance has often been measured by the number of publications throughout their careers. According to Horta et al. (2022), in the context of "publish or perish", publication is considered a relevant dimension of scientific activity and a priority, as it is a requirement for promotion and a way to gain competitive research funds. Moreover, publishing is a source of esteem for researchers because it represents peer recognition of scientific excellence (Carli et al., 2019; Sabharwal & Hu, 2013). Within the scientific community, researchers with a more significant number of publications can be promoted and obtain other nonpecuniary benefits like research freedom (Christensen et al., 2020; Horodnic & Zait, 2015). In addition, researchers can consider publishing as a mechanism to transfer knowledge to the scientific community and society because publications are a valuable input for follow-up research (Sauermann & Roach, 2014).

In general terms, the objective of research activity is to produce knowledge, either tangible (e.g., publications) or intangible (e.g., tacit knowledge) (Abramo & D'Angelo, 2014). However,

following these authors, the researchers' performance can be measured in different ways depending on the goals pursued, so different indicators could be used. Thus, a distinction is made between quantity (measured by the number of publications) and quality (measured by citation counts). According to Waltman (2016), these impact indicators play a significant role in assessing scientific performance, and their use has gained acceptance in recent decades as they provide information about the relevance of publications. The journal impact factor and the h-index are among the most well-known impact indicators. Balancing quantity and quality can be challenging, as there is increasing pressure to produce high-quality work, and at the same time, the publication may be delayed due to review processes (Nygaard, 2017). Therefore, academic career success requires effort, time, and dedication to achieve the expected performance in terms of both quantity and quality (Horta et al., 2022).

Previous studies have analysed the determinants of researchers' performance, focusing on aspects that range from individual researchers' characteristics to the institutional context, collaboration patterns, and reward systems, among others (Albert et al., 2018; Brew et al., 2016; Christensen et al., 2020; Dietz & Bozeman, 2005; Goel & Göktepe-Hulten, 2020; Kyvik & Aksnes, 2015; Seibert et al., 2017). However, as Seibert et al. (2017) point out, "Yet there is much to be learned about the research process itself and the way specific research strategies enable individuals to produce high-quality academic research" (p. 104). In that line, our work suggests that providing evidence regarding how researchers' ability, motivation, and opportunities play a role in determining scientific performance could significantly contribute to the field by giving a strategic behavioural perspective.

Academic researchers' abilities

The human capital theory argues that employees' performance depends on having the necessary capabilities, knowledge, and skills to successfully do their job (Van Iddekinge et al., 2018; Wright

& McMahan, 2011). In the academic research context, according to the scientific and technical human capital model, researcher human capital is defined as "the sum of an individual researcher's professional network ties, technical knowledge and skills, and resources broadly defined" (Bozeman et al., 2001, p. 636). Lee et al. (2010) consider that researcher human capital is composed of generic and specific knowledge, as well as abilities, such as applying information technologies and data processing, analytical skills, report writing, project management, and problem-solving. Several studies have analysed the individual attributes of researchers, as their human capital is an intangible resource that can impact scientific performance (Corley et al., 2019). Thus, Ulrich and Dash (2013) emphasise the importance of having a solid basis of scientific knowledge and skills. Based on this framework, De Frutos-Belizón et al. (2020) state that researchers' human capital is a critical factor in scientific performance.

Furthermore, it is worth noting that past performance can predict future behaviour. Following Carli et al. (2019), successfully completing a research task improves knowledge and increases the level of skills, as past research excellence indicates the ability to achieve research excellence in the future. This is based on the argument that the researchers who have published papers and have undergone review processes are likely to develop a set of abilities that they would not have without that prior experience.

Therefore, in this study, we consider that the ability dimension represents researchers' cognitive skills, knowledge, and craft skills. That is, the human capital of academic researchers refers to their internal capacity (Munshaw et al., 2019) to acquire tacit and explicit knowledge about the theories and methodologies of their scientific discipline, as well as the specific scientific competencies that allow them to identify research problems, formulate hypotheses, analyse data, and communicate their results (Ulrich & Dash, 2013).

Academic researchers' motivation

In the context of academic research activity, many studies have attempted to determine the effect of motivation on scientific performance, analysing internal and external motivation factors following the self-determination theory proposed by Deci and Ryan (2008). Considering this theory, motivation arises from the interplay between external factors and individuals' intrinsic needs for self-determination and autonomy. Thus, the intrinsic factors that motivate researchers are those nonmonetary aspects related to the enjoyment or pleasure of carrying out a challenging activity as part of self-expression and personal satisfaction with the research activity itself (Christensen et al., 2020; Stupnisky et al., 2019), while the traditional factors that explain researchers' extrinsic motivation are remuneration, desire for promotion, and working conditions (Horodnic & Zait, 2015; Ryan & Berbegal-Mirabent, 2016; Sondari et al., 2016; Stupnisky et al., 2023).

According to Lam's (2011) study, academic researchers' motivation can be influenced by a mix of factors such as financial rewards (gold); peer recognition associated with fame and reputation (ribbon) that can subsequently lead to other rewards such as professional promotion; or satisfaction by achieving new discoveries, advancing science, and engaging in challenging activities (puzzle). The author concludes that when examining scientists' performance, consideration should be given not only to extrinsic rewards, but also social and affective aspects related to intrinsic motivation, as most scientists are motivated by the "ribbon" rewards and the satisfaction of solving the "puzzle." Other authors, such as Horodnic and Zait (2015), discovered that intrinsic motivation positively influenced researchers' performance, while extrinsic motivation had a negative effect. Finally, Peng and Gao (2019) stated that extrinsic motivation is not enough to ensure persistence in the research process.

Therefore, considering the results of previous studies, we argue that the distinction between internal and external motivation should be used to gain a better understanding of academic researchers' performance from the AMO perspective.

Academic researchers' opportunity

Opportunity reflects the means or resources that encourage employees to make an effort to develop their abilities to improve their performance (Jiang et al., 2013). According to Jiang et al. (2012), employees' performance depends on their opportunities because "employees who are motivated, but lack the opportunities to use their abilities, will likely display lower contributions than similar employees provided with such opportunities" (pp. 78-77).

In the academic context, researchers demand specific inputs, such as physical and economic resources, scientific and support staff, and so on, to carry out their work. Following Han et al. (2020), job resources are related to researchers' positive performance because when researchers have the resources to carry out their work, they will be more engaged and, consequently, improve their performance. In this regard, a significant element in the scientific context is the role of technological resources and information and communication systems (e.g., computers, software, bibliographical repositories, databases) because these resources improve the conditions of the research environment and modify the possibilities of managing knowledge by facilitating scientific performance (Kyvik & Aksnes, 2015). Moreover, financial funds are also considered a resource for research because, as several studies have shown, sponsored academics are more highly cited and published in higher-impact journals (Hottenrott & Lawson, 2017; Wang et al., 2018). Besides, the financial resources required to carry out research activity are also an essential organisational aspect that influences scientific results by facilitating the development of human research capital (Kyvik & Aksnes, 2015). In countries where universities have a low level of

research funding to run labs and hire doctoral and postdoctoral staff, competitive funding is increasingly used to support the human and physical capital required to perform (Ganguli, 2017).

Therefore, financial resources to invest in human capital and provide the infrastructures required to develop research activity could be considered an opportunity to improve scientific results (Amara et al., 2015; Lawson et al., 2021; Sutherland, 2017).

2.3. Hypothesis development

Considering the above arguments that justify the relevance of the AMO dimensions in the academic research context, in this paper, we use this model to analyse how the researchers' human capital (ability), motivation, and opportunity operate to explain researchers' performance as substitute or complement factors (Bos-Nehles et al., 2023). First, we will consider that academic researchers' ability, motivation, and opportunity are positively related to their performance directly. Based on our reasoning, the following hypotheses are presented:

Hypothesis 1. Researchers' ability is positively associated to their scientific performance.

Hypothesis 2. Researchers' motivation is positively associated to their scientific performance.

Hypothesis 3. Researchers' opportunity is positively associated to their scientific performance.

Following the logic of the moderating model, academics must have high levels of research abilities, be motivated, and have enough opportunities to carry out their activities to achieve better scientific performance (Bos-Nehles et al., 2023). In that sense, this model establishes a configuration where each dimension supports the other two in a "virtuous cycle" (Kim et al., 2015). Thus, researchers' motivation and opportunity would influence their ability (Bos-Nehles

et al., 2013). If academics have high motivation levels, they would be encouraged to strengthen their research abilities and increase their scientific performance. Moreover, a supportive research environment fosters academics' efforts to apply their research expertise abilities, leading to higher engagement in achieving their research objectives. The following hypotheses are therefore proposed:

Hypothesis 4. Researchers' motivation positively moderates the association between their ability and scientific performance.

Hypothesis 5. Researchers' opportunities positively moderate the association between their ability and scientific performance.

Hypothesis 6. Researchers' opportunities positively moderate the association between their motivation and scientific performance.

At the same time, a lack of opportunity may lead to academics' frustrated efforts to apply their research expertise even with high abilities and motivation, thereby reducing their performance (Amara et al., 2015). Similarly, academics with high research expertise may not apply it without motivation, leading to poor performance (Van Iddekinge et al., 2018). In such a situation, even with great research opportunities, academics cannot put their abilities to good use. Finally, in the absence of research abilities, even highly motivated academics with several opportunities to apply their knowledge are likely to achieve low scientific performance (Corley et al., 2019). In contrast, academics with simultaneously high levels of research abilities, motivation, and opportunity would achieve higher scientific performance, justifying the complementary nature of the three AMO dimensions (e.g., Hong & Gajendran, 2018; Kim et al., 2015; Wang et al., 2019). Therefore, the following hypothesis is proposed:

Hypothesis 7. There is a positive three-way association between researchers' ability, motivation, and opportunity and their scientific performance.

3. The Spanish university system

In Spain, academics have three essential functions — teaching, research, and knowledge transfer — that have been affected by substantial reforms initiated in 2001 by the Organic Law of Universities (LOU) (6/2001). Due to those reforms, higher education institutions in Spain have gained greater autonomy, with research performance assuming a pivotal role in career progression, in line with other European countries. According to Castro-Ceacero et al. (2023), the model of higher education institutions in Spain has moved from a bureaucratic and academic model based on strong administrative dependence and internal control through collegiate structures towards a new model based on closer links between the university, labour market, and economic systems. This new way "to respond to the need of the economy in terms of scientific and economic innovation, has created the basis for a shift to a more competitive and market-oriented university system" (Ion & Castro-Ceacero, 2017, p. 312).

Research is the function of Spanish higher education institutions that have most and best adapted to a marked-oriented model where universities are externally evaluated based on research output (Castro-Ceacero et al., 2023). Spanish universities "have established systems to promote research and scholarship, such as transfer networks, systematic support for publication, project presentations and visibility of successful results" (Ion & Castro-Ceacero, 2017, p. 312). This shift has contributed to a notable improvement in the quantity and quality of scientific output. Reports from the Spanish Foundation for Science and Technology show that in the period 2006–2019, the impact of Spanish scientific publications surpassed the global average, being cited approximately 20% more frequently than the world average. Furthermore, data from the Elsevier Scopus database indicate that a significant portion (59.8%) of Spanish scientific publications appear in top-tier journals in their respective fields (De Frutos-Belizón et al., 2023).

Nevertheless, due to these changes, Spanish academic researchers have been subjected to significant pressure from external accreditation agencies and internal university policies, suffering high stress levels due to market-oriented managerial reforms that enhance the achievement of *sexenios* as essential merit for promotion (Albert et al., 2018). The *sexenio* is a voluntary assessment of a researcher's five most relevant scientific merits (e.g., the publication of scientific results in high-impact journals) that takes place every six years. It represents a monetary bonus for researchers, added prestige to their academic careers, and a chance of success in promotion and fundraising. This aspect is particularly important in countries like Spain, where public universities depend on external funding to run labs and hire doctoral and postdoctoral staff.

4. Methodology

4.1. Sample and data

To achieve the proposed objectives, we conducted a quantitative study with a sample of academics from Spanish public universities. The information gathering was carried out through an online survey between March and November 2017, sent to all the email addresses available on universities' websites. We included a cover letter to explain the purpose of the study. To ensure the highest number of responses, up to three reminders were sent. A total of 1,290 academics accepted the invitation to participate, but many responses were excluded for lack of data. A total of 824 researchers provided subjective information regarding their scientific performance, and although we guaranteed confidentiality, only 607 provided their identity, which we consider necessary for bibliometric retrieval. Evaluating the trade-off between sample size and using an objective measure of performance, we decided that the latter option would provide more robustness to the analysis. Thus, the final sample was comprised of 607 Spanish academic researchers. Since the sample deals with a finite population, and according to the simple random sampling criteria, for a confidence level of 95.5 (two sigmas) and in the least favourable

hypothesis (p=q=50), the sampling error was ±3.9%. The sample was formed by academic researchers respecting the gender and age quotas of the Spanish academic population (Spanish Government, 2019). Thus, the mean age of the academics in the participating and analytical sample was 50.3 and 48.47 years, respectively, quite similar to the population[1] (49.6 years on average). In terms of gender, women comprised 40.8% of staff at Spanish public universities, and they comprised 40.7% of the participating sample and 39.70% of our analytical sample.

4.2. Measures

Performance

In this study, scientific performance is measured by the number of articles published by researchers in journals included in the Scopus database (Santos et al., 2022). Moreover, the final model is also estimated with the h-index in order to consider not only the quantity but also the quality of scientific performance.

Ability

To measure this variable, we used 11 items in a five-point Likert scale adapted from De Frutos-Belizón et al. (2019). This scale was created to capture the research capabilities of Spanish academics based on a previous Delphi study. Researchers rate their level of agreement with several statements regarding the knowledge and skills needed to perform the research task, for example, "I have the required capacity to obtain and manage research information" and "I know how to conduct research (thesis, research projects, etc.)." The validity and reliability of the construct are tested through exploratory factorial analysis, where the factor loadings are above 0.7, and Cronbach's alpha value is 0.918 (see Appendix 1).

[1] According to statistics, the number of academic staff in Spanish public universities was 102,297 (Spanish Government, 2019).

Motivation

Researchers' motivation is measured through a scale designed by Ballesteros-Rodríguez et al. (2020). It is a six-item intrinsic and extrinsic motivation scale adapted to the Spanish university context. Examples of the items used are "I research for my own personal satisfaction" and "I research for financial reward." After performing factorial analyses and testing the validity and reliability of the scale, we obtained two factors regarding researchers' intrinsic and extrinsic motivation (see Appendix 1).

Opportunity

Opportunity is measured by a dichotomous variable that takes the value of 1 if the researcher has participated in projects supported by competitive funding during the study period and 0 if not. This issue is critical in the Spanish academic context, where researchers only receive a basic level of research funding from their university. This variable has been used in other studies on the influence of competitive research funding on scientific productivity (Lawson et al., 2021; Wang et al., 2018).

Control variables

Additional variables are included to control the effects of other characteristics influencing researchers' scientific performance, such as age, gender (female academics is the baseline), and civil servant status that represents the researchers' position (Lafuente & Berbegal-Mirabent, 2019). In Spanish universities, academics who obtain a permanent position are granted "civil servant" status (Cruz-Castro & Sanz-Menéndez, 2010). We also control the cultural or idiosyncratic issues and shared practices of academics belonging to the same scientific arena (Whitley, 2016; Santos et al., 2022), including dummy variables for the five fields of knowledge, where the omitted dummy in the models is science. Moreover, to consider the institutional

differences in the university context, we include a dummy variable that takes the value of 1 if the university is in the Shanghai Ranking (The Academic Ranking of World Universities) and 0 in other cases. We also include a variable that differentiates among the different Spanish universities where the researchers work. The U-ranking (Synthetic Indicators of Spanish Universities) classifies Spanish universities into other dimensions. In this study, we consider the research and innovation U-ranking index 2019. Finally, the institutional context also can influence research performance. For this reason, we include the regional gross domestic product as a control variable.

Table 1 displays the descriptive statistics and the correlation matrix. The mean number of articles published is 48.47 per researcher. The mean researcher's age is 48.4. Regarding gender, women comprised 39.70% of the sample, and civil servants (academics with permanent positions) represent about 61.9%. Moreover, the variance inflation factor analysis shows values below five in all cases, with a mean value of 1.48, including the nonlinear terms and the interactions (not reported).

[Table 1 near here]

5. Results

Table 2 reports the results of regression models estimated to test the association between the different dimensions of the AMO model and the researchers' scientific performance. Models 1 to 5 are estimated by a negative binomial regression according to the characteristic of the dependent variable (a non-negative over-dispersed count variable). The dependent variable (number of articles published in Scopus) is a non-negative integer count one, not normally distributed and positively skewed, with large values being infrequent. For such data, count models provide an econometric improvement over the classical linear (OLS) regression models.

Similarly, the Poisson model is not appropriate because it assumes equity between the conditional mean and variance. The negative binomial model extends the Poisson model and allows over-dispersion to be handled. We conducted the Lagrange multiplier test of over-dispersion to test this assumption, and the results revealed that a negative binomial model provides a significantly better fit than the Poisson model. Moreover, using the Stata econometric programme, we estimated all the models with clusters at the university level to control the fixed effect of universities and robust standard errors.

Model 1 presents the estimation of direct linear association between the AMO dimensions and scientific performance. The results show a positive and significant association between researchers' ability and publications ($\beta = 0.1248$, $p<0.05$). Likewise, greater intrinsic motivation is associated with higher performance because the coefficient of this variable is positive and significant ($\beta = 0.1576$, $p<0.01$). By contrast, the results show a negative and statistically significant association between the researchers' extrinsic motivation level and the number of publications ($\beta = -0.1049$, $p<0.05$). Finally, the opportunity variable is positively associated to researchers' number of articles published in Scopus journals ($\beta = 0.7062$, $p<0.01$). Thus, Hypotheses 1 and 3 are supported, while Hypothesis 2 is partially supported.

[Table 2 near here]

To test the interaction between the AMO model dimensions and their association to researchers' performance, we estimated Model 2. Thus, in Model 2 we consider jointly the variables of AMO dimensions and all the interactions between them (ability, motivation, and opportunities). The results are consistent with previous findings because there is a statistically significant positive coefficient of ability and intrinsic motivation. However, in this model, the coefficient of extrinsic motivation is not statistically significant (see Table 2). Regarding the interactions, Model 2 shows that intrinsic motivation does not moderate the association between researchers' ability and the

number of publications. Similarly, the results show that the coefficient of the interaction between extrinsic motivation and ability is not statistically significant. Therefore, Hypothesis 4 is not supported.

Model 2 also tests the moderating effect of opportunity in the association between researchers' ability and performance as well as the association between motivation and scientific performance. Results show that the coefficient of the interaction between opportunity and ability is not significant. Thus, Hypothesis 5 is not supported. Related to motivation, the interaction term between opportunity and intrinsic motivation is not significant. On the contrary, the interaction coefficient between opportunity and the extrinsic motivation is negative and statistically significant (β = -0.1983, $p<0.05$). Therefore, Hypothesis 6 is not supported. Finally, the results show that the coefficient of the three-way interaction is positive and significant (β = 0.1165, $p<0.01$). These results reveal that the dimensions of the AMO model jointly are positivity associated to the number of articles published in Scopus journals. Thus, the findings support Hypothesis 7.

Due to the unexpected and contradictory results, we decided to go deeper into the analysis, and we tested if the effect of the AMO dimensions on scientific performance would be nonlinear. On this basis, Model 3 was estimated, considering a nonlinear association between each of the three AMO dimensions with performance. As we can see in Model 3, the first coefficient term of ability is significant and positive (β = 0.2099, $p<0.05$); however, its second term is not significant. These results reinforce the direct and linear association between ability and the number of publications. In the case of motivation, the results depend on whether intrinsic or extrinsic motivation is analysed. In the first case, the linear coefficient of intrinsic motivation is positive and significant (β = 0.1902, $p<0.01$), whereas its second term is not significant. Again, the results are in line with those shown in the previous two models. By contrast, both coefficients of extrinsic motivation

are negative, although only the second term is statistically significant. These findings reveal a negative exponential association between the level of extrinsic motivation and researchers' scientific performance (see Table 2). That is, an increase in academics' extrinsic motivation is translated into a more than linear (exponential) reduction in the number of articles published in Scopus journals. The coefficient of the opportunity variable remains positive and significant.

In the estimation of Model 3, we also considered all the interactions between the AMO dimensions, and some results emerged. As we can see in Table 2, the intrinsic motivation does not moderate the association between ability and the number of articles published. However, the coefficient of the interaction between the first term of extrinsic motivation and ability is significant and negative (β = -0.0931, p<0.1). The coefficient of the interaction between the second term of extrinsic motivation and ability is not significant. These results point out that extrinsic motivation moderates the association between ability and scientific performance in a negative way up to a certain level of extrinsic motivation. Regarding the moderating effect of opportunities, the results show that the non-significant moderation remains when the association between ability and the number of articles published is considered as well as the association between intrinsic motivation and scientific performance. On the contrary, a positive moderating effect emerges when the association to extrinsic motivation is analysed. Thus, the coefficient of the interaction between opportunity and the second term of extrinsic motivation is positive and significant (β = 0.1947, p<0.01). This finding means that the existence of opportunities moderates the association between extrinsic motivation and the number of articles published. Finally, the results reveal that the coefficient of the three-way interaction remains positive and significant (β = 0.1228, p<0.05).

The results of Models 1 to 3 show the robustness of the direct and linear association between ability, intrinsic motivation, and opportunity and researchers' scientific performance. Similarly,

the changes in the level of significance of extrinsic motivation could be explained by a nonlinear association, which even affects the interaction between extrinsic motivation and the other AMO dimensions. Therefore, Model 4 is estimated taking into account the significant relationships tested in the previous model. As we can see in Table 2, the results remain the same as those of Model 3. Finally, to illustrate the magnitude of the association between the AMO dimensions and scientific performance, Model 5 is estimated (see Table 2). This model is the same as Model 4, but the coefficients are the incidence rate ratios because they can show how many times the dependent variable (number of articles) would change (increase or decrease) for one unit of change in the explanatory variable (Carli et al., 2019).

The dependent variable in Models 1 to 5 is the number of Scopus publications, which reflects the quantitative scientific performance of researchers. However, to check the findings with a quality measure of scientific performance, Model 6 is estimated using the h-index as the dependent variable. In this case, as the h-index is also a count variable, a negative binomial model was estimated. The results show that the associations between the AMO dimensions and the h-index are the same as previously commented; even the two extrinsic motivation terms are negative and significant, indicating the nonlinear association. However, the interaction between extrinsic motivation and ability is not significant in this model.

The direction and significance of the control variables are the same in all models (1 to 6). Thus, results show that researchers' gender and permanent position affect scientific performance. In this sense, men and researchers who are civil servants (academics with permanent positions) present higher scientific performance. Regarding fields of knowledge, researchers in the arts and humanities, social sciences and law, and engineering and architecture have fewer articles published in Scopus journals than researchers in the sciences. Similarly, according to the

Shanghai Index, researchers who belong to highly prestigious universities have more articles published.

6. Discussion and conclusions

This study analyses academic researchers' performance from the AMO perspective. The findings show that academic researchers' ability, intrinsic motivation, and opportunity have a positive and linear relationship with their scientific performance, whereas extrinsic motivation has a negative exponential association. Therefore, our findings reveal that the AMO dimensions of researchers have a significant and independent association with their scientific performance, and they show the interaction of extrinsic motivation and opportunity. Regarding motivation, contrary to our expectations, the results show a negative moderation of extrinsic motivation because it reduces the positive association between researchers' ability and their performance. Moreover, our results reveal that opportunity reduces the negative relationship between extrinsic motivation and researchers' scientific performance.

Based on these findings, we can state that academic researchers' ability is an essential dimension in explaining their scientific performance, in line with authors such as Jørgensen and Hanssen (2018), who argue that "skilled researchers will spend more time on research and, consequently, produce more pages of higher quality research than their less skilled colleagues" (p. 1045). That is, in a university setting, "individuals who have more, or higher levels of human capital are more versatile in utilising their KSA (knowledge, skills and abilities) to enhance exploitation and better able to exercise and leverage their expertise to search" (Munshaw et al., 2019, p. 1219).

Regarding motivation, as Lam (2011) points out, the academic context is complex, and "the different motivational drivers can co-exist, and scientist may be extrinsically or intrinsically motivated to different degrees" (p. 1358). Thus, in this study, when the dimension of motivation

is considered, our findings lead us to conclude that intrinsically motivated researchers have more interest, willingness, and trust in themselves when performing research than those motivated by extrinsic factors (Deci & Ryan, 2008). Specifically, for intrinsic motivation, the findings support the positive effect on researchers' performance of satisfaction and identification with research tasks (Christensen et al., 2020; Sondari et al., 2016; Stupnisky et al., 2023). These findings suggest that researchers who are satisfied and engaged with their research continue publishing and trying riskier research agendas because their motivation is more intrinsic than extrinsic (Santos et al., 2022).

For extrinsic motivation, our findings reveal a negative nonlinear association with scientific performance. Moreover, high levels of researchers' external motivation directly reduce not only their number of publications but also the positive effect of academics' ability on their scientific performance. According to Peng and Gao's (2019) work, this finding could be explained because extrinsically motivated researchers want to satisfy their needs quickly, so they need more persistence and commitment to cope with the challenging process of researching and publishing an article. Moreover, the particularities of the Spanish university system in which this study was conducted could also be considered. As explained previously, Spanish academic researchers have been subjected to significant pressure from external accreditation agencies and internal university policies, resulting from the market-oriented managerial reforms that enhance the achievement of *sexenios* as an essential merit for promotion (Albert et al., 2018).

Finally, opportunity was found to have a direct and moderating effect on researchers' performance. Academics perceive participation in a project supported by competitive funding to obtain the financial and human resources required to successfully carry out their research, which would directly improve their scientific performance. Opportunity also plays a moderating role by reducing the negative association between extrinsic motivation and researchers' performance

(Amara et al., 2015). One explanation could be that "competitive research funding is considered a mechanism to reward and, thus, incentivise the most able academics […]. As a result, competitive funding tends to be associated with increased productivity, regardless of the sponsor" (Lawson et al., 2021, p. 104182).

In analysing the findings, it is relevant to highlight the effects found in the control variables. The results show that gender, researchers' positions, and the field of knowledge and university they belong to are associated with scientific performance. Regarding gender, men publish a higher number of articles than women. This result is in line with the work of Lawson et al. (2021), who justify that women may be less productive due to biases in funding policies and the existence of a "motherhood penalty". Furthermore, academics with permanent positions (civil servants) also have more publications. Thus, non-tenured researchers are usually in training and skill development stages, while tenured researchers publish as a central part of their work (De Frutos-Belizón et al., 2023).

Regarding the field of knowledge, researchers in science have the highest number of published articles. This result aligns with previous works (see Ballesteros-Rodríguez et al., 2022; Dietz & Bozeman, 2005; Piro et al., 2013), as the publication dynamics vary across fields. Finally, the university that researchers work at can also influence their productivity, as the data reveal that researchers at prestigious universities, according to the Shanghai Index, have more published articles (Demeter et al., 2022).

An important contribution of this paper is to describe how academic researchers' ability, motivation, and opportunity interact to improve scientific performance in a nonlinear way, combining all the postulates of the AMO model, because as Bos-Nehles et al. (2023) point out, "Despite its apparent simplicity, the AMO framework is indeed complex when researchers

consider different levels of analysis, mutual influences between AMO variables, as well as interactions" (p. 737).

6.1. Practical implications

From a practical point of view, the results of our study offer broad-scale guidance about which decisions on employee relations will advance scientific performance at universities. According to our results, academic managers who want to increase their researchers' contribution should promote the use of strategies to increase the levels of academics' abilities, motivation, and opportunity to research, taking into account that several human resource management practices can influence the AMO dimension itself (Kellner et al., 2019). Thus, universities can implement and design programmes to enhance researchers' skills, promote training, and develop selection and reward practices to attract, develop, and retain talented researchers (Jørgensen & Hanssen, 2018; Kozhakhmet et al., 2022). Regarding motivation, our results suggest that universities should foster human resource practices that create an autonomy-supportive work environment to encourage academics to engage with their research rather than invest in external rewards (Kuvaas et al., 2017; Stupnisky et al., 2023). In this sense, as Horta et al. (2022) remark, universities should give academics the autonomy to perform according to their research strategic agendas. Thus, researchers' intrinsic motivation will be fostered by working on subjects they like and consider challenging because they perceive they contribute to the scientific community and society. Finally, concerning the effect of opportunity on researchers' performance, universities can consider how they should strategically distribute funds to encourage research productivity and obtain a more excellent reputation. Thus, they can devote resources towards attracting and retaining talented researchers with high productivity indicators.

6.2. Limitations and future research

Some of the study's limitations should be considered when interpreting the results and for future research. Regarding the variables used in this study, opportunity has been measured as a dichotomous variable that reflects the participation in research projects supported by public funding. This way of measuring the variable could limit the analysis of the complexity of the opportunity effect. For example, it is not possible to study a nonlinear effect. In future studies, using another variable related to the academic researcher's organisational or employment environment could be interesting. Continuing with the opportunity variable, the funding projects obtained by researchers in the years prior to data collection have been considered. Therefore, in future studies, it would be interesting to conduct the study using an opportunity variable that includes the funding resources obtained by researchers throughout their careers. Moreover, other issues might need to be addressed in this work, such as those related to the researchers' well-being (e.g., stress and burnout) generated by market-oriented managerial reforms, which would be interesting to analyse in future studies. This study focuses on a sample of Spanish academic researchers, and the Spanish university system has specific characteristics that may condition extrapolating the results to other researchers and universities. Therefore, in future research, it would be interesting to analyse the model in different contexts and university systems to identify similarities and differences across countries. Finally, this study has included some control variables to better understand and explain the results. However, future research should consider additional aspects that can explain the nonlinear association between extrinsic motivation and researchers' performance, such as an early versus late academic's career because the firsts could have higher extrinsic motivation than the second one. Additionally, it would be interesting to analyse the time researchers must devote to teaching or management, which may represent a workload to publish papers.

References

Abramo, G., and D'Angelo, C.A. 2014. "How do you define and measure research productivity?" *Scientometrics*, 101, 1129–1144. doi: https://doi.org/10.1007/s11192-014-1269-8

Albert, C., Davia M.A. and Legazpe, N. 2018. "Job satisfaction amongst academics: the role of research productivity." *Studies in Higher Education,* 43(8): 1362–1377. doi: https://doi.org/10.1080/03075079.2016.1255937

Amara, N., Landry, R. and Halilem, N. 2015. "What can university administrators do to increase the publication and citation scores of their faculty members?" *Scientometrics*, 103: 489–530. doi: https://doi.org/10.1007/s11192-015-1537-2

Ballesteros-Rodríguez, J.L., De Saá-Pérez, P., García-Carbonell, N., Martín, F. and Sánchez-Gardey, G. (2020). "The influence of team members' motivation and leaders' behaviour on scientific knowledge sharing in universities". *International Review of Administrative Science*, 88(2): 320–336. doi*:* https://doi.org/10.1177/002085232092122

Ballesteros-Rodríguez, J.L., De Saá-Pérez, P., García-Carbonell, N., Martín, F. and Sánchez-Gardey, G. 2022. "Exploring the determinants of scientific productivity: a proposed typology of researchers." *Journal of Intellectual Capital*, 23(2): 195–221. doi: https://doi.org/10.1108/JIC-07-2019-0178

Beltrán-Martín, I. and Bou-Llusar, J.C. 2018. "Examining the intermediate role of employee abilities, motivation and opportunities to participate in the relationship between HR bundles and employee performance." *Business Research Quarterly,* 21: 99–110. doi: https://doi.org/10.1016/j.brq.2018.02.001

Bos-Nehles, A., Townsend, K., Cafferkey, K., and Trullen, J. 2023. "Examining the Ability,

Motivation and Opportunity (AMO) framework in HRM research: Conceptualization, measurement and interactions". *International Journal of Management Reviews*, 25, 725–739. doi: https://doi.org/10.1111/ijmr.12332

Bos-Nehles, A.C., Van Riemsdijk, M.J. and Looise, J.K. 2013. "Employee perceptions of line management performance: Applying the AMO theory to explain the effectiveness of line managers' HRM implementation." *Human Resource Management*, 52: 861–877. doi: https://doi.org/10.1002/hrm.21578

Boxall, P. and Purcell, J. 2003. *Strategy and human resource management*. New York: Palgrave Macmillan.

Bozeman, B., Dietz, J. and Gaughan, M. 2001. "Scientific and technical human capital: An alternative model for research evaluation". *International Journal of Technology Management*, 22: 716–740. https://doi.org/10.1504/IJTM.2001.002988

Brew, A., Boud, D., Namgung, S.U., Lucas, L. and Crawford, K. 2016. "Research productivity and academics' conceptions of research." *Higher Education*, 71(5): 681–697. doi: https://doi.org/10.1007/s10734-015-9930-6

Carli, G., Tagliaventi, M.R. and Cutolo, D. 2019 "One size does not fit all: the influence of individual and contextual factors on research excellence in academia." *Studies in Higher Education*, 44(11): 1912–1930. doi: https://doi.org/10.1080/03075079.2018.1466873

Castro-Ceacero, D., Rodriguez-Gomez, D., Muñoz-Moreno, J.L. and Calatayud, A. 2023. "The intergenerational climate of Spanish university research." *Studies in Higher Education*. doi: https://doi.org/10.1080/03075079.2023.2211088

Christensen, M., Dyrstad, J.M. and Innstrand S.T. 2020. "Academic work engagement, resources

and productivity: empirical evidence with policy implications." *Studies in Higher Education*, 45(1): 86–99. doi: https://doi.org/10.1080/03075079.2018.1517304

Corley, E.A., Bozeman, B., Zhang, X., and Tsai, C.C. 2019. "The expanded scientific and technical human capital model: the addition of a cultural dimension." *The Journal of Technology Transfer*, 44(3): 681–699. doi: https://doi.org/10.1007/s10961-017-9611-y

Cruz-Castro, L. and Sanz-Menéndez, L. 2010. "Mobility versus job stability: Assessing tenure and productivity outcomes." *Research Policy*, 39(1): 27–38. doi: http://doi.org/10.1016/j.respol.2009.11.008

Deci, E.L. and Ryan, R.M. 2008. "Self-determination theory: A macrotheory of human motivation, development, and health". *Canadian Psychology*, 49: 182–185. doi: https://doi.org/10.1037/a0012801

De Frutos-Belizón, J., García-Carbonell, N., Ruíz-Martínez, M. and Sánchez-Gardey, G. 2023. "Disentangling international research collaboration in the Spanish academic context: Is there a desirable researcher human capital profile?" *Research Policy*, 52(6): 104779. doi: https://doi.org/10.1016/j.respol.2023.104779

De Frutos-Belizón, J., Martín-Alcázar, F. and Sánchez-Gardey, G. 2019. "Conceptualising academic intellectual capital: definition and proposal of a measurement scale." *Journal of Intellectual Capital*, 20: 306–334. doi: http://doi.org/10.1108/jic-09-2018-0152

De Frutos-Belizón, J., Martín-Alcázar, F. and Sánchez-Gardey, G. 2020. "An intellectual capital approach to explaining the determinants of scientific productivity in the field of management." *European Management Review*, 17: 943–959. doi: https://doi.org/10.1111/emre.12406

Degn, L., Franssen, T., Sørensen, M.P. and De Rijcke, S. 2018. “Research groups as communities of practice: A case study of four high-performing research groups.” *Higher Education*, 76: 231–246. doi: https://doi.org/10.1007/s10734-017-0205-2

Demeter, M., Jele, A. and Major, Z.B. 2022. “The model of maximum productivity for research universities SciVal author ranks, productivity, university rankings, and their implications.” *Scientometrics*, 127:4335–4361. doi: https://doi.org/10.1007/s11192-022-04432-4

Dietz, J.S. and Bozeman, B. 2005. “Academic careers, patents, and productivity: industry experience as scientific and technical human capital.” *Research Policy,* 34(3): 349–367. doi: https://doi.org/10.1016/j.respol.2005.01.008

Ganguli, I. 2017. “Saving Soviet science: The impact of grants when government R&D funding disappears.” *American Economic Journal: Applied Economics*, 9(2): 165–201. doi: http://doi.org/10.1257/app.20160180

Goel, R.K. and Göktepe-Hultén, D. 2020. “Drivers of innovation productivity of academic researchers through career advancement.” *The Journal of Technology Transfer*, 45(2): 414–429. Doi: https://doi.org/10.1007/s10961-018-9689-x

Han, J., Yin, H., Wang, J. and Bai, Y. 2020. “Challenge job demands and job resources to university teacher well-being: the mediation of teacher efficacy.” *Studies in Higher Education*, 45(8): 1771–1785. doi: https://doi.org/10.1080/03075079.2019.1594180

Hong, W. and Gajendran, R.S. 2018. “Explaining dyadic expertise use in knowledge work teams: an opportunity–ability–motivation perspective”. *Journal of Organizational Behavior*, 39: 796–811. doi: https://doi.org/10.1002/job.2286

Horodnic, I.A. and Zaiţ, A. 2015. “Motivation and research productivity in a university system undergoing transition.” *Research Evaluation*, 24(3): 282–292. doi: https://doi.org/10.1093/reseval/rvv010

Horta, H. 2022. “Trust and incentives in academic research and the position of universities within innovation systems.” *Higher Education*, 84: 1343–1363. doi: https://doi.org/10.1007/s10734-022-00954-1

Horta, H. and Li, H. 2022. “Nothing but publishing: the overriding goal of PhD students in mainland China, Hong Kong, and Macau.” *Studies in Higher Education*. doi: https://doi.org/10.1080/03075079.2022.2131764

Horta, H. and Santos, J.M. 2016. “The impact of publishing during PhD studies on career research publication, visibility, and collaborations.” *Research in Higher Education*, 57*:* 28–50. doi: https://doi.org/10.1007/s11162-015-9380-0

Horta, H., Santos, J.M. and Loureiro, P.M. 2022. “The strategic research agenda of academics and the involvement of non-academic peers in research in regimes of academic nested hybridity.” *European Journal of Higher Education*, 12: 355–372. doi: https://doi.org/10.1080/21568235.2022.2105373

Hottenrott, H. and Lawson, C. 2017. “Fishing for complementarities: Research grants and research productivity.” *International Journal of Industrial Organization,* 51: 1–38. doi: https://doi.org/10.1016/j.ijindorg.2016.12.004

Ion, G. and Castro-Ceacero, D. 2017. “Transitions in the manifestations of the research culture of Spanish universities.” *Higher Education Research & Development*, 36(2): 311–324. doi: https://doi.org/10.1080/07294360.2016.1208153

Jiang, K., Lepak, D.P., Han, K., Hong, Y., Kim. A. and Winkler, A.L. 2012. "Clarifying the construct of human resource systems: Relating human resource management to employee performance." *Human Resource Management Review*, 22(2): 73–85. doi: https://doi.org/10.1016/j.hrmr.2011.11.005

Jiang, K., Takeuchi, R. and Lepak, D.P. 2013. "Where do we go from here? New perspectives on the black box in strategic human resource management research." *Journal of Management Studies*, 50: 1448–1480. doi: https://doi.org/10.1111/joms.12057

Jørgensen, F., and Hanssen, T.E.S. 2018. "Research incentives and research output." *Higher Education,* 76: 1029–1049. doi: https://doi.org/10.1007/s10734-018-0238-1

Kellner, A., Cafferkey, K. and Townsend, K. 2019. "Ability, motivation and opportunity theory: a formula for employee performance?" In K. Townsend, K. Cafferkey, A.M. McDermott, & T. Dundon (Eds.), *Elgar introduction to theories of human resources and employment relations* (pp. 311–323). Cheltenham: Edward Elgar Publishing. doi: http://doi.org/10.4337/9781786439017.00029

Kim, K.Y., Pathak, S. and Werner, S. 2015. "When do international human capital enhancing practices benefit the bottom line? An ability, motivation, and opportunity perspective." *Journal of International Business Studies*, 46: 784–805. doi: https://doi.org/10.1057/jibs.2015.10

Kozhakhmet, S., Moldashev, K., Yenikeyeva, A. and Nurgabdeshov, A. 2022. "How training and development practices contribute to research productivity: a moderated mediation model." *Studies in Higher Education*, 47(2): 437–449. doi: https:// doi.org/10.1080/03075079.2020.1754782

Kuvaas, B., Buch, R., Weibel, A., Dysvik, A. and Nerstad, C.G.L. 2017. "Do intrinsic and

extrinsic motivation relate differently to employee outcomes?" *Journal of Economic Psychology*, 61: 244–258. doi: https://doi.org/10.1016/j.joep.2017.05.004

Kyvik, S. and Aksnes, D.W. 2015. "Explaining the increase in publication productivity among academic staff: a generational perspective." *Studies in Higher Education*, 40(8): 1438–1453. doi: https://doi.org/10.1080/03075079.2015.1060711

Lafuente, E. and Berbegal-Mirabent, J. 2019. "Contract employment policy and research productivity of knowledge workers: An analysis of Spanish universities." *International Journal of Human Resource Management*, 30: 2360–2386. doi: http://doi.org/10.1080/09585192.2017.1323226

Lam, A. 2011. "What motivates academic scientists to engage in research commercialization: 'Gold', 'ribbon' or 'puzzle'?" *Research Policy*, 40(10): 1354–1368. doi: https://doi.org/10.1016/j.respol.2011.09.002

Lawson, C., Geuna, A. and Finardi, S. 2021. "The funding-productivity-gender nexus in science, a multistage analysis." *Research Policy*, 50(3): 104182. doi: https://doi.org/10.1016/j.respol.2020.104182

Lee, H.F., Miozzo, M. and Laredo, P. 2010. "Career patterns and competences of PhDs in science and engineering in the knowledge economy: The case of graduates from a UK research-based university." *Research Policy*, *39*: 869–881. doi: https://doi.org/10.1016/j.respol.2010.05.001

Le Roy, F. and Fernandez, A.S. 2015. "Managing coopetitive tensions at the working-group level: The rise of the coopetitive project team." *British Journal of Management*, 26: 671–688. doi: https://doi.org/10.1111/1467-8551.12095

Marin-Garcia, J.A. and Martinez-Tomas, J. 2016. "Deconstructing AMO framework: a systematic review", *Intangible Capital*, 12(4): 1040–1087. doi: http://dx.doi.org/10.3926/ic.838

Mudrak, J., Zabrodska, K., Kveton, P., Jelinek, M., Blatny, M., Solcova, I., and Machovcova, K. 2018. "Occupational well-being among university faculty: a job demands-resources model." *Research in Higher Education*, 59: 325–348. doi: https://doi.org/10.1007/s11162-017-9467-x

Munshaw, S., Lee, S.H., Phan, P.H. and Marr, K.A. 2019. "The influence of human capital and perceived university support on patent applications of biomedical investigators." *The Journal of Technology Transfer*, 44(4): 1216–1235. doi: https://doi.org/10.1007/s10961-018-9649-5

Nygaard, L.P. 2017. "Publishing and perishing: an academic literacies framework for investigating research productivity." *Studies in Higher Education*, 42(3): 519–532. doi: http://dx.doi.org/10.1080/03075079.2015.1058351

Olaya-Escobar, E.S., Berbegal-Mirabent, J., Alegre, I. and Duarte-Velasco, O.G. 2017. "Researchers' willingness to engage in knowledge and technology transfer activities: an exploration of the underlying motivations." *R&D Management*, 47: 715–726. doi: https://doi.org/10.1111/radm.12263

Organic Law of Universities (LOU) 6/2001.

Pak, K., Kooij, T.A.M., De Lange, A.H. and Van Veldhoven, M.J.P.M. 2019. "Human Resources Management and the ability, motivation and opportunity to continue working: A review of quantitative studies." *Human Resource Management Review*, 29: 336–352. doi: https://doi.org/10.1016/j.hrmr.2018.07.002

Peng, J.E., and Gao, X. 2019. “Understanding TEFL academics’ research motivation and its relations with research productivity”. *SAGE Open*, 9(3). https://doi.org/10.1177/2158244019866295

Piro, F.N., Aksnes, D.W. and Rørstad, K. 2013. “A macro analysis of productivity differences across fields: challenges in the measurement of scientific publishing”. *Journal of the American Society for Information Science and Technology*, 64(2): 307–320. https://doi.org/10.1002/asi.22746

Ryan, J.C. and Berbegal-Mirabent, J. 2016. “Motivational recipes and research performance: A fuzzy set analysis of the motivational profile of high performing research scientists.” *Journal of Business Research*, 69(11). 5299–5304. doi: 5299–304. https://doi.org/10.1016/j.jbusres.2016.04.128

Sabharwal, M. and Hu, Q. 2013. “Participation in university-based research centers: Is it helping or hurting researchers?” *Research Policy*, 42(6-7): 1301–1311. https://doi.org/10.1016/j.respol.2013.03.005

Santos, J.M., Horta, H. and Li, H. 2022. “Are the strategic research agendas of researchers in the social sciences determinants of research productivity?” *Scientometrics,* 127: 3719–3747. doi: https://doi.org/10.1007/s11192-022-04324-7

Sauermann, H. and Roach, M. 2014. “Not all scientists pay to be scientists: PhDs’ preferences for publishing in industrial employment”. *Research Policy*, 43(1): 32–47. https://doi.org/10.1016/j.respol.2013.07.006

Seibert, S.E., Kacmar, K.M., Kraimer, M.L Downes, P.E. and Noble, D. 2017. “The role of research strategies and professional networks in management scholars’ productivity.” *Journal of Management,* 43(4), 1103–1130. doi:

https://doi.org/10.1177/2F0149206314546196

Sondari, M.C., Tjakraatmadja, J.H. and Bangun, Y.R. 2016. "What motivate faculty member to do research? A literature review." *The Social Sciences*, 11: 5265–5269. doi: http://doi.org/10.36478/sscience.2016.5265.5269

Spanish Government (2019). Datos y cifras del sistema universitario español. Publicación 2018-2019. Gobierno de España

Stupnisky, R.H., BrckaLorenz, A., and Nelson Laird, T.F. 2019. "How does faculty research motivation type relate to success? A test of self-determination theory." *International Journal of Educational Research, Special Edition on Faculty Motivation*, 98: 25–35. doi: https://doi.org/10.1016/j.ijer.2019.08.007

Stupnisky, R.H., Larivière, V., Hall, N.C., and Omojiba, O. 2023. "Predicting research productivity in STEM faculty: The role of self-determined motivation." *Research in Higher Education*, 64: 598–621. doi: https://doi.org/10.1007/s11162-022-09718-3

Sutherland, K.A. (2017). Constructions of success in academia: an early career perspective. *Studies in Higher Education*, *42*: 743–759. http://doi.org/10.1080/03075079.2015.1072150

Ulrich, W. and Dash, D.P. 2013. "Research skills for the future: Summary and critique of a comparative study in eight countries." *Journal of Research Practice*, 9: 1–21.

Van Iddekinge, C.H., Aguinis, H., Mackey, J.D. and DeOrtentiis, P.S. 2018. "A meta-analysis of the interactive, additive, and relative effects of cognitive ability and motivation on performance." *Journal of Management*, 44: 249–279. doi: https://doi.org/10.1177%2F0149206317702220

Walsh, J.P. and Lee, Y.N. 2015. "The bureaucratisation of science." *Research Policy*, 44: 1584–

1600. doi: https://doi.org/10.1016/j.respol.2015.04.010

Waltman, L. 2016. “A review of the literature on citation impact indicators.” *Journal of Informetrics*, 10 (2): 365–391. doi: https://doi.org/10.1016/j.joi.2016.02.007

Wang, X., Dolfsma, W. and van der Bij, H. 2019. “Individual performance in a cooperative R&D alliance: motivation, opportunity and ability”. *R&D Management*, 49: 762–774. doi: https://doi.org/10.1111/radm.12370

Wang, J., Lee, Y.N. and Walsh, J.P. 2018. “Funding model and creativity in science: Competitive versus block funding and status contingency effects.” *Research Policy*, 47: 1070–1083. doi: https://doi.org/10.1016/j.respol.2018.03.014

Whitley, R. 2016. “Varieties of scientific knowledge and their contributions to dealing with policy problems: A response to Richard Nelson’s ‘The sciences are different and the differences matter’”. *Research Policy*, 45: 1702–1707. doi: https://doi.org/10.1016/j.respol.2016.06.004

Wright, P.M. and McMahan, G.C. 2011. “Exploring human capital: Putting human back into strategic human resource management”. *Human Resource Management Journal*, 21: 93–104. https://doi.org/10.1111/j.1748-8583.2010.00165.x

Table 1. Descriptive statistics and correlation matrix

	mean	s.d.	1	2	3	4	5	6	7	8	9	10	11
1. Nº articles	48.051	62.101	1										
2. h-index	12.24	11.33	0.833***	1									
3. Ability	0.000	1.000	0.235***	0.292***	1								
4. Intrinsic motivation	0.000	1.000	0.200***	0.235***	0.431***	1							
5. Extrinsic motivation	0.000	1.000	-0.155	-0.152***	-0.019	-0.011	1						
6. Opportunity	0.705	0.456	0.299***	0.361***	0.263***	0.265***	-0.023	1					
7. Age	48.474	10.198	0.256***	0.224***	0.275***	0.119***	-0.113***	0.305***	1				
8. Men	0.603	0.489	0.249***	0.192***	0.104**	0.062	-0.140***	0.078**	0.221***	1			
9. Civil servant	0.619	0.489	0.260***	0,279***	0.318***	0.155***	-0.016	0.319***	0.660***	0.178***	1		
10. U-ranking index	1.053	0.171	0.027	0.043	0.058	0.035	-0.048	0.151***	0.007	0.050	0.015	1	
11. Regional gross domestic product	99.573	21.812	-0.004	0.015	0.034	0.028	-0.025	0.089**	0.097**	0.051	0.030	0.430***	1
12. Shanghai ranking	0.746	0.435	0.152***	0.160***	0.052	0.072*	-0.046	0.121***	0.160***	-0.010	0.136***	0.021	0.184***

Note: ***, ** significant at 1% and 5%, respectively.

Table 2. Association between the AMO components and researchers' scientific performance

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Ability	0.1248**	0.1834**	0.2099**	0.1495**	1.1612**	0.1520***
Ability^2			-0.0011			
Intrinsic motivation	0.1576***	0.1492***	0.1902***	0.1685***	1.135***	0.1117***
Intrinsic motivation^2			0.0066			
Extrinsic motivation	-0.1049**	0.0404	-0.0495	-0.0527	0.9486	-0.1376**
Extrinsic motivation^2			-0.2399***	-0.2392***	0.7872***	-0.1727***
Opportunity	0.7062***	0.7047***	0.5365***	0.5513***	1.7355***	0.4900***
Intrinsic motivation * ability		0.0361	0.0346			
Extrinsic motivation * ability		-0.0666	-0.0931*	-0.0890*	0.9148*	-0.0499
Extrinsic motivation^2 * ability			-0.0348	-0.0267	0.9736	-0.0154
Opportunity * ability		-0.0837	-0.0712			
Opportunity * intrinsic motivation		0.0472	0.0039			
Opportunity * extrinsic motivation		-0.1983**	-0.1257	-0.1224	0.8848	0.0059
Opportunity * extrinsic motivation^2			0.1947***	0.1877***	1.2064***	0.1329***
Ability * intrinsic motiv * extrinsic mot * opportunity		0.1165***	0.1228**	0.1050**	1.1102**	0.0697*
Age	-0.0057	-0.0042	-0.0054	-0.0056	0.9944	-0.0105***
Gender	0.5001***	0.5096***	0.5262***	0.5293***	1.6978***	0.2526***
Civil servant	0.4609***	0.4364***	0.4066***	0.4110***	1.5083***	0.3814***
Arts and humanities	-1.9482***	-1.9687***	-1.9330***	-1.9371***	0.1441***	-2.0155***
Social sc. and law	-0.8120***	-0.8450***	-0.8709***	-0.8599***	0.4232***	-0.8965***
Health sciences	0.1526	0.1379	0.1282	0.1282	1.1367***	-0.0442
Engineering and architecture	-0.3247***	-0.3176***	-0.3165***	-0.3204***	0.7258***	-0.6055***
U-ranking index	0.1643	0.0769	-0.0454	-0.0511	0.9502	0.0510
Regional gross domestic product	-0.0013	-0.0010	-0.0007	-0.0008	0.9991	-0.0001

Shanghai ranking	0.3644***	0.3633***	0.3770***	0.3754***	1.4555***	0.2205***
Intercept	2.8172***	2.8052***	3.1789***	3.2052***	24.6614***	2.3951***
Fixed effect: universities	yes	Yes	Yes	yes	yes	yes
Wald Test	1098.18***	3722.31***	14117.00***	4587.54***	4587.54***	2121.29***
Log pseudolikelihood	-2582.1089	-2576.4201	-2568.0917	-2568.8113	-2568.8113	-2570.73
Observations	607	607	607	607	607	607

Notes:
- Researchers' performance for Models 1–5 (dependent variable) is measured as the researchers' number of articles published in Scopus journals, whereas the h-index is considered as dependent variable in Model 6.
- Models 1–6 are estimated by a negative binomial model with robust standard errors and clustered by universities.
- ***, **, * significant at 1% , 5%, and 10%, respectively.

APPENDIX 1

Table A.1. Exploratory factor analysis

Ability (A)			
Items	Com.	Factor loading	Cronbach's alpha
I can relate the observed facts to the results obtained and draw conclusions.	0.655	0.809	0.918
I can expose and communicate my research results.	0.643	0.802	
I can autonomously develop research.	0.606	0.778	
I am able to identify research topics in my research context.	0.590	0.768	
I have the required capacity to obtain and manage the information for the research.	0.587	0.766	
I know how to conduct research (thesis, research projects, etc.).	0.568	0.754	
I have the ability to interact fluently with other researchers.	0.532	0.729	
I have the necessary training in research methodologies and techniques.	0.525	0.725	
I am able to adapt to changes in my research context.	0.515	0.718	
I have the theoretical training necessary to research in my scientific field.	0.513	0.716	
I know the most relevant publication within my scientific field.	0.488	0.699	
Eigenvalue		6.223	
Explained variance		56.57	
Kaiser–Meyer–Olkin measure of sampling adequacy		0.929	
Barlett's test of sphericity		10034.172***	

Intrinsic motivation			
Items	Com.	Factor loading	Cronbach's alpha
I research for my own personal satisfaction.	0.609	0.828	0.658
I research because it is important to me.	0.686	0.781	
I research because I enjoy doing that work.	0.521	0.722	
Eigenvalue		1.816	
Explained variance		60.53	
Kaiser–Meyer–Olkin measure of sampling adequacy		0.640	
Barlett's test of sphericity		598.186***	

Extrinsic motivation			
Items	Com.	Factor loading	Cronbach's alpha
I research for *sexenios*.	0.732	0.856	0.719
I research for financial reward.	0.661	0.813	
I research for promotion.	0.530	0.728	
Eigenvalue		1.923	
Explained variance		64.104	
Kaiser–Meyer–Olkin measure of sampling adequacy		0.643	
Barlett's test of sphericity		777.219***	