# Doctoral Thesis

## *Academic Human Capital and Research Performance*

Félix Guerrero Alba

*Departament of Business Management*
Facultad de Ciencias Económicas y Empresariales
Universidad de Cádiz

# Doctoral Thesis

## *Academic Human Capital and Research Performance*


Félix Guerrero Alba
*Departament of Business Management*

Supervisors:
PhD. Fernando Martín Alcázar
PhD. Gonzalo Sánchez Gardey

# INDEX

## INTRODUCTION



## EMPIRICAL ANALYSIS

## CONCLUSIONS, LIMITATIONS, AND FUTURE LINES OF RESEARCH

# FIGURES

# TABLES

# INTRODUCTION

# INTRODUCTION

## 1. Aim and relevance of the research: Academic human capital in the development of research activities

Universities are strategic actors in today's society. These institutions are considered major generators of knowledge. Approaches such as the Triple Helix (Leyderdorff & Etzkowitz, 1998) or the models of knowledge generation (Tian et al., 2009) have highlighted the role of universities in the context of both knowledge generation and transmission to society (Bikard et al., 2019; Lin, 2021). Thus, universities have experienced multiple changes to achieve greater autonomy (Amaral et al., 2004), deepen transparency (Hockfield, 2008), or obtain new sources of financing (Newman, 2004; Piro et al., 2020) to have management tools available to improve their performance. Universities are especially focused on the specification of their strategic plans, research objectives, staff, and internal functioning. Universities have therefore been required to provide performance evaluations to better and more efficiently manage their resources (Geuna & Martin, 2003; Hicks, 2012; Hicks & Katz, 2011). In some research in the field, the stratification of science has been proposed to encourage research activity in universities (Bak & Kim, 2019) with the aim of concentrating resources in those most outstanding areas of the field. Indeed, the importance of universities in designing appropriate management measures serves as a basis for promoting the research activity of academics (Alfawaire & Atan, 2021; Butt et al., 2020; Tseng et al., 2020; Stensaker & Fumsali, 2017).

This thesis highlights the role of academic researchers as units of analysis. The literature has questioned the profile of academic researchers as a knowledge base for management without reaching an adequate consensus on what characteristics drive the research activity itself. In

essence, universities need to acquire, develop, and manage human capital whose quality and composition allows the development of their teaching and research functions in an efficient way (Leitner, 2004). For example, numerous studies have analysed intellectual capital in universities, highlighting the importance of human capital as a relevant intangible resource in the generation of valuable physical and financial resources (Bezhani, 2010; Ramírez-Córcoles et al., 2011; Secundo et al., 2016; Siboni, 2013; Swanson & Holton, 2001). The literature in the field has highlighted several approaches to conceptualising academic human capital, which makes the issue particularly complex. Following Ballesteros-Rodriguez et al. (2020b), research on academic human capital can be organised into three main perspectives: 1) studies that analyse the effect of unique academic attributes; 2) studies that focus on the examination of a set of unobservable individual characteristics; and 3) research based on the traditional theory of human capital or KSA (knowledge-skills-abilities). Consequently, this diversity of approaches leads to a lack of consensus on these specific measures of human capital in academic and research fields. Further, the existing literature presents several different perspectives that explain the link between human capital and performance in the academic context, which has led to a lack of consensus on the specific characteristics that affect research performance. Regarding the first group of analyses, some research has highlighted different attributes, such as passion, research management, and research skills applicable to research activity (Mayrath, 2008). Other studies have focused on a set of attributes in a more systematic and integrated manner. For example, Pric (1996) concluded that professional and social characteristics form the human capital of eminent researchers who make a greater number of scientific contributions. Ulrich and Dash (2013) grouped a set of 20 academic attributes into three categories: a) scientific competences, such as learning capacity; b) project and management skills, such as communication; and c) personal skills, such as creativity, and motivation. Studies such as Mcnie et al. (2016)

described the "hard" and "soft" skills required to carry out the research function. Hard skills refer to specific research capacities, such as hypothesis formulation or field-specific knowledge. Soft skills refer to the general skills necessary for research, such as social skills and leadership. The third approach is based on more traditional and classical theories of human capital. One of the most used studies in this area is Bozeman et al.'s (2001) model. This model of "scientific and technical human capital" is described as "the sum of the links of the professional network of an individual researcher, knowledge, and technical skills and widely defined resources" (Bozeman et al., 2001, p. 636). This model considers aspects of scientific social capital to complement academic human capital. The model has been used in other investigations to explain the capacity and development of the academic career of researchers (Corley et al., 2019; Jonkers & Tijssen, 2008; Lin & Bozeman, 2006; Bozeman & Corley, 2004), as well as to address collaboration and transfer between university and industry (Gaughan & Corley, 2010; Lin & Bozeman, 2006; Dietz & Bozeman, 2005). The model contextualises the attributes that can affect academic performance in a classic way without specifically clarifying which of them are the most relevant. In this thesis, our vision of human capital is based on the KSA dimension, based on the intrinsic characteristics that affect the research results (Ballesteros et al., 2020; Wright et al., 2014; Ployhart, 2014).

Regarding *knowledge*, as the first of the KSA dimensions, we can observe that the literature has traditionally distinguished between tacit knowledge, which refers to the theories, arguments, and assumptions of academic disciplines (that is, knowing that), and explicit knowledge, which is understood as knowledge of the research methodology and techniques (know-how) (Bozeman et al., 2001). However, other disciplines, even those that follow these approaches, have used different labels. Tacit knowledge has been called "knowledge-how", implicit, or procedural knowledge. For explicit knowledge, some authors have used "knowledge-that", declarative,

or propositional knowledge (Sahdra & Thagard, 2003). Others, such as Whitehill (1997), distinguished between "knowing how to do" to identify tacit knowledge and "knowing what" for explicit knowledge. In the field of universities, Lovitts (2005) classifies knowledge into two alternative and complementary categories: formal knowledge, linked to "knowledge-that" and informal or "knowledge-how". Therefore, through the integration of different arguments from the literature, to define knowledge as part of the human capital of academic researchers, we will describe it as "the significant information (Nonaka & Takeuchi, 1995), combined with experience, the context, reflection, and interpretation (Davenport et al., 1998), obtained through formal education (Ployhart & Moliterno, 2011), from the analysis and reading of concrete theories and explanations, as well as empirical results (Bozeman et al., 2001)". According to this definition, and following the predominant classification in the literature, we will understand that academic knowledge is divided into two connected dimensions: "knowledge-how" or tactical and "knowledge-that" or explicit. First, we will mainly introduce what Lovitts (2005) called formal knowledge, which refers to the theoretical body of a discipline—that is, the theories and assumptions that compose it (Bozeman et al., 2001). Studies such as those of Bozeman et al. (2001) and Ulrich and Dash (2013) labelled it scientific knowledge. Lee et al. (2010) specified this attribute as specialist knowledge of a topic and general knowledge of the area. Second, we will consider applied or explicit knowledge as the language used in scientific texts in a given field of knowledge (Prpic, 1996; Ulrich & Dash, 2013). Academic researchers must also possess the necessary training in methodology and research techniques typical of the area (Bozeman et al., 2001; Mooken & Sugden, 2014).

Thus, knowledge generation processes in universities occur both at the individual level and in their research units, such as research groups or research collaborations (Veer-Ramjeawon & Rowley, 2020). Thus, at the organisational level, it has been justified that knowledge is created, shared,

enriched, extended, and rationalised through social or individual processes (Nonaka & Toyama, 2003). The process through which organisations seek to produce and acquire knowledge between implicit and explicit knowledge is knowledge creation (Obeid & Rabea, 2016). New knowledge is created through the interaction between implicit and explicit knowledge to ensure different types of knowledge for future decision-making (Abualoush et al., 2018; Obeid & Rabea, 2016; Zawaideh et al., 2018). Universities, therefore, should encourage knowledge generation as the main output of these institutions, both individually and in each of their core research units (Sa et al., 2011; Safavi & Hakanson, 2018) or research collaborations (Numprasertchai & Igel, 2005; Tan, 2016).

Regarding research *skills and abilities*—the other two dimensions of the KSA—the literature is very sparse. Van der Heijden and Van der Heijden (2006) proposed a clear differentiation in the organisational field, describing skills as those individual and general attributes, such as dynamism, motivation, communication skills, and teamwork, which are usually acquired through formal education. However, abilities are considered attributes that allow individuals to perform well in their specific jobs and work environments. In the field of research, these attributes include the identification of research topics, writing capacities, and language proficiency. According to this typology, we can determine that skills are general attributes of the individual himself, whereas abilities pertain to performance in a particular job. Although both concepts are theoretically differentiated, we observe that in the literature, there is also no clear distinction about those attributes that can be classified as skills or abilities. The research thus far does not offer a valid classification of characteristics applicable to the field of academic researchers, which allows us to clarify the specific composition of these two dimensions. Ulrich and Dash (2013) distinguished between scientific abilities (ability to formulate research questions or analytical skills), skills management teams and projects (communication skills, languages, teamwork, etc.), and

interpersonal skills (creativity, motivation, commitment, adaptability, etc.). Thunnissen and Van Arensbergen (2015) categorised skills and abilities into three categories: abilities (critical, open to feedback, tolerant to criticism, reflective, and cooperation skills, etc.), intrapersonal characteristics (motivation, perseverance, passion for science, and ambition), and performance (international experience). More research has paid special attention to one or a few personal attributes compared to an integrated and synergistic set of skills and abilities. Authors such as Neumman (2006), Mayrath (2008), and Duran-Bellonch and Ion (2014) highlighted the need for academic researchers to have a vocation and passion for their work, as well as a certain intrinsic interest in research (Bentley & Kyvik, 2013). Another attribute that the literature highlights for its effect on scientific productivity is the ability of researchers to be creative (Marie, 2008; Whitelock et al., 2008). Others consider research ethics as a necessary attribute to carry out research activity (Bell & Bryman, 2007; De Vries et al., 2006; Kintisch, 2005). Other studies have focused on cognitive abilities. For example, Bozeman et al. (2001) noted that cognitive capacities, such as mathematical reasoning, memory, or the ability to synthesise, although closely linked to the field of science, are perfectly applicable to other work contexts. Marie (2008) pointed out that research skills include the identification of research problems and the ability to collect data and formulate hypotheses. Furthermore, Timmerman et al. (2011) added to this list of cognitive abilities the ability to analyse data and generate conclusions, which usually appear in more advanced researchers. Mayrath (2008), Barnacle and Dall'Alba (2014), and Thunnissen and Van Arensbergen (2015) indicated the ability of researchers to write scientific texts, which other authors included as part of communication skills, along with the ability to present research and its results (Meerah et al., 2012).

These research skills and abilities make research activities valued by universities and scientific journals. At the organisational level, the

development of these skills and abilities has led to increased organisational performance (David et al., 2021; Ghilinchlee & Bayat, 2021; Xie & Li, 2021) and job satisfaction (Lee, 2021; Panda et al., 2021). Therefore, the research domain also expects these skills as the development of new research capabilities.

Thus, it is necessary to study the human capital of academics using the KSA model mentioned above to understand the complex nature of research activities. The complementarity between attributes and the design of a measure that allows the human capital of academics should be accurately assessed. Therefore, it is necessary to construct an integrative measure that considers research activity at the individual level. This scale will make it possible to describe human capital through its specific attributes as well as the need to strengthen those that are not valued or evaluated by the university for a good performance of research activity.

Universities, therefore, need to find an appropriate measure to test the effectiveness of their researchers (Guarini et al., 2020; Rahmandad & Vaklili, 2019; Kyvik, 2013). In this context, the search for determinants of research performance is postulated as fundamental to the evaluation and development of researchers. One of these approaches in the organisational field is the ability-motivation-opportunity (AMO) framework (Appelbaum et al., 2000). The AMO framework is an approach that aims to explain how these elements affect organisational performance. In the university context, few studies have addressed these variables from an integrative perspective at the individual level of analysis. This approach could emphasise how abilities, motivation, and opportunity affect the performance of academic researchers. The research activity performance of academic researchers could be explained through the three dimensions mentioned above: a) being able to do so—that is, they have the knowledge, skills, and abilities necessary to carry out the research activity; b) they are motivated to do so—that is, because they want to and are adequately rewarded for their behaviour; and c) their work environment provides the opportunities to

carry out research—that is, they have the necessary support and pathways to enable the desired behaviour. Regarding the first dimension, academic human capital measured through the set of knowledge, skills, and abilities (KSA) is essential for researchers to efficiently develop their research activity. The distinction between these variables has been described in depth in the previous paragraph by designing a measurement scale that evaluates the human capital of academic researchers.

Concerning academic motivation, different investigations have determined that motivation can be produced through the intrinsic and extrinsic characteristics of academic researchers (Ballesteros et al., 2020c; De Witte & Rogge, 2010; Sawitri & Creed, 2021; Sondari et al., 2016). The main difference between both types of motivation is that extrinsic motivation is mainly driven by economic rewards and promotional aspects, whereas intrinsic motivation comes through the interests and values of the person himself, because his work fully satisfies him (Albert et al., 2018; Sondari et al., 2016). Therefore, the intrinsic motivation of researchers allows them to obtain rewards from the individual himself through recognition, pleasure, and effort to continue developing his activity (Mayrath, 2008; Stubb et al., 2014). Van der et al. (2015) highlighted some elements specific to favour the intrinsic motivation of the researcher, such as the involvement of the work, the identification of the research as a part of the researcher, and whether the place of work of the researcher is challenging (Ma, 2019; Mayrath, 2008; Ryan, 2014; Ryan & Berbegal-Mirabent, 2016; Stubb et al., 2014). Fox (1983) emphasised that researchers have their own psychological characteristics that allow them to continue carrying out their work, even in the absence of external rewards. As Lovitts (2005) pointed out, researchers with the autonomy to define their topic of interest in the research field will be more internally motivated than those who cannot, since it affects the autonomy of the researcher to develop it. These intrinsically motivated researchers will have a feeling of satisfaction in being able to conduct their own investigations and achieve

greater results (Chen et al., 2006). We could consider other factors that extrinsically motivate academic researchers, such as the promotion of researchers (Backes-Gellner & Schillinghoff, 2004; Chen et al., 2006; Kim & Bak, 2020; Lissoni et al., 2011; Tien, 2000, 2008) as well as obtaining salary improvements (Chen et al., 2006; Edgar & Geare, 2013; Kim & Bak, 2020) or certain incentives to publish (Lu, 2021; Ma, 2019, Ryan, 2014). As the previous arguments highlight, extrinsic motivation allows researchers to behave in a certain way through external stimuli. The relationship between extrinsic motivation and performance has received little attention in the literature, although studies on certain incentives and performance can serve as guides for the study. Importantly, researchers respond to both intrinsic and extrinsic motivational perspectives. They have to pursue their intrinsic motivations to be satisfied in their jobs, just as universities must construct a system of incentives and promotions to motivate their researchers in an extrinsic way. Designing appropriate measures to encourage motivation, both intrinsic and extrinsic, could lead to greater research results.

Regarding the third dimension, the research opportunity corresponds to the resources offered by the university for the development of its activities. Universities also need to provide researchers with certain inputs (physical resources, financial resources, and scientific and support staff) to properly conduct investigations (Agasisti et al., 2011; 2012; Khan & Siriwardhane, 2021; Lee et al., 2021; Schuelke-Leech, 2013). Auranen and Nieminen (2010) and Van der Weijden et al. (2008) considered certain contingencies in research performance at the group level, highlighting the need for certain material resources, such as equipment and job spaces, as well as the human resources and information resources available to students. Researchers within their own teams, in addition to their personal characteristics, can adequately carry out their activities. Researchers need financial resources as a basis for research (Lee, 2021; Lind, 2020). With these resources, they can finance certain infrastructures, support personnel,

and personnel in training, as well as computer programs, electronic resources, and essential equipment for research. Financial resources are limited and highly competitive, and are essential for research in the academic field (Fadda et al., 2021; Hicks & Katz, 2011; Litwin, 2009). Further, the availability of adequately trained personnel would be an opportunity to obtain greater scientific contributions. Various studies have analysed these effects (see, for example, Su, 2011), indicating that postdoctoral training leads to a higher level of productivity. Furthermore, Calma (2014) highlighted that one of the main challenges for research is the construction of a critical mass of researchers, as well as the facilities and resources that support it. The physical resources available to investigate either through laboratories prepared for this purpose, or having prepared equipment with access to databases will be essential to have the opportunity to research (Chirstensen et al., 2020; Lee et al., 2021). More experienced laboratories can accumulate higher levels of input, which can influence their results (Lee et al., 2021; Schuelke-Leech, 2013). Physical resources facilitate research activity based on experiments in the field of science and access to previous research with existing databases. Wang et al. (2006) emphasised that one of the facilitators of the productivity of academic knowledge is access to information through libraries and conferences, which promote new lines of research and the production of new ideas. Studies such as those of Käpylä et al. (2010) identified the management and use of ICT as the basis of scientific productivity. It would be necessary to understand the effect of the types of motivation and opportunity in the relationship between research abilities (human capital) and performance, since they could improve or worsen it.

Further, research management processes have generated a great deal of interest in the literature (Beerkens, 2013; Drake et al., 2019; Nguyen et al., 2020; Nguyen & Van Gramberg, 2018; Piro et al., 2020; Veer-Ramjeawon & Rowley, 2020). Such management variables have played a preponderant role in the effectiveness of academic researchers (Beerkens,

2013; Nguyen & Van Gramberg, 2018; Piro et al., 2020). The design of strategies in universities aimed at developing researchers' human capital is postulated to be an essential resource for scientific productivity (Webber, 2012). Although it cannot be said that there is consensus on the conclusions of these studies (Albert et al., 2016), the general idea of the existence of a relationship between scientific performance and human resources policies (Nguyen & Van Gramberg, 2018; Pham-Thai et al., 2018) or certain incentives that promote research (Xu et al., 2021) does seem to emerge. The design of adequate incentives for research staff allows researchers to be motivated to boost their research activities exponentially (Horta et al., 2019; Kenny, 2017). However, authors such as Almubarak (2021) and Martin-Sardesai and Guthrie (2018) pointed out that rather than the direct effect of research policies on the level of scientific output, the effect comes from the researcher's perception of them. The literature in the field of human resources highlights the existence of adequate synergies between jobs and the incentives of the organisation itself. The researchers' perception of research policies may be essential to obtain greater scientific contributions by being more satisfied with their job than others. The literature has not particularised on the type of psychological contract that is established between the institution and its research staff. By enhancing this bidirectional relationship, universities design their strategy and policies with the aim of optimising the scientific performance of their staff, considering their idiosyncratic particularities (Fumasoli & Lepori, 2011; Leathwood & Read, 2013; Sá & Tamtik, 2012), as well as the resources to fund research units (Piro et al., 2020; Benito et al., 2019), which is one of the main challenges for the development of their scientific strategy (Link & Müller, 2020). Studies such as those by Kenny (2017) and Horta et al. (2019) have highlighted the importance for universities of designing a policy system that promotes research autonomy, flexible professional opportunities in academic work, and the simplification of administrative procedures. Appropriate personnel management therefore promotes

research careers and greatly supports the performance of academic researchers (Alshaikhmubarak et al., 2020; Laudel & Gläser, 2008; Sutherland, 2017). Thus, an enabling performance management approach, based on learnings from management theory, and emphasising engagement, communication, and staff development, is positively related to the well-being of academics (Franco-Santos & Doherty, 2017). Researchers need to understand that research activities are vital to the functioning of university institutions (Beerkens, 2013; Kyvik, 2013; Pedro et al., 2019). However, the literature suggests that researchers' perceptions of university management measures could be a relevant explanatory factor (Khvatova & Dushina, 2017). However, little research has addressed researchers' perceptions at the individual level (Rosewell & Ashwin, 2019; Delaney, 2001). Some studies have attempted to determine the effect of researchers' perceptions on the management of universities themselves (Castro-Ceacero & Ion, 2019; Khvatova & Dushina, 2017), research outputs (Bryce et al., 2020), academic research integrity and behaviours (Huybers et al., 2020) or engagement (Smeenk et al., 2006). However, most studies have not sufficiently addressed the effects that perception has on the institutional incentives that enable them to carry out research activities from an integrative perspective. According to Bak and Kim (2019) and Jørgensen and Hanssen (2018), incentives are necessary attributes for research activity (Xu et al., 2021; Sandoval-Romero & Lariviere, 2020; Kwiek, 2018; Prakhov, 2019; Sandy & Shen, 2019), conditioning those impulses or stimuli that promote research activity in some way (Ballester et al., 2019). The incentive system has traditionally been related to the level of researcher satisfaction (Albert et al., 2018), promoting the achievement of adequate research results (Kyvik & Akness, 2015). Some seminal research has focused on these incentives through researcher motivation (Moses, 1986). Academic researchers have traditionally been 'self-motivated' by working in a stimulating environment that allows them to pursue their research goals from an intrinsic perspective. Research positions are

becoming increasingly demanding and challenging over time. Another important consideration in this context is that the design of research incentives changes throughout an academic career. Kawaguchi et al. (2016) suggested that appropriate incentives and job designs for more experienced researchers increase their research output. Following researcher life-cycle models, they proposed that the scientific publications of academic researchers have declined over the years (Costas et al., 2010; Levin & Stephan, 1991). This decline may be due to the deterioration of the researcher's own capabilities and the attenuation of added incentives, such as promotion and/or attainment of a permanent position in the university. Furthermore, the design of appropriate incentives will not be the same in the early stages as at the end of the research career. A noteworthy study in this area is that developed by Stroebe (2010), in which he concluded that research output decreases due to the incentives themselves and the shortening of the planning horizon for this group. Some authors have shown that long-term contracts can have a negative effect on promotion opportunities (Harney et al., 2014) and research output (Lafuente & Berbegal-Mirabent, 2017) due to the disappearance of extrinsic incentives. It is thus assumed that by stabilising their positions in universities, researchers will be less motivated to make scientific contributions.

Having described the research field of the present thesis, we propose the objectives that we want to achieve with the different research works that compose it.

## 2. Objectives and research questions

The main objective of this thesis is to achieve a better understanding of the relationship between human capital and the performance of university researchers. Further, it aims to analyse the moderating role of research motivation and opportunity, as well as certain institutional variables of universities that favour research activity.

Although human capital has generated great interest in the academy, a greater understanding of the topic applied in the academic context is still required. This thesis examines the attributes required for research activities and how they can affect the performance of the investigation. The thesis proposes a conceptual framework derived from an examination of the literature on academic human capital, the attributes that build the KSA framework of academic researchers, the AMO approach (with A as human capital), and the extent of their effects on the performance of the research activity. In this area, our research proposes the existence of a direct relationship between academic human capital and performance, as well as motivation and opportunity, as moderating variables that favour this direct relationship. Further, contextual variables and how universities manage researchers' human capital should improve their performance.

Specifically, the objectives of this thesis, which are addressed in the empirical works, can be summarised as follows:

**a) Conceptualise and construct a scale for measuring human capital in an academic context**

Human capital has been conceptualised as the attributes that enhance organisational performance (Ployhart et al., 2014; Wright, 2021; Wright & McMahan, 2011). However, only a few studies have analysed human capital in an integrative way in the field of academic research. Research in the field has dealt with specific aspects or attributes of the field without going so far as to analyse those that can influence academic human capital in an integrative way.

Therefore, the previous discussion reveals two research questions: 1) What are the attributes of human capital that drive the research activity of researchers? 2) To what extent does this scale provide valuable information for management researchers to be useful for application in universities? Consequently, this thesis aims to propose and validate a specific scale designed to measure the human capital of academic researchers.

**b) Analyse the determinants of academic performance from the AMO approach**

Academic human capital is an asset that helps universities generate sustainable competitive advantages. The AMO approach has determined that the three dimensions that make it up are basic to organisational performance. This thesis aims to address the importance of these three dimensions in the field of academic research. Our research is supported by studies on the direct relationship between human capital and performance (Ployhart et al., 2014; Wright, 2021; Wright & McMahan, 2011). We propose that motivation and opportunity exert a moderating effect on this relationship. Various investigations in the field of management have proposed synergistic effects between the variables of the AMO approach (Bello-Pintado, 2015; Kim et al., 2015). However, our research provides a new approach in a research context as well as in the establishment of the potential relationships between the mentioned variables.

The following research questions are addressed in this thesis: 1) What are the attributes of human capital, motivation, and opportunity that make up the research activity? 2) To what extent does human capital influence the performance of academic researchers? 3) Does the motivation of academic researchers improve the effect of human capital and performance? 4) Does the opportunity for academic researchers improve the effect of human capital and performance? To address these questions, we analysed a moderating relationship between the variables of motivation and opportunity research and its effect on the relationship directly between research abilities (academic human capital) and research performance.

**c) Analyse the effect of the perception of incentives on research activity**

Research policies have been considered fundamental in the scientific literature (Pham-Thai et al., 2018). However, in organisations, rather than the policies of human resources, are the perceptions of workers who have

propelled the performance thereof (Almubarak, 2021; Martin-Sardesai & Guthrie, 2018). This thesis aims to respond to the importance of these perceptions in the scientific field. Our research is supported by studies on academics' incentives (Xu et al., 2021) and on academics' financing (Aagard et al., 2015; Hicks, 2012; Piro et al., 2020). This research proposes an integrative approach to incentives that can provide greater results for both researchers and their research groups.

Therefore, from this research, the following research questions arise that must be addressed: 1) How do academic researchers perceive the set of incentives for research? 2) How does this perception of incentives influence research results? 3) What incentives best explain the research results? 4) What incentives best explain the motivation of researchers to continue promoting academic research? 5) Are current management measures effective in acquiring the resources needed for research activities?

The study aims to describe the incentives that act as drivers of research activity. It also aims to provide a set of incentives that serve as a management basis for academic researchers during their academic careers. These perceived research incentives act as a specific and integrated measure that enables universities to implement them strategically in a targeted way to boost research activity.

## 3. Data and methodology

To carry out the empirical research contained in this thesis, two databases on academics were constructed: one at a national level, and another a database of academics at the University of Cadiz. Further, diverse methodologies, both qualitative and quantitative, were used to test the hypotheses established in the empirical analysis.

This section describes the data collection procedure and methodology applied in the empirical analysis of the three contributions provided in the doctoral thesis. The databases used to contrast the objectives defined in the

thesis are briefly explained using qualitative and quantitative methodologies. The combination of more than one research method contributes to a better interpretation and understanding of the results obtained (Denzin, 2017; Hussein, 2009). Qualitative data were obtained from the opinions of a group of experts in the field. The quantitative methodologies used in each of the contributions covered by this doctoral thesis are described and include: I) exploratory factor analysis, II) confirmatory factor analysis, and III) multiple linear regression models.

**Data**

*Database 1: Academics at the University of Cádiz*

Regarding the first source of data, a questionnaire was designed as part of a broader study that aimed to study academic intellectual capital, leadership issues, research motivation, timeliness of available and strategic resources, research incentives, and other demographic issues in the context of the University of Cadiz. Although the questionnaire was comprehensive, this thesis did not analyse all the dimensions of intellectual capital; it only focused on the study of the human capital dimension and therefore only used the items related to this dimension, as well as those related to the AMO approach and research incentives.

The questionnaire was constructed as follows: The questionnaire items were extracted from the literature and from the Delphi methodology (which will be explained in more detail in the section on methodologies). This group of 62 experts allowed us to elaborate and agree on the necessary items for the questionnaire. The questionnaire was then tested with a sample of researchers from the University of Cadiz. The database of academics from the University of Cadiz and 62 experts of Delphi methodology were used as a pre-test for any question that was not understood or that could establish response bias, as well as for the composition and structure of the questionnaire itself. The aim of this questionnaire was to validate the questionnaire itself to serve as a basis for the next national database. All suggestions were incorporated into

the final version of the questionnaire. At the end of this testing procedure, 22 items related to academic human capital, 6 items related to academic motivation, 8 items related to research opportunities, and 14 items related to incentives perceived by academics as drivers of research activity were obtained for the purpose of this thesis. The questionnaire asked academics to assess the significance of the measurement items using a 5-point Likert scale (1 strongly disagree to 5 strongly agree) and to answer a set of supplementary questions about the functioning of research activity in their research group, as well as the management of the university itself. Further, each respondent was required to provide demographic variables to be used as control variables in the different studies of this thesis, such as areas of knowledge, six-year periods, gender, and rank, among others.

The designed questionnaire was sent by email to the vice rector of research for distribution to the academics of the university itself. In this process, several reminders were sent to potential participants to increase the sample size. The final sample size of the questionnaire was 425 academics at the University of Cadiz. Table 1.1. describes the main demographic variables of the sample.

**Table 1.1. Sample of academics from the University of Cadiz**

| **VARIABLE** | | **%** |
|---|---|---|
| Field of study (*n = 425*) | Art & Humanities | 21.10% |
| | Sciences | 33.60% |
| | Health Sciences | 11.80% |
| | Law & Social Sciences | 24.40% |
| | Engineering & Architecture | 9.00% |
| Academic rank (*n = 425*) | Full Professor (*Catedráticos*) | 17.4% |
| | Professors (*Titulares de universidad*) | 46.60% |
| | Associate Professors (*Contratado Doctores*) | 22.90% |
| | Assistant Professor (*Ayudante doctores*) | 2.40% |
| | Postdoctoral PhD | 3.80% |
| | PhD Student | 7.10% |
| Six-year research periods (sexenios de investigación) (n = 425) | 0 | 36.20% |
| | 1 | 19.70% |
| | 2 | 17.50% |
| | 3 | 14,00% |
| | 4 | 9,10% |
| | 5 | 3,40% |
| Gender (*n = 425*) | Female | 39.90% |
| | Male | 60.80% |

*Database 2: Academics at Spanish universities*

This second database was created to study the variables dealt with in the previous database from a national perspective. The survey was distributed to academics at different Spanish universities belonging to all areas classified as scientific activities by the Spanish Ministry of Science and Technology. To collect information, a link to the questionnaire was sent by e-mail to the vice-rectors of research and the department directors of all Spanish universities for further distribution. The questionnaire was sent with a cover letter describing the aim of our research project, emphasising the declaration of confidentiality of the answers. The fieldwork was carried out from January 2017 to October

2017. As was the case with the sample of academics at the University of Cadiz, we followed up with several reminders (May and September) to increase the response rate of our study population. The final sample size of the questionnaire was 2223 academics (response rate 6.25%) (Table 1.2). The questionnaire asked academics to assess the significance of the measurement items using a 5-point Likert scale (1 strongly disagree to 5 strongly agree) and to answer a set of supplementary questions on group structure and management.

Further, to obtain the outcome variable, we developed a separate database that collected the performance of the academics. We collected the scientific output of each of the academics who had identified themselves by name or ORCID code in the questionnaire. We obtained scientific output in the form of publications from the SCOPUS database. This database contains both the research output of academics and some measures of researcher quality, for example, the H-index, as well as over various periods (output in the last 5 and 10 years). These measures provide a good outcome variable for the academic productivity of our sample. However, H-index is not without limitations (Bihari et al., 2021; Ding et al., 2020; Iglesias & Pecharroman, 2007). For this reason, the variable of research efficiency, data envelopment analysis (DEA), was also included in the database. This measure has been used in the literature to understand efficiency among universities (Abbott & Doucouliagos, 2003; Altamirano-Corro & Peniche-Vera, 2014; Avkiran, 2001; Ghimire et al., 2021; Leitner et al., 2007; Sagarra et al., 2017), university departments (Aziz et al., 2013), and academics (Abramo et al., 2011). The DEA measure constructed in our research is the researcher's H-index as a numerator and the years of researcher experience from an individual perspective as the denominator of the efficiency measure. With this measure, the aim was to measure efficiency among academics at a given point in their research careers.

**Table 1.2. Sample of academics from Spanish universities**

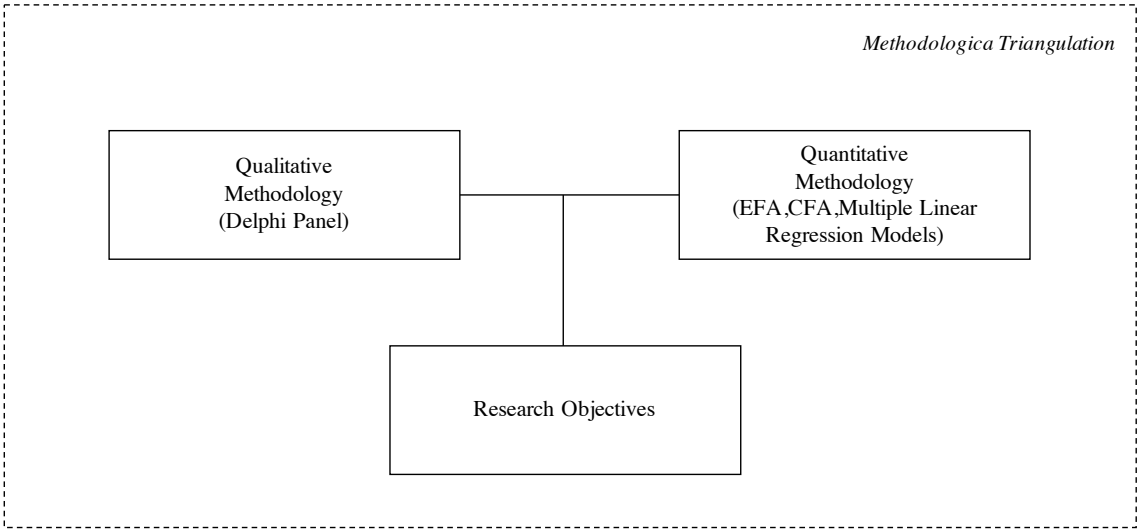
| VARIABLE | | % |
|---|---|---|
| Field of study (*n = 2223*) | Art & Humanities | 21.10% |
| | Sciences | 24.40% |
| | Health Sciences | 12.70% |
| | Law & Social Sciences | 23.30% |
| | Engineering & Architecture | 18.50% |
| Academic rank (*n = 2223*) | Full Professor (*Catedráticos*) | 17.50% |
| | Professors (*Titulares de universidad*) | 41.70% |
| | Associate Professors (*Contratado Doctores*) | 13.10% |
| | Assistant Professor (*Ayudante doctores*) | 5.70% |
| | Postdoctoral PhD | 2.80% |
| | PhD Student | 7.60% |
| | Lecturer | 9.50% |
| | Others | 2.10 |
| Six-year research periods (sexenios de investigación) (n = 2223) | 0 | 36.90% |
| | 1 | 13.80% |
| | 2 | 16.20% |
| | 3 | 15.30% |
| | 4 | 10.80% |
| | 5 | 5.10% |
| | 6 | 1.80% |
| Gender (*n = 2223*) | Female | 41.50% |
| | Male | 58.50% |

## Methodology

To achieve the set research aims, we opted for a mixed analysis in the design of the research methodology using both quantitative and qualitative techniques. Studies such as Henwood (2004) have proposed that mutually exclusive quantitative and qualitative methodological approaches only restrict

the rigour of the research, as polarising the use of methodological perspectives limits the search for new ways of achieving or reinventing new forms of knowledge. The use of qualitative and quantitative methodologies together is essential for explaining complex realities in the social sciences. As Turner et al. (2017) and Hernández-Sampieri et al. (2014) indicated, methodological validity will not lie in the use of one research method or another but will be conditioned by the quality of the data, the analyses developed, or the interpretation and conclusions reached by using a methodological perspective for a specific purpose and in a specific setting. The mixed approach (Figure 1.1) is related to what is known in the methodological literature in the social sciences as the triangulation or convergent validation of the findings or results reached in fieldwork (Jick, 1979). Triangulation is the combination of two or more theoretical or methodological perspectives in the study of a particular phenomenon (Denzin, 1989). The main rationale of methodological triangulation suggests that a hypothesis tested and verified by confronting different methodological perspectives achieves a higher degree of validity than if it results from a single technique (Cowman, 1993). Social science scholars argue that the use of a single methodological approach to test propositions studying a particular social phenomenon can lead to methodological biases in the data itself or in the researchers' interpretations (Denzin, 2017; Oppermann, 2000; Smith, 1975). Therefore, quantitative and qualitative methodological techniques are, as we have previously indicated, perfectly complementary (Jick, 1979), and combining these techniques allows us to achieve more valid and rigorous results when crossing and contrasting data. Furthermore, using a strategy of methodological triangulation allows for more precise answers to research questions by offering different techniques for generalising results, the precision of control and measurement of measurement, and the authenticity of the research context itself (McGrath, 1995). Thus, the weaknesses of one technique can be complemented by other techniques for the generalisation of the studied model.

**Figure 1.1. Methodological triangulation**




In our research, we applied methodological triangulation through the use of the Delphi technique as a qualitative methodology and other quantitative methodological techniques, such as exploratory and confirmatory factor analysis, as well as multiple regression analysis, which we will describe later.

*Qualitative Methodology (Delphi Panel)*

Qualitative methodology is designed with the aim of posing questions that favour a reconstruction of reality as it is perceived and observed by certain subjects that make up a defined social system (Hernández-Sampieri et al., 2014). Qualitative techniques have been widely recognised in the literature as methods for generating new knowledge and evidence that are aimed at understanding complex issues (Kvale, 2007; Rodríguez-Gómez et al., 1999). Therefore, in our study, we resorted to these techniques, as it was necessary to obtain information about the processes surrounding human capital in the field of scientific research, as well as other dimensions in academia (motivation, opportunity, incentives, resources needed for research, etc.). This methodology is necessary in this type of research to clarify the attributes that are important for the measurement and analysis of the topic to be addressed. Qualitative methodology allows the researcher to conceptualise or describe facts based on

non-numerical data collection, with the aim of answering the research questions. According to Flick (2007), qualitative methods accommodate a set of research approaches and practices that can be classified according to the information they provide. We identified (1) methods based on obtaining verbal evidence, which could be found in qualitative techniques such as interviews or focus or discussion groups, where information is analysed through transcription methods; (2) methods focused on making specific descriptions from observed facts, such as ethnography or observation. In this case, information is generated from notes developed in case studies or memos that have been collected from specific observations of groups or processes in their natural habitat; (3) methods based on transforming and obtaining data through the analysis of documents contained in texts or photographs; and (4) methods focused on coding and analysing data, such as conversations generated in a focus group, or testimonies from interviews. Our research used the first of the aforementioned methods types, involving expert groups on complex and unobservable issues in the field of academic research.

This methodology can be classified using the same approach proposed by Flick (2007), in which the aim is to obtain verbal evidence from expert subjects. Specifically, the Delphi technique is developed through a structured and iterative process in which a sample of experts in the field anonymously share their opinions with the rest of the experts on the issue to be analysed until consensus is reached (Landeta, 1999; Okoli & Pawlowski, 2004).

Two aspects are essential in this type of analysis (Landeta, 1999; Okoli & Pawlowski, 2004). First, the issue to be analysed must be set out in a way that provokes debate and allows a consensus to be reached among experts. The issues to be addressed in this case were the attributes of human capital, research motivation and opportunity, research incentives, and determinants of research performance. To inspire the discussion, a document was designed consisting of eight open-ended questions covering all aspects of the issues related to the object of study. The second key element is the identification of experts who should participate in the panel. In this case, the panel was

composed of the principal investigators of the active research groups at the University of Cadiz. In the selection of the panel members, we followed the recommendations of Okoli and Pawlowski (2004), who tried to avoid the response bias and subjectivity problems derived from this type of technique. To establish a criterion that would allow us to obtain an objective and diverse sample, we selected leaders of scientific teams that met two conditions: (I) were recognised by the Spanish National Plan for Scientific Research, Development and Technological Innovation (National R&D&I Plan), and (II) had active and continuous research activity, according to their performance records. Once the database was established, we contacted the leaders of these scientific teams by telephone: (I) to inform them about the purpose of the research, (II) to request their active participation, and (III) to communicate the expected date of sending the study questions telematically. For the present methodology, 62 valid responses were obtained from research team leaders from different scientific areas (Table 1.3).

Based on an analysis of the information obtained from the Delphi panel experts, a final questionnaire was designed. This instrument served as the basis for the second phase of the study to analyse the validity of the proposed scale. In the different phases of the data collection process of the experts' comments, changes were made to the instructions and/or procedures of the statements to improve the clarity of the questions and the subsequent validity of the data. By synthesising the opinions after each round, we tried to reach a consensus within the expert panel, consistent with the objectives of the Delphi technique (Landeta, 1999; Okoli & Pawlowski, 2004). Therefore, after three rounds of discussion, we obtained 50 indicators and concretised them into a research questionnaire, following the design recommendations of Hinkin (1998).

**Table 1.3. Participant Delphi panel data**

| VARIABLE | | % |
|---|---|---|
| **Field of study** | Art & Humanities | 32.26% |
| **(*n = 62*)** | Sciences | 27.42% |
| | Health Sciences | 14.52% |
| | Law & Social Sciences | 9.68% |
| | Engineering & Architecture | 16.13% |
| **Academic rank** | Full Professor (*Catedráticos*) | 66.13% |
| **(*n = 62*)** | Professors (*Titulares de universidad*) | 33.87% |
| **Gender** | Female | 22.58% |
| **(*n = 62*)** | Male | 77.42% |

*Quantitative Methodology*

To achieve the research objectives, multivariate techniques common to this type of research were applied in the development of the empirical section (Aguinis et al., 2009). Quantitative methodology makes it possible to obtain relevant information from a sample and to test the research hypotheses set out in the theoretical review. These techniques are based on measurement and statistical methods to identify and establish patterns of behaviour. In our study, as we will describe below, based on the research objectives set out, we highlighted the exploratory and confirmatory factor analyses through which the study of variables and underlying constructs was carried out. We also analysed multiple regressions to determine the causal relationship between the variables studied.

*A) Exploratory factor analysis*

The first step of our analysis was to identify an optimal factor structure using exploratory factor analysis (EFA) techniques. The determination of the factor structure provided a theoretical understanding of how items from the different dimensions were grouped together to create one or multiple constructs

within the instrument. Given that we did not rely on validated scales in the literature and no previous studies, we had to check and confirm the construct validity. To do so, it is useful to start with an exploration of the factor structure using EFA techniques (Tabachnick & Fidell, 2013). According to the literature, regardless of how effectively the researcher considers that the item generation has replicated the theoretical latent variables, it is advisable that the initial and preliminary validation of an instrument involve empirical assessment of the underlying factor structure, which in particular would be an EFA (Cabrera-Nguyen, 2010; Hurley et al., 1997; Rentz et al., 2002; Worthington & Whittaker, 2006; Yong & Pearce, 2013). However, although an EFA is useful for determining the dimensionality of an instrument, it only provides evidence of a theoretical factor structure. With the EFA, the researcher has no prior information about the number of factors. Thus, EFA is a data reduction technique and is useful in preliminary analysis when there is an absence of a specific theory about the relationships of the manifest variables and the underlying constructs.

Therefore, we applied an EFA to the data obtained from the questionnaires to identify and eliminate unrelated elements. We used IBM SPSS 21 software to perform the analysis. The efficiency of the factorisation of the original variables analysed and the joint significance of the model were assessed using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. To determine the number of extracted factors, we chose the latent root criterion (Hair et al., 2006). In this method, particular values (eigenvalues) are ordered by size, and values equal to unity (1) or greater are retained. Similarly, a factor solution that accounted for at least 60% of the total variance was considered satisfactory (Hair et al., 2006). Items that loaded insufficiently on a factor were removed if (1) different items measured similar realities, or (2) they did not have strong theoretical or qualitative relevance as indicators of human capital.

The method for factor extraction was principal component analysis (PCA). It is true that PCA has had multiple detractors, as some current studies

in the literature argue that it does not represent a real factor analysis (Costello & Osborne, 2005; Hair et al., 2010; Steiger, 2004). However, a review of the literature revealed no consensus on this issue. We found studies suggesting the restricted use of PCA in favour of a true factor extraction analysis method, such as maximum likelihood or principal axis factorisation (PAF) (Bentler & Kano, 1990; Floyd & Widaman, 1995; Mulaik, 1990; Snook & Gorsuch, 1989; Velicer & Jackson, 1990; Widaman, 1993). By contrast, other authors disagree and point out that there is no difference between PCA and any of the other techniques for factor extraction, or even that the application of PCA is preferable (Arrindell & van der Ende, 1985; Guadagnoli & Velicer, 1988; Steiger, 1990; Velicer & Jackson, 1990). Fabrigar et al. (1999) suggested that the relative usefulness of each method depends on the intentions of the researchers and the distribution of the observed data. Pett et al. (2003) even pointed to PCA as a good method of extracting factors to obtain preliminary results if this does not represent the fundamental analysis of the study.

First, under these arguments, it is important to note that in our study, PCA does not represent the fundamental analysis by which we comprehensively examine the underlying structure or relationships between variables. For this, we performed a subsequent confirmatory factor analysis. In fact, this same procedure has been followed in relevant publications in the field, such as Way et al. (2015), who used a PCA to subsequently give consistency to the results through a confirmatory factor analysis. Therefore, we can consider that the initial exploratory analysis aims to reduce the number of variables that are highly related to a smaller number of principal components that account for most of the variance in the observed variables. As indicated in the literature, it is common to proceed with a subsequent analysis to verify the underlying structure among the variables that the PCA initially proposes (Tracey & Tews, 2005; Reio & Shuck, 2015). Therefore, through the confirmatory factor analysis that we subsequently conducted, we proceeded to assess the underlying factor structure of the set of variables as well as to detect and assess the unidimensionality of the theoretical constructs.

However, to confirm our decision, in the development of our analyses, different extraction methods and decision rules were tested and used simultaneously. PCA, principal axis factorisation, and maximum likelihood tend to be common extraction strategies that are highly accepted and used in the social sciences (Conway & Huffcutt, 2003; Onwuegbuzie & Daniel, 2003; Pett et al., 2003). According to Costello and Osborne (2005), in general, maximum likelihood and principal axis factorisation provide the best results, depending on whether the data are normally distributed or significantly non-normal, respectively. Considering the nature of the Likert scales and the multivariate non-normal distribution of the variables, the extraction method that best suited our data a priori was principal axis factorisation (Fabrigar et al., 1999). The results obtained through this extraction method were similar to those obtained through PCA. Other methods less used in our field, such as unweighted least squares, were also tested to obtain similar factor solutions and factor groups. Therefore, given that the results obtained after testing different methods were not significantly different and that the factorial solution that made the most theoretical sense was the one reached in the PCA, we decided to use this method of factor extraction. As reflected in the literature, there is some explanation for the similar factorial results obtained in our research. The discrepancies between the solutions provided by PCA and other factor analysis methods seem clearer when the number of variables for factor identification is insufficient, the sample size is small, and the factor loadings are low (Velicer & Jackson, 1990; Thompson, 2004; Rietveld & Van Hout, 1993). Achieving stable and replicable solutions is possible as long as factor loadings are high (>0.6) (Fabrigar et al., 1999; Fidell, 2013; Field, 2000; MacCallum et al., 1999; MacCallum et al., 2001; Tabachnick & Thompson, 2004). However, as Osborne and Costello (2004) pointed out, in empirical social science research, strong factor loadings can be considered loading values greater than 0.5. In our work, in addition to the fact that we had a large number of variables, the factor loadings were consistent and significantly high. Therefore, the loading patterns were remarkably similar across the different extraction and rotation techniques.

Moreover, the confirmatory factor analysis supported the results of the exploratory analysis using PCA as the extraction method; thus, it is likely that these similarities indicate that the scale has a strong factor structure.

One of the elements that characterise exploratory factor analysis is the rotation method chosen to provide a factorial solution. The ultimate aim of applying rotation techniques to the solution is to select one that offers the greatest simplicity in the interpretation of the results obtained (Hair et al., 2006). In our research, before establishing the orthogonal method (Varimax) as the rotation technique, several tests were carried out with different rotation strategies. A review of the literature in the context of scale validation shows that most works use rotation techniques to extract factors (components) to aid their interpretation (Reio & Shuck, 2015; Ruscio & Roche, 2012). The criterion traditionally used to opt for one of the two existing rotation strategies (orthogonal or oblique) is the researcher's hypothetical estimation of the independence or correlation between the supposed factors. Specifically, the orthogonal rotation method is used in the case of factor independence, while oblique rotation techniques admit the possible correlation of factors (Fabrigar et al., 1999; Lloret-Segura et al., 2014; Nunnally, 1978; Reio & Shuck, 2015; Ruscio & Roche, 2012; Treiblmaier & Filzmoser, 2010). In our work, we initially estimated that the different factors of each variable were not highly interrelated. However, to examine possible differences in the results and to dispel doubts about the estimates regarding the possible intercorrelation or not between factors, we also checked the use of other oblique rotation methods. According to these studies, if a priori the construct does not show a clear correlation between factors or a presumed independent factor structure, the results will show this orthogonality. If we allow the correlations between factors to be an oblique approximation, the correlations we obtain will be low. Lastly, these studies insist that if the correlations obtained are not consistently high, the analysis should be repeated using an orthogonal solution. Moreover, if a situation arises in which both solutions are similar, taking into account the parsimony criterion, it is advisable to admit the orthogonal solution (Ferrando

& Anguiano-Carrasco, 2010). Therefore, the analyses were repeated to obtain an oblique solution (Oblimin). First, the solutions obtained with oblique rotation were similar (the same percentage of variance was explained). Second, as expected, no consistent intercorrelation was obtained, and the orthogonality was reflected in the results obtained. Therefore, following the indications reviewed in the literature (Fabrigar et al., 1999; Finch, 2006; Henson & Roberts, 2006; Lloret-Segura et al., 2014; Matsunaga, 2010; Park et al., 2002), and following the parsimony criterion (Ferrando & Anguiano-Carrasco, 2010), we accepted the initial orthogonal solution (Varimax). It is important to note that the rotated solution is fundamentally aimed at achieving the greatest simplicity and interpretability. As argued by Sass and Schmitt (2010), no definitive answer can be concluded regarding which rotation criterion produces the "best" solution. We cannot conclude that there is a consistent criterion for correct or incorrect rotations. However, it is important to note that the choice of one method or another method can lead to errors in the construction of theories (Schmitt & Sass, 2011). Therefore, it is very important to choose a rotation criterion that provides the easiest results to interpret (Asparouhov & Muthén, 2009). Ultimately, the selection of the method that is most appropriate in terms of the theoretical meaning of the solution should be made by the researcher (Browne, 2001; Sass & Schmitt, 2010). That is, the researcher must test the different factorial solutions following the alternative rotation techniques, and depending on the results achieved, choose as the best rotation method the one that shows the factorial solution with the greatest theoretical interpretability and simplicity (Browne, 2001; Sass & Schmitt, 2010). Following this premise, after performing the recommended checks, it was also possible to conclude that the solution that made the most theoretical sense and provided the best interpretation of the data was the orthogonal solution (Varimax).

*B) Confirmatory factor analysis*

The second step was to confirm the structure using confirmatory factor analysis (CFA) methodology. This process determines the internal correlations

between the items and the behaviour of the dimensions in an integrated manner. The literature recommends that EFA should be followed by CFA to evaluate and refine the resulting scales (Farooq, 2016; Gerbing & Anderson, 1988; Lloret-Segura et al., 2014). CFA methods, which use a separate sample, should be used to support factor structure and provide additional evidence of construct validity (Cabrera-Nguyen, 2010; Fabrigar & Wegener, 2012; Worthington & Whittaker, 2006). Therefore, following the usual recommendations in the literature, CFA was conducted using the responses of a randomly selected half of the sample so that the results of the EFA were subsequently confirmed through CFA with the other half of the sample (Brown, 2014; Lloret-Segura et al., 2014; Nimon et al., 2011).

As previously noted, we relied on the results of the EFA to specify the factor models used in the CFA. This analysis was used to assess the construct validity and reliability of subjective measurement instruments and to verify the goodness of fit of measurement scales (Brown, 2014; Hair et al., 2006). The sociometric properties of the measurement scale and construct validation were assessed following the most accepted practice in the literature (Anderson & Gerbing, 1988; De Vellis, 2003; Hinkin, 1998; Rogers & Wright, 1998). Specifically, the methodology followed by the most relevant publications in the field was replicated using the structural equation technique (SEM) as a tool to validate scales (Chiva et al., 2007; Crucke & Decramer, 2016; Farooq, 2016; Tracey & Tews, 2005; Way et al., 2015). These analyses were carried out through structural equations using the statistical software EQS 6.1 for Windows. The use of SEM is appropriate for the conceptualisation of academic human capital and AMO dimensions, as it allows for the inclusion of latent variables that are not directly observable (Mueller 1997; Kline 2015). As suggested by Chin (1998), these techniques aim to respond to the emerging need to introduce psychometric variables that are not directly observable in econometric estimations. Thus, structural equations allow for the modelling of multiple links between latent variables that are indirectly inferred from a set of indicators that are directly observable. The development and validation of a

construct through SEM has been widely used and accepted by multiple relevant works in our field (Alegre et al., 2006; Alegre et al., 2009; Chiva et al., 2007; Crucke & Decramer, 2016; Tracey & Tews, 2005; Way et al., 2015; Yu & Hsu, 2013). This method also provides correlations between factors or dimensions (Anderson & Gerbing, 1988; Yu & Hsu, 2013). Such analysis allows the researcher, based on theory, to establish a priori the number of latent variables, and the relationships between these and the variables that are observable (Hair et al., 2010).

To carry out the analysis, we constructed a second-order model for each human capital and AMO dimension with formative indicators through structural equation modelling. The model for determining a measurement scale can be formative or reflective. A formative indicator differs from a reflective indicator in that the former affects the latent variable, whereas in the latter, the latent variable produces an effect on the indicator. Formative constructs are a composite of multiple measures (MacCallum & Browne, 1993). Unlike reflective measures, where a change in the construct affects the underlying measures, formative constructs work differently—changes in the formative measures cause changes in the underlying construct (Jarvis et al., 2003). The indicators that determine a construct are called causal or formative indicators. Constructs formed by these causal indicators together with a disturbance term are called formative constructs or composite variables (MacCallum & Browne, 1993). In our research, we postulate this type of formative construct because if any item or construct of academic human capital were removed, it would become meaningless as a variable or would not form the construct under study. For example, if we removed one dimension of human capital (knowledge, skills, and abilities), the construct would lose explanatory power and could not be interpreted in its entirety. Therefore, considering the nature of the Likert scales and the multivariate non-normal distribution of the variables, we used the elliptical least squares (ELS) estimator (Brown, 2014). In designing our study, we considered the relationship between the measures and the constructs to be a formative model.

Moreover, the fit of each model was assessed by examining conventional fit indices (Brown, 2014; Kline, 2015). Therefore, indicators such as the *standardised root mean square residual* (SRMR), *root mean square error of approximation* (RMSEA), *comparative fit index* (CFI), *goodness-of-fit statistic* (GFI), *and Tucker-Lewis index* (TLI) were used. We also report the chi-square test statistics divided by the degrees of freedom ($\chi^2$/df) (Hair et al., 2006). To assess model fit, we relied on the guidelines on cut-off values described by Hair et al. (2006) and Kline (2015). For the $\chi^2$/df ratio, Schumacker and Lomax (2004) suggested a value below 5. For the SRMR, Hair et al. (2006) argued that values below 0.08 indicate a good fit with the data. For the RMSEA, Brown (2014) suggested a cut-off value of 0.06, that the range of 0.8–0.1 indicates a mediocre fit, and that models with RMSEA greater than 0.1 should be rejected. For the CFI, GFI, and TLI, different authors indicate that values in the range 0.9–0.95 indicate an acceptable fit, with values closer to 1.0 indicating a good fit (Brown, 2014; Hair et al., 2006). To assess convergent validity, the factor loadings provided evidence of adequate convergence of constructs. Convergent validity is accepted when factor loadings are greater than 0.5 and t-coefficients are significant ($p < 0.001$) (Kline, 2015). Lastly, we assessed the internal consistency or reliability of the scales using Cronbach's alpha values (Hair et al., 2006; Kline, 2015). Cronbach's alpha values above 0.6 were considered acceptable in the social sciences, according to Hair et al. (2006).

Further, based on the accepted literature on scale development and construct validation (Hinkin, 1998; DeVellis, 2003), we proceeded to verify the (i) dimensionality, (ii) validity, and (iii) reliability of the scale. The dimensionality of the scale ensures that the factor structure used to conceive the latent variable is correct. A good fit of the measurement model would support the proposed factor structure (Yu & Hsu, 2013). Therefore, a second-order CFA was conducted to confirm dimensionality. The loadings of the measurement items on the first-order factors and the loadings on the first- and second-order factors were all significant at $p < 0.001$. All estimated parameters

were statistically significant, and factor loadings were reasonably high, obtaining values well above the minimum recommended values (Hair et al., 2010; Tippins & Sohi, 2003). Therefore, the proposed dimensionality of the three dimensions of human capital (knowledge, skills, and abilities) and AMO (abilities, motivation, and opportunities) was supported by the correct fit of the second-order factor model. The *root mean square residual* (RMR) was close to 0, and the goodness of fit index (GFI) was above the recommended minimum of 0.9. The *Bentler–Bonett normative fit index* (BBNFI) exceeded the recommended acceptance threshold of 0.9. The normed chi squared (NC) fell between 1 and 2, indicating an excellent parsimonious fit. The *comparative fit index* (CFI) exceeded the recommended value of 0.9 for all three measurement models, indicating a good model fit and confirmation of the scale's dimensionality. Validity ensures that the scale satisfactorily measures what it is intended to measure. The convergent validity of a concept implies that the measure used has a high correlation with other measures that assess the same concept (Churchill, 1979). CFA was used to establish convergent validity by confirming that all scale items loaded significantly on their hypothesised construct factors (Anderson & Gerbing, 1988). Convergent validity is accepted when factor loadings are greater than 0.4, and t-coefficients are significant, that is, greater than 1.96. We also considered the Bentler–Bonett coefficient, which should be higher than 0.9 (Hair et al., 2010). Furthermore, a measurement scale is considered to have content validity if its items are representative of the construct it intends to measure, and are easy to answer (Bearden & Netemeyer, 1999, p. 4). Consequently, the generation of the dimensions and items that make up the measurement scale of the dimensions of academic human capital and AMO are based on previous theoretical arguments, such as the qualitative evidence obtained through the Delphi panel. By pre-testing with different academic experts, we ensured that the items and indicators were clear and understandable. Therefore, we determined that the proposed scale comprised the integrative nature of the studied topic.

Lastly, reliability is an indication of the degree to which a measure is free of random error and therefore produces consistent results. This property could be thought of as the difference between the true variance and the variance of the observed variable. For a comprehensive reliability assessment, we used Cronbach's alpha coefficients. The Cronbach's alpha coefficients in our studies were satisfactory, as they were higher than 0.7 (Hair et al., 2010, 2006; Kline, 2015; Nunnally, 1978).

*C) Multiple linear regression models*

The empirical research attempts to explain how research performance is affected by academic human capital by exploring the potential moderating role of research motivation and opportunities. Therefore, to establish the possible relationships that occurred between the dependent variable and the different independent variables in the studies, we used multiple linear regression analysis.

Multiple linear regression analysis is closer to complex phenomena than simple ones, since it explains these facts through a series of variables that participate in their concretion. Through this analysis, we can identify the different causal elements (independent variables) that explain a dependent variable, compare different causal models simultaneously, or approximately predict the behaviour or values of a variable (Cohen et al., 2014). As in the cases described above, we used IBM SPSS 21 to estimate the parameters of the equations that make up the linear regression model. To obtain the regression coefficients, we followed the least squares criterion (Hayes, 2013), which involves minimising the sum of the squares of the residuals. Thus, the regression line defined is the one closest to the observed point cloud and, hence, the one that best symbolises the observed points. To reduce potential bias and contextual differences between the dependent variables, it was decided to create a generalised linear model with the variable "university". This regression analysis involves clustering the standard errors according to a variable that categorises their relationships. We performed this analysis to

understand the reasons for the existence of problems in the sample due to differences in the data according to the universities from which they originated. We believe that neither academic human capital nor motivation should differ at the university level. Although universities can foster the development of academic human capital and motivation, these dimensions are intrinsic aspects of the academic him/herself. However, academics' opportunities could certainly be affected by their universities, which suggests that the available resources may be more substantial in some universities than in others. This regression model is considered more cautious because it considers this type of standard error clustered by university. In this sense, we can conclude that standard errors are not a problem in our study. To explain the model and reduce possible omitted variable bias (OVB), we used academic career seniority as a control variable due to its contrasting potential effect on scientific productivity (Amara et al., 2020; Mwesigwa et al., 2020). Furthermore, as mentioned above, the direct relationship between human capital and performance was incorporated into the model, thereby including the indirect or moderating variables of motivation and research opportunity in the final model.

To assess the goodness of fit of the data to the linear multiple regression model, we used statistics widely accepted in the literature (Cohen et al., 2014; Hayes, 2013). For example, we assessed the (1) *multiple correlation coefficient* R, which measures the magnitude of the relationship between a set of independent variables and the dependent variable. Following standard procedures, the variable with the highest partial correlation, in this case, the human capital of the academic, was introduced into the model. To this end, the partial correlation matrix was initially calculated, observing the interrelationship between the independent variables and their relationships with the dependent variable. To identify biases caused by multicollinearity problems, we also checked that the correlation between the independent variables was not very high. Other indicators were also considered, such as the

(2) *coefficient of determination* ($R^2$), which measures the percentage of variability of the dependent variable that can be explained by the independent variables that make up the regression model. The increase in this indicator in reference to the independent variables added to the model may be an indicator that shows the estimated predictive importance of this new independent variable. Furthermore, (3) *standard errors of prediction* were also evaluated, which indicate the part corresponding to the variability of the dependent variable that cannot be explained by the regression model. Therefore, the higher the levels of the coefficient of determination, the smaller the errors.

The goodness of fit of the regression model was also assessed through (4) *analysis of variance*. It is possible to assess the validity of the regression model for estimating the dependent variable. The analysis of variance (ANOVA) was carried out using the *ANOVA* provided by the *F* statistic. This statistic is used to test whether the slope of the regression line is null (Ho)—that is, whether the variables are uncorrelated in each of the models that make up the multiple linear regression. If in this statistical test the *p-value* is less than the significance level (0.05), the null hypothesis is rejected. This indicates that the findings obtained in our sample can be generalised to the population context to which our sample belongs. Lastly, we considered the (5) *analysis of the residuals,* which are considered to be the estimation of the errors. Sometimes, there may be a certain correlation between the two variables, despite the fact that this relationship is strongly non-linear in nature. Therefore, the residuals were evaluated to check whether the linear regression model and goodness of fit were adequate. For the model to be adequate, the distribution of the variable representing the residuals must be normal, but the residuals must also be independent and uncorrelated. To assess these conditions, the plot of the typed residuals was checked to determine how the residuals were distributed. If most of the points lie on the diagonal without being scattered, there are not many residuals, indicating a worse fit. Importantly, the Durbin–Watson statistic that assesses the degree of autocorrelation between the

residuals in the model was also tested. If the residuals are independent, the observed value of one variable should not be affected by the observed values of the same variable in other subjects. Values of this statistic close to 2 indicate that the residuals are uncorrelated, which shows a better goodness of fit for the regression model. However, values close to 4 suggest that they are negatively autocorrelated, and if they are close to 0, they are positively autocorrelated.

## 4. Structure and content of the thesis

This thesis presents an empirical analysis across three papers. The empirical analysis contains an explanation of the methodology used in the research and the results obtained. The hypotheses established in the proposed model are contrasted.

In the **first of the empirical studies**, to develop and validate a tool to measure human capital in the academic context, the stages established in the literature for the validation of measurement scales were developed. The literature review provided an overview of previous research efforts to measure academic human capital. This review revealed that there was a lack of tools or instruments to evaluate this construct in a purely scientific research context. Studies in the field have not described in an integrated way the specific attributes that make up academic human capital. This lack of tools in the literature is even more evident when we search for the specific measurement and management of the human capital of researchers in different fields of knowledge. Therefore, to build an initial set of indicators, we needed to resort to the generic literature that addressed human capital in the organisational context (Ployhart et al., 2014; Wright, 2021; Wright & McMahan, 2011), which describes the existence of three dimensions of human capital: knowledge, skills, and abilities. Given this lack of theoretical support, we decided to combine the deductive approach of the literature review with additional inductive evidence (Hinkin, 1998). Thus, the proposed scale

contributes by conceptualising new variables that could be used to deepen and broaden the study of the determinants of research performance. The contextualisation of the human capital approach can also help to assess the value of intangibles, offering an external reporting tool, making universities' social contributions more visible to public and private stakeholders, and justifying the efforts made by societies in the generation of academic knowledge.

In the **second of the empirical studies**, we analysed the relationship that exists between each of the dimensions of human capital and the level of scientific productivity of the researcher, using academic motivation and the opportunity of the availability of resources as moderating variables. The present study aims to analyse the AMO approach in the field of university research. To test our hypotheses, we used multiple regression analysis. The extracted factors in the measurement analysis were introduced into multiple regression models as interaction terms to test the hypotheses established in the previous section. The contributions of this paper also offer interesting implications for both academics and research institutions because they provide evidence of the internal behaviour of academic researchers and how they affect academic performance. The conceptualisation of AMO by the researcher also offers a management tool by providing a self-assessment instrument in the academic context. These findings contribute to drawing a general image of how individual and collective attributes improve the research performance extracted from them. Thus, the results of the study also have interesting implications for both research team leaders and decision-making within universities, and the proposal of policies that manage the research.

In the **third of the empirical studies**, we analysed the relationship that exists between researchers' perceptions of research incentives that allow greater scientific productivity as well as their motivation. The present study attempted to analyse the perceptions of suitable incentives at the research university. To reduce the number of items, an EFA was carried out. After the EFA, we obtained a total of four incentives that were perceived as fundamental

to the research activity. The contributions of this paper also offer interesting implications for both academics and research institutions because they provide evidence of the incentives of academic researchers and their perceptions in the field of academic research. The conceptualisation of incentives by academic researchers offers a management tool by providing an instrument for measuring and assessing the incentives that drive the research results and the motivation of researchers. These findings help to draw a clear, general picture of how the specific attributes of research incentives drive research results in some way.

Lastly, **general conclusions** are drawn to highlight potential conceptual and empirical **limitations** that have been identified throughout the study. The results obtained in the quantitative analysis (first, second, and third empirical studies) should be considered in light of a series of limitations that allow us to better understand the significance of the conclusions drawn, as well as to qualify certain aspects of the investigation. Among the conclusions that can be drawn are that universities, as well as their academics, need to be analysed in depth. Academics need to be understood to promote measures that boost their performance. The findings support the idea that the human capital management of academics and their motivations must be considered for the contributions of science, and the opportunities offered by the university to support research. Among the conclusions drawn, we can highlight that academics' perceptions of researchers contribute to the satisfaction and impulse of research. We conclude this work with the proposal of a series of **future research ideas** that will allow us to deepen and continue with the opened research line. In this section, we propose future studies that mainly pertain to certain criteria, such as the use of different study variables that can provide new contributions, the use of a single respondent, and the use of different research methodologies to corroborate the results. These future investigations will allow us to further explore new contributions and analyse more complex and deeper questions in this field of study.

# EMPIRICAL ANALYSIS

# Paper 1

*Academic human capital in universities: Definition and proposal of a measurement scale*

* García-Carbonell, N., Guerrero-Alba, F., Martín-Alcázar, F., & Sánchez.Gardey, G: (2021). Academic human capital in universities: Definition and proposal of a measurement scale, *Science and Public Policy, 48(6), 877-888.*

# Academic human capital in universities: Definition and proposal of a measurement scale


## Abstract

*Academic human capital (AHC) is a key element in the explanation of scientific productivity. However, few studies have analysed this topic in the academic context, and their conclusions about composition and measurement remain ambiguous. This study proposes a measurement scale to assess AHC, following a systemic procedure composed of two steps: qualitative and quantitative phases. First, the Delphi technique was applied to reach a consensus on the AHC factors, resulting in a scale of 22 items. Secondly, exploratory and confirmatory factor analyses were conducted to determine the underlying factorial structure of the scale, using a sample of 2,223 researchers in Spanish universities. The results provided a five-dimensional structure of AHC, measuring the knowledge and abilities required to perform research activities, as well as skills related to the organization of scientific processes, alertness to research opportunities, and the openness to provide and receive criticism. This study poses interesting challenges for knowledge management in universities.*



**Keywords:** human capital, academic research, university, scale development

## 1. Introduction

In the last decade, European universities have experienced a sustainably steady growth in their academic staff, close to 12 per cent per year, and an increase in investment of around 12.21 per cent in Gross domestic product (GDP) (Pruvot et al. 2017). However, universities have not always reached the desired levels of research productivity, suggesting the existence of certain inefficiencies in their management research policies (Bandola-Gill, 2019; Fussy, 2018; Edgar & Geare, 2013). The design of strategies oriented at generating, disseminating, and transferring knowledge to society is particularly relevant for universities (Dang et al. 2019; Yeo 2018; Almeida et al. 2019; Berbegal-Mirabent et al. 2013). This study considers academic human capital (AHC) to be a strategic resource (Thienput et al. 2015). Therefore, universities should reorient their recruitment policies by looking for academic staff who fit their academic goals. To this end, universities must be able to identify the right attributes that interest them and then assess them.

The literature on AHC is, to a very extent, disperse and disconnected. As a result, there are varied approaches to the conceptualization of AHC, making the topic particularly complex. Few studies have proposed a systematic classification of the works in the area (Ballesteros-Rodríguez et al. 2020). Consequently, such a diversity of approaches leads to a lack of consensus on the attributes conforming to the concept and on those specific measures of human capital in academia as well. In fact, there is no explicit measure that contains, in an integrated manner, the dimensions of AHC to explain their effects on scientific productivity.

Therefore, the objective of this study is to propose and validate a measurement instrument that enables the assessment of human capital in academic staff. Despite the existence of studies focused on examining intellectual capital in the academic context (de Frutos-Belizón et al. 2019), the present research aims to go a step further, deepening the analysis of AHC from an individual perspective. To do so, we applied the traditional and widely accepted knowledge-skills-abilities (KSA) framework. The proposed measurement scale offers a self-assessment or evaluation to be applied to the university

context, which can be effective in shaping decision-making in the academic research process.

Due to the particularities of this research, to design the mentioned scale and to ensure its validity and quality, we followed a systemic procedure composed of two steps (Hinkin 1998; DeVellis 2003): qualitative and quantitative phases. First, the qualitative research, including the design and content validity of the human capital questionnaire, was conducted. The questionnaire was designed using the consensus opinion of an expert panel about relevant issues for measuring human capital in the academic research. The questionnaire was composed of 22 items related to the KSA framework in the research context.

Second, the quantitative phase was performed via exploratory and confirmatory analysis. In the first step, an exploratory analysis was performed to generate factors from the set of 22 items constituting the factor structure of the model. Then, a confirmatory factorial analysis was performed to confirm the psychometric properties of the scale.

The contribution of this paper is twofold: 1) the measurement scale, which is based on the panel of experts, is developed to provide specific human capital attributes in the academic context; and 2) a set of relevant managerial implications because the proposed scale may be particularly useful by providing guidelines to manage and strengthen AHC from an integrative perspective and therefore improve researchers' scientific productivity.

This paper is structured as follows: (1) we review the existing literature on human capital in the academic context; (2) we describe the empirical analysis, including the design of the questionnaire to measure human capital in the academic context, the sample, and scale validity; and (3) we discuss the findings and limitations of the study.

## 2. Academic human capital: The KSA framework

Although general human capital theories have conceptualized and studied the construct from multiple theoretical perspectives (Fulmer & Ployhart 2014), the differentiation

between knowledge, skills, and abilities (Becker 1962; Schultz 1963) is the most frequently used way of defining human capital at the individual level (Nyberg et al. 2014). This classification assumes that the three dimensions build different aspects of human capital with different effects on the results (Fleishman & Reilly 1992). One of the most relevant contribution of this framework is that AHC components have a synergistic behaviour between them (Bartram and Roe, 2005; Nonaka and Von Krogh, 2009). The complementarities-synergistic factors of human capital enhance the value that can be derived from a given stock (Ployhart et al., 2014; Wright et al., 2014; Ennen & Ritchter 2010). In the research context, this approach is especially interesting in clarifying the combination of attributes of academic researchers that are necessary to develop efficient research and how the complement of these attributes adds value to the research activity. Drawing on this approach, we will begin clarifying and defining each of the AHC dimensions, with the objective of delineating the attributes that define knowledge, skills, and abilities in the academic research context.

### *2.1. Knowledge*

Despite the relevance of knowledge as a crucial resource for innovation and economic success, it is one of the most unclear concepts in the management literature (Meyer & Sugiyama 2007). As the literature points out, 'knowledge' has been conceptualized from a variety of perspectives in different disciplines. Consequently, there is not a broadly accepted definition for it, leading to an imprecise and vague understanding of the concept (Alvesson & Kärreman 2001).

One of the first attempts to define 'knowledge' was from a philosophical perspective, describing knowledge as a 'justified true belief', where 'truth' is a *required feature of knowledge to distinguish it from errors* (Meyer & Sugiyama, 2007:18). However, to delimit the concept to the management context, a more pragmatic definition is needed (Gourlay, 2006a).

Accordingly, Nonaka et al. (2000) introduced and adapted Polanyi's (1966) ideas to the management discipline. In particular, Nonaka et al.'s definition differentiated technical from cognitive tacit knowledge to give Polanyi's concepts a more practical perspective (Gourlay, 2006a). Thus, the traditional and most commonly used notion of knowledge

in management and organizational studies understands knowledge as a "*certain justified belief*" (Nonaka et al. 2000: 7). This definition distinguishes between the objective "true belief" and subjective "justified belief" aspects of the concept. On the one hand, the *objective* part understands knowledge as a representative object of the world, independent of human perceptions. This knowledge exists in a wide variety of forms and locations (Hedlund, 1994). On the other hand, the *subjective* dimension of knowledge depends on human experience, through which people individually develop meanings and concepts from social relations, losing their universal and objective character (Nonaka et al. 2000; Sabherwal & Becerra-Fernández 2003).

Regarding the conceptualization of knowledge in the present study, in addition to Nonaka and colleagues' considerations of knowledge in the management literature, we assumed that, in the university context, knowledge should also integrate different aspects. In particular, as part of the AHC concept, knowledge will imply not only a *certain justified belief* and *meaningful information* (Nonaka et al. 2000; Nonaka & Takeuchi 1995), but also *experience, context, reflection, and interpretation* (Davenport et al. 1998), *obtained through formal education* (Ployhart & Moliterno 2011), *analysis and reading of specific theories and explications, and empirical results* (Bozeman et al. 2001).

The second particular issue around knowledge delimitation is clarifying the types of knowledge that may exist. Despite it is possible to find some different labels in the literature to refer to kind of knowledge, there seems to be wide acceptance of the distinction between two fundamental and connected types of knowledge: tacit and explicit (Hautala 2011; Gourlay 2006a). Tacit knowledge–also known as scientific knowledge (Bozeman et al. 2001; Ulrich & Dash 2013)–is embedded in procedures, routines, actions, or ideas and can, therefore, be shared in a systematic way through language, dates, specifications, and manuals (Griffith & Sawyer 2010; Gourlay 2006b; Nonaka et al. 2000). Other approaches have used different labels for the same concept; tacit knowledge has been called *knowledge-how*, *implicit*, or *procedural knowledge*. Explicit knowledge has also been termed *knowledge-that*, *declarative*, or *propositional knowledge* (Sahdra & Thagard 2003). Others, such as Whitehill (1997), used *know-how* to identify tacit knowledge and *know-what* for explicit. In the university context, Lovitts (2005) classified knowledge into two complementary categories: formal knowledge, which is linked to the *knowledge-that*, and informal knowledge or *knowledge-how*. The

first suggests that the academic researcher has acquired a broad and deep knowledge of their discipline. The second proposes that informal knowledge is procedural in nature and involves possessing scripts, metaphors, and semantic qualifiers in specialist languages. Informal knowledge draws on practical intelligence and is about knowing how.

Following the mentioned classification, we introduce tacit and explicit knowledge using the labels *knowledge-how* and *knowledge-that*, respectively. We refer to *knowledge-how (tacit knowledge)* as the theoretical body of a discipline, the theories and assumptions that compose it (Bozeman et al. 2001), and specialist knowledge in a topic, combined with general knowledge in the subject area (Lee et al. 2010).

To define *knowledge-that (explicit knowledge)*, we consider that applied or explicit knowledge would be related to the language used in the scientific text of a certain field of knowledge (Prpic, 1996; Ulrich & Dash, 2013; Gilmore et al. 2006; Jönsson, 2006). And, additionally, as a complement to this, academic researchers should also have the necessary knowledge in the methodology and research techniques used in the area (Bozeman et al. 2001; Mooken & Sugden, 2014).

### *2.2.Skills and Abilities*

The literature on skills and abilities in the academic context is disconnected and lacking consistent conclusions. Consequently, there is an intense debate about the differences between the both concepts. To avoid ambiguity, we base this section on Van der Heijde and Van der Heijden's (2006) proposal to differentiate skills and abilities conceptually. Therefore, *skills* as those individual capabilities related to the execution of tasks have a generic character and mostly reflect what has been learned through formal education (Ployhart & Moliterno 2011).

On the other hand, *abilities* are defined as the potential of individuals for the adequate performance of the different tasks that form a certain profession (Lindberg & Rantatalo 2015), acquired by experience in the workplace. These abilities rest on the knowledge, skills, and attitudes of individuals (Bartram & Roe 2005). In contrast to skills, abilities are applicable to a specific workplace, creating an interaction between the individual

and that particular workplace (Ellström & Kock, 2008). According to Van der Heijde and Van der Heijden's (2006), when referring to *skills,* the focus is on the *general character* of an attribute to be applied in diverse work environments (i.e. proactiveness or team working). By contrast, *abilities* are *research context-focused*; that is, they are related to attributes that are common and relevant to do research (i.e. ability to integrate theoretical frameworks, ability to critically discuss findings, etc.)

Although they are theoretically considered to be different concepts (Fleishman & Reilly, 1992), empirical evidence is not yet clear (Nyberg et al. 2014). Most studies in the academic context focus on single or a few disconnected attributes that can be grouped into two main lines of work: 1) *cognitive abilities and other skills*, closely linked to the research activity, and 2) *behavioural attributes*, with a wider character and applicable not only to the research context, but also to many other work environments.
The first group includes studies on cognitive abilities such as mathematical reasoning (Bozeman et al. 2001); research skills such as data collection, identification research problem, and creativity (Marie, 2008); cognitive abilities such as conclusion drawing (Timmerman et al. 2011); and ability to communicate skills (Mayrath, 2008; Barnacle & Dall'Allba, 2014; Thunnissen & Van Arensbergen, 2015; Wang et al. 2006).
Second, another set of studies pays particular attention to behavioural attributes such as researcher's motivation (Ryan & Berbegal-Mirabent, 2016), vocation, and passion (Neumann, 2006; Mayrath, 2008) for their work, as well as some intrinsic interest in research (Bentley & Kyvik, 2013) or unethical behaviours (Grant et al. 2018) such as duplications of studies (Bell & Bryman, 2007), data manipulation (Kintisch, 2005) or plagiarism (De Vries et al. 2006).

By contrast, only a few studies offer a comprehensive classification of the attributes applicable to the academic field to allow clarification of the specific composition of research skills and abilities (Durette et al. 2016; McNie et al. 2016). The works of Ulrich and Dash (2013) and Thunnissen and Van Arensbergen (2015) are notable exceptions. Ulrich and Dash (2013) distinguished between research abilities (ability to formulate a research issue, capability for analysis), team, and project management skills (communication skills, languages, teamwork, etc.), and interpersonal skills (creativity, motivation, commitment, adaptability, etc.). Thunnissen and Van Arensbergen (2015) classified skills and abilities into three categories: abilities (critical, open to feedback,

tolerant to criticism, reflective, cooperation skills), intrapersonal characteristics (motivation, perseverance, passion for science, ambition), and performance (international experience). These studies, although interesting, only present analyses of different researchers' abilities, skills, and other attributes linked to research activity, leading to partial conclusions.

The former theoretical review allows us to reach the main conclusions to reinforce the contribution of our study. First, most of the studies focus on analysing one or a few isolated attributes, so what neither describes and tests a comprehensive profile of academic abilities and skills as well as nor clearly distinguishes (Nyberg et al., 2014) and, second, there is a need for clarification around the differences between skills and abilities, empirically speaking.

Thus, a broader approach is necessary to analyse how these elements are complemented and integrated with knowledge to generate synergistic effects that improve researchers' capability to perform research activities.

## 3. Empirical study

### *3.1. Qualitative stage: Scale design*

Drawing on the distinction between knowledge, skills, and abilities (Ployhart & Moliterno, 2011), we developed a scale to measure AHC with a first qualitative step, designed to get a deeper look at the construct and define an initial set of items.

To do so, we used the Delphi technique to reach a consensus among specialists on the factors that build AHC. The Delphi technique encompasses a structured, iterative process in which experts share their anonymous opinions in subsequent phases (Landeta, 2006; Schmidt, 1997). Our objective was to identify relevant indicators to assess AHC, motivating in-depth discussions of the emerging and unexplored dimensions of the construct. The experts received a form consisting of eight open-ended questions about intellectual capital in academia and other questions about research activity (group functioning, research policies, resources, and results). As the literature widely recognized, the intellectual capital construct includes three different dimensions:

human capital, social capital, and structural capital (Roos et al., 1997). The present study only pays particular attention to the human capital dimension because of its focus on the micro/individual level of analysis.

Examples of the designed questions are: *"In your opinion, what knowledge, skills, and abilities should a researcher have to develop his/her research activity efficiently?"*; *In the research, what role, if any, do the relationships that a researcher establishes with other researcher–both within our university and outside it (research networks, personal relationships with researchers from other universities, scientific meetings, etc.)? How important are they? Do they include researchers from other areas of knowledge?"* .

The Delphi panel contained 62 scholars who led research groups at Spanish universities. They were chosen because of their knowledge and contrasting experience in the development and management of scientific processes, as well as project and research team management. Different areas of knowledge were represented in the panel to avoid biases of response and the subjectivity problems derived from this type of technique (Okoli & Pawlowski, 2004). Descriptive statistics for the qualitative stage are shown in Table 1.

**Table 1: Descriptive statistics of the qualitative stage**

| Variable | Descriptive statistics | % |
|---|---|---|
| Gender | Female | 22.58 |
| (n=62) | Male | 77.42 |
| | | 66.13 |
| Academic rank | Full professor | 33.87 |
| (n=62) | Professor | |
| | | 32.26 |
| Field of knowledge | Arts and humanities | 27.42 |
| (n=62) | Sciences | 14.52 |
| | Health sciences | 9.68 |
| | Social sciences and Legal sciences | 16.13 |
| | Engineering and Architecture | |

Several rounds of discussion were needed to reach consensus. In the first two rounds, an open question accompanying all the statements asked the respondents to include as much information as they considered relevant. In this first phase, according to the purpose of this study, the experts were specifically asked about AHC, and they sent their responses to the following question via email: "*In your opinion, what knowledge,*

*skills, and abilities should a researcher have to develop his/her research activity efficiently?"*. The information was collected, analysed, and discussed by our research team. In this first phase, 40 AHC attributes were obtained.

In the second phase, a new document, including the 40 AHC attributes obtained in the first round, was sent to the experts to be confirmed. In this phase, the experts chose those attributes that they considered relevant to define AHC. In addition, this document includes a section to collect experts' suggestions, clarifications, or questions of interest. The received information and suggestions were analysed, which allowed us to design a questionnaire about not only AHC but also its effects on scientific results.

In the last round, the questionnaire was refined, and experts were asked about the final version of the items. The required consensus was obtained in 22 items. All items were integrated in a Likert-type survey with a 5-point response format (1 = completely disagree and 5 = completely agree). It was completed with questions about the respondent's demographic profile. Prior to the survey, a pre-test was conducted among a group of researchers to discard any incidents in the design and drafting of each one of the items. We then developed procedures to control for possible biases based on recommended studies, such as Conway and Lance (2010) and Podsakoff et al. (2003), and concluded that common method bias (CMB) may not be a serious concern. In particular, we reduced the ambiguous and unclear items, vague concepts, and complex wordings during the expert panel and survey design stages to minimize the CMB problems. Moreover, we submitted our questionnaire for a pre-test to explain each item and clarify the questionnaire design, again reducing the CMB problems. Table 2 provides an overview of the accepted items and the classification of their dimensions of AHC. This instrument represents the first step in the scale development process and serves as a starting point for subsequent confirmatory analyses.

**Table 2: Initial scale extracted from Delphi panel.**

| | **Item** |
|---|---|
| HC1 | *I have the theoretical training necessary to research in my scientific field* |
| HC2 | *I have the necessary training in research methodologies and techniques* |
| HC3 | *I know the most relevant publications in my scientific field* |
| HC4 | *I have the required capacity to obtain and manage the information necessary for research* |
| HC5 | *I master the language usually used in journals/books and in scientific meetings in my academic field* |
| HC6 | *I am able to identify research topics in my research context* |
| HC7 | *I can relate the observed facts to the results obtained, and draw conclusions* |
| HC8 | *I can autonomously develop research* |
| HC9 | *I know how to conduct research (thesis, research projects, etc.)* |
| HC10 | *I can present and discuss my research results* |
| HC11 | *I have the ability to interact fluently with other researchers* |
| HC12 | *I am able to adapt to changes in my research context* |
| HC13 | *I consider myself a self-critical person* |
| HC14 | *I consider myself a person with the ability to accept criticism from others* |
| HC15 | *I consider myself an organized person* |
| HC16 | *I consider myself an observer* |
| HC17 | *I consider myself a person motivated by research* |
| HC18 | *I consider myself a creative person* |
| HC19 | *I consider myself a persevering person* |
| HC20 | *I consider myself an altruistic person* |
| HC21 | *I consider myself a person with initiative* |
| HC22 | *I consider myself a disciplined person* |

### *3.2.Quantitative stage: Scale confirmation*

#### *3.2.1. Sample*

Data used to test scale design were collected though a self-administered online questionnaire delivered to Spanish academic researchers in all the different fields of knowledge. To identify and contact potential respondents, we contacted the vice rector for the researcher to send the questionnaires. The Vice-rector for Research at our university emailed Vice-rectors for Research at other Spanish public universities to

explain our research and to request the collaboration of their academics to respond the survey. We have included a cover letter that briefly explained the purpose of the study. The email specified that the survey should be responded to those researchers who had research results in previous years or had research activity among their functions. Each item was measured using Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). To guarantee anonymity, no personal identifying information was requested from respondents. As regards the statistical method, we carried out the Harman one-factor test. Several factors emerged from this analysis, suggesting that CMB does not significantly affect the empirical analysis (Podsakoff et al. 2003). After analysing the data and eliminating all incomplete cases, we counted 2223 usable questionnaires (response rate of 6,25%). Descriptive statistics and correlations for the whole sample are shown in Tables 3 and 4.

**Table 3: Descriptive statistics of quantitative stage.**

| Variable | Descriptive statistics | % |
|---|---|---|
| Gender | Female | 41.50 |
| (n=2080) | Male | 58.50 |
| Academic Rank | Full professor | 17.50 |
| (n=2061) | Professor | 41.70 |
| | Associate professor | 13.10 |
| | Assistant professor | 5.70 |
| | Postdoctoral PhD | 2.80 |
| | PhD Student | 7.60 |
| | Lecturer | 9.50 |
| | Others | 2.10 |
| Field of knowledge | Arts and Humanities | 21.10 |
| (n=1964) | Sciences | 24.40 |
| | Health sciences | 12.70 |
| | Social sciences and Legal sciences | 23.30 |
| | Engineering and Architecture | 18.50 |

**Table 4: Correlation matrix of the AHC scale.**

| Variable | M | DT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HC1 | 4.49 | .705 | 1 | | | | | | | | | | | | | | | | | | | | | |
| HC2 | 4.24 | .823 | .684** | 1 | | | | | | | | | | | | | | | | | | | | |
| HC3 | 4.35 | .791 | .521** | .546** | 1 | | | | | | | | | | | | | | | | | | | |
| HC4 | 4.43 | .724 | .569** | .627** | .608** | 1 | | | | | | | | | | | | | | | | | | |
| HC5 | 4.10 | .953 | .332** | .371** | .386** | .435** | 1 | | | | | | | | | | | | | | | | | |
| HC6 | 2.36 | 1.348 | .516** | .476** | .512** | .526** | .302** | 1 | | | | | | | | | | | | | | | | |
| HC7 | 3.75 | 1.287 | .555** | .513** | .502** | .558** | .322** | .693** | 1 | | | | | | | | | | | | | | | |
| HC8 | 4.46 | .693 | .494** | .489** | .449** | .538** | .296** | .574** | .630** | 1 | | | | | | | | | | | | | | |
| HC9 | 4.54 | .630 | .467** | .461** | .465** | .490** | .266** | .533** | .551** | .675** | 1 | | | | | | | | | | | | | |
| HC10 | 4.32 | .934 | .477** | .482** | .490** | .544** | .357** | .574** | .645** | .589** | .628** | 1 | | | | | | | | | | | | |
| HC11 | 4.21 | 1.067 | .437** | .423** | .450** | .484** | .384** | .505** | .558** | .481** | .512** | .656** | 1 | | | | | | | | | | | |
| HC12 | 4.51 | .689 | .392** | .444** | .438** | .471** | .321** | .476** | .531** | .450** | .434** | .568** | .657** | 1 | | | | | | | | | | |
| HC13 | 4.31 | .841 | .170** | .161** | .158** | .185** | .126** | .210** | .221** | .137** | .103** | .193** | .150** | .200** | 1 | | | | | | | | | |
| HC14 | 4.29 | .781 | .188** | .209** | .173** | .188** | .115** | .211** | .238** | .168** | .178** | .235** | .229** | .308** | .473** | 1 | | | | | | | | |
| HC15 | 4.33 | .705 | .107** | .112** | .155** | .131** | .044* | .152** | .164** | .097** | .108** | .181** | .203** | .223** | .192** | .165** | 1 | | | | | | | |
| HC16 | 4.11 | .751 | .204** | .185** | .198** | .217** | .120** | .298** | .295** | .220** | .226** | .245** | .244** | .269** | .266** | .183** | .287** | 1 | | | | | | |
| HC17 | 3.99 | .939 | .275** | .292** | .351** | .353** | .220** | .345** | .334** | .328** | .325** | .322** | .327** | .348** | .131** | .180** | .143** | .277** | 1 | | | | | |
| HC18 | 4.32 | .715 | .224** | .237** | .234** | .258** | .155** | .352** | .345** | .306** | .289** | .312** | .283** | .313** | .194** | .187** | .117** | .399** | .348** | 1 | | | | |
| HC19 | 4.25 | .903 | .156** | .187** | .203** | .224** | .103** | .221** | .233** | .203** | .180** | .235** | .243** | .262** | .227** | .198** | .416** | .251** | .350** | .248** | 1 | | | |
| HC20 | 3.98 | .864 | .112** | .128** | .131** | .118** | .038 | .186** | .186** | .138** | .144** | .203** | .190** | .197** | .229** | .261** | .138** | .217** | .161** | .221** | .195** | 1 | | |
| HC21 | 4.38 | .762 | .239** | .255** | .287** | .292** | .159** | .401** | .365** | .332** | .322** | .367** | .366** | .381** | .204** | .204** | .220** | .388** | .408** | .526** | .377** | .301** | 1 | |
| HC22 | 4.13 | .824 | .135** | .148** | .175** | .183** | .068** | .156** | .186** | .155** | .130** | .209** | .205** | .217** | .204** | .180** | .631** | .228** | .209** | .117** | .525** | .192** | .277** | 1 |

Exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) were combined to analyse and test the scale structure. We applied the two-step process proposed by Lloret-Segura et al. (2014) and Anderson and Gerbing (1988). The sample was therefore subdivided into two equal subsamples using a random procedure. EFA using SPSS was applied to the first part of the sample to analyse the structure of the underlying items. In the second step, this structure was tested by CFA, which was developed over the second subsample using EQS structural equation modelling (Bentler 1995).

*3.2.1.1.Exploratory factor analysis*

The aim of this phase in the research process was twofold: to identify overarching AHC factors and compare them with the theoretical description of the construct; and to validate the developed survey instrument. The analysis was developed using the main components method of extraction, resulting later in the varimax rotated solution. EFA allowed us to reach the first goal, while the internal consistency of the remaining scale was assessed using Cronbach's alpha.

The EFA was developed on the whole set of items in the initial scale of the AHC (knowledge, abilities, skills) (Dziuban & Shirkey, 1974). Likewise, a Bartlett test showed a level of significance below 0.05, confirming that the factorial model obtained would be adequate to explain the data. The decision on the number of factors to be accepted was based on an examination of the sedimentation chart (Catell, 1966) and the eigenvalues, which should be greater than one (Kaiser, 1974). The sample size in this phase (n = 1090) allowed high variance levels in the data, facilitating factor extraction and interpretation.

The results for the EFA showed that AHC could be reliably measured through the initial set of items ($\alpha$ = .893), although the internal composition of the construct indicates its multidimensional nature. Five different factors were finally extracted, as depicted on table 5. The structure of the scale corroborated the initial description of the construct based on the results of the Delphi panel. The first factor, composed of seven items,

measured *research ability* ($\alpha$ = .884), while the second factor, with five items, related to *research knowledge* ($\alpha$ = .816). The first factor–*research ability*–consists of seven items related to the research-specific context abilities of researchers. Among these items, it is possible to find the ability to communicate research findings, relationships with colleagues, and research management. These elements allow the researcher to carry out the investigation and to progress adequately in his/her academic career.

The second factor—*research knowledge*—consists of five items related to the researcher's level of theoretical training and methodology, his/her ability to find and manage the information from the publications relevant to his/her knowledge field, and knowledge of the scientific publications within the research area.

The third factor grouped four items measuring *alertness skill* ($\alpha$ = .704), the fourth one, with three items, was labelled *work organization skill* ($\alpha$ = .762), while the last one, also composed of three items, reflected researchers' *criticism skills* ($\alpha$ = .609). The third factor, *alertness skill*, consists of four items related to the researcher's creativeness, initiative, and motivation to conduct research. The fourth factor–*work organization skill*–consists of three items related to constancy, discipline, and organization in the research workplace. Lastly, the fifth factor–*criticism skills*– comprises other three items that measure the extent to which the researcher accepts criticism and reviews of his/her work as a research function.

Table 6 shows the relationship between the theoretical and factorial analysis dimensions.

**Table 5: Exploratory factor analysis of the academic human capital scale (n = 1090)**

| | Component | | | | |
|---|---|---|---|---|---|
| **Item** | **1** | **2** | **3** | **4** | **5** |
| HC10 I can present and discuss my research results | .787 | | | | |
| HC11 I have the ability to interact fluently with other researchers | .749 | | | | |
| HC7 I can relate the observed facts to the results obtained, and draw conclusions | .710 | | | | |
| HC9 I know how to conduct research (thesis, research projects, etc.) | .654 | | | | |
| HC12 I am able to adapt to changes in my research context | .631 | | | | |
| HC8 I can autonomously develop research | .609 | | | | |
| HC6 I am able to identify research topics in my research context | .587 | | | | |
| HC2 I have the necessary training in research methodologies and techniques | | .716 | | | |
| HC4 I have the required capacity to obtain and manage the information necessary for research | | .713 | | | |
| HC3 I know the most relevant publications in my scientific field | | .699 | | | |
| HC1 I have the theoretical training necessary to research in my scientific field | | .673 | | | |
| HC5 I master the language usually used in journals/books and in scientific meetings in my academic field | | .559 | | | |
| HC18 I consider myself a creative person | | | .756 | | |
| HC21 I consider myself a person with initiative | | | .719 | | |
| HC17 I consider myself a person motivated by research | | | .629 | | |
| HC16 I consider myself an observer | | | .542 | | |
| HC22 I consider myself a disciplined person | | | | .870 | |
| HC15 I consider myself an organized person | | | | .832 | |
| HC19 I consider myself a persevering person | | | | .656 | |
| HC13 I consider myself a self-critical person | | | | | .799 |
| HC14 I consider myself a person with the ability to accept criticism from others | | | | | .755 |
| HC20 I consider myself an altruistic person | | | | | .505 |
| Eigenvalue | 4.004 | 3.351 | 2.296 | 2.090 | 1.742 |
| Variance explained by the factor | 18.202 | 15.234 | 10.438 | 9.501 | 7.917 |
| Kaiser–Meyer–Olkin .911<br>Bartlett test<br>Approximate Chi-Square: 8860.117<br>Degrees of freedom: 231<br>Significance level: .000 | | | | | |

**Table 6: Correspondence between theoretical and factorial analysis dimensions**

| KSA Framework | Theoretical Dimensions | Factorial analysis dimensions /Items | Concepts |
|---|---|---|---|
| *K* | *Knowledge-how (tacit)* / *Knowledge-that (explicit)* | *Research Knowledge (HC2, HC4, HC3, HC1, HC5)* | Elements related to the researchers' theoretical and methodological understanding, researchers' English (or other predominant languages in the field of research) language domain, researchers' comprehension to find, manage information from relevant publications in their field of research and know relevant publications in the scientific field. |
| *S* | *Research skills* | *Alertness Skills (HC18, HC21, HC17, HC16)* | Composed of attributes related to the researcher's creative perception, initiative and motivation to carry out the research activity. |
| | | *Work organization Skills (HC22, HC15, HC19)* | Composed of attributes related to the constancy, discipline and organization in the research workplace. |
| | | *Criticism Skills (HC13, HC14, HC20)* | Composed of those attributes related to extent the researcher accepts criticism and reviews of his work as research function. |
| *A* | *Research abilities* | *Research ability (HC10, HC11, HC7, HC9, HC12, HC8, HC6)* | Composed of research-specific context abilities of researchers (observe facts and identify research topics, discuss research results, interact with other researchers, know how conduct and autonomously develop research and adapt to changes in the research context. |

*3.2.1.2. Confirmatory factor analysis*

The measurement model extracted from the previous stages was finally tested using CFA. This technique complements previous scale development procedures not only by providing an alternative measure of internal consistency but also by assessing the extent to which the scale is externally consistent (Sethi & King 1994). Drawing on the results of the EFA, the scale was specified as a second-order model, which was tested by applying CFA to the second subsample of 1133 academic researchers. The objective was to verify the relevance of the five factors extracted and the extent to which they loaded onto a second-order factor measuring *AHC*. A previous analysis of the dataset showed that it did not follow either univariate or multivariate normality, which led us to avoid the application of maximum likelihood estimation methods (Bentler, 2006). The value for Mardia's coefficient (159.4297) and the analysis of items' asymmetry and kurtosis suggested that the data followed an elliptical distribution, so following Bentler

(2006), we opted to estimate the model using an ordinary least squares method. Figure 1 provides an overview of the CFA results of the AHC model.

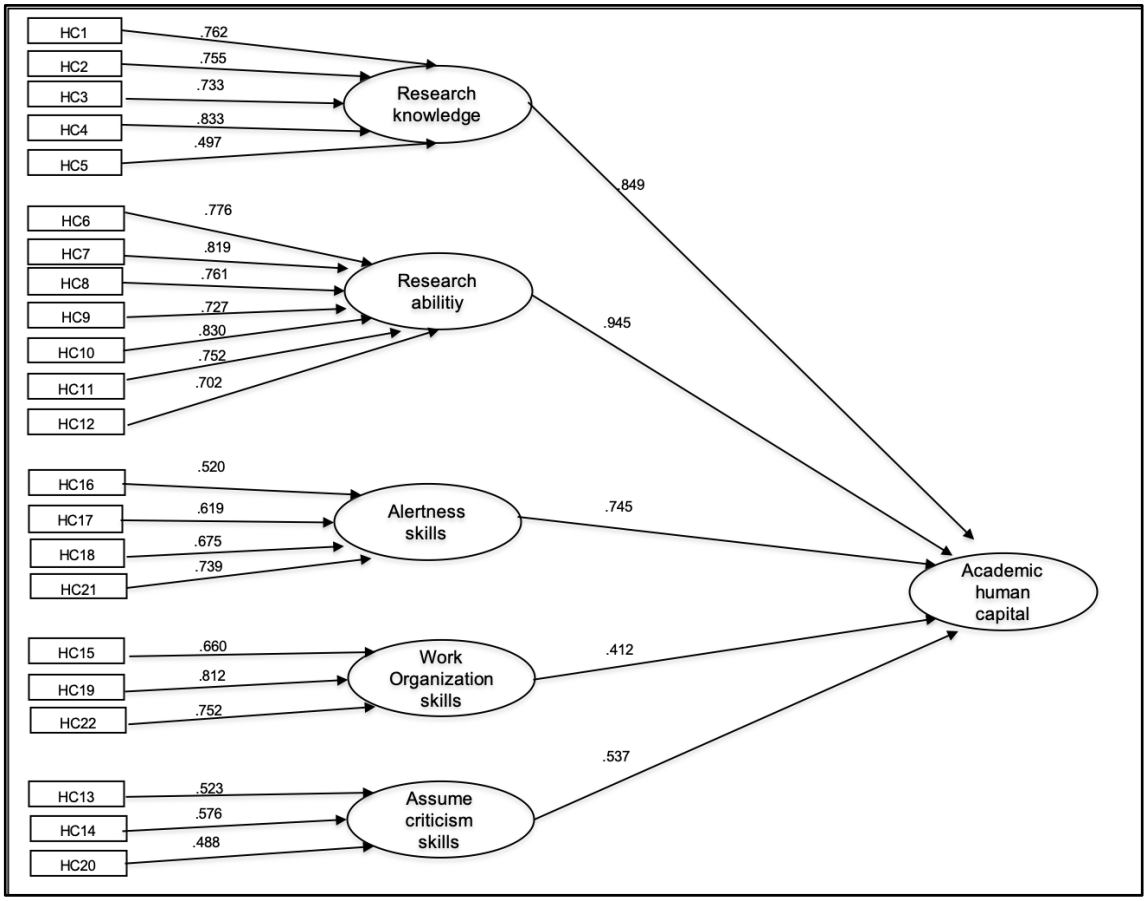
We first analysed the convergent validity of each factor building the AHC construct. Model estimation confirmed that factor loadings were significant at 5 per cent, with values generally over 0.5. Standard errors showed acceptable levels. Therefore, these results show the appropriate convergent validity of the constructs. Moreover, the results indicate that the five factors are relevant to measure AHC. We confirmed discriminant validity through the average variance extracted measure, which exceeded the 0.50 level in all cases (Bagozzi, Yi & Phillips 1991). This index also met the second condition proposed by Hulland (1999) by showing levels above the squared correlations between constructs. Lastly, to assess composite reliability, we calculated the Rho coefficient, which reached a value of 0.930 (Nunnally & Bernstein 1994).

To analyse the overall model fit, we first used the chi-square statistic. The test provided a significant result at a 0.05 threshold ($\chi^2$ = 922.020; N = 1133; df = 204; sig. = 0.00000). Byrne (1998) suggested that the chi-square is usually influenced by data non-normality, model complexity, and sample size, which indicates that there is a "lack of fit" between the sample and the covariance matrices. In accordance with the recommendations of Hu and Bentler (1999), we complemented model fit evaluation with alternative criteria to provide a deeper assessment: (1) comparative fit index (CFI), to evaluate model fit against a null model; (2) the goodness of fit index (GFI); (3) the adjusted goodness of fit index (AGFI); and (4) the root mean square error of approximation (RMSEA), which provides an adjustment for both sample size and degrees of freedom. General guidelines for the interpretation of good fit were used, accepting values for CFI, GFI and AGFI greater than 0.90 and RMSEA less than 0.08. As shown in Figure 1, these fit indexes showed good fit levels, confirming that AHC can be consistently measured as a second-order construct composed of the five proposed factors.

The fit indices showed a good fit. We checked the internal consistency of the scales used to measure these indicators by calculating Cronbach's alpha, obtaining 0.906. Therefore, the results indicate that the indicators of (1) research ability, (2) research

knowledge, (3) alertness skills, (4) work organization skills, and (5) criticism skills are relevant for measuring AHC.

**Figure 1: AHC: items and item loadings confirmatory factor analysis**




Fit indexes: Chi-square (x2) = 922.020; Goodness-of-fit index (GFI) = 0.982; Adjusted goodness-of-fit index (AGFI) = 0.977; Root mean square residual (RMR) = 0.036; Standardized root mean square residual (SRMR) = 0.052; Root mean square error of approximation (RMSEA) = 0.060; Normed fit Index (NFI) = 0.957; Non-normed fit index (NNFI) = 0.962; Comparative fit index (CFI) = 0.966; Akaike Information Criterion (AIC) = 514.020; Consistent Akaike Information Criterion (CAIC) = –686.832

## 4. Discussion and conclusions

The present research conceptualizes AHC, providing a specific tool to measure it. We confirmed that the measurement instruments developed in this study meet the psychometric requirements of dimensionality, validity, and reliability. The estimation of measurement models corroborated that the traditional differentiation between knowledge, skills, and abilities (Ployhart & Moliterno, 2011) was also relevant in the

academic field, although with some interesting particularities. However, our results showed that AHC reality is more complex, as we expected. Instead of the three classical KSA dimensions, our empirical analyses confirmed the need to differentiate between five factors that measure additional dimensions of AHC. The first factor grouped all the items related to scholars' *research abilities*, identifying relevant aspects as topic selection abilities, conclusion drawing, communicational abilities, adaptability, and the capability to develop collaborative research projects. In addition, *research ability*, by its very nature, can be obtained when a PhD is achieved, as described by Durette et al. (2016). However, these research abilities will be refined thorough the research career. The second factor measured the *research knowledge* dimension of the construct, including the comprehension of the theoretical underpinnings of the field and the understanding of contemporary literature. The analysis also confirmed the need to complement this knowledge with a sound command of the research methodologies and techniques used in the field. Regarding researcher's knowledge, our scale supports the proposals of other studies, such as Bozeman et al. (2001). New contributions and research lines allow researchers to create new scientific knowledge. In this sense, theoretical, and methodological knowledge led us to study more complex and profound aspects of research topics as well as to contribute new knowledge in each of the scientific fields.

One of the most interesting results is that *research skills* are grouped into three different components, which implies a new classification for the extant literature. This tool has shown that *research skills* have a different composition in the academic field compared to the organizational context. These specific attributes of *research skills* highlight the need to deploy *alertness skills*, *work organization skills,* and *criticism skills* from an integrative way to develop the research activity. First, the results highlighted the need to measure scholars' *alertness skills* to assess their openness to external stimuli that could inspire innovative research lines. However, as the results also suggested, these creativity-related skills must be complemented with other rational attributes of organizational capabilities and perseverance (*work organization skills*). As it is conceived nowadays, scientific progress is highly dependent on the peer review system, which relies on a process of continuous constructive criticism (*criticism skills*). Regarding the *researcher's skills*, our results supported the proposals of other studies,

such as Thunnissen and Van Arensbergen (2015), regarding the study of an integrative classification of different skills and attributes, and Marie (2008) or Ryan and Berbegal-Mirabent (2016) in relation to propose specific *research skills*.

The results from EFA and CFA indicate that AHC can be conceptualized as a second-order construct compound by the five proposed factors. This construct showed good levels of validity and reliability, and it was confirmed to be stable across different samples. This instrument provides a generic framework to organize diverse results about how the KSA framework is applied to research activity. More specifically, it may help to explain why the identified individual attributes are considered relevant to explain research performance, because extant studies have not specifically determined the related KSA in the academic context yet.

From a different point of view, it should be noted that the applied KSA framework allows for the study of the synergistic effect between AHC dimensions. Thus, the proposed scale may help explain how the relationships between specific *research skills (alertness skills, work skills, criticism skills),* as well as between them and *research abilities* and *research knowledge,* determine scientific productivity. The development of these synergistic effects between the dimensions of AHC could be conditioned by differences in scientific performance in different research fields. In this sense, universities could use this list of attributes to guide academic careers.

The measurement scale proposed in this study could be interesting not only for future research in the field but also as a tool to be used at different levels. From individual research perspective, this measurement tool can serve as an adequate instrument to establish a guide for researchers to define how their careers should be developed in the near future, complementing subjective and more objective scales (research results or SciVal metrics). The tool provides direct information about aspects that are particularly difficult to be measured as human capital attributes. The scale should be understood as a complementary tool to support specific process in the academic context. For instance, researchers may identify limitations in certain KSA attributes to plan their future training.

A different implication of the scale is that it could foster and improve self-criticism of the researchers, making them more conscious and being more objective in terms of their training limitations at each stage of their careers. In this sense, this scale development is highly relevant, not only for senior researchers to know whom to encourage to take an academic career track, but also for junior researchers to be able to decide in what trainings to invest. In a similar vein, this tool could help academic researchers conduct a self-evaluation of their AHC to be compared with other team members or even researchers in the same knowledge area.

Universities may offer certain measures of human capital attributes considering mean values or ranges to be achieved in order to improve their human capital profile. In this case, the researchers would carry out a self-assessment to check if they are average or, by contrast, need to improve any of attributes. Once the researcher profiles are measured, they can be compared with their research group or area of knowledge to detect those KSA attributes they lack. Therefore, this measure of self-evaluation would allow, to a greater extent, knowing how to establish improvements for both researchers who are in the starting stages of their academic careers, as well as for those who can evaluate their attributes for hiring purposes at university.

This tool would also be useful in academic research teams and for principal investigators, as strategic agents, to manage their research staff. From this perspective, principal investigators should enhance the synergies derived from researchers' human capital. This consists of mutual reciprocity between KSA components. For example, the methodological knowledge of academic researchers could be complemented by observed facts and another member of the team may draw conclusions.

The complementarities of KSA could also be highlighted between dimensions of AHC. For example, different members of a research team could identify research topics, while others members could be considered a motivated or creative researcher to develop the research. In this regard, principal investigators could strategically manage the KSA attributes of academic researchers to improve team results. In this context, the principal investigator would promote and guide KSA attributes and the academic careers of their team members. More specifically, it would reveal the informal structure of the research

group itself regarding AHC attributes, for example, by detecting whether a researcher is well connected to AHC complementarities among group members. Therefore, the principal investigator can support the development and promotion by improving the AHC of their team members. A better understanding of the AHC composition of academic researchers would allow measures to build an AHC at the group level.

This measurement scale also provides the universities with an important input of information to support the design of practices related to the promotion of researchers. This scale could be used as a supplementary way of assessing potential promotions and conducting evaluations of academic researchers (Kwiek, 2018). Therefore, this measurement tool could be an interesting input of information in decision-making at the research management level of the institutional perspective (de Frutos-Belizon et al. 2019). The measurement scale would help universities to know and be more focused on the specific academic attributes needed to perform better. Thus, universities would be able to design research strategies that are more coherent with their internal and academic needs (Cocos and Lepori, 2020; Morris, 2003). Job descriptions also provide an understanding of the specific KSA that are required to perform in the research role successfully. In fact, universities could use this to design their talent management initiatives (Van den Brink et al. 2013). In this vein, universities could propose a research profile that can be used to evaluate researchers' careers in an objective and equal way, following a clear list of attributes. The scale development may be used as a guiding framework for developing an evaluation instrument for academic researchers. Ideally, such an instrument would comprise the integrative attributes of knowledge, skills, and abilities specifically required for research activity. The researcher profile would allow us to analyse the nature of the teaching and research staff, as well as to propose a fair distribution between university activities (White et al. 2012).

Similarly, the scale could be used as a report to justify the research funding received to improve the configuration of the AHC and the needs of academic research groups (Scholtez et al. 2021; Lind, 2020). In this context, the proposed scale would be used to add information about specific AHC attributes to clarify fund allocation at the university level, in particular, differentiating between areas of knowledge or emergent research groups. Therefore, scale could be applied in those research contexts where it is

not possible to efficiently distribute research funds, considering, for example, different performance in diverse knowledge areas. The funds received from research projects or research grants condition AHC improvements obtained through research training (Kishi, 2020).

Universities may also publish AHC configurations based on the KSA framework to facilitate comparative analyses between researchers at universities or between universities. These configurations of AHC may help universities to focus on the specific needs of researchers rather than proposing homogeneous research policies. In conclusion, this instrument could provide a list of AHC attributes to promote the strategic value of researchers. Moreover, it would be useful to support decision-making to achieve research excellence in universities. Universities can increase their AHC by attracting highly skilled academic researchers. This measurement of the KSA provides many of the valuable tools necessary to create human capital and to fulfil the research mission of universities.

Despite its contributions, this study has some limitations that should be addressed in future research. To confirm the validity of the AHC scale, more data are required. The scale was developed on a sample of Spanish academics, so it should be tested on different sample populations to verify the extent to which the measurement instrument can be reliably used in other national contexts. Future research may also establish discriminant validity by exploring alternative measures of similar constructs. A future line of research may also focus on examining the synergist effect between KSA dimensions. Their effects and implications on scientific results may be particularly interesting. Although mentioned in different sections of the article, it could not be deepened because it exceeded the scope of the study. Furthermore, the relationship between AHC scores and research performance has yet to be established. Longitudinal studies based on the proposed scale could be particularly interesting in this sense, contributing to the ongoing debate about the determinants of research performance.

**Funding**

This study was supported by the Spanish Ministry of Economy and Competitively under Grant ECO2014-56580-R; the Andalusian Government (Spain) under Grant P12-SEJ-

1810; the Andalusian Government (Spain) under Grant P12-SEJ- 1618; and Research Projects University of Cadiz under Grant PR2016-018.

Conflict of interest statement. None declared.

**Note:**

Authors are ordered alphabetically and have contributed equally to this paper.

**References:**

Almeida, M. V., Ferreira, J.J.M., and Ferrerira, F.A.F. (2019). "Developing a multi-criteria decision support system for evaluating knowledge transfer by higher education institutions". *Knowledge Management Research & Practice*, 17 (4): 358-72.

Anderson, J.C., and Gerbing, D.W. (1988). "Structural equation modeling in practice: A review and recommended two-step approach". *Psychological Bulletin*, 103 (3): 411–23.

Alvesson, M., & Kärreman, D. (2001). Odd couple: making sense of the curious concept of knowledge management. *Journal of management studies*, 38(7), 995-1018.

Bagozzi, R.P., Yi, Y., and Phillips, L.W. (1991). "Assessing construct validity in organizational research". *Administrative Science Quarterly*, 36 (3): 421–458.

Barnacle, R. and Dall'Alba, G. (2014). "Beyond skills: Embodying writerly practices through the doctorate". *Studies in Higher Education,* 39: 1139–49.

Bartram, D., and Roe, R.A. (2005). "Definition and assessment of competences in the context of the European Diploma in Psychology". *European Psychologist*, 10: 93–102.

Ballesteros-Rodríguez, J.L., De Saá-Pérez, P., García-Carbonell, N., Martín-Alcázar, F. and Sánchez-Gardey, G. (2020). "Exploring the determinants of scientific productivity: a proposed typology of researchers", Journal of Intellectual Capital, In press

Bandola-Gill, J. (2019). "Between relevance and excellence? Research impact agenda and the production of policy knowledge". *Science and Public Policy*, 46 (6): 895–905.

Becker, G. (1962). "Investment in human capital: A theoretical analysis". *Journal of Political Economics*, 70 (5): S9–S49.

Bell, E., and Bryman, A. (2007). "The ethics of management research: an exploratory content analysis", *British Journal of Management*, 18: 63–77.

Bentler, P.M. (2006). *EQS 6 structural equations program manual*. Inc. Encino, CA. Multivariate Software. www.mvsoft.com

Bentler, P.M. (1995). *EQS Structural Equations Program Manual*. Encino, CA: Multivariate Software Inc.

Bentley, P.J., and Kyvik. S. (2013). "Individual differences in faculty research time allocations

across 13 countries". *Research in Higher Education*, 54: 329–348.

Berbegal-Mirabent, J., Lafuente, E., and Sole, F. (2013). "The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities". *Journal of Business Research,* 66: 2051-9.

Bozeman, B., Dietz, J.S., and Gaughan, M. (2001). "Scientific and technical human capital: an alternative model for research evaluation". *International Journal of Technology Management*, 22: 716–40.

Byrne, B.M. (1998). *Structural equation modeling with LISREL, PRELIS and SIMPLIS: Basic concepts, applications and programming*, Mahwah, New Jersey: Lawrence Erlbaum Associates

Catel, R.B. (1966). *The 16 personality factor questionnaire*. Illinois: Institute for Personality and Ability Testing.

Conway, J.M., and Lance, C.E. (2010). "What reviewers should expect from authors regarding common method bias in organizational research". *Journal of Business and Psychology*, 25: 325–34.

Cocos,M., and Lepori, B. (2020). "What we know about research policy mix". *Science and Public Policy*, 47(2), 235–45,

Dang, Q.T., Jasovska, P., Rammal, H.G., and Schlenker, K. (2019). "Formal-informal channels of university-industry knowledge transfer: the case of Australian business schools". *Knowledge Management Research & Practice*, 17 (4): 384-95.

Davenport, T.H., De Long, D.W., and Beers, M. (1998). "Successful knowledge management projects". *Sloan Management Review*, 39(2): 43–57.

De Frutos-Belizón, J., Martín-Alcázar, F., & Sánchez-Gardey, G. (2019). "Conceptualizing academic intellectual capital: definition and proposal of a measurement scale". *Journal of Intellectual Capital*. 20 (3): 306-334.

De Vries, R., Anderson, M.S., and Martinson. B.C. (2006). "Normal misbehavior: scientists talk about the ethics of research". *Journal of Empirical Research on Human Research Ethics*, 1(1): 43–50.

DeVellis, R.F. (2003). Scale Development: Theory and Applications, Sage Publications, Thousand Oaks, CA.

Durette, B, Fournier, M, & Lafon M. (2016). The core competencies of PhDs. *Studies in Higher Education*, 41(8),1355–1370.

Dziuban, C.D., and Shirkey, E.C. (1974). "When is a correlation matrix appropriate for factor analysis? Some decision rules". *Psychological Bulletin,* 81(6): 358–61.

Edgar, F. and Geare, A. (2013). "Factors influencing university research performance". *Studies in Higher Education,* 38(5): 774-92.

Ellström, P., and Kock, H. (2008). "Competence development in the workplace: concepts, strategies and effects". *Asia Pacific Education Review*, 9(1): 5–20.

Ennen, E., and Richter, A. (2010). "The whole is more than the sum of its parts – Or is it? A review of the empirical literature on complementarities in organizations". *Journal of Management,* 36: 207–233.

Fleishman, E.A., and Reilly, M.A. (1992). *Handbook of human abilities: Definitions, measurements, and job task requirements*, Palo Alto: Consulting Psychologists Press, Inc.

Fulmer, I.S., and Ployhart, R.E. (2014). ""Our most important asset": a multidisciplinary/multilevel review of human capital valuation for research and practice". *Journal of Management*, 40(1): 161-92.

Fussy, D.S. (2018). Policy directions for promoting university research in Tanzania. *Studies in Higher Education,* 43(9), 1573-85.

Gilmore, A., Carson, D., and Perry, C. (2006). "Academic publishing: Best practice for editors, guest editors, authors and reviewers". *European Business Review,* 18(6): 468-78

Gourlay, S. (2006a). "Conceptualizing knowledge creation: a critique of Nonaka's theory". *Journal of Management Studies*, 43: 1415–36.

Gourlay, S. (2006b). "Towards conceptual clarity for 'tacit knowledge': A review of empirical studies". *Knowledge Management Research & Practice*, 4(1), 60-9.

Grant, D.B., Kovács, G., and Spens, K. (2018). "Questionable research practices in academia: antecedents and consequences". *European Business Review*, 30 (2): 101-27.

Griffith, T.L., and Sawyer, J.E. (2010). "Multilevel knowledge and team performance". *Journal of Organizational Behavior*, 31: 1003–1031.

Hautala, J. (2011). "International academic knowledge creation and ba. A case study from Finland". *Knowledge Management Research & Practice,* 9: 4-16.

Hedlund, G. (1994). "A model of knowledge management and the N-form corporation". *Strategic Management Journal*, 15: 73–91.

Hinkin, T.R. (1998), "A brief tutorial on the development of measures for use in survey questionnaires", *Organizational Research Methods*, 1(1): 104-21.

Hu, L. and Bentler, P. (1999). "Cut off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives". *Structural Equation Modelling*, 6(1): 1–55.

Hulland, J. (1999). "Use of partial least squares (PLS) in strategic management research: a review of four recent studies". *Strategic Management Journal*, 20(2): 195–204.

Jönsson, S. (2006). "On academic writing". *European Business Review*, 18 (6): 479-90.

Kaiser, H.F. (1974). "An index of factorial simplicity". *Psychometrika*, 39 (1): 31–6.

Kintish, E. (2005). "Researcher faces prison for fraud in NIH grant applications and papers". *Science*, 307: 1851.

Kishi, N. (2020). "How does policy focus influence scientific research?", *Science and Public Policy*, 47 (1), 114–124.

Kwiek, M. (2018). "Academic top earners. Research productivity, prestige generation, and salary patterns in European universities". *Science and Public Policy*, 45(1):1–13.

Landeta, J. (2006). "Current validity of the Delphi method in social sciences". *Technological Forecasting and Social Change. Change*, 73 (5): 467–82.

Lee, H., 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, 869–81.

Lind, J.K. (2020). "Resource environment and hierarchy in universities", *Science and Public Policy*, 47 (2), 184–193.

Lindberg, O., and Rantatalo, O. (2015). "Competence in professional practice: A practice theory analysis of police and doctors". *Human Relations*, 68 (4): 561–82.

Lloret-Segura, S., Ferreres-Traver, A., Hernández-Baeza, A., and Tomás-Marco, I. (2014). "El análisis factorial exploratorio de los ítems: una guía práctica, revisada y actualizada". *Anales de Psicología,* 30 (3), 1151–69.

Lovitts, B.E. (2005). "Being a good course-taker is not enough: a theoretical perspective on the transition to independent research". *Studies in Higher Education*, 30: 137–154.

Marie, J. (2008). "Postgraduate science research skills: the role of creativity, tacit knowledge, thought styles and language". *London Review of Education*, 6:149–58.

Mayrath, M.C. (2008). "Attributions of productive authors in educational psychology journals". *Educational Psychology Review*, 20: 41–56.

McNie, E.C., Parris, A., and Sarewitz. D. (2016). "Improving the public value of science: A typology to inform discussion, design and implementation of research". *Research Policy*, 45, 884–95.

Meyer, B. and Sugiyama, K. (2007). "The concept of knowledge in KM: a dimensional model". *Journal of Knowledge Management*. 11 (1), 17-35

Mooken, M., and Sugden, R. (2014). "The capabilities of academics and academic poverty". *Kyklos*, 67, 588–614.

Morris, N. (2003). "Academic researchers as "agents" of science policy". *Science & Public Policy,* 30(5): 359–70.

Neumann, A. (2006). "Professing passion: Emotion in the scholarship of professors at research universities", *American Educational Research Journal*, 43: 381–424.

Nonaka, I., and Takeuchi, H. (1995). *The knowledge-creating company: how Japanese companies create the dynamics of innovation,* Oxford: Oxford University Press.

Nonaka, I., Toyama, R., and Konno, N. (2000). "SECI, Ba and leadership: a unified model of

dynamic knowledge creation". *Long Range Planning*, 33: 5–34.

Nonaka, I., and Von Krogh, G. (2009). "Tacit knowledge and knowledge conversion: controversy and advancement in organizational knowledge creation theory". *Organization Science*, 20: 635–652.

Nunnally, J.C., and Bernstein, I.H. (1994). *Psychometric theory,* New York, NY: McGraw-Hill.

Nyberg, A.J., Moliterno, T.P., Hale, D., and Lepak, D.P. (2014). "Resource-based perspectives on unit-level human capital: a review and integration", *Journal of Management*, 40: 316–46.

Okoli, C., and Pawlowski, S.D. (2004). "The Delphi method as a research tool: an example, design considerations and applications". *Information & Management*, 42 (1): 15–29.

Ployhart, R.E., and Moliterno, T.P. (2011). "Emergence of the human capital resource: a multilevel model". *Academy of Management Review*, 36, 127–50.

Ployhart, R. E., Nyberg, A. J., Reilly, G., and Maltarich, M. A. (2014). Human Capital Is Dead; Long Live Human Capital Resources!. *Journal of Management*, 40(2), 371–398.

Podsakoff, P. M., MacKenzie, S.B., Lee, J.Y., and Podsakoff, N.P. (2003). "Common method biases in behavioral research: a critical review of the literature and recommended remedies". *Journal of Applied Psychology*, 88(5): 879-903.

Polanyi, M. (1966). *The tacit dimension*. London, England: Doubleday & Co.

Prpić, K. (1996). "Characteristics and determinants of eminent scientists' productivity", *Scientometrics*, 36: 185–206.

Pruvot, E.B., Estermann, T., and Kupriyanova, V. (2017). *EUA Public Funding Observatory 2017*. European University Association (EUA). Brussels.

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 scientist". *Journal of Business Research,* 69: 5299-304.

Roos, J., Roos, G., Dragonetti, N.C. et al., (1997), Intellectual Capital: Navigating the New Business Landscape. London Macmillan Business.

Sabherwal, R., and Becerra-Fernandez, I. (2003). "An empirical study of the effect of knowledge management processes at individual, group, and organizational levels". *Decision Sciences*, 34: 225–60.

Sahdra, B., and Thagard, P. (2003). "Procedural knowledge in molecular biology". *Philosophical Psychology*, 16 (4): 477–98.

Schmidt, R.C. (1997). "Managing Delphi surveys using nonparametric statistical techniques". *Decision Sciences,* 28 (3): 763–74.

Scholten, W., Franssen, T., van Drooge, L., de Rijcke, S. Hessels, L.K. (2021). "Funding for few, anticipation among all: Effects of excellence funding on academic research

groups". *Science and Public Policy*, 48(2): 265–75.

Schultz, T.W. (1963). *The economic value of education*, New York: Columbia University Press.

Sethi, V., and King. W.R. (1994). "Development of measures to assess the extent to which an information technology application provides competitive advantage". *Management Science*, 40 (12): 1601–24.

Thienphut, D., Jiamprachanarakorn, S., Sirasiririusth, J., and Boonloisong, R. (2015). "Strategic human capital management for a new University: a case study of Suan Dusit Rajabhat University". *Journal of Knowledge Management*, 19 (1), 108-20.

Thunnissen, M., and Van Arensbergen, P. (2015). "A multi-dimensional approach to talent". *Personnel Review*, 44, 182–99.

Timmerman, B.C., Feldon, D., Maher, M., Strickland, D., and Gilmore, J. (2011). "Performance-based assessment of graduate student research skills: timing, trajectory, and potential thresholds". *Studies in Higher Education*, 38 (1): 1–18.

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 den Brink, M., Fruytier, B. and Thunnissen, M. (2013), "Talent management in academia: performance systems and HRM policies", *Human Resource Management Journal*, 23 (2), 180-195.

Van der Heijde, C.M., and Van der Heijden, B.I.M. (2006). "A competence-based and multidimensional operationalization and measurement of employability". *Human Resource Management*, 45 (3): 449–76.

Wang, J., Peters, H.P., and Guan, J. (2006). "Factors influencing knowledge productivity in German Research groups: lessons for developing countries", *Journal of knowledge Management*, 10 (4): 113 126.

White, C. S., James, K., Burke, L. A., & Allen, R. S. (2012). What makes a "research star"? Factors influencing the research productivity of business faculty. *International Journal of Productivity and Performance Management*, 61 (6), 584-602.

Whitehill, M. (1997). "Knowledge-based strategy to deliver sustained competitive advantage". *Long Range Planning*, 30 (4), 621–7.

Wright, P. M., Coff, R., and Moliterno, T. P. (2014). Strategic Human Capital: Crossing the Great Divide. *Journal of Management*, 40(2), 353–370.

Yeo, B. (2018). "Societal impact of university innovation". *Management Research Review*, 41 (11), 1309-1335.

# Paper 2

*Identifying the determinants of individual scientific performance: a perspective focused on AMO theory*

* Guerrero-Alba, F., Martín-Alcázar, F., & Sánchez.Gardey, G: (2021). Identifying the determinants of individual scientific performance: a perspective focused on AMO theory, *Intangible Capital, 17(2), 124-147.*

**Identifying the determinants of individual scientific performance: a perspective focused on AMO theory**

**Purpose:** The aim of this study is to empirically analyse how motivation and the opportunity to investigate enhance the direct relation between the researcher's human capital and individual scientific performance.

**Design/methodology/approach:** Following recent investigations of strategic human capital and the abilities-motivation-opportunity (AMO) theory, we propose a double quantitative-qualitative methodology to identify the determinants of individual scientific performance.

**Findings:** Applying regression analysis to a sample of 471 Spanish academic researchers, we confirm the moderating role of a researcher's motivation and opportunities.

**Originality/value:** Drawing on the empirical evidence obtained, this work discusses the relevant determinants of scientific productivity, providing practical recommendations for research management and policy making.

**Keywords:** Academic Human capital, researcher, AMO theory, DEA, individual scientific performance.

**JEL codes:** M10; M12; J24; O15.

## 1. Introduction

While direct funding from the government remains the predominant source of university research funding, in recent decades, it has been losing prominence in favour of external funds (Auranen and Nieminen, 2010). It is generally assumed that academic research productivity and efficiency are linked to external competitive incentives by fundraising (Gonzalez-Brambilia and Veloso, 2007). Since scientific productivity determines the allocation of funds and drives success in academic careers, the researchers have tried to identify those factors that could help to explain individual research performance. Some studies have analysed factors such as gender (Turner and Mairesse, 2003), age (Rorstad and Aknes, 2015; Wollersheim et al., 2015), education (Buchmueller et al. 1999) or individual membership in highly productive academic cohorts (Kwiek, 2016), with mixed results (Gonzalez-Bambrilia and Veloso, 2007).

The application of approaches that contextualize the determinants of academic researcher performance becomes necessary to design more efficient research management policies (Diem and Wolter, 2013; Hedjazi and Behravan, 2011; Bazeley, 2010; Dundar and Lewis, 1998). In this context, abilities-motivation-opportunity (AMO) theory has emerged as a suitable approach to evaluate employee performance by differentiating between its key factors (Marin-Garcia and Martinez Tomas,2016; Jiang et al., 2012). AMO theory considers that individual performance depends not only on individuals' abilities and job-related motivation, but also on the opportunities offered by their universities and immediate surrounding environment (sectorial technology centres, business foundations, research and development institutes, etc.).AMO theory has been applied by a large number of papers in the organizational context (Van Waeyenber & Decramer, 2018; Benet-Zepf et al., 2018; Bos-Nehles et al., 2013); however, to our knowledge, there are few studies in the educational context (Bouwmans et al., 2019; Runhaar, 2017; Wollersheim et al., 2015), and

none of them explore these variables in the academic research context. Some studies indicate a developing understanding of how context impacts these relationships (Johns, 2017). In summary, the behaviour of the AMO variables according to field of research could offer new perspectives to university managers.

This AMO theory-based study contributes to the literature to better understand the factors that explain individual scientific performance in the context of academic institutions. Based on a review of the existing literature and application of a double quantitative-qualitative methodology, a set of AMO elements was defined and analysed. The study is organized as follows. After this introduction, we review the literature and propose a model where individual scientific performance is linked to the three AMO elements by defining three hypotheses. We propose a double quantitative-qualitative methodology to identify the determinants of individual scientific performance. Then, the process of data gathering and analysis, based on a sample of 471 Spanish researchers, is explained in detail. Accordingly, four regression models have been developed with the goal of contrasting the proposed hypotheses. The last section explains the conclusions and limitations of this study and identifies possible future lines of research.

## 2. Theoretical framework and hypotheses

Researchers have put great effort into analysing the link between individual employee effort and individual performance (Wright & McMahan, 2011). In this context, AMO theory suggests that an individual´s discretionary effort is conditioned by the ability, motivation and opportunity to participate (Appelbaum et al., 2000). The role of these elements in individual performance has been explored by authors such as Beltrán-Martín & Bou-Llusar (2018) and Wang & Xu (2017). However, it is necessary to further investigate their

relevance in different organizational contexts (Van Waeyenber & Decramer, 2018; Knies & Leisink, 2014). In the next sections, we explore the impact of AMO elements in the research academic context, with the objective of defining hypotheses for the relationships specified in the proposed AMO models. Only research ability, we argue, has an independent, direct, and positive effect on scientific performance, and this effect could be positively or negatively influenced by motivation and opportunity. *Researcher ability* is defined as the research knowledge, skills and abilities of academic researchers necessary for scientific performance. *Researcher motivation* represents the desire and willingness to scientific performance. Finally, researchers' abilities are involved in decisions that impact scientific performance when they are given the *opportunity* to do so. In the next sections, we review what is known about researchers' abilities, motivation and opportunities.

### 2.1. Research abilities: Academic human capital perspective

The literature has identified the first dimension of the AMO approach as human capital, defined as the set of knowledge, skills and abilities (KSA) that enables an individual to carry out a particular activity in a specific context (Kim et al., 2015; Jiang et al., 2012). The scientific literature has not reached a consensus on which human capital-specific attributes enable academics to carry out research activities (Durette et al., 2016; McNie et al., 2016; Thunnissen & Van Arensbergen, 2015).

Generally, knowledge has been classified by researchers into two types: tacit and explicit (Nonaka & Takeuchi, 1995). Tacit knowledge refers to formal knowledge associated with the procedures, routines or ideas acquired through specific training received during academic studies (Horta & Santos, 2016; Su, 2011). This individual-based knowledge is generated as an implicit combination of the acquired cognitive models, experiences, points of view,

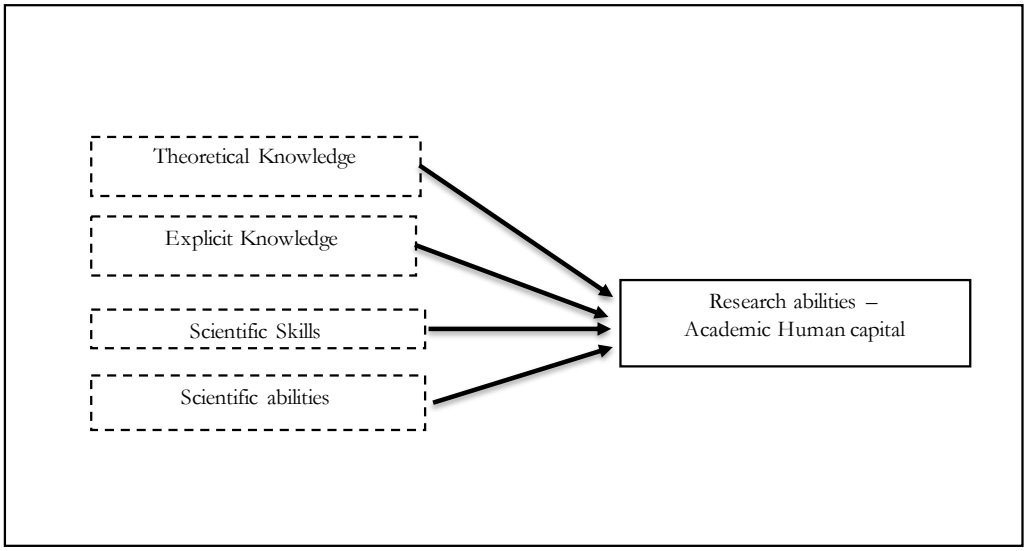
intuition, etc., that enables individuals to understand the nature of a research topic within a specific field. Therefore, it is composed of both the fundamental theories and assumptions of a specific discipline (Bozeman et al., 2001; Lovitts, 2005), as well as the essential and specific elements of a particular research line (Lee et al., 2010).

Second, existing studies considered explicit knowledge as the knowledge stored in various knowledge repositories, such as books, research dissertations, academic journals, and databases, which are available to future researchers (Rowley, 2000; Tiam et al., 2009; Prpić, 1996). In this case, such knowledge is perfectly coded in a systematized language that can be easily transmissible between academic researchers.

The literature does not show a clear differentiation between scientific skills and scientific abilities. Some authors have characterized scientific skills as general personal attributes applicable to different types of jobs, such as *vocation to work* (Bentley & Kyvik, 2013), *creativity* (Marie, 2008) or *professional ethics* (Bell & Bryman, 2007). From this point of view, academic skills can be understood as those individual capabilities related to the execution of a single task. Conversely, scientific abilities are composed of job attributes more specific to research, such as *the capacity to identify research topics* (Ulrich & Dash, 2013), *the capacity to communicate research outcomes* (Thunnissen & Van Arensbergen, 2015) or *the capacity to formulate hypotheses and collect data* (Marie, 2008). In this sense, scientific abilities are defined as individual capabilities that foster adequate research performance.

Figure 1 summarizes this conceptualization of research abilities.

**Figure 1: Theoretical research model for researcher abilities.**




Different studies have confirmed the positive influence of human capital on performance (Wright et al., 2014; Harris et al., 2012; Coff & Kryscynski, 2011). For this purpose, they have argued that the stock of aggregated human capital helps to generate sustainable competitive advantages (Ployhart & Moliterno, 2011). According to the above arguments, it seems clear that human capital is essential for research. Based on the above, we propose the following hypothesis to determine the composition of human capital in the academic field:

*Hypothesis 1: There is a direct and positive relationship between a researcher's abilities (academic human capital) and individual scientific performance.*

> *Hypothesis 1a: There is a direct and positive relationship between theoretical knowledge and individual scientific performance.*

*Hypothesis 1b: There is a direct and positive relationship between explicit knowledge and individual scientific performance.*

*Hypothesis 1c: There is a direct and positive relationship between scientific skills and individual scientific performance.*

*Hypothesis 1d: There is a direct and positive relationship between scientific abilities and individual scientific performance.*

This direct relation between human capital and individual scientific performance will be used as a starting point to examine the effect of the other two AMO theory dimensions: motivation and opportunity. These two dimensions are studied as moderating variables of the main and direct relation. The moderation effects will be explained in the next section.

### 2.2. The moderating dimensions: motivation and opportunity

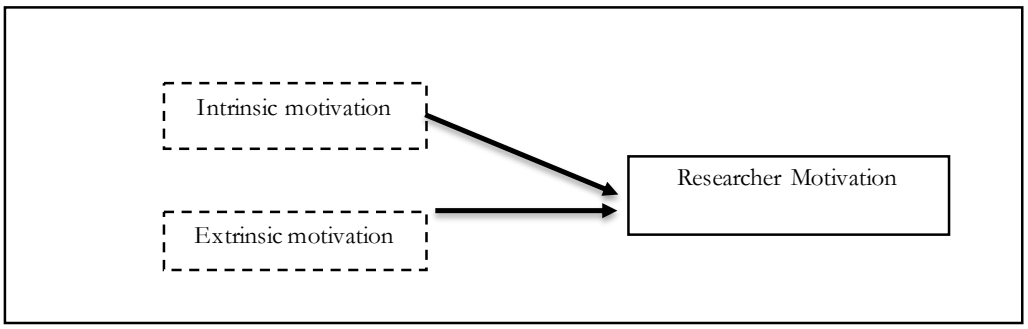
Human capital (Ability) is a necessary condition for a researcher to carry out his or her activity. An additional element is required, which is the will to conduct research. Motivation is the trigger that activates researchers' human capital (Bos-Nehles et al., 2013). Motivation is defined as the desire and the amount of effort that people are willing to put into a particular activity (Mitchell, 1982). Individual motivation, or absence of it, can inhibit, encourage or compensate for the knowledge and/or abilities of an individual (MacDuffie, 1995). Within the academic field, this factor encourages the researcher to explore, understand and propose his or her own ideas in the scientific field, thereby generating new knowledge (Bland et al., 2005).

The literature on motivation has identified two classic types of motivation: internal or intrinsic motivation and external or extrinsic motivation (Wollersheim et al., 2015; Deemer et al., 2010). Intrinsic motivation is related to the level of involvement and identification of the individual with his/her job. It is thereby determined by the extent to which the researcher considers his or her research activity to be relevant, stimulating and challenging (Van der Weijden et al., 2015). Extrinsic motivation, on the other hand, is associated with individual interests and values that enable the design of reward and promotion systems linked as much to the development of the activity as to personal acknowledgement (Peng & Gao, 2019). For researchers, the literature considers a set of mechanisms such as academic career promotion (Tien, 2008), salary increases or teaching workload reduction based on academic performance (Lissoni et al., 2011).

In the university sector, studies have analysed the joint effects of researchers' intrinsic and extrinsic motivation and reported inconclusive conclusions (Janger & Nowotny, 2016; Hardre & Kollmann, 2012). Some studies, such as those by Shmatko and Volkova (2017) or Kwiek (2016), concluded that intrinsic motivation has a more positive contribution than extrinsic motivation because of the resulting satisfaction associated with carrying out research activity. Fox (1983) found that researchers´ intrinsic motivation may compensate for the absence of external motivation. As Lovitts (2005) pointed out, those researchers who have enough autonomy to define and carry out their research projects are more internally motivated because of the satisfaction of developing research studies that are actually appealing to them (Chen et al., 2006).

Considering previous arguments, we expect that intrinsic and extrinsic motivation contribute to the satisfaction, professional prestige and reward of researchers. In short, we summarize researcher motivation in figure 2.

**Figure 2: Theoretical research model for researcher motivation.**




Thus, we propose the following hypotheses in the research context:

*Hypothesis 2: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the researcher's motivation increases.*

> *Hypothesis 2a: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the researcher's intrinsic motivation increases.*
>
> *Hypothesis 2b: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the researcher's extrinsic motivation increases.*

Existing research points out that even when employees have the ability and motivation to perform their jobs, there might be no effect on performance if the organization does not provide the necessary resources (Lepak et al., 2006; Jiang et al., 2012). An opportunity represents the contextual mechanisms that encourage action, such as the work environment and organizational facilities (Boxall & Purcell, 2003; Siemsen et al., 2008). This dimension includes those elements that facilitate or restrict job execution, such as the particular configuration of the environment surrounding the employee (Blumberg & Pringle, 1982). The literature has identified three basic categories of resources for research: financial funds, availability of qualified human resources, and

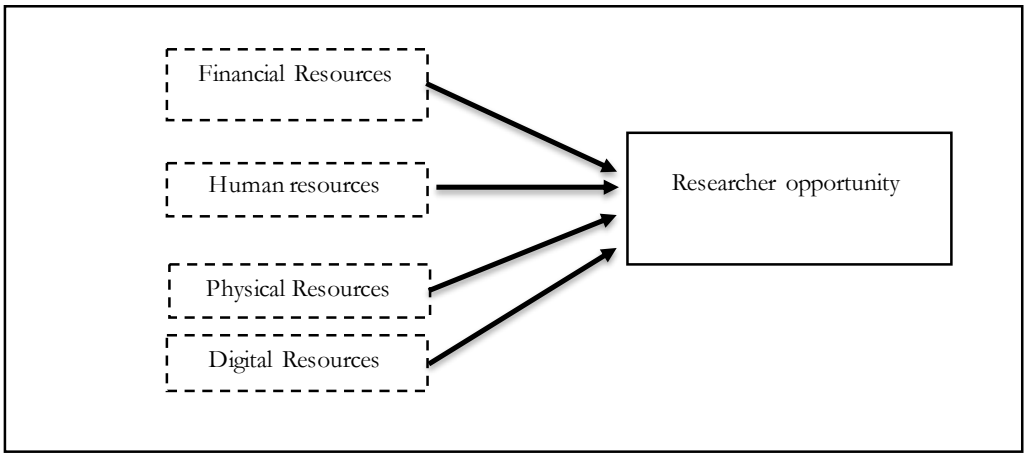
physical and digital resources (Agasisti et al., 2011; 2012; Schuelke-Leech, 2013). *Financial funds*, although showing noticeable differences by the field of knowledge, have traditionally been considered one the main resources for research (Hicks, 2012). Some studies propose that the concentration of financial funds allows greater research results to be achieved (Lariviére et al., 2010; Zucker et al., 2007).

The literature has also explored the *availability of qualified human resources* in the research context. Some authors have proposed that individual research productivity is conditioned by the researcher life cycle (Gonzalez-Bambrila and Veloso, 2007). Such studies suggest that scientific production is highly concentrated within only a few senior researchers (Kwick, 2016). Nonetheless, inasmuch as scientific research activities are currently mainly a question of collaboration within a team, the availability of qualified human resources appears to be a question of balance in team composition. If senior researchers are responsible for providing the human and material resources needed to foster research activity (Carayol & Matt, 2004; Delamont et al., 1997), junior researchers should support research activities, allowing senior researchers to improve the team's intellectual resources, which leads to new knowledge and skills in scientific performance (White et al, 2012). Furthermore, an experienced researcher is key to improving the psychosocial working conditions of PhD students, increasing the number of successful PhD candidates and research group performance (Levecque et al., 2017; Nguyen, 2016; Curtin et al., 2016). Last, senior researchers must ensure that support staff help academic researchers focus on research activity and increase their time devoted to research (Mudrak et al., 2018; Nguyen, 2016; Barham et al., 2014).

Finally, academic research requires the *availability of physical resources* (space, infrastructure and equipment) as well as the *availability of digital resources* (databases, scientific and statistical software) (Schuelke-Leech, 2013). Access to specialized equipment and academic knowledge, among other resources, facilitates scientific productivity (Wang et al., 2006). Within this context, studies such as Käpylä et al. (2010) identify the management and use of ICT as facilitators of scientific productivity as they enable access to the databases necessary for literature reviews. However, this finding contrasts with those of other studies, such as the results reported by Agasisti et al. (2011), which were not consistent when contrasting the effect of infrastructure and the research efficiency of different departments.

In short, we summarize the conceptualization of research opportunities in figure 3.

**Figure 3: Theoretical research model for researcher opportunities.**




The literature review suggests that opportunity conditions the relationship between academic human capital (researcher abilities) and individual scientific performance. Different classic frameworks, such as the job-demands-control model, have considered the multiplicative effects between the abilities and

opportunities dimensions (Karasek, 1979). Consequently, our model suggests that opportunities are necessary to promote researchers´ abilities and scientific performance. Therefore, we propose the following hypotheses:

*Hypothesis 3: The positive effect of a researchers´ abilities (academic human capital) on individual scientific performance is higher as the researcher´s opportunities increase.*

*Hypothesis 3a: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the availability of financial resources increases.*

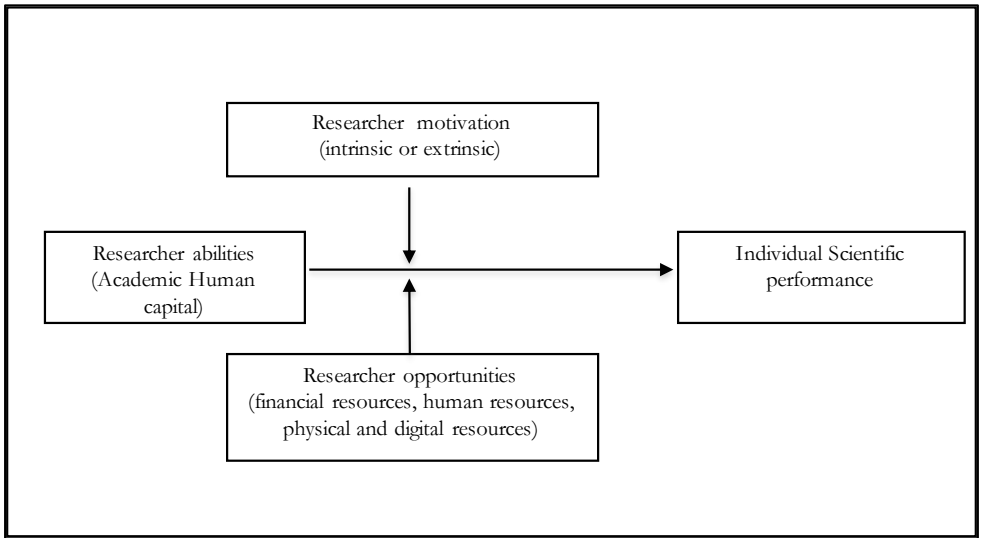
*Hypothesis 3b: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the availability of qualified human resources increases.*

*Hypothesis 3c: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the availability of physical resources increases.*

*Hypothesis 3d: The positive effect of a researcher's abilities (academic human capital) on individual scientific performance increases as the availability of digital resources increases.*

Figure 4 shows the theoretical model proposed based on the AMO approach for the academic context.

**Figure 4: Theoretical research model for the effectiveness of academic researchers.**




**Own elaboration**

## 3. Methodology

### 3.1. Survey design

Since the literature does not offer a validated measurement scale, we considered designing and validating a scale adapted to the research field. For this purpose, a qualitative process was developed based on expert opinion and the Delphi methodology (Landeta, 1999). This methodology offers a systematic and iterative procedure that aims to achieve expert consensus. Experts are informed about the opinions of others with the purpose of reaching consensus (Landeta, 1999). Our expert panel was composed of principal investigators (PIs) from the Plan Andaluz de Investigación (Andalusian Research Plan). They were chosen because of their knowledge and varied experience in the development and management of scientific processes, as well as project and research team management. Experts were selected from the different scientific fields of study to avoid response bias and subjectivity issues resulting from this type of technique (Okoli & Pawlowski, 2004). The final

expert panel was composed of 62 PIs (20 in arts and humanities, 18 in sciences, 8 in health sciences, 6 in law and social sciences and 10 in engineering and architecture). The distribution according to field of study suggests that the studied variables will be similar to those seen in other Spanish universities due to their nature. Also, the criteria used in the Andalusian Research Plan are the same the criteria used in other Spanish universities to define the research groups and their evaluation. In summary, the selected experts have similar characteristics to the research groups from other Spanish universities. Eight open questions were presented to the PIs in order to reach an expert consensus. After three rounds of discussion, the PIs reached consensus. Thirty-six items were identified: 22 items for measuring human capital (abilities), 6 for motivation, and 8 for opportunity. From these, we designed a questionnaire with 36 items on a 5-point Likert scale (1= completely disagree and 5= completely agree), including demographic questions on gender, age, length of academic career, number of six-year period of research positively assessed-sexenio-, academic rank, field of study, and university. Then, a pre-test was conducted among a group of researchers to eliminate any issues in the design and drafting of each item. Prior to the survey, we reduced the ambiguous and unclear items, vague concepts, and complex wording during the expert panel and survey design stages to minimize common method bias (CMB).

### *3.1.1. Sample description*

Data were gathered through an online survey aimed at researchers from Spanish universities. The fieldwork took place from January–October 2017. The survey was submitted to the research vice-rectorate of Spanish public universities with the request to distribute them among researchers, and a total of 2223 responses were obtained. Considering the nature of our model and dataset, we paid particular attention to controlling for CMB. We developed

procedures to control for possible biases based on the recommended studies, such as Conway and Lance (2010) and Podsakoff et al. (2003), which allowed us to conclude that CMB was not a serious concern. From the Harman one-factor test, several factors emerged from each AMO dimension, suggesting that CMB did not significantly affect the empirical analysis (Podsakoff et al., 2003). On the other hand, we studied the partial correlation adjustment in the sample obtained. We defined one marker variable to compare the correlation matrix of the factor variable and correlations adjusted following the indications of Lindell and Whitney (2001) (see Appendix). Our results showed that only one of the significant correlations became non-significant after adjustment. These results demonstrate that CMB did not significantly influence the analyses.

To define the final sample, we kept only individuals who identified themselves by name or ORCID code and who had a permanent position at the university (full professors-*"catedráticos",* professors-*"titulares de universidad"* and associate professors- *"contratado doctores"*). The identification of respondents was necessary to analyse their academic results. Since the identification of researchers could induce social desirability bias in their responses, we placed the items used for identification at the end of the questionnaire.

The final sample consisted of a total of 471 valid responses (21,19%), which provided valid and reliable measures of the dimensions treated in the present study. Table 1 presents the sample descriptive statistics.

**Table 1: Descriptive statistics (n= 471)**

| ***Variable*** | **Descriptive Statistics** |
|---|---|
| *Gender* | Male: 65% |
| | Female: 35% |
| *Age* | >65 years: 4.8% |
| | 56-65 years: 26.5% |
| | 46-55 years: 49.1% |
| | 36-45 years: 19% |
| | < 35years: 0.8% |
| *Length of academic career* | >20 years: 67.3% |
| | 16-20 years: 17.2% |
| | 11-15 years: 10.2% |
| | 5-10 years:4.7% |
| | < 5years: 0.6% |
| *Number of six-year period of research positively assessed (sexenio)* | 6: 3.0% |
| | 5:10.4% |
| | 4: 20.3% |
| | 3: 22.4% |
| | 2: 20.7% |
| | 1: 15.8% |
| | 0: 7.5% |
| *Academic rank* | Full Professors (*catedráticos*): 31.8% |
| | Professors (*titulares de universidad*): 50.5% |
| | Associate Professors (*contratado doctores*): 17.6% |
| *Field of study* | Art & Humanities: 15.1% |
| | Sciences: 37.7% |
| | Health Sciences: 8.1% |
| | Law & Social Sciences: 23% |
| | Engineering & Architecture: 16.2% |
| *University* | University of Oviedo: 9.6% |
| | University of Valladolid: 8.5% |
| | University of Politécnica de Madrid: 7.9% |
| | University of Las Palmas de Gran Canaria: 7% |
| | University of Málaga: 6,8% |
| | University of Complutense de Madrid: 5.3% |
| | University of Sevilla: 4.5% |
| | University of Alcalá: 3.8% |
| | University of Alicante: 3.8% |
| | University of León: 3.4% |
| | University of Zaragoza: 3.4% |
| | University of Cantabria: 3% |
| | University of Barcelona: 2,8% |
| | University of Granada: 2.8% |
| | University of La Laguna: 2.5% |
| | University of Politécnica de Valencia: 2.5% |
| | University of Vigo: 2.3% |
| | University of Autónoma de Madrid: 2.1% |
| | University of Coruña: 1.9% |
| | University of País Vasco: 1.9% |
| | University of Valencia: 1.9% |
| | University of Vic:1.7% |
| | University of Politécnica de Cataluña: 1.5% |
| | University of Autónoma de Barcelona: 1.3% |
| | University of Burgos: 1.3% |
| | University of Córdoba: 1.3% |
| | University of Girona: 1.3% |
| | University of Almería: 0.6% |
| | University of Politécnica de Cartagena:0.6% |
| | University of Rey Juan Carlos: 0.6% |
| | University of Salamanca:0.6% |
| | University of Carlos III: 0.4% |
| | University of Pompeu Fabra: 0.4% |
| | University of Castilla La Mancha: 0.2% |
| | University of IE University: 0.2% |
| | University of Ramón Llull: 0.2% |

## 4. Empirical analysis

### *4.1. Factor Analysis*

First, a factor analysis was conducted to identify the implicit dimensions of the three model components in the data: abilities, motivation and opportunity. The analysis was based on the main components method of extraction, resulting later in a varimax rotated solution. Kaiser-Meyer-Olkin and Bartlett's sphericity tests were performed in the three factor analyses. The decision regarding the number of factors was based on the scree test (Cattell, 1966) and on the eigenvalue selection criterion being superior to the unit (Kaiser, 1974). Those items that did not load adequately on their factor were eliminated, and the test was repeated.

*Researcher Abilities (Academic Human Capital)*

For the first dimension (academic human capital), five factors were obtained (table 2). The item "*I master the language usually used in journals/books and in scientific meetings in my academic field*" was eliminated from the analysis since it loaded insufficiently onto one factor. The first factor consisted of seven items linked to elements associated with the implementation of research activity. Among these items are the ability to communicate research findings, relationship with colleagues and research management. These elements allow a researcher to carry out his or her research and continue to progress adequately in his or her academic career. For this reason, we labelled it "*Research abilities*". The second factor consisted of four items related to the researcher´s level of theoretical training and methodology, his or her ability to find and manage information from publications relevant to his or her field of knowledge, and knowledge of the scientific publications within the research area. Consequently, we labelled it "*Scientific knowledge*". The third factor consisted of four items related to the researcher´s creative perception and his or her initiative in carrying out research activity, so we labelled it "*Proactive*

*creativity"*. The fourth factor consisted of three items related to constancy, discipline and organization in the workplace, labelled "*Research accuracy*". Finally, the fifth factor consisted of three other items that measured to what extent the researcher accepts criticism and reviews of his or her work. We labelled this factor *"skill of accepting criticism*".

**Table 2: Analysis of the main components (varimax rotation) of researcher abilities (academic human capital) (n=471)**

| Items | Components | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| I know how to present and communicate my research findings | .831 | | | | |
| I am able to fluently relate to other researchers | .770 | | | | |
| I know how to manage research activities (thesis, research projects, etc.) | .739 | | | | |
| I know how to link observations with test results and arrive at conclusions | .703 | | | | |
| I am able to carry out research on my own | .675 | | | | |
| I am able to adapt to changes within my research context | .653 | | | | |
| I am able to identify research themes within my research context | .635 | | | | |
| I have the necessary training in research methodologies and techniques | | .732 | | | |
| I have the necessary theoretical training to conduct research within my scientific field | | .723 | | | |
| I know the most relevant publications within my scientific field | | .716 | | | |
| I have the required skill to obtain and manage the information necessary for research | | .677 | | | |
| I am a creative researcher | | | .797 | | |
| I am a researcher who takes initiative | | | .718 | | |
| I am a resilient researcher | | | .626 | | |
| I am a researcher with observation skills | | | .522 | | |
| I am a disciplined researcher | | | | .873 | |
| I am an organized researcher | | | | .838 | |
| I am a persevering researcher | | | | .687 | |
| I am a researcher who accept criticism | | | | | .817 |
| I am a self-critical researcher | | | | | .729 |
| I am an altruistic researcher | | | | | .526 |
| Eigenvalues | 7.042 | 2.251 | 1.370 | 1.338 | 1.091 |
| Explained variance | 33.54 | 10.72 | 6.52 | 6.37 | 5.19 |
| Cronbach' alpha .884 | | | | | |
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy: .896 | | | | | |
| Bartlett's Test of Sphericity: | | | | | |
| Approx. Chi-Square: 4010.596 | | | | | |
| gl: 210 | | | | | |
| Significance: .000 | | | | | |

*Researcher motivation*

For the second dimension (motivation), two factors were obtained (table 3). The item "*I research for my own personal prestige*" was eliminated from the analysis since it loaded insufficiently onto one factor. The first factor consisted of those items related to the researcher´s external aspects, such as promotion or achievement of research merits. The second factor consisted of incentives associated with the internal satisfaction of carrying out research activity. Hence, the first factor was labelled "*Extrinsic Motivation"*, and the second factor was labelled "*Intrinsic Motivation"*.

**Table 3: Analysis of the main components (varimax rotation) of researcher motivation (n= 471)**

| | **Components** | |
|---|---|---|
| **Item** | **1** | **2** |
| I conduct research to obtain research merits | .857 | |
| I conduct research to obtain financial rewards | .754 | |
| I conduct research to obtain promotions | .741 | |
| Research is part of my work | | .871 |
| I conduct research for my own personal satisfaction | | .843 |
| Eigenvalue | 2.010 | 1.372 |
| Explained variance | 40.19 | 27.44 |
| Cronbach's alpha | .617 | |
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy: | .599 | |
| Bartlett's Test of Sphericity | | |
| Approx. Chi-Square: | 417.064 | |
| gl: | 10 | |
| Significance: | .000 | |

*Researcher opportunities*

The third dimension (opportunity) consisted of eight items grouped into two factors (table 4). The first factor includes items that explain the availability of financial and human resources, while the second factor includes items related

to the availability of information resources. Therefore, the first one was labelled "*Availability of financial and human resources"*, and the second one was labelled "*Availability of information resources"*.

**Table 4: Analysis of the main components (varimax rotation) of researcher opportunities (n= 471)**

| | Components | |
|---|---|---|
| **Item** | **1** | **2** |
| Availability of financial resources | .751 | |
| Availability of experienced researchers | .694 | |
| Availability of researchers in training | .635 | |
| Availability of equipment | .578 | |
| Availability of technical staff | .533 | |
| Availability: Database access | | .760 |
| Availability of software | | .613 |
| Availability of literature resources | | .591 |
| Eigenvalue | 2.609 | 1.205 |
| Explained variance | 32.616 | 15.061 |
| Cronbach's alpha | .690 | |
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy: | .741 | |
| Bartlett's Test of Sphericity | | |
| Approx. Chi-Square: | 176.433 | |
| gl: | 28 | |
| Significance: | .000 | |

Additionally, we conducted the AMO dimension test using EQS structural equation modelling (Bentler, 1995) as proof of nomological validity. To test the dimensionality of the academic AMO scale, we first examined the unidimensionality of each component by assessing the fit indices, parameter validity, and statistical significance of single-factor confirmatory factor analyses (CFA). For this, we used all the AMO dimensions for the expert panel and exploratory factor analysis. Our study considered the AMO dimensions as a reflective construct. Table 5 presents the fit indices for each construct (researchers abilities-academic human capital, motivation, and opportunities). Fit indices were also used to verify the unidimensionality of the three scales

because they fell within the commonly accepted limits. Therefore, each of the AMO dimensions formed a second-order construct.

**Table 5: Fit indices for the unidimensional models of researcher abilities (academic human capital), motivation and opportunities dimensions.**

| Model | BBNNFI | CFI | IFI | RMSEA | GFI | AGFI |
|---|---|---|---|---|---|---|
| Researcher abilities (Academic human capital) | .949 | .955 | .955 | .061 | .964 | .955 |
| Researcher Motivation | .918 | .975 | .976 | .065 | .998 | .991 |
| Researcher Opportunities | .920 | .949 | .951 | .068 | .982 | .964 |

*Notes: Bentler-Bonnett Non-Normed Fit index (BBNNFI); Comparative fit index (CFI), Incremental Fit Index (IFI); the root mean square error of approximation (RMSEA); the goodness of fit index (GFI); the adjusted goodness of fit index (AGFI).*

### *4.2. Regression analysis*

Independent variables:

The five factors associated with researcher´s abilities (academic human capital), the two factors associated with motivation and the two factors associated with opportunity were all used as *independent variables*. Table 6 identifies the correspondence between the hypothesis and factorial analysis. As can be observed in the factorial analysis, the researcher´s motivation is the same between the theoretical dimension and factorial analysis, considering extrinsic and intrinsic motivation. However, the researcher´s abilities and opportunities showed some differences. In the researcher´s abilities, we observed academic human capital, such as the KSA framework, as having three dimensions, while factorial analysis has been established with five dimensions. Surprisingly, research skills differed in three different dimensions: *proactive creativity, research accuracy and skill of accepting criticism*. Likewise, the knowledge dimension was integrated into a single factor. Similarly, in the opportunity dimension, the *availability of financial resources and availability of qualified human resources* were integrated into a single factor, and the

*availability of physical resources* and *digital resources* were also integrated into a single factor.

**Table 6: Correspondence between theoretical and factorial analysis dimensions**

| **Theoretical Dimensions** | **Factorial analysis dimensions** |
|---|---|
| *Theoretical knowledge*<br><br>*Explicit knowledge* | *Scientific Knowledge* |
| *Scientific skills* | *Proactive creativity*<br>*Research accuracy*<br>*Skill of accepting criticism* |
| *Scientific abilities* | *Research abilities* |
| *Intrinsic Motivation* | *Intrinsic Motivation* |
| *Extrinsic Motivation* | *Extrinsic Motivation* |
| *Availability of financial resources*<br><br>*Availability of qualified human resources* | *Availability of financial and human resources* |
| *Availability of physical resources*<br>*Availability of digital resources* | *Availability of information resources* |

Dependent variables:

Research performance is the dependent variable of the proposed model. From the researcher's name or ORCID code, we obtained the H-index of researchers in the Scopus database. The H-index (Hirsch, 2005) is generally used to measure research impact and quality, as it is not sensitive to the number of published documents, which happens with impact factor, thereby improving the assessment of a researcher´s general impact (Egghe, 2008). Since the H-index presents some serious methodology restrictions, mainly related to distribution issues (Iglesias & Pecharroman, 2007), we opted for to data envelopment analysis (DEA) to define an H-based efficiency frontier. DEA is a nonparametric linear-programming technique that compares multiple inputs

and outputs of each sample researcher to the reference of optimal researchers (Amara et al., 2020; Cook et al., 2019). The efficiency measure is equivalent to the radial distance from the optimal frontier production (Papadimitriou & Johnes, 2018; Sagarra et al., 2017). This frontier is obtained through the scores of each output category that is produced by the most efficient sample researcher (Kumar and Thakur, 2019). In this study, we constructed this indicator based on the H-index, considering this measurement relative to a researcher's number of active years. This measure therefore makes it possible to compare researchers at different categories in their academic careers in comparison with other absolute indicators, such as the H index or productivity itself. This means that the DEA is more suitable as a dependent variable.

Control variables:
In line with similar studies, we decided to use length of academic career as a control variable to reduce the potential omitted bias variables in the empirical analysis (Leahey et al., 2017; Bäker, 2015).

### *4.3.Results*

With the purpose of contrasting the proposed hypotheses, four regression models have been developed using SPSS (version 21). Table 7 presents the correlation matrix of those variables used in the models together with their descriptive statistics. Table 8 presents the regression model results. Models 1 and 2 include the effect of the control variable and the researcher´s human capital variable on individual scientific performance. The direct effects in Model 2 confirm that human capital has a positive and significant influence on individual scientific performance. More specifically, our results indicate that *research abilities* ($p < 0.01$) and *scientific knowledge* ($p < 0.05$) affect scientific performance. Our results do not indicate that *research accuracy* ($p > 0.10$) *and skill of accepting criticism* ($p > 0.10$) have a direct effect on individual scientific performance. However, the test results indicate certain

negative and significant relationships between *proactive creativity* and individual scientific performance ($p < 0.10$). This result confirms hypotheses 1a, 1b and 1d but rejects hypothesis 1c.

Models 3 and 4 incorporate the moderating effects as defined in the model: motivation (model 3) and opportunity (model 4). As indicated by the results (model 3), extrinsic motivation moderated the linkage between *research abilities* ($p<0.01$) and *research knowledge* ($p<0.01$) with individual scientific performance. In the case of intrinsic motivation, the moderation effects impact *research abilities* ($p<0.05$) is negative. While this moderation relation between intrinsic motivation and *proactive creativity* ($p<0.01$), *research accuracy* ($p<0.01$) and *skill of accepting criticism* ($p<0.01$) is positive. A significant change in $R^2$ (0.411), after the interaction variable was added to the model, substantiates the moderating effect (refer to model 3). Consequently, hypotheses 2a and 2b could be partially accepted. In accordance with H3, the researcher´s opportunity moderated the linkage between academic human capital-research abilities and scientific performance. In this case, the moderating effect of availability of economic and human resources occurred for *researcher abilities* ($p < 0.01$), *scientific knowledge* ($p < 0.01$) and *research accuracy* ($p < 0.10$). The moderating effect of availability of information resources arose for only two human capital dimensions: research abilities ($p < 0.01$) and skill of accepting criticism ($p < 0.01$). As indicated, a relative change in $R^2$ (0.108), after the interaction variable was added to the model, explains the moderating effect (refer to model 4). These findings partially confirm hypotheses 3a, 3b, 3c, and 3d.

**Table 7: Descriptive statistics and correlations.**

| | Variable | M | DT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Research abilities | 0 | 1 | 1 | | | | | | | | | | |
| **2** | Scientific knowledge | 0 | 1 | .000 | 1 | | | | | | | | | |
| **3** | Proactive creativity | 0 | 1 | .000 | .000 | 1 | | | | | | | | |
| **4** | Research accuracy | 0 | 1 | .000 | .000 | .000 | 1 | | | | | | | |
| **5** | Skill of accepting criticism | 0 | 1 | .000 | .000 | .000 | .000 | 1 | | | | | | |
| **6** | Extrinsic motivation | 0 | 1 | -.005 | -.019 | -.054 | .064 | -.006 | 1 | | | | | |
| **7** | Intrinsic motivation | 0 | 1 | .314** | .225** | .340** | -.039 | -.066 | .000 | 1 | | | | |
| **8** | Availability of human and financial resources | 0 | 1 | .044 | .040 | .000 | -.075 | .011 | .037 | .090 | 1 | | | |
| **9** | Availability of information resources | 0 | 1 | -.025 | .036 | .120* | .045 | .086 | .072 | .027 | .000 | 1 | | |
| **10** | DEA | .420 | .139 | .299** | .101* | -.069 | .001 | -.018 | -.077 | .069 | .223** | .121* | 1 | |
| **11** | Length of academic career | 4.459 | .900 | .098* | .133** | .032 | .082 | .013 | -.131** | .017 | -.027 | .071 | .125* | 1 |

**Table 8: Linear regression model results.**

| Variables | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| **Constant** | .337** (.034) | .358** (.034) | .387** (.026) | .353** (.029) |
| **Length of academic career** | .015* (.007) | .011 (.007) | .004 (.006) | .011+ (.007) |
| **Research abilities** | | .052** (.005) | .059** (.005) | .052** (.005) |
| **Scientific knowledge** | | 0.19* (.008) | .014* (007) | .018* (.007) |
| **Proactive creativity** | | -.013+ (.007) | .002 (.005) | -.016* (.007) |
| **Research accuracy** | | .001 (.008) | .001 (.005) | .000 (.007) |
| **Skill of accepting criticism** | | -.003 (.009) | .001 (.004) | -.007 (.009) |
| **Extrinsic motivation x Research abilities** | | | .034** (.005) | |
| **Extrinsic motivation x Scientific knowledge** | | | .048** (.009) | |
| **Extrinsic motivation x Proactive creativity** | | | -.001 (.005) | |
| **Extrinsic motivation x Research accuracy** | | | -.001 (.005) | |
| **Extrinsic motivation x Skill of accepting criticism** | | | .005 (006) | |
| **Intrinsic motivation x Research abilities** | | | -.009* (.004) | |
| **Intrinsic motivation x Scientific knowledge** | | | -.003 (.004) | |
| **Intrinsic motivation x Proactive creativity** | | | .045** (.004) | |
| **Intrinsic motivation x Research accuracy** | | | .037** (.004) | |
| **Intrinsic motivation x Skill of accepting criticism** | | | .043** (.004) | |
| **Availability of economic and human resources x Research abilities** | | | | .048** (.007) |
| **Availability of economic and human resources x Scientific knowledge** | | | | .036** (.009) |
| **Availability of economic and human resources x Proactive creativity** | | | | .000 (.008) |
| **Availability of economic and human resources x Research accuracy** | | | | .014+ (.008) |
| **Availability of economic and human resources x Skill of accepting criticism** | | | | .011 (.007) |
| **Availability of information resources x Research abilities** | | | | .027** (.008) |
| **Availability of information resources x Scientific knowledge** | | | | .003 (.007) |
| **Availability of information resources x Proactive creativity** | | | | -.008 (.006) |
| **Availability of information resources x Research accuracy** | | | | .010 (.006) |
| **Availability of information resources x Skill of accepting criticism** | | | | .022** (.007) |
| **Model F** | 4,222 * | 27.261** | 48.202** | 11.356** |
| **Model $R^2$** | .015 | .183 | .594 | .291 |
| **Increase $R^2$** | - | .168 | .411 | .108 |

*Notes: n=471.: Dependent variable: DEA*
*The table presents the non-standardized beta coefficients, the standardized errors clustered are found between brackets, and the change in $R^2$ indicates the comparison with the previous model.*
*+ p < .10; * p< .05; ** p < .01*

### *4.4. Discussion*

The literature considers that human capital has a positive and significant influence on individual performance. Studies such Mcnie et al. (2016) argue that both "hard skills" and "soft skills" are necessary for research performance. Hard skills are those capabilities that allow an individual to formulate hypotheses, develop research protocols, undertake research, and publish articles. On the other hand, soft skills are the capabilities of academic researchers that focus on behaviour and relationships. Therefore, we would consider *research abilities* and *scientific knowledge* as "hard skills" and regard *proactive creativity, research accuracy* and *skill of accepting criticism* as "soft skills". In fact, our data suggest that *scientific knowledge* and *research abilities* are the essence of academic human capital, as described by studies such Bozeman et al. (2001) and Durette et al. (2016). In addition, our results do not show that *research accuracy and skill of accepting criticism* had a direct effect on individual scientific performance. However, the test results indicate certain negative and significant relationships between *proactive creativity* and individual scientific performance. These findings are partially unexpected because theoretically, all human capital factors should contribute significantly and positively to individual scientific performance. One possible explanation is that researchers have very innovative and creative proposals that hinder publication in scientific journals, hence undermining performance. This relationship needs to be investigated further to confirm its existence as well as significance.

Similarly, we have shown that the explanatory model improves when it includes the researcher's motivation and opportunity as moderating variables. In view of the results, we can confirm that researcher motivation contributes as a moderating variable rather than the researcher opportunity dimensions ($R^2$ = 0.411 vs $R^2$ = 0.108). According to our model in relation to the researcher´s

motivation, individual scientific performance is a product of an interaction between the researcher's intrinsic and extrinsic motivation and his or her abilities (academic human capital), as indicated in studies such as Janger and Nowotny (2016). Our results seem to indicate that extrinsic motivation encourages "hard skills" (*research abilities* and *scientific knowledge*), while intrinsic motivation stimulates "soft skills" (proactive creativity, research accuracy and skill of accepting criticism). Specifically, improvement in contractual conditions and financial rewards relevant to extrinsic motivation increases the effect of *research ability and scientific knowledge* on individual scientific performance. On the other hand, intrinsic motivation strengthens the effect of research skills *(proactive creativity, research accuracy and skill of accepting criticism)* on individual scientific performance. However, the moderation effect of *intrinsic motivation between research abilities* on individual scientific performance is negative. One reason could be the sample chosen, which included only individuals with permanent positions. The results indicate that academic researchers have adequate research abilities, and they do not particularly benefit from being intrinsically motivated to perform research. Therefore, further study is necessary to confirm these findings. In short, we can confirm that academic researchers have the same intrinsic and extrinsic motivations as other employees in different organizations.

In relation to researcher opportunities, our results support the proposals of other studies, such as Van der Weijden et al. (2008) and Sutherland (2017). As expected, universities providing economic and human resources reinforce the relationships between their researchers´ abilities (academic human capital) and scientific performance. More specifically, the *availability of economic and human resources* enhances the effect of "hard skills" *(research abilities and scientific knowledge)* and one of the dimensions of "soft skills" *(research accuracy)*. The same effect is not supported for the *availability of information* except for one dimension of "hard skill" (*research abilities*) and the last

dimension of "soft skills" (*skill of accepting criticism*). One reason for this result could be, as previously stated, the sample used. Economic and human resources allow academic researchers to continue acquiring knowledge, abilities and greater discipline to achieve higher scientific performance. In the case of information resources, the results seem to indicate that they are not very necessary to publish for academic researchers who have obtained a tenured position. Information resources enable researchers to accept criticism as they observe the research of their peers.

## 5. CONCLUSIONS

The aim of this study was to identify the factors that determine individual academics' scientific performance. From a theoretical perspective, we looked to examine the applicability of the AMO model in an academic context. We applied this model to explore how motivation and opportunity affect researchers' abilities (their academic human capital). Although several studies indicate that AMO theory is an appropriate framework for explaining individual performance (Bos-Nehles et al., 2013), few have considered the research academic context. Nevertheless, the dimensions proposed by AMO theory have helped identify the specific factors that have a significant impact on individual scientific performance. We therefore offer a novel model, based on the AMO framework, that explains whether research abilities improve in the presence of different types of research motivations and opportunities. In a mixed methodology study, our proposed hypotheses were widely supported. Theoretically, the reported research contributed toward the existing breadth of knowledge on the factors that influence academic researchers in terms of their abilities, motivations, and opportunities in their field. We believe that our focus on motivation and opportunity for research can be used to explain performance improvements in a given individual researcher's abilities.

More specifically, these research findings contribute to the literature in several different ways. First, the proposed model, based on AMO theory, has helped thoroughly explain the relationship between the prescribed dimensions and individual scientific performance. AMO theory offers a better understanding of this phenomenon and of the interrelationships between researchers' abilities (academic human capital), motivation, and opportunities. It is worth noting that, despite the evident contextual differences, researchers seem to respond to concerns in ways that are similar to workers in different organizational contexts (Szulc et al., 2021; Szulc & Smith, 2021). Academic researchers, like other workers, develop a series of abilities and motivations that allow them to achieve certain returns in their jobs. Likewise, the opportunities offered by their organizations and environments allow them to make improvements, as shown in this study. Additionally, our study contributes to identifying specific variables within the academic context: five that are academic human capital-based (*research abilities, scientific knowledge, proactive creativity, research accuracy,* and *skill of accepting criticism*), two that are research motivation-based (*extrinsic* and *intrinsic motivation*) and that are two research opportunity-based (*availability of economic and human resources* and *availability of information resources*). These elements are essential for the successful academic activity of university researchers. The different research units (universities, research groups, and researchers) can utilize these attributes in order to encourage research activity. In complex jobs like conducting research, a comprehensive list of AMO attributes could be especially useful in analysing one's position in order to clarify what is needed to successfully perform. Secondly, the tests indicated that researchers' abilities (academic human capital) have a positive influence on individual scientific performance. The positive influence of human capital on research activity implies that researchers must acquire, maintain, and develop a set of specific competencies to appropriately carry out research activity; these results, as expected, are consistent with the academic human capital literature (Bozeman et al., 2001).

Surprisingly, our results reflect a certain negative relationship between *proactive creativity* and performance, perhaps because the research process and lines of research groups somewhat limit the "gaps" in the different research topics or innovative proposals that are generally not sought after in scientific journals. According to our results, academic researchers have both an extrinsic motivation that encourages hard skills (*research abilities* and *scientific knowledge*), and an intrinsic motivation that stimulates soft skills (p*roactive creativity, research accuracy,* and *skill of accepting criticism*). This study therefore supports previous conclusions in the literature regarding the connection between intrinsic and extrinsic researcher motivation in the academic context (Janger & Nowotny, 2016; Wollersheim et al., 2015). In fact, the theoretical discussion describes a two-way relationship between these two motivation dimensions on scientific performance (Peng & Gao, 2019). Additionally, researchers' opportunities are particularly relevant in the academic context. Although opportunities for researchers to engage in scientific activity have been explored previously, this study highlights the necessity of going beyond description by employing inferential statistics to examine the relationships between research abilities and scientific performance; our participants exhibited a greater availability of economic and human resources than of information resources. According to our results, economic and human resources must be available to support researchers' hard skills (*research abilities* and *scientific knowledge*) and certain one dimension of "soft skills" (*research accuracy)*. However, our data indicated the availability of information resources in terms of only one dimension of "hard skills" (*research abilities*) and the last dimension of "soft skills" (*skill of accepting criticism*). Therefore, we can conclude that researchers' motivation and opportunities stimulate their ability to achieve greater scientific performance.

From a practical perspective, this study has a number of implications that may be relevant for university managers and PIs who strive to advance the quality and effectiveness of academic human capital (researchers' abilities), foster researchers' motivation, and offer the opportunities required for conducting research. The conceptual model presented here can help universities develop a comprehensive approach to abilities, motivation, and opportunity enhancement practices tailored to the specific needs of researchers in the given workplace. More specifically, adequate policies for hiring new academic researchers, training, researcher evaluations, and academic rewards (Thunnissen & Van Arensbergen, 2015; Ayaita et al., 2019) could impact the development of researchers' abilities and motivation. Thus, university managers must promote adequate human resource management policies that improve the ability and motivation of academic researchers; these are both directly and indirectly related to research performance, suggesting that universities retain and generate high levels of performance of researchers focusing on the potential relationships that drive them. Also, universities who provide researchers with the necessary resources (financial, human, and information), are likely to enable them to improve their research performance. Since research collaborations are commonly positively associated with development and performance outcomes (Lee and Bozeman, 2005), cooperation between new researchers and support staff can both facilitate the creation of new research abilities and provide a more holistic view of job satisfaction, for example. A second practical implication of the AMO framework can be seen in its usefulness as an external reporting tool. The AMO framework could be utilized at the university level to better allocate resources and foster academic motivation. University leaders could therefore use this study to develop ability-motivation-and opportunity enhancing strategies and methods to help researchers improve individual scientific performance; Andreeva and Sergeeva (2016) and Beltran-Martín and Bou-Llusar (2018) showed examples of this in the organizational context.

### *5.1. Limitations and directions for future research*

Our study has a number of limitations that offer potential directions for future research. First, the analysis of the complex relationships between the examined factors requires a longitudinal investigation in order to correctly identify the dynamics existing between the different elements of the model. Moreover, the findings suggest that the results may be affected by specific characteristics within a given field of study. Further analyses should be performed to study which characteristics of a field are the most relevant, as they may eventually influence the results. Secondly, we need to acknowledge the sample's national character; this study should be replicated at an international level considering the differences in each AMO variable that might be affected by contextual variables. Finally, another limitation of the study could be mitigated by separating the results according to university regional context, field of study, or academic rank; these results could illuminate differences between these variables, primarily in terms of the availability of resources.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding and Acknowledgments:**

Authors are ordered alphabetically and have contributed equally to this paper. This study was supported by:

1.- the Spanish Ministry of Economy and Competitively under Grant ECO2014-56580-R;

2.- the Andalusian Government (Spain) under Grant P12-SEJ-1810;

3.-the Andalusian Government (Spain) under Grant P12-SEJ-1618; and

4.-Research Projects University of Cadiz under Grant PR2016-018.

## References

Auranen, O, & Nieminen, M. (2010). University research funding and publication performance—An international comparison. *Research Policy* 39:822-834.

Agasisti, T, Catalano, G, Landoni, P, & Verganti, R. (2012). Evaluating the performance of academic departments: an analysis of research-related output efficiency. *Research Evaluation*, 21, 2-14.

Agasisti, T, Dal Bianco, A, Landoni, P, Sala, A, & Salerno, M. (2011). Evaluating the Efficiency of Research in Academic Departments: an Empirical Analysis in an Italian Region. *Higher Education Quarterly* 65(3), 267-289.

Amara, N, Rhaiem, M, & Halilem, N. (2020). Assessing the research efficiency of Canadian scholars in the management field: Evidence from the DEA and fsQCA. *Journal of Business Research*. *Journal of Business Research*, 115, 296-306.

Andreeva, T, & Sergeeva, A. (2016). The more the better ... or is it? The contradictory effects of HR practices on knowledge-sharing motivation and behaviour. *Human Resource Management Journal*, 26(2), 151–171

Appelbaum, E, Bailey, TT, Berg, P, & Kallenberg, A. (2000). *Manufacturing advantage: Why high-performance work systems pay off*. *Ithaca*, NY: Cornell University Press.

Ayaita, A, Pull, K, Backes-Gellner, U. (2019). You get what you 'pay'for: academic attention, career incentives and changes in publication portfolios of business and economics researchers. *Journal of Business Economics*, *89*(3),273-290.

Bäker, A. (2015). Non-tenured post-doctoral researchers´job mobility and research output: An analysis of the role of research discipline, department size, and coauthors. *Research Policy,* 44,634-650.

Barham, B.L, Foltz, J.D, & Prager, D. (2014). Making time for science. *Research Policy,* 43,21-31.

Bazeley, P. (2010). Conceptualising research performance. *Studies in Higher Educatio*n, 35(8),889-903

Bell, E, & Bryman, A. (2007). The ethics of management research: An exploratory content analysis. *British Journal of Management,* 18,63–77.

Beltrán-Martín, I, & 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 Quaterly,* 21,99-110.

Benet-Zepf, A., Marin-Garcia, J., & Küster, I. (2018). Clustering the mediators between the sales control systems and the sales performance using the AMO model: A narrative systematic literature review. *Intangible Capital*, 14(3), 387-408.

Bentler, P.M. (1995). *EQS Structural Equations Program Manual*. Encino, CA: Multivariate Software Inc.

Bentley, P.J, & Kyvik, S. (2013). Individual Differences in Faculty Research Time Allocations Across 13 Countries. *Research in Higher Education*, *5*4 (3),329–348.

Bland, C.J, Center, B.A, Finstad, D.A, Risbey, K.R, & Staples, J.G. (2005). A theoretical, practical, predictive model of faculty and department research productivity. *Academic Medicine : Journal of the Association of American Medical Colleges*, *80*(3),225–237.

Blumberg, M, & Pringle, C. (1982). The missing opportunity in organizational research: Some implications for a theory of work performance. *Academy of Management Review*, 7(4),560-569.

Bos-Nehles, A.C, Van Riemsdijk, M.J, & Kees-Looise, J. (2013). Employee perceptions of line management performance: Applying the AMO theory to explain the effectiveness of line managers' HRM implementation, *Human Resource Management*, 52(6),861-877.

Bouwmans, M, Runhaar, P, Wesselink, R, & Mulder, M. (2019). Stimulating teachers' team performance through team-oriented HR practices: the roles of affective team commitment and information processing. *The International Journal of Human Resource Management,* 30(5),856-878

Boxall, P, & Purcell, J. (2003). *Strategy and Human Resource Management,* Basingstoke: Palgrave Macmillan.

Bozeman, B, Dietz, J, & Gaughan, M. (2001). Scientific and Technical Human Capital : An Alternative Model for Research Evaluation. *International Journal of Technology Management*, 22(8),716–740.

Buchmueller, T.C, Dominitz, J, & Hansen, W.L. (1999). Graduate training and the early career productivity of Ph. D. economists. *Economics of Education Review*, 18(1),65-77.

Carayol, N, & Matt, M. (2004). Does research organization influence academic production? Laboratory level evidence from a large European university. *Research Policy*, 33(8),1081-1102.

Cattell, R.B. (1966). The Scree Test for the Number of Factors. *Multivariate Behavioral Research*, 1,245–276.

Chen, Y, Gupta, A, & Hoshower, L. (2006). Factors That Motivate Business Faculty to Conduct Research: An Expectancy Theory Analysis. *Journal of Education for Business*, 81(4),179–189.

Coff, R, & Kryscynski, D. (2011). Invited Editorial: Drilling for Micro-Foundations of Human Capital-Based Competitive Advantages. *Journal of Management*, 37(5),1429–1443.

Conway, J.M, & Lance, C.E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology*, 25,325–34.

Cook, W.D, Ramón, N, Ruiz, J.L, Sirvent, I, & Zhu, J (2019). DEA-based benchmarking for performance evaluation in pay-for-performance incentive plans. *Omega*, 84,45-54.

Curtin, N, Malley, J, & Stewart, A.J (2016). Mentoring the Next Generation of Faculty: Supporting Academic Career Aspirations Among Doctoral Students. *Research in Higher Education,* 57,714-738.

Deemer, E.D, Martens, M.P, & Buboltz, W.C. (2010). Toward a Tripartite Model of Research Motivation: Development and Initial Validation of the Research Motivation Scale. *Journal of Career Assessment,* 18(3),292-309.

Delamont, S, Atkinson P, & Parry O. (1997). Critical mass and doctoral research: reflections on the Harris report. *Studies in Higher Education*, 22(3), 319-331.

Diem, A, & Wolter, S.C. (2013). The Use of Bibliometrics to Measure Research Performance in Education Sciences. *Research in Higher education*, 54,86-114

Dundar, H, & Lewis D.R. (1998). Determinants of research productivity in higher education. *Research in higher education*, *39*(6), 607-631.

Durette, B, Fournier, M, & Lafon M. (2016). The core competencies of PhDs. *Studies in Higher Education*, 41(8),1355–1370.

Egghe, L. (2008). Mathematical theory of the h- and g-index in case of fractional counting of authorship. *Journal of the American Society for Information Science and Technology*, 59(10),1608-1616.

Fox, M.F. (1983). Publication Productivity among Scientists: A Critical Review. *Social Studies of Science*, 13(2),285-305.

Gonzalez-Brambila, C, & Veloso, F.M. (2007). The determinants of research output and impact: A study of Mexican researchers. *Research policy,* 36,1035-1051

Hardre, P.L, & Kollmann, S.L. (2012). Motivational Implications of Faculty Performance Standards. *Educational Management Administration & Leadership*, 40(6),724–751.

Harris, C.M, McMahan, G.C, & Wright, P.M. (2012). Talent and time together: The impact of human capital and overlapping tenure on unit performance. *Personnel Review*, 41(4), 408-427

Hedjazi, Y, & Behravan, J. (2011). Study of factors influencing research productivity of agriculture faculty members in Iran. *Higher education,* 62(5), 635-647.

Hicks, D. (2012). Performance-based university research funding systems. *Research Policy*, 41(2),251–261.

Hirsch, J.E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, 102(46), 16569-16572.

Horta, H, & Santos, J.M. (2016). The impact of publishing during PhD studies on career research publication, visibility, and collaborations. *Research in Higher Education*, 57(1), 28-50.

Iglesias, J.E, & Pecharroman, C. (2007). Scaling the h-index for different scientific ISI fields. *Scientometrics*, 73(3),303-320

Janger, J, & Nowotny, K. (2016). Job choice in academia. *Research Policy*, 45(8),1672–1683.

Jiang, K, Lepak, D.P, Hu, J, & Baer, J.C. (2012). How Does Human Resource Management Influence Organizational Outcomes? A Meta-analytic Investigation of Mediating Mechanisms. *Academy of Management Journal*, 55(6), 1264–1294.

Johns, G. (2017), "Reflections on the 2016 decade award: incorporating context in organisational research", Academy of Management Review, 42, 577-595.

Kaiser H.F. (1974). An Index of Factorial Simplicity. *Psychometrika*, 39,31–36.

Käpylä, J, Jääskeläinen, A, & Lönnqvist A .(2010). Identifying future challenges for productivity research: evidence from Finland. *International Journal of Productivity and Performance Management*, 59(7),607–623.

Karasek R.A. (1979). Job demands, job decision latitude and mental strain. Implications for job redesign. *Administrative Science Quarterly*, 24,285–308.

Kim, K.Y, Pathak, S, & 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(7),784–805.

Knies, E, & Leisink P. (2014). Linking people management and extra-rolebehaviour: Results of a longitudinal study. *Human Resource Management Journal,* 24(1),57-76.

Kumar, A, & Thakur, R.R. (2019). Objectivity in performance ranking of higher education institutions using dynamic data envelopment analysis. *International Journal of Productivity and Performance Management,* In press.

Kwiek, M. (2016). The European research elite: a cross-national study of highly productive academics in 11 countries. *Higher Education*, 71(3), 379–397.

Landeta, J. (1999). *El método Delphi, una técnica de previsión del futuro*. Barcelona: Ariel S.A.

Lariviere, V, Macaluso, B, Archambault, E, & Gingras, Y. (2010). Which scientific elites? On the concentration of research funds, publications and citations. *Research Evaluation*, 19,45–53.

Leahey, E, Beckman, C.M, & Stanko T.L. (2017). Prominent but less productive: the impact of interdisciplinarity on scientifist´s research. *Administrative Science Quaterly,* 62(1),105-139.

Lee, S., & Bozeman, B. (2005). The impact of research collaboration on scientific productivity. *Social studies of science*, 35(5), 673-702.

Lee, H.F, Miozzo M, & 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(7),869–881.

Lepak, D.P, Liao, H, Chung, Y, & Harden, E. (2006). A conceptual review of human resource management systems in strategic human resource management research. *Research in Personnel and Human Resource Management*, 25(1), 217-271.

Levecque, K, Ansell, F, De Beuckelaer, A, Van der Heyden, J, & Gisle, L. (2017) Work organization and mental health problems in PhD students. *Research Policy*, 46, 868-879.

Lindell, M.K, & Whitney, D.J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of applied psychology*, 86(1), 114.

Lissoni, F, Mairesse, J, Montobbio, F, & Pezzoni, M. (2011). Scientific productivity and academic promotion: a study on French and Italian physicists. *Industrial and Corporate Change*, 20(1): 253–294.

Lovitts, B.E. (2005). Being a good course-taker is not enough: a theoretical perspective on the transition to independent research. *Studies in Higher Education,* 30(2), 137-154.

MacDuffie, J.P. (1995). Human resource bundles and manufacturing performance: Organizational logic and flexible production systems in the world auto industry. *Industrial and Labor Relations Review*, 48(2), 197-221.

Marie, J. (2008). Postgraduate science research skills: the role of creativity, tacit knowledge, thought styles and language. *London Review of Education*, 6(2),149–158.

Marin-Garcia, J.A, & Martinez-Tomas, J. (2016). Deconstructing AMO framework: A systematic review *Intangible Capital*, 12(4), 1040-1087.

McNie, E.C, Parris, A, & Sarewitz, D. (2016). Improving the public value of science: A typology to inform discussion, design and implementation of research, *Research Policy*, 45(4), 884–895.

Mitchell, T.R. (1982). Motivation: New directions for theory, research and practice. *Academy of Management Review*, 7 (1),80–88.

Mudrak, J, Zabrodska, K, Kveton, P, Jelinek, M, Blatny, M, Solcova, I, & Machovcova, K. (2018). Occupational well-being among university faculty: A job demands-resources model. *Research in Higher Education*, *59*(3),325-348.

Nguyen, T.L.H. (2016). Building human resources Management capacity for university research: The case at four leading Vietnamese universities. *Higher education,* 71, 231-251.

Nonaka I, & Takeuchi, H. (1995). *The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press.

Okoli, C, & Pawlowski, S.D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, 42(1),15-29.

Papadimitriou, M, & Johnes, J. (2018). Does merging improve efficiency? A study of English universities. *Studies in higher education, In Press*.

Ployhart, R.E, & Moliterno, T.P. (2011). Emergence of the human capital resource: A mulitlevel model. *Academy of Management Review*, 36(1),127–150.

Peng, J.E, & Gao X. (2019). Understanding TEFL Academics' Research Motivation and Its Relations with Research Productivity. *SAGE Open*, *9*(3), 2158244019866295.

Podsakoff, P.M, MacKenzie, S.B, Lee, J.Y, & Podsakoff N.P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5),879-903.

Prpić, K. (1996). Characteristics and determinants of eminent scientists' productivity. *Scientometrics*, 36(2), 185–206.

Rorstad, K, & Aksnes, D.W. (2015). Publication rate expressed by age, gender and academic position – A large-scale analysis of Norwegian academic staff. *Journal of Informetrics*, 9, 317-333.

Rowley, J. (2000). Is higher education ready for knowledge management?. *International Journal of Educational Management*, 14(7), 325-333.

Runhaar, P. (2017). How can schools and teachers benefit from human resources management? Conceptualising HRM from content and process perspectives. *Educational Management Administration & Leadership*, 45(4), 639-656.

Sagarra, M, Molinero, C.M, & Agasisti, T. (2017). Exploring the efficiency of Mexican universities: integrating Data Envelopment Analysis and Multidimensional Scaling. *Omega*, 67,123-133.

Shmatko, N, & Volkora, G. (2017). Service or Devotion?. Motivation Patterns of Russian Researchers. *Foresight and STI Governance,* 11(2),54-66

Schuelke-Leech, B.A. (2013). Resources and research: An empirical study of the influence of departmental research resources on individual STEM researchers involvement with industry. *Research Policy*, 42(9),1667–1678.

Siemsen, E, Roth, A.V, & Balasubramanian, S. (2008). How motivation, opportunity, and ability drive knowledge sharing: The constraining-factor model. *Journal of Operations Management*, 26(3), 426–445.

Su, X. (2011). Postdoctoral training, departmental prestige and scientists' research productivity. *The Journal of Technology Transfer*, 36(3),275–291.

Sutherland, K.A. (2017). Constructions of success in academia: an early career perspective. *Studies in Higher Education*, 42(4),743-759

Szulc, J.M., Davies, J., Tomczak, M.T. & McGregor, F.L. (2021), "AMO perspectives on the well-being of neurodivergent human capital", *Employee Relations*, 43(4), 858-872.

Szulc, J.M., & Smith, R. (2021), "Abilities, Motivations, and Opportunities of Furloughed Employees in the Context of Covid-19: Preliminary Evidence From the UK", *Frontiers in Psychology*, 12, 635144.

Thunnissen, M, & Van Arensbergen, P. (2015). A multi-dimensional approach to talent: An empirical analysis of the definition of talent in Dutch academia. *Personnel Review*, 44(2),182–199.

Tiam, J, Nakamori, Y, & Wierzbicki, A.P. (2009). Knowledge management and knowledge creation in academia: a study based on surveys in a Japanese research university. *Journal of Knowledge Management,* 13(2),76-92.

Tien, F.F. (2008). What Kinds of Faculty Are Motivated to Perform Research by the Desire for Promotion?. *Higher Education*, 55,17–32

Turner, L, & Mairesse, J. (2003). Individual productivity differences in scientific research: An econometric study of the publications of French physicists. Working Paper.

Ulrich, W, & 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), 1–21.

Van der Weijden, I, Belder, R, Van Arensbergen, P, Van den Besselaar, P. (2015). How do young tenured professors benefit from a mentor? Effects on management, motivation and performance. *Higher Education*, 69(2),275–287.

Van der Weijden, I, de Gilderb, D, Groenewegenb, P, & Klasenc, E. (2008). Implications of managerial control on performance of Dutch academic (bio) medical and health research groups. *Research policy*, 37, 1616-1629

Van Waeyenber, T, & Decramer, A. (2018). Line managers' AMO to manage employees' performance: The route to effective and satisfying performance management. *International Journal of Human Resource Management,* 29(22), 3093-3114.

Wang, J, Peters, H.P, Guan, J. (2006). Factors influencing knowledge productivity in German research groups: lessons for developing countries. *Journal of Knowledge Management*, 10(4), 113–126.

Wang, Z, & Xu, H. (2017). How and when service-oriented high-performance work systems foster employee service performance: A test of mediating and moderating processes. *Employee Relations*, 39(4),523-540.

White, C.S, James, K, Burke, L.A, & Allen, R.S. (2012). What makes a research star?. Factors influencing the research productivity of business faculty. *International Journal of Productivity and Performance Management,* 61(6), 584-602.

Wollersheim, J, Lenz, A, Welpe, I.M, & Spörrle, M. (2015). Me, myself, and my university: a multilevel analysis of individual and institutional determinants of academic performance. *Journal of Business Economics*, 85(3),263-291.

Wright, P.M, Coff, R, & Moliterno, T.P. (2014). Strategic Human Capital: Crossing the Great Divide. *Journal of Management*, 40(2), 353–370.

Wright, P.M, & McMahan, G.C. (2011). Exploring human capital: putting 'human'back into strategic human resource management. *Human Resource Management Journal,* 21(2),93-104.

Zucker, L.G, Darby, M.R, Furner, J, Liu, R.C, & Ma, H. (2007). Minerva unbound: knowledge stocks, knowledge flows and new knowledge production. *Research Policy,* 36, 850–863.

**Appendix:**

**Table 9:** Correlations and correlations adjusted for potential common method bias

| | Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Research abilities | 1 | -.022 | -.022 | -.022 | -.022 | -.028 | .299** | .022 | -.048 | .283** |
| **2** | Scientific knowledge | .000 | 1 | -.022 | -.022 | -.022 | -.042 | .208** | .018 | .014 | .081 |
| **3** | Proactive creativity | .000 | .000 | 1 | -.022 | -.022 | -.078 | .325** | -.022 | .100* | -.093 |
| **4** | Research accuracy | .000 | .000 | .000 | 1 | -.022 | .043 | -.062 | -.099 | .024 | -.021 |
| **5** | Skill of accepting criticism | .000 | .000 | .000 | .000 | 1 | -.029 | -.090 | -.011 | .065 | -.041 |
| **6** | Extrinsic motivation | -.005 | -.019 | -.054 | .064 | -.006 | 1 | -.022 | .015 | .051 | -.101 |
| **7** | Intrinsic motivation | .314** | .225** | .340** | -.039 | -.066 | .000 | 1 | -.115 | .005 | .048 |
| **8** | Availability of human and financial resources | .044 | .040 | .000 | -.075 | .011 | .037 | .090 | 1 | -.022 | .206** |
| **9** | Availability of information resources | -.025 | .036 | .120* | .045 | .086 | .072 | .027 | .000 | 1 | .101* |
| **10** | DEA | .299** | .101* | -.069 | .001 | -.018 | -.077 | .069 | .223** | .121* | 1 |
| | Marker Variable | -.113* | -.146** | .044 | -.060 | -.054 | .029 | -.101 | -.107* | .022 | -.086 |

# Paper 3

Exploratory analysis of the perception of academic researchers about incentives: evidence from a spanish public university

* Guerrero- Alba, F., Martín-Alcázar, F., & Sánchez.Gardey, G: Exploratory analysis of the perception of academic researchers about incentives: evidence from a spanish public university, under review in *Higher Education Policy and Management*.

**Exploratory analysis of the perception of academic researchers about incentives: evidence from a Spanish public university**


## Abstract

The perception of academic researchers on management instruments has generated significant controversy in the literature. Studies have highlighted that these perceptions affect research performance more than management itself. This work addresses this issue by proposing a subjective measurement that explains research incentives in a public university. The study was conducted using a mixed-methodology approach. To initially identify the research incentives, a Delphi study was developed through the inclusion of 62 experts. Based on the Delphi results, to contrast the internal composition of the research incentive system, 259 academic researchers from a Spanish university were subjected to an exploratory factor analysis. The results revealed four potential incentives that were perceived by the researchers. The analysis of these factors contributes to the debate about the way in which academic managers can promote the design of effective incentives that could be assumed and accepted by researchers.



**Keywords**: perception; incentives; academic researchers; university; factorial analysis

## 1. Introduction

Over recent decades, studies focusing on the management of universities have become increasingly relevant. Research policy in universities has been transformed in recent years due to changes in research management, the complexity of the policy goals, and the introduction of new management measures (Castro-Ceacero & Ion, 2019). Facing a reduction of funds for research, universities have had to continue adapting to maintain the production of academic research (Civera et al., 2020). As a result, the management of universities has become an element of great interest for institutions, universities, and research groups (Lepori et al., 2016). Several studies have concluded that there is a positive effect of research policies on levels of scientific productivity from both an individual and a group perspective (Wollersheim et al., 2015). Thus, some studies have focused on the acquisition of research competencies (Nguyen, 2016; Thienphut et al., 2015); the attraction, retention, and development of researchers (Xia et al., 2020); or the design of incentives (Thienphut et al., 2015; Kyvik & Aksnes, 2015). Although there is no consensus in the conclusions of these studies (Albert et al. 2016), there is a general idea of the existence of a relationship between scientific performance and the incentives that universities propose to their researchers (Pham- Thai et al., 2018). In this sense, authors such as Almubarak (2021) or Martin-Sardesai and Guthrie (2008) pointed out that, rather than the direct effect of research policies on the level of scientific performance, the effect of management incentives is highly dependent on the researcher's perception. Surprisingly, despite the importance that university academic research has in the global context of R&D activities, there are few studies that have fully elucidated the elements that promote research in the field of academic research (Castro-Ceacero & Ion, 2019). Further, it must be borne in mind that the scientific fields of the universities are very different from each other. For these reasons, it is necessary to find an appropriate measure of incentives for the

research community at universities in an integrative and individualistic way. To this end, researchers' perceptions of these incentives could be crucial for their research management at universities.

The objective of this research was to explore the perceptions of researchers about the incentives that affect their own research activity. This study was developed in two phases: a qualitative phase, in which the measures of the different incentives were defined, and a quantitative phase, in which the effect of the perception of these incentives was studied. The study has a dual contribution to the previous literature by (a) proposing a subjective tool that allows us to measure the perceptions about research incentives and (b) describing the potential effects of these perceptions in research activity from an integrative perspective.

Considering this double objective, the study is structured into four sections. After this introduction, we present a review of the literature on incentives for the management of research activity and the researcher's perceptions about them. In the third section, the data collection is detailed and scientific incentives are identified. Finally, the fourth section discusses the results, conclusions, and limitations of the study, paying special attention to the possible implications that can be developed from our findings.

## 2. Review of the literature: perception of incentives from academic researchers.

The complexity of research activity requires the design of specific research policies in universities to promote research productivity (Xia et al., 2020; Naeem et al., 2019). Following Bak and Kim (2019) and Jørgensen and Hanssen (2018), this study attempts to identify incentives that have an impact on the development of research activity. Incentives are an important part of research careers since they promote the development and recognition of scientific activity. Considering the particularities of the university research

context, we adopted a configurational perspective (Martín-Alcázar et al., 2005). This perspective allowed us to clarify the mix of management instruments necessary for incentive research and how the complementarities of these policies add value to the research activity (Xu et al., 2021; Abell & Becker, 2021). Drawing on this approach, we begin exploring the nature of research incentives, with the objective of delineating the elements that configure incentives in the academic research context.

Several studies have described the particularities of incentive systems in the academy, characterizing them as stimuli aimed at conditioning research activity by universities (Xu et al., 2021; Sandoval-Romero & Lariviere, 2020). Traditionally, incentive systems have been related to the level of satisfaction (Albert et al., 2018) or motivation of researchers (Hendriks & Sousa, 2008), acting as stimulus that affects scientific activity (Kyvik & Akness, 2015). However, studies have proposed that the effects of research incentives change throughout the academic career. Kawaguchi et al. (2016) suggested that appropriate incentives and job designs for researchers with more experience increase their research results. Following the life cycle models of researchers, scholars have proposed that scientific publications by academic researchers decrease over the years (Levin & Stephan, 1991). Studies, such that of Stroebe (2010), have concluded that research production decreases in part due to the incentives themselves and the shortening of the planning horizon of academic careers. From this perspective, some studies have shown that long-term contracts can have a negative effect on promotion opportunities and research performance due to the disappearance of extrinsic incentives (Lafuente & Berbegal-Mirabent, 2017). Thus, it is assumed that, by stabilising their position in universities, researchers will decrease their motivation for research activity. However, the literature pays special attention to academic careers and promotion (Barrow & Grant, 2019; Sadiq et al., 2019) as a means of stimulating the academic researcher. The design of the promotion system

should explicitly and objectively collect recognition of the research merits of academic researchers (Pietilä, 2019).

Another aspect to be considered by universities should be training as an incentive for academic researchers. Training incentives produce new forms for the transmission of new abilities (Nguyen, 2016; Svetlik & Lalic, 2016) and certain attitudes towards research (Kyvik & Aksnes, 2015), and they generate a certain commitment to the university (Martin- Sardesai & Guthrie, 2008). In this sense, Bashir and Long (2015) showed a positive relationship between training-related variables, such as availability of training, motivation to learn, co-worker support for training, supervisor support for training, and benefits of training, with affective and normative commitments. However, other research has highlighted that an excess of training could negatively affect the research results of universities (Fernández-López et al., 2018). Therefore, it is necessary to focus on research training that encourages researchers to acquire certain abilities necessary for research activity.

Another aspect that has generated great controversy to encourage research activity is the availability of resources. A positive perception of the availability of resources by academic researchers provides the necessary stimulus for research activity. In this context, academic researchers who perceive these resources as incentives would provide better research results than those who do not perceive them as such. These resources, especially financial resources, guarantee the provision of infrastructure, support staff, and equipment, as well as access to databases (Benito et al., 2019; Kyvik & Aksnes, 2015). Some studies defend the convenience of establishing allocation mechanisms that favour the concentration of public financial resources in those universities with better research results (Cropper & Cowton, 2021; Lariviére et al., 2010). This mechanism is reflected at the individual level, so that more productive researchers, who have a greater number of publications and citations, obtain greater resources, resulting in a cyclical effect that places them in a better position to compete in accessing new resources (Lariviére et al., 2010). For this

reason, universities have an additional incentive to stimulate and encourage excellence in research activity in terms of research results, since it affects the institution's ability to access financial resources. However, the system has been questioned in this regard because it presents different incentives at the individual and institutional levels. Despite the potential benefits of the availability of resources, the incentives perceived by the researchers do not always contribute to the strategic objectives of the university's scientific policy (Maisano et al., 2020). Similarly, other studies have highlighted that the effects of these incentives are not significant on the quantity and quality of research carried out by academic staff at universities (Loomes et al., 2019; Jørgensen & Hanssen, 2018). Therefore, by systematizing the previous literature, we can conclude that incentives are necessary, but not sufficient, for research activity from an integrative perspective.

Studies have pointed out that the perception of researchers about university management policies could be a relevant explanatory factor of scientific productivity (Khvatova & Dushina, 2017). Nevertheless, very few studies have addressed the perception of researchers at the individual level (Woelert et al., 2021; Rosewell & Ashwin, 2019). Some studies have analysed the effect of the researchers' perception on the research results (Bryce et al., 2020), the integrity and conduct of academic research (Huybers et al., 2020), or their commitment (Smeenk et al., 2006). However, studies have not addressed in sufficient depth the effects that institutional incentives have on research activity in an integrative way. Therefore, this study proposes an exploratory measure, following a qualitative and quantitative methodology, of the incentives of research activity.

## 3. Empirical study

This empirical study proposes the design of a measurement tool that describes university research incentives. In the literature, there is no specific measure of

incentives for research activity that applies to all scientific fields in universities. As previously observed, the literature does not provide theoretical support for the definition of a specific set of items for assessing the research incentives of the individual perspective. In this context, the methodological literature recommends, for the definition of its own tools, the triangulation of qualitative and quantitative methods (Hinkin, 1998). The combination of research methods contributes to a more complete interpretation and understanding of the results obtained (Jick, 1979). Firstly, a qualitative analysis oriented towards the development of the measures was proposed. We developed a Delphi panel (Landeta, 2006), which allowed the identification of the research incentive attributes. After reaching the required consensus, the Delphi panel made it possible to identify the items and measures of the perceptions that were later used in the quantitative phase of the study. Based on the results of this first inductive process, an exploratory factor analysis was carried out to determine the internal structure of the research incentive system.

### 3.1. Qualitative stage: delphi panel

The Delphi panel is a technique that can be particularly useful to investigate issues that are not sufficiently addressed in the literature based on expert consensus (Landeta, 2006; Okoli & Pawlowski, 2004). This method is based on a series of open questions that are sent in successive rounds to a panel of experts together with the answers obtained in the previous round until the consensus of the panel is reached. To avoid response biases and the subjectivity problems derived from this type of technique, the recommendations of Okoli and Pawlowski (2004) were followed for the drafting of the questions. Through the different questions, the experts were required to define the incentives, stimuli, and actions that are perceived as drivers of research results in their scientific field. In the development of the Delphi panel, it was necessary to pay special attention to the identification of the group of experts participating in the panel. For this study, the panel consisted of a group of Spanish research team leaders who were experts in

different scientific fields. Their research experience and the fact that they cover all scientific domains offered guarantees of a wide knowledge basis to explore the object of study. Table 1 presents the descriptive statistics of the 62 principal investigators selected in this phase of analysis.

**Table 1: Descriptive statistics.**

| Variable | Descriptive Statistics | % Qualitative phase | % Quantitative phase |
|---|---|---|---|
| **Gender** | Female | 22.58 | 29.70 |
| | Male | 77.42 | 70.30 |
| **Academic Rank** | Full Professor (*Catedráticos*) | 66.13 | 28.30 |
| | Professors (*titulares de universidad*) | 33.87 | 60.60 |
| | Associate Professors (*contratado doctores*) | - | 11.20 |
| **Field of study** | Art & Humanities | 32.26 | 22.50 |
| | Sciences | 27.42 | 40.70 |
| | Health Sciences | 14.52 | 12.40 |
| | Law & Social Sciences | 9.68 | 18.30 |
| | Engineering & Architecture | 16.13 | 6.20 |

Several rounds of discussion were needed to reach consensus. In the first two rounds, an open question accompanying all the statements asked the respondents to include as much information as they considered relevant. In this first phase, according to the purpose of this study, the experts were specifically asked about incentives, and they sent their responses to the following question via email: *'In your opinion, what are the policies and actions that you think the university should activate to improve research results in your scientific field?'*. The information was collected, analysed, and discussed by the authors to highlight all the attributes provided by the experts at each stage of the Delphi panel. In this first phase, 54 incentive attributes were obtained. In the second phase, a new document, including the incentives attributes obtained in the first round, was sent to the experts for confirmation. In this phase, the experts chose those attributes that they considered relevant to define the incentives. This document also included a section to collect experts' suggestions, clarifications,

or questions of interest. The information and suggestions received were analysed, allowing us to design a questionnaire about incentives and their effects on scientific results. Considering this information, the statements could be weighted and prioritized. After three rounds of discussion, a consensus was reached on 14 items that describe the actions that the universities should implement to encourage academic research (Table 2). These items constituted the questionnaire used in the next phase of the study, which focused on institutional incentives of research activity. This second stage of the study represented the first step in the measurement development process and served as a starting point for subsequent validation of the instrument.

**Table 2: Scale about university research incentives drawn from the panel of experts (Third round)**

| **Items** | |
|---|---|
| ***In his/her opinion, to encourage research and improve the research results obtained, the university should ...*** | |
| **RI1** | Promote those lines of research in which university is strong |
| **RI2** | Establish an objective, reliable and equitable system to measure research |
| **RI3** | Increase the endowment of pre-doctoral contracts |
| **RI4** | Increase the endowment of postdoctoral contracts |
| **RI5** | Increase financial resources |
| **RI6** | Differentiate between staff with a teaching and research profile |
| **RI7** | Promote and support the presentation of research projects in European calls |
| **RI8** | Encourage participation in public calls for research funding |
| **RI9** | Give administrative support for the preparation and presentation of projects in public calls |
| **RI10** | Establish a policy to attract students with better abilities, defining mechanisms for their incorporation into the university * |
| **RI11** | Promote the updating and recycling of researchers |
| **RI12** | Train researchers in research methodology |
| **RI13** | Improve the dissemination, national and international, of the research carried out at the university |
| **RI14** | Promote and finance research stays for academic researchers |

* Item eliminated in the factorial analysis process

### 3.2. Quantitative stage: exploratory factorial analysis

To define the incentive system, an exploratory factor analysis was carried out with the aim of contrasting the internal composition of the construct and determining its constitutive dimensions. The following subsection describes the sample and the exploratory factor analysis used in the study.

#### 3.2.1. Sample

The population of our study was academic researchers from a general Spanish public university. The university studied has about 1,700 professors, belonging to 46 departments. It currently offers a total of 44 undergraduate degrees, 53 master's degrees, and 19 doctoral programmes for about 20,000 students. The academic researchers of the university, as collected from the Scival database (Scopus), had a total of 5,241 publications in the last 5 years, obtaining an increase of 57.1% in the number of publications in that period. With these indicators, the university can be considered medium-sized in the Spanish context. For the purposes of this study, it is necessary to consider that all Spanish public universities are subject to the same regulation regarding the hiring and promotion of academic researchers. However, some universities have certain internal functioning dynamics that allow them to decide on the management of their personnel, distribution of funding, or the commitment of strategic research groups in their universities. The selection of a single university has made it possible, in this sense, to homogenize the perception of researchers by isolating the effect of the university's own incentive system.

To identify and reach potential respondents, we contacted the vice-rector for research and heads of the departments to distribute the questionnaires to the researchers. The email included a cover letter that explained the purpose of the study and a form with the 14 items collected from the previous Delphi process. All items were measured using Likert scales with a range from 1 (totally

disagree) to 5 (completely agree). A total of 425 valid completed questionnaires were obtained. Considering the objectives of the study, we ensured that the respondents had sufficient information about the university research incentives and university management research mechanisms. Therefore, we considered academic researchers who had at least one positively assessed six-year period of research (*sexenio*) in recognition of their research career. The "*sexenios"* are the main tool for incentivizing and evaluating research activity in Spanish universities. Table 1 shows a synthetic characterization of the sample of the quantitative phase through descriptive statistics.

### 3.2.2. Exploratory factorial analysis

To explore the dimensionality of the research incentive system construct, we conducted an exploratory factor analysis (EFA) using the principal components method and applied a VARIMAX rotation in SPSS (version 21). We initially conducted the Kaiser Meyer Olkin sample adequacy test to verify that the factor analysis could be applied to the data extracted from the sample, based on the criteria described by Dziuban and Shirkey (1974). The Bartlertt sphericity test was carried out to confirm the adequacy of the factorial model to explain the data.

The results for the EFA showed that research incentives could be reliably measured through the initial set of items ($\alpha$=.826), although the internal composition of the construct indicated its multidimensional nature. Four different factors were finally extracted, as depicted in Table 3. The item "*Establish a policy to attract students with better abilities, defining mechanisms for their incorporation into the university*" was eliminated from the analysis since it loaded insufficiently onto one factor. The structure of the scale corroborated the initial description of the construct based on the results of the Delphi panel.

The first factor, *Perception of incentives for training* (α=.764), consisted of four items related to the training and updating of researchers. The second factor, *Perception of incentives for staffing research at the university* (α=.816), included three items related to the staffing and financial resources for scientific research. The third factor, *Perception of the university's support for competitive funding calls* (α=.792), grouped three items related to the researchers' perception of their participation in public calls for funding. Finally, the fourth factor, *Perception of the strategic focus of the university* (α=.530), comprised three other items related to strategic perspective of research policy in university regarding the definition of its strategic objectives and the general lines of its own research plans. Although we observed that the Cronbach's alpha was relatively low for this fourth factor, in the early phases of research or exploratory studies, an internal consistency value of 0.6 or 0.5 may be considered sufficient (Nunnally, 1978). Thus, we decided to leave this fourth factor because its items explained part of the scale obtained.

**Table 3: Analysis of the main components (varimax rotation) of research incentives (n = 259)**

| **Variable:** ***In his/her opinion, to encourage research and improve the research results obtained, the university should…*** | **Component** | | | |
|---|---|---|---|---|
| **Item** | 1 | 2 | 3 | 4 |
| RI11 | .743 | | | |
| RI12 | .742 | | | |
| RI13 | .708 | | | |
| RI14 | .695 | | | |
| RI3 | | .865 | | |
| RI4 | | .850 | | |
| RI5 | | .749 | | |
| RI8 | | | .797 | |
| RI9 | | | .751 | |
| RI7 | | | .698 | |
| RI2 | | | | .736 |
| RI1 | | | | .682 |
| RI6 | | | | .682 |
| Eigenvalue | 4.663 | 1.534 | 1.399 | 1.063 |
| Explained variance | 19.595 | 17.587 | 15.859 | 13.564 |
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy .809 | | | | |
| Bartlett´s Test of Sphericity<br>Approx. Chi-Cuadrado:1071.939<br>gl:78<br>Significance: .000 | | | | |

## 4. Discussion and conclusions

This study described institutional incentives that promote the academic career of researchers in all scientific fields. From the organizational perspective, different studies have shown that perceptions have a remarkable impact on the behaviour of employees, differing in many cases from the practices promoted by the manager (Van Beurden et al., 2021). From a university research view, this includes the set of incentives to stimulate its research activity (Nguyen et al., 2020; Drake et al., 2019). One of the questions raised in the literature is whether these institutional incentives are applied efficiently and generate the desired effects among academic researchers and university managers (Wan et al., 2007). However, as mentioned above, despite the current literature, there

are still many unexplored aspects in the description of the incentives by which academic institutions stimulate their researchers. Further, no studies explain how individual researchers perceive the incentives. Therefore, there is a need to promote a typology of research incentives, which is essential to understanding the complex nature of academic researchers and other reasonable attributes for a successful academic career.

The results of this study contribute to the literature in different ways. The preliminary model sheds light on the explanation of the incentives that researchers perceive in an integrative way for the set of knowledge areas of universities. Our results identify fourteen attributes for the design of adequate incentives. This set of attributes can provide the basis for understanding the elements that researchers need for research activity. These measures are a starting point to identify the policies that are most valued by the research staff. A surprising finding was that the expert panel did not include attributes related to the compensation and promotion of researchers, which are considered essential in the research field in universities (Barrow & Grant, 2019; Sadiq et al., 2019). A possible reason could be that Spanish academic researchers know that these institutional aspects are nationally regulated, limiting the autonomy of individual universities in this regard. Another contribution of the study is that on the part of the university's part, we found the non-existence of the academic researcher's interests as an incentive for research activity. In this sense, universities should propose different incentives that promote appropriate attitudes and behaviours to obtain greater results (Kyvik & Aksnes, 2015). However, researchers seem to have, according to our results, a certain institutional independence being mainly motivated by their research groups or by collaborations with other researchers. In general, the expert panel suggested that there was no singular form of management to promote researchers' activity, since research incentives should aim to support an open, ethical, equitable, and autonomous research culture that fosters the results of academic

researchers (Castro-Ceacero & Ion, 2019). Therefore, it is necessary to study the intrinsic nature of researchers' incentives to understand their behaviour in scientific research. One of these stimuli can be recognition, status, or the job satisfaction provided the university to researchers when they belong to the institution, as highlighted by Albert et al. (2018). As the study by Ballestar et al. (2019) concluded, the most effective stimuli or incentives will be those that promote research activity on the job itself. From this perspective, universities should value and support academics as thinkers, researchers, scholars, and educators rather than mere producers of research results.

From our data, we were able to analyse the internal relationships between the fourteen elements highlighted by the experts. The results offered four research incentives: *"the perception of incentives for training", "the perception of the incentives for staffing research at the university", "the perception of the university's support for competitive funding calls", and "the perception of the strategic focus of the university"*.

*The perception of incentives for training* confirmed the training process as a key element for researchers who want to be productive in their research careers, in line with other studies, such as those by Xia et al. (2020) and Alshaikhmubarak et al. (2020). Generally, the best-trained researchers have more resources to conduct research in their scientific fields. However, universities must be particularly careful in the design of training activities, as some studies have indicated that excessive training could decrease research capacities (Fernández-López et al., 2018). One of the possible explanations for this observation lies in the training plans that do not satisfy the training needs of university academic research, mainly focused on teaching skills, leaving research training to be handled by the research groups. In this aspect, research groups focus on aspects such as methodological training, literature search, preparation of articles, or participation in specific conferences in the learning process of academic researchers. Thus, we should consider the formal training

developed by the university compared to the informal training implemented by the research groups to support its researchers as a success measure.

Second, we propose the importance of the factor *"the perception of the incentives for staffing research at the university"*. These results confirm the value for researchers of obtaining resources and especially the recruitment of new research staff, both predoctoral and postdoctoral, as had already been proposed in previous studies, such as Kyvik and Aksnes (2015) or Herschberg et al. (2018). Researchers who perceive that their universities provide new personnel to their research groups have better conditions for research activity. Several studies have analysed the design of new research strategies based on the development of professional networks, which can favour the production of new knowledge in academia (Seibert et al., 2017). From this perspective, experienced researchers form informal commitments with new researchers to encourage the "pooling" of scientific knowledge and, thus, the development of new research among them. In this collaboration, expert researchers contribute their research experience, while early researchers provide self-motivating characteristics, such as enthusiasm, passion, and commitment, which encourages the development of research activity.

The third factor, "*the perception of the university's support for competitive funding calls*", highlighted how the university supports its researchers in better conditions to apply for funding calls (e.g. with administrative support, more information on calls, or specific training on project design to increase the success rate). Institutional support also gives academic researchers an incentive to pursue specific research topics and influences the trend of scientific research and the funds to conduct it (Kishi, 2020). Some studies have highlighted the lack of institutional support as a problem regarding research identity in universities (Dugas et al., 2020). In essence, researchers must seek new funding formulas to support their research in their universities (Berbegal-

Mirabent et al., 2013). In summary, the results seem to indicate that academic researchers perceive that support from the university in terms of funding calls is vital to obtaining higher returns on research activity (Santini et al., 2021). The distribution of financing should be guaranteed by a significant part of the basic financing based on the research results and the strategic objectives of the institution.

Finally, our data proposed "*the perception of the strategic focus of the university*" as an element for stimulating the promotion of academic research. Universities should establish research priorities in different scientific fields, as well as in the acquisition of resources and strategic decision-making (Dowsett, 2020). In this area, the internal functioning of the research groups should be taken into consideration in strategic collaborations (Celis & Kim, 2018) and researchers' strategic vision (Luukknoen & Thomas, 2016) to favour the autonomy of the research groups and universities.

Together, these four factors could provide the basis for incentive system implementation in a university context from point of view of academic researcher. Their adequate consideration could produce improvements in the satisfaction of academic researchers and clarify the direction universities should follow to promote academic research.

From a practical perspective, our study could have several practical implications of interest to university managers and principal investigators of research groups. The identification of the perception of incentives provides the basis for the definition of management systems for universities, as well as tools for the evaluation and monitoring of research capacities and scientific performance. These factors could improve the commitment and feeling of belonging to the university, so that researchers would be motivated in the research activity and universities could strengthen the bonds between them. These career incentives are particularly complex so person centred approaches

allow to know the composition of factors that enhance academic career success. A second practical implication could be the management of incentives designed should be focused on each stage of the academic career (Levin & Stephan, 1991). Universities should manage knowledge competencies as a process, not as permanent conditions in order to offer an incentive system coherent to the stage of the academic career. From this perspective, universities should plan and implement an incentive system that is based on research performance.

In addition, University managers can use rewards to influence attitude and behaviour to improve research results in each of the academic stages. The incorporation of new researchers may require that universities and research groups plan specific training programmes that may create an adequate work environment that encourages informal learning and synergies among the researchers. Universities should also propose strategies and policies to boost confidence among researchers to carry out their research activity. This may involve selecting highly experimented researchers with novice researchers to conduct training them to a large extent to promote research groups. A third practical implication could be the use of the model as an instrument to guide the definition of scientific strategies in universities, focusing on those incentives that are perceived among researchers as generators of better research results and satisfactory performance of their scientific activity. Also, the involvement of the researchers in the strategic process would probably make an important difference in research culture, both regarding the understanding of institutional orientation encouraging academic researchers to feel part of their institutions (Xu et al., 2021). Similarly, the universities could design research profiles that allow differentiating such culture as a strategic line from the rest of universities.

It is necessary to acknowledge some of the study's limitations that condition the scope of the conclusions and that may inspire future lines of research in this area. We believe it necessary to incorporate in future models the influence of variables that describe appropriate behaviours or attitudes as possible moderating variables of the perception of research incentives. Second, the characteristics of university institutions suggest that scientific activity has both individual and group conditioning factors, as well as organizational level; thus, to continue advancing in the understanding of these effects, it would be necessary to propose a multilevel model. The analysis of the complex relationships between the analysed factors requires a cross-sectional investigation that delves into the interrelationship between the different dimensions of the system, adopting a configurational perspective. Another limitation of the present study is the characteristics of the sample itself. The replication of the analysis in other university contexts would allow an analysis of the differences in the perception of incentives, which may be affected by conditions derived from the national university system and by those in other international research university models. Such an analysis could establish the differential effects of incentives among universities, as well as the understanding of the configurations from an international perspective. Finally, the use of "*sexenio*" in our analysis could also be a limitation of the study since researchers who have not obtained one may need other research incentives. Therefore, a future line of research could be aimed at understanding the incentives of this subgroup of academic researchers, who are usually in the early stages of their academic careers.

## References

Abell, D. & Becker, K. (2021). "Enhancing university employer attractiveness for the next generation of academics". *Journal of Higher Education Policy and Management*, 43(5): 457-473.

Albert, C., Davia, M.A., & Legazpe, N. (2018). "Job satisfaction amongst academics: the role of research productivity". *Studies in Higher Education,* 43(8): 1326-

1377.

Albert, C., Davia, M.A., & Legazpe, N. (2016). “Determinants of research productivity in Spanish Academia”. *European Journal of Education*, 51(4): 535-549.

Almubarak, S.A.H. (2021). “Promoting Internationally Visible Researchers through Research Performance Policies: The Case of a Saudi University”. *Higher Education Policy*: 34, 1027–1048.

Alshaikhmubarak, A., Da Camara, N., & Baruch, Y. (2020). “The impact of high-performance human resource practices on the research performance and career success of academics in Saudi Arabia”. *Career Development International*, 25(6): 671-690.

Barrow, M., & Grant, B. (2019). "The uneasy place of equity in higher education: tracing its (in) significance in academic promotions". *Higher Education*, *78*(1): 133-147

Bashir, N. & Long, C. (2015). "The relationship between training and organizational commitment among academicians in Malaysia". *Journal of Management Development,* 34 (10): 1227-1245

Bak, H.J., & Kim, D.H. (2019). "The unintended consequences of performance- based incentives on inequality in scientists’ research performance".*Science and public policy*, 46(2): 219-231.

Ballestar, M.T., Doncel, L.M., Sainz, J., & Ortigosa-Blanch, A. (2019). "A novel machine learning approach for evaluation of public policies: An application in relation to the performance of university researchers". *Technological Forecasting and Social Change*, 149: 119756.

Beerkens, M. (2013). "Facts and fads in academic research management: The effect of management practices on research productivity in Australia". *Research Policy*, 42: 1679-1693.

Benito, M., Gil, P., Romera, R. (2019). "Funding, is it key for standing out in the university rankings?". *Scientometrics*, 121: 771-792.

Berbegal-Mirabent, J., Lafuente, E., & Solé, F. (2013). "The pursuit of knowledge

transfer activities: An efficiency analysis of Spanish universities". *Journal of Business Research*, *66*(10): 2051-2059.

Bryce, C., Dowling, M., Lucey, B. (2020). "The journal quality perception gap". *Research Policy*, 49 (5): In press.

Castro-Ceacero, D., & Ion, G. (2019). "Changes in the University Research Approach: Challenges for Academics' Scientific Productivity". *Higher Education Policy*, *32*(4): 681-699.

Cattell, R.B. (1966). "The Scree Test for the Number of Factors". *Multivariate Behavioral Research*, 1: 245–276

Celis, S., & Kim, J. (2018). "The making of homophilic networks in international research collaborations: A global perspective from Chilean and Korean engineering". *Research Policy*, 47(3): 573-582.

Civera, A., Lehmann, E.E., Paleari, S., & Stockinger, S.A. (2020). "Higher education policy: Why hope for quality when rewarding quantity?". *Research Policy*, 49(8): 104083.

Cropper, P. & Cowton, C.J. (2021). "Financial scenario modelling: a study of UK universities". *Journal of Higher Education Policy and Management*, 43:6, 592-606,

Dowsett, L. (2020) Global university rankings and strategic planning: a case study of Australian institutional performance, *Journal of Higher Education Policy and Management*, 42(4), 478-494.

Drake, A., Struve, L., Meghani, S.A., & Bukoski, B. (2019). "Invisible Labor, Visible Change: Non-Tenure-Track Faculty Agency in a Research University". *The Review of Higher Education,* 42(4): 1635-1664.

Dugas, D., Stich, A.E., Harris, L.N. & Summers, K.H. (2020). "'I'm being pulled in too many different directions': academic identity tensions at regional public universities in challenging economic times". *Studies in Higher Education*, 45(2): 312-326.

Dziuban, C.D., & Shirkey, E.C. (1974). "When is a Correlation Matrix Appropriate for Factor Analysis? Some Decision Rules". *Psychological Bulletin*, 81: 358–361.

Fernández-López, S., Rodeiro-Pazos, D., Calvo, N., & Rodríguez-Gulías, M. J. (2018). "The effect of strategic knowledge management on the universities' performance: An empirical approach". *Journal of Knowledge management*, 22 (3), 567-586

Hendriks, P., & Sousa, C. (2008). "Motivating University Researchers". *Higher Education Policy*, 21: 359–376.

Herschberg, C., Benschop, Y., & van den Brink, M. (2018). "Selecting early-career researchers: the influence of discourses of internationalisation and excellence on formal and applied selection criteria in academia". *Higher Education*, 76(5): 807–825.

Hinkin, T.R. (1998). "A brief tutorial on the development of measures for use in survey questionnaires". *Organizational Research Methods*, 1(1): 104-121.

Huybers, T., Greene, B. & Rohr, D.H. (2020). "Academic research integrity: Exploring researchers' perceptions of responsibilities and enablers". *Accountability in Research*, 27 (3): In press.

Jick, T.D. (1979). "Mixing qualitative and quantitative methods: triangulation in action". *Administrative Science Quarterly*, 24(4): 602-611.

Jørgensen, F., & Hanssen, T.E.S. (2018). "Research incentives and research output". *Higher Education*, *76*(6): 1029-1049.

Kaiser, H.F. (1974). "An Index of Factorial Simplicity". *Psychometrika*, 39: 31–36.

Khvatoka, T., & Dushina, S. (2017). "To manage or govern? Researching the legitimacy of NPM-based institutional reforms in Russian universities". *Journal of Management Development*, 36 (2): 250-267.

Kishi, N. (2020). "How does policy focus influence scientific research?". *Science and Public Policy*, 47(1): 114–124.

Kyvik, S. & Aksnes, D.W. (2015). "Explaining the increase in publication productivity among academic staff: a generational perspective". *Studies in Higher Education*, 40(8): 1438-1453.

Lafuente, E., & Berbegal-Mirabent, J. (2017). "Contract employment policy and research productivity of knowledge workers: an analysis of Spanish

universities". *International Journal of Human Resource Management*, 1–27.

Landeta, J. (2006). "Current validity of the Delphi method in social sciences". *Technological forecasting and social change*, 73(5): 467-482.

Lariviere, V., Macaluso, B., Archambault, E., & Gingras, Y. (2010). "Which scientific elites? On the concentration of research funds, publications and citations". *Research Evaluation*, 19: 45–53.

Lepori, B., Wise, M., Ingenhoff, D., & Buhmann, A. (2016). "The dynamics of university units as a multi-level process. Credibility cycles and resource dependencies". *Scientometrics*, *109*(3): 2279-2301.

Levin, S., & Stephan, P. (1991). "Research productivity over the life cycle: Evidence for academic scientists". *American Economic Review*, 81(1): 114–132.

Loomes, S., Owens, A. & McCarthy G. (2019). "Patterns of recruitment of academic leaders to Australian universities and implications for the future of higher education" *Journal of Higher Education Policy and Management*, 41(2): 137-152.

Luukkonen, T., & Thomas, D.A. (2016). "The 'Negotiated Space' of University Researchers' Pursuit of a Research Agenda". *Minerva* 54, 99–127.

Maisano, D.A., Mastrogiacomo, L., & Franceschini, F. (2020). "Short-term effects of non-competitive funding to single academic researchers". *Scientometrics*, *123*(3): 1261-1280.

Martín-Alcázar, F., Romero-Fernandez, P.M., & Sánchez-Gardey, G. (2005). "Strategic human resource management: integrating the universalistic, contingent, configurational and contextual perspectives". *The International Journal of Human Resource Management*, 16(5): 633-659.

Martin-Sardesai, A. & Guthrie, J. (2018). "Human capital loss in an academic performance measurement system". *Journal of Intellectual Capital*, 9 (1): 53-70.

Naeem, A., Mirza, N.H., Ayyub, R.M. & Lodhi, R.N. (2019). "HRM practices and faculty's knowledge sharing behavior: mediation of affective commitment and affect-based trust". *Studies in Higher Education*, 44(3): 499-512.

Nguyen, H.V., Phan, T.T.H., Nguyen, H., Nguyen, N., & Nguyen, M.H. (2020). "What is a Good Journal? Perceptions of Vietnamese Early-Career and

Mid-Career Researchers". *Publishing Research Quaterly,* 36: 296–303.

Nguyen, T.L.H. (2016). "Building human resources management capacity for university research: The case at four leading Vietnamese universities". *Higher Education*, 71(2): 231–251.

Nunnally, J.C. (1978). Psychometric theory (2nd ed.). New York: McGraw-Hill.

Okoli, C., & Pawlowski, S.D. (2004). "The Delphi method as a research tool: an example, design considerations and applications". *Information & management*, 42(1): 15-29.

Pham-Thai, N.T., McMurray, A.J., Muenjohn, N., & Muchiri, M. (2018). "Job engagement in higher education". *Personnel Review,* 47(4): 951–967.

Pietilä, M. (2019). "Incentivising academics: experiences and expectations of the tenure track in Finland". *Studies in Higher Education*, 44(6): 932-945,

Rosewell, K. & Ashwin, P. (2019). "Academics' perceptions of what it means to be an academic". *Studies in Higher Education*, 44(12): 2374-2384.

Sadiq, H., Barnes, K.I., Price, M., Gumedze, F., & Morrell, R.G. (2019). "Academic promotions at a South African University: Questions of bias, politics and transformation". *Higher education*, 78: 423-442.

Sandoval-Romero, V., & Larivière, V. (2020). "The national system of researchers in Mexico: implications of publication incentives for researchers in social sciences". *Scientometrics*, *122*(1): 99-126.

Santini, M.A.F., Faccin, K., Balestrin, A., & Martins, B.V. (2021). "How the relational structure of universities influences research and development results". *Journal of Business Research*, 125: 155-163.

Seibert, S.E., Kacmar, K.M., Kraimer, M.L., Downes, P.E., & Noble, D. (2017). "The Role of Research Strategies and Professional Networks in Management Scholars' Productivity". *Journal of Management,* 43(4): 1103–1130.

Smeenk, S.G.A., Eisinga, R.N., Teelken, J.C., & Doorewaard, J.A.C.M. (2006). "The effects of HRM practices and antecedents on organizational commitment among university employees". *International Journal of Human Resource Management*, 17(12): 2035–2054.

Stroebe, W. (2010). "The graying of academia: Will it reduce scientific productivity?". American Psychologist, 65(7): 660–673.

Svetlik, I. & Lalić, A. (2016). "The impact of the internationalisation of higher education on academic staff development – the case of Slovenian public universities". *Studies in Higher Education*, 41(2): 364-380

Thienphut, D., Jiamprachanarakorn, S., & Boonloisong, R. (2015)."Strategic human capital management for a new University: a case study of Suan Dusit Rajabhat University". *Journal of Knowledge Management*, 19(1): 108–120.

Van Beurden, J., Van De Voorde, K., & Van Veldhoven, M. (2021). The employee perspective on HR practices: A systematic literature review, integration and outlook. *The International Journal of Human Resource Management*, 32(2), 359-393.

Wan, C.D., Chapman, D., Hutcheson, S., Lee, M., Austin, A., & Zain, A.N. (2017). "Changing higher education practice in Malaysia: the conundrum of incentives". *Studies in Higher Education*, *42*(11): 2134-2152.

Woelert, P., Lewis, J.M. & Le, A.T. (2021). "Formally Alive yet Practically Complex: An Exploration of Academics' Perceptions of Their Autonomy as Researchers". *Higher Education Policy,* 34: 1049–1068.

Wollersheim, J., Lenz, A., Welpe, I.M., & Spörrle, M. (2015). "Me, myself, and my university: a multilevel analysis of individual and institutional determinants of academic performance". *Journal of Business Economics*, 85(3): 263-291.

Xia, J., Zhang, M.M., & Zhu, J.C. (2020). "HRM reforms and job-related well-being of academics". *Personnel Review,* 49 (2): 597-619.

Xu, X., Oancea, A., & Rose, H. (2021). "The Impacts of Incentives for International Publications on Research Cultures in Chinese Humanities and Social Sciences". *Minerva*, 59: 469-492.

# CONCLUSIONS, LIMITATIONS, AND FUTURE LINES OF RESEARCH

# CONCLUSIONS, LIMITATIONS, AND FUTURE LINES OF RESEARCH

With the development of the present doctoral thesis, an attempt has been made to advance the knowledge of the processes of management of academic researchers in the university context. In general, we can conclude that universities must encourage the development of academics and other researchers contributing to society's development. In a knowledge-intensive society, the university is a key institution characterised by autonomy and responsibility, having to deal with many changes in recent decades (Highman, 2020). Universities, as with any other organisation, should achieve efficiency levels in developing their activities. Regarding the efficiency of universities, there are considerable differences in academics' performance. Research performance varies over time due to the management and strategies followed by each university. Therefore, it is difficult to establish an appropriate measure for managing the performance of academics. In short, our thesis focuses on the management of university research and academic performance from an individual perspective (academic researchers). The achievement of this scientific objective is a significant contribution both to the development of the literature within the framework of human capital and to the understanding of the determinants that condition research performance in the context of a university.

We focused on identifying and relating various elements that generate human capital that could affect research productivity. As noted in the introduction, the growing importance of the research process and management has meant a substantial change in the role that universities and research organisations develop in society as agents responsible for generating and transmitting knowledge. The theoretical approach offered by human capital theory (Ployhart, 2021; Wright, 2021; Wright & McMahan, 2011) allowed us

to deepen the dynamics of scientific knowledge generation based on the intangible assets that researchers possess. The analysis of academic human capital allowed us to analyse the most internal dimensions of academic researchers, describing the nature of their main intangible assets. To characterise them, a distinction was made between the dimensions of human capital described in the literature as the KSA framework. In the research context, this approach is especially interesting in clarifying the combination of attributes of academic researchers that are necessary to develop efficient research and how the complement of these attributes adds value to the research activity. Therefore, before developing the empirical analysis in this thesis, we started by concreting the variables for the specific case and identifying the description of the elements. To conceptualise human capital in an academic context, we returned to the evidence offered by the expert's academics. Subsequently, we focused on analysing the role that the dimensions of academic human capital play in the processes of generating scientific knowledge and the performance of the researchers. Therefore, the estimation of measurement models corroborated that the traditional differentiation between knowledge, skills, and abilities (Ployhart & Moliterno 2011) was also relevant in the academic field, although with some interesting particularities.

However, as clarified since the introduction of this thesis, the very development of the research and the exploratory study that identified the lack of specific research on this topic led us to propose a model showing that some research is too broad to develop within the objectives of a doctoral thesis. Therefore, it is important to consider this thesis as the beginning of an incipient strand of research that offers us the opportunity to develop future works that contemplate broader objectives. This is something that we will subsequently develop in future strands of research, in which specific developments are proposed that address all of the initially proposed objectives. However, in the empirical section of this thesis, we focused on achieving research objectives

that were within the limits of a doctoral thesis. Specifically, we focused on specifying (1) the definition of human capital constructs and validation of the scale of measurement in an academic context, (2) the empirical model that describes the causal relationships between the dimensions of the AMO framework and research performance, and (3) the perceptions of academic researchers about research incentives.

We draw certain conclusions and contributions from our findings, as presented below.

## 1. Principal conclusions derived from the proposed objectives

### a) Conceptualise and construct a scale for measuring human capital in the academic context

#### a.1) Assess academic human capital

The empirical definition of the concept of human capital cannot be constructed in an abstract way, but it should be contextualised based on the particularities of the unit on which it is applied. We found that human capital has singularities in its differential elements in the organisational context. Although organisations have increasingly made efforts to identify, measure, and manage human capital (Ployhart, 2021; Wright & McMahan, 2011), there is still a lack in the literature with regard to its management and reporting in academic institutions (Beerkens, 2013; Horta & Santos, 2020; Sousa & Hendriks, 2008). The application and contextualisation of this approach at this level of analysis represents a significant novelty because studies have paid attention only to the analysis of specific attributes in scientific activity and their effect on scientific productivity (Barnacle & Dall'Alba, 2014; Seibert et al., 2017; Ulrich & Dash, 2013; White et al., 2012;). They have not systematised the study of these attributes in an integrated way, nor have they provided comprehensive theoretical support for the construct of human capital in the context of academic researchers. Therefore, one of the implications is to

understand in detail the behaviour of academic human capital from an integrative perspective as an emerging strand of research.

**a.2) Elaborate on the elements and dimensions of academic human capital**

Having clarified the complex nature of human capital and the context at hand, we specify the elements and dimensions that constitute academic human capital. We deepen the study of the more internal dimensions that constitute the research process in the context of academic researchers as well as of the nature of its intangible assets from an integrative perspective. Initially, in the literature, we identified studies that address the attributes of academic human capital. We believe that to synthesise these attributes, we can take into consideration the classical dimensions of the KSA framework that are so well accepted in the organisational context.

According to the results of our studies, academic human capital is composed of five different factors (*research capacity, research knowledge, alertness, work organisation capacity, and ability to assume criticism*). However, our results show that the reality of academic human capital is more complex from a theoretical and empirical point of view. We conclude that academic human capital behaves as a complex construct, given that each item contributes value to each of the elements that comprise it. That is, if we eliminate one factor or item of human capital, the construct changes completely. In this sense, the specific items of the scale accurately provide the specific variables necessary for academic research, such as theoretical and methodological understanding, observing facts and identifying research topics, discussing research results, interacting with other researchers, knowing how to conduct and autonomously develop research, and adapting to changes in the research context. Another aspect that has been highlighted in the context of

academic human capital is that there is no clear clarification between research skills and abilities. Our study clarifies skills into three broad dimensions, where they are general attributes, and abilities are more specific to the job itself.

To clarify human capital attribute classification and its labels, we have added Table 3.1, which shows the correspondence between the theoretical framework (KSA) and the results of our study. To assign labels, we paid particular attention to the nature and composition of each factor, attempting to propose coherent labels.

**Table 3.1: Correspondence between theoretical and factorial analysis dimensions**

| KSA Framework | Theoretical Dimensions | Factorial analysis dimensions | Concepts |
|---|---|---|---|
| *K* | *Knowledge-how (tacit)*<br>*Knowledge-that (explicit)* | *Research Knowledge* | Elements related to researchers' theoretical and methodological understanding, researchers' English (or other predominant languages in the field of research) language domain, researchers' comprehension to find, manage information from relevant publications in their field of research and know relevant publications in the scientific field. |
| *S* | *Research skills* | *Alertness Skills* | Composed of those attributes related to the researcher's creative perception, initiative, and motivation to carry out the research activity. |
| | | *Work organisation Skills* | Composed of those attributes related to the constancy, discipline and organisation in the research workplace. |
| | | *Assume Criticism Skills* | Composed of those attributes related to extent the researcher accepts criticism and reviews of his work as research function. |
| *A* | *Research abilities* | *Research ability* | Composed of those research-specific context abilities of researchers (observe facts and identify research topics, discuss research results, interact with other researchers, know how conduct and autonomously develop research and adapt to changes in the research context. |

**a.3) Elucidate complementarities of dimensions of academic human capital**

In this regard, we have clarified the explanations given regarding the complementarities between different dimensions of human capital. We use this argumentation to explain the importance of using the knowledge, skills, and abilities (KSA) framework as the basis upon which we build our theoretical discussion. As explained in this thesis, this framework offers an integrative view of human capital, considering how the interrelationships between human capital dimensions can influence performance and competitive advantage. Complementarities exist when one resource enhances the effectiveness of other resources (Brymer & Hitt, 2019). The vast majority of these strategically relevant complementarities within human capital involve individuals (or groups) interacting with a host of other individuals and groups.

Although the study of such complementarities exceeds the scope of the article, it is especially interesting to know more about how these constructs combine to influence each other.

**b) Analyse the determinants of academic performance using the AMO approach**

**b.1) Analyse the AMO approach in a different context than that of academic research**

The application of approaches that contextualise the determinants of academic researcher performance becomes necessary to design more efficient research management policies (Bazeley, 2010; Diem & Wolter, 2013; Dundar & Lewis, 1998 Hedjazi & Behravan, 2011). In this context, the AMO framework has emerged as a suitable approach for evaluating employee performance by differentiating among its key factors (Marin-Garcia and Martinez Tomas, 2016; Jiang et al., 2012). The literature on the AMO framework still has several "gaps" in the management context (Benet-Zepf et

al., 2018; Bos-Nehles et al., 2013; Hauff et al., 2021; Knies & Leisink, 2014; Jiang et al., 2012; Salas-Vallina et al., 2021; Van Waeyenber & Decramer, 2018), and its impact on employees remains unclear (Pak et al., 2019). The AMO framework considers that individual performance depends not only on individuals' abilities and job-related motivation but also on the opportunities offered by their universities. However, only a few studies have analysed these variables from an integrated perspective in the academic research context.

We have therefore concluded that the AMO framework has the same effects in the field of academic research as in other organisational contexts. We respond to these demands, as the contextualisation of the AMO framework involves the identification and conceptualisation of new constructs that allow for deepening the analysis of research performance. By nature, human capital has been used to define performance in organisations (Ployhart, 2021; Wright, 2021; Wright & McMahan, 2011). However, this framework considers other dimensions, such as motivation and opportunities to generate greater value. Therefore, our study allows us to understand the relationships between the variables of the AMO approach from an integrative perspective.

**b.2) Specify the elements and dimensions of AMO in an academic context**

Interest in the AMO approach in recent years has led to the need to establish the elements of each dimension. To propose specific elements, we propose a scale of specific dimensions in the academic environment. Following our study, we have provided the existing relationships in the AMO framework in the academic environment in Table 3.2. In complex jobs, such as conducting research, a comprehensive list of AMO attributes could be especially useful in analysing one's position to clarify what is needed to perform successfully.

These elements have allowed us to develop further analyses, as described below.

**Table 3.2: Correspondence between theoretical and factorial analysis dimensions**

| AMO framework | Theoretical dimensions | Factorial analysis dimensions |
|---|---|---|
| *A* | *Theoretical knowledge* | *Scientific Knowledge* |
| | *Explicit knowledge* | |
| | *Scientific skills* | *Proactive creativity* |
| | | *Research accuracy* |
| | | *Skill of accepting criticism* |
| | *Scientific abilities* | *Research abilities* |
| *M* | *Intrinsic Motivation* | *Intrinsic Motivation* |
| | *Extrinsic Motivation* | *Extrinsic Motivation* |
| *O* | *Availability of financial resources* | *Availability of financial and human resources* |
| | *Availability of qualified human resources* | |
| | *Availability of physical resources* | *Availability of information resources* |
| | *Availability of digital resources* | |

**b.3) Analyse the moderating effect of research motivations and opportunities on human capital and performance.**

In our study, the objective was to determine the behaviour of these variables in the research university context and examine the effects of motivation and opportunity on the direct relationship between abilities

(academic human capital) and research performance. We therefore offer a novel model based on the AMO framework that explains whether research abilities improve in the presence of different types of research motivations and opportunities.

First, we observed the existence of a direct relationship between human capital and academic performance. The positive influence of human capital on research activity implies that researchers should develop a set of specific competencies to appropriately carry out research activity. These results, as expected, are consistent with the academic human capital literature (Bozeman et al., 2001). However, our results also reflect a certain negative relationship between *proactive creativity* and performance, perhaps because the research process and lines of research groups somewhat limit the "gaps" in the different research topics or innovative proposals that are generally not sought after in scientific journals. This certain seemingly negative relationship needs to be studied in more detail to see why the relationship is inverse.

Considering the moderating dimensions, academic researchers have both an extrinsic motivation that encourages hard skills (*research abilities* and *scientific knowledge*), and an intrinsic motivation that stimulates soft skills (*proactive creativity, research accuracy,* and *the skill of accepting criticism*). These conclusions are supported by other studies by Janger and Nowotny (2016), Wollersheim et al. (2015), and Peng and Gao (2019). In relationship researchers' opportunities, our results exhibited a greater availability of economic and human resources than of information resources. According to our results, economic and human resources must be available to support researchers' hard skills (*research abilities* and *scientific knowledge*) and one dimension of "soft skills" (*research accuracy*). However, our data indicated the availability of information resources in terms of only one dimension of "hard skills" (*research abilities*) and the last dimension of "soft skills" (*skill of accepting criticism*). Our results indicate that universities need to provide

adequate opportunities in the form of resources to improve the skills and performance of academics, as indicated by previous research, such as Kwick (2016) and Hicks (2012).

Therefore, we can conclude that researchers' motivations and opportunities stimulate their ability to achieve greater scientific performance. Universities and research units need to focus on these variables to emphasise their contributions to improving academic research. Furthermore, it is worth noting that despite the evident contextual differences, researchers seem to respond to concerns in ways that are similar to workers in different organisational contexts (Szulc et al., 2021; Szulc & Smith, 2021). Academic researchers, like other workers, develop a series of abilities and motivations that allow them to achieve certain returns in their jobs. Similarly, the opportunities offered by their organisations and environments allow them to make improvements, as shown in this study. These have allowed us to show those characteristics that are most sensitive to the research activity of academics. Thus, the different research units (universities, research groups, and researchers) should utilise these attributes to encourage research activity. The research units should provide first-hand knowledge of the elements that would allow for greater performance.

**b.4) Identify the research performance measurement**

Research performance has been widely debated in the literature. In the current university environment, scoring well on measured criteria of research performance establishes our authenticity as researching academics at both the institutional and personal levels (Bazeley, 2010). Traditional measures of research performance have been based on the number of publications or citations as a measure of impact. These measures have allowed universities to establish different criteria for the good performance of researchers. However, as mentioned in the contributions of this thesis, these measures suffer from

certain problems, such as the so-called "publish or perish" (Garfield, 1996 Hangel & Schmidt-Pfister, 2017; Heng et al., 2020; Van Dalen, 2021) or the adequate distribution of researchers' time among the different functions (Kenny & Fluck, 2021; White et al., 2012), for example. Research performance has also been criticised because it does not adequately reflect the contribution of researchers to academia. For these reasons, other measures have been developed that could establish the comparison and recognition that researchers bring to their universities, such as the H-index. Given the limitations of the H-index, we used DEA to define an efficiency frontier. This efficiency frontier makes the performance of each researcher comparable to that of other researchers with different seniorities, for example. DEA gives us a value for the closeness of the researcher's efficiency frontier to the ideal, which makes the compatibility between the samples homogeneous and easily understandable. However, the focus of our study is not only to know the performance of researchers but also the determinants that promote academic research from an individual perspective.

Therefore, we can conclude that the performance measure, DEA, used for the study is suitable for our analyses, as it allows for compatibility between researchers at different points in their academic careers and as an average of research efficiency. Beyond their comparison, this measure allowed us to clearly rank the efficiency of the members of our sample.

**c) Analyse the effect of the perception of incentives on research activity**

**c.1) Elucidate the nature of researchers' perceptions in the field of university management**

Employee perceptions have recently generated some interest in human resource management research (Nishii and Wright, 2008; Van Beurden et al., 2020). Some studies have proposed that more important than research policies are the perceptions of researchers towards them (Gaus & Hall, 2016; Kenny & Fluck, 2021; Khan & Siriwardhane, 2021). The importance of a clear fit between the job and the organisation is essential for the expected results. One of the most important assumptions is how researchers have certain synergies with universities and how universities join their efforts to achieve their goals (Drake et al., 2019; Nguyen et al., 2020). This can lead to new contributions as well as enhance certain performance-driven behaviours of researchers.

As a conclusion of this study, we posit that the incentive system is of vital importance for researchers, as universities should offer management tools so that academics feel valued in their jobs. In general, our results suggest that there is no single form of management to improve the perception of researchers, since research incentives should aim to support an open, ethical, equitable, and autonomous research culture that promotes the research results of their researchers. University managers should support academics as thinkers, researchers, academics, and educators rather than producers of their research results. The satisfaction of researchers at universities allows them to develop research activities in better conditions (Mwesigwa et al., 2020). Ultimately, if universities take these perceptions of researchers into account, they will provide better incentives for research activities. The sample used in this study to elaborate on the role of incentives was diverse and experienced to offer better guarantees of success in the field of research.

**c.2) Define the types of incentives for research activity**

As mentioned in the previous section, one of the conclusions reached in this thesis is that research incentives should be synchronised with the universities. In Table 3.3, we propose four incentives that are basic to research

activity. With these incentives, academics will enhance the development of research careers by boosting performance and professional and international networks.

Universities should not only provide these incentives for researchers but should also understand the complexity of research activities and inherent problems to consistently identify solutions. Therefore, universities, and academics should work together to establish synergies between all research units to offer value to society and be efficient in the market.

**Table 3.3: Factorial analysis dimensions and items of research incentives**

| Research incentives | Items |
|---|---|
| **The perception of incentives for training** | *Promote the updating and recycling of researchers* |
| | *Train researchers in research methodology* |
| | *Improve the dissemination, national and international, of the research carried out at the university* |
| | *Promote and finance research stays for academic researchers* |
| **The perception of the incentives for staffing research at the university** | *Increase the endowment of pre-doctoral contracts* |
| | *Increase the endowment of postdoctoral contracts* |
| | *Increase financial resources* |
| **The perception of the university's support for competitive funding calls** | *Encourage participation in public calls for research funding* |
| | *Give administrative support for the preparation and presentation of projects in public calls* |
| | *Promote and support the presentation of research projects in European calls* |
| **The perception of the strategic focus of the university** | *Establish an objective, reliable and equitable system to measure research* |
| | *Promote those lines of research in which university is strong* |
| | *Differentiate between staff with a teaching and research profile* |

## 2. Contributions and implications

Many studies have concluded that to respond to this new context, institutions dedicated to scientific research must articulate new types of resources and different forms of management that favour their contribution to research performance. The application and contextualisation of new approaches that help to understand the determinants of research performance and facilitate new tools for the management of science is an important contribution.

The achievement of the scientific objectives set out in the empirical section of the thesis also makes a significant contribution to the literature on the management of human resources in an academic context. The application of the human capital approach involves the conceptualisation of new variables that deepen the study of the determinants of research performance. Therefore, by applying and contextualising the human capital approach in the unit of analysis on which we focused our research, we reached an important series of academic and practical implications. It is also important to note that, with the contextualisation of the human capital approach to the research environment, we respond to the call for more studies to develop research on this topic in a specific context, something that facilitates the practical application of human capital approaches (Marginson, 2019). As Wright et al. (2014) noted, the empirical definition of the concept of human capital cannot be done in an abstract way but must be contextualised depending on the particularities of the unit to which it is applied. Therefore, in our work, which follows a synergist approach, we will focus on the study of human capital in the specific context of academic research to deepen how human capital is mobilised in this context, conceptualising, and identifying which measures and attributes set of human capital are fundamental in the development of research. Thus, the contextualisation of the human capital approach in a research environment is also justified by the particularities and notorious differences between

organisations dedicated to research and traditional organisations, which means that traditional measures of human capital do not capture all the variables that make up the research environment. This work therefore proposes using the perspective offered by the human capital approach to deepen the identification, conceptualisation, and measurement of new variables that reflect the competences necessary to develop research.

To demonstrate the contributions of our thesis, we carried out the study following methodological triangulation. We developed our analysis using both qualitative and quantitative techniques. To conceptualise and identify the intangible elements that make up the human capital, motivations, opportunities, and research incentives construct in the academic context in general, a Delphi analysis was carried out. In this case, given that the initial conceptualisation proposal was carried out in an academic environment that included different fields of scientific knowledge, the panel consisted of a group of Spanish research team leaders who were experts in different fields. This qualitative phase was essential for the identification of all the elements mentioned above. The experts had to reach a consensus on each element of the study. Thus, the process was repeated until acceptance of each item was reached. Furthermore, the Delphi panel was complemented with another quantitative phase to confirm the constructs developed. For this purpose, a questionnaire was designed to be answered by Spanish researchers. Exploratory and confirmatory factor analyses were carried out to validate each of the proposed scales. Therefore, we contextualised and proposed a construct that allowed us to conceptualise different constructs in an academic context.

With the proposal made in the empirical study, we tried to address the limitations of previous studies in the field by focusing more on the specific attributes of academic researchers that explain higher scientific performance. In essence, the proposed scale presents two specific advantages that justify its application in an academic context. It provides direct information from researchers about aspects that are particularly difficult to measure, such as their competence profiles. Although this information is subjective, it can be used as

preliminary data to supplement more objective information and to understand the antecedents of scientific performance. Scopus offers tools such as SciVal, a web-based analytics solution that allows us to obtain and process a large amount of comprehensive information on the research performance of over 14,000 research institutions and their associated researchers from 230 nations worldwide. We consider that the availability of different metrics or information allows universities to make more efficient decisions about their academic researchers and provides an integrative measure that includes different dimensions of human capital. We deem this especially interesting because the scales used to assess academic human capital globally consider some attributes that define researchers' competence profiles. Further, we are aware that the manuscript provides subjective information about researchers' competences, which can be particularly useful if the scale is applied as a complement to other objective measures (i.e., SciVaL).

The proposal of this measurement instrument involves important uses and practical implications, differentiating between the *individual*, *research group*, and *institutional/organisational* level. Specifically, as we have argued, the proposal and validation of this tool for measuring academic human capital allowed us to identify certain intangible elements that are relevant to the research process and to determine scientific productivity. Considering what the literature has pointed out, these key intangible assets in research processes are difficult to capture through the traditional and decontextualised measures of human capital that can be found in the organisational literature. Therefore, in our view, building a measurement tool specifically designed for the academic research context will be particularly valuable for different agents.

- *Individual researchers*: This tool can be used to analyse the level of human capital a researcher has and, on the basis of this information, to detect training needs. The specific training offered to academic researchers will serve to develop and improve the KSA. Further, the tool provides an adequate

measurement for the self-evaluation of KSA attributes in research context. From this perspective, academic researchers could know their potential knowledge, ability, and skill limitations with the objective of improving the way in which they conduct research and their results. In a different vein, we agree regarding the valuation of the individual data points. The scale can also be used to establish comparisons between the scores obtained by researchers within their research teams and even their research areas. To this end, it is possible to determine whether a researcher is average or needs to improve specific attributes.

- *Research teams*: This measure scale is useful for principal investigators to manage their research teams in three main aspects. First, it provides principal investigators with useful input and preliminary information about the stock of competencies within their teams. In this respect, collaboration between researchers, either within the research group itself or among other researchers, can facilitate the generation of new knowledge and research capacities, as has been described in studies such as Lee and Bozeman (2005). Second, complementarities between KSA dimensions can be determined using the scale. Principal investigators may use the scale to perceive the complementarities of academic human capital to improve the research performance of team members. This could be very useful for decision-making regarding how to foster complementarities between team members or advising younger researchers on their potential training needs and help manage their academic careers. Lastly, the research careers of team members need to be managed. This scale could be used to analyse the evolution of academic careers by examining how much human capital they have and, using this information, detecting specific training needs.
- *University management*: The need for adequate management policies are essential in academia, as described in studies such as Alshaikhmubarak et al. (2020), Xia et al. (2020); Ayaita et al., 2019 or Nguyen, (2016). This measurement scale is useful for university research management in six main areas. First, the scale could be used as a guide to promotion opportunities for

researchers. This scale would imply that faculties' policies to manage young and senior researchers can be communicated more directly. Our scale could be used as a supplement to the research team's decisions about promotion opportunities. Decision-making about the promotion of researchers could be complex by its nature; therefore, the process can be complemented with this scale of measurement for the decision to be fair and equitable. In fact, the scale can be used as a guide of researchers´ competence profiles, utilising not the specific scores but serving as a checklist for potential candidates. Second, this scale provides the university with a tool to obtain interesting information about academic human capital to design talent management initiatives. In this sense, universities would have a better understanding of the training needs and development opportunities offered to their staff. Revealing the underlying determinants of the production of scientific knowledge makes it possible to define, with greater precision, the reward systems and professional careers of people working in the field of science (White et al., 2012). Thus, university managers must promote adequate human resource management policies that improve the ability and motivation of academic researchers; these are both directly and indirectly related to research performance, suggesting that universities retain and generate high levels of performance of researchers. Third, the scale could also foster the design of an academic human capital profile for academic researchers. Academic researchers must combine their scientific activities with teaching and management responsibilities (White et al., 2012). This profile would reinforce the idea that there is a need to differentiate the nature and evaluation perspectives between research, teaching, and management activity. In complex jobs, such as conducting research, having a comprehensive list of human capital attributes could be especially useful as a job analysis to clarify what is needed to perform. Fourth, the scale provides a tool that could be useful for the allocation of research funding, for example, assigning more funds to research teams that present higher levels of

academic human capital, or according to the training needs exhibited by the team. Thus, this distribution could be more equitable, considering the differences between areas of knowledge. Some studies have highlighted financial incentives from a macro-level imperative in the development of university-based research (Auranen & Nieminen, 2010). As these studies mention, there is no straightforward mechanism from funding incentives to research activities. Therefore, the proposed measure scale could be used to add information about specific academic human capital attributes to clarify fund allocation at the university level between areas of knowledge or emergent research groups. Furthermore, the scale could be employed to provide integrative value to support the system of funding assignments. The scale could be a good tool for assessing the academic human capital of academic research in the research teams that respond to calls to adequately develop the research. A fifth practical implication will be related to the strategic decision-making of the universities regarding their research policies (Fumasoli et al., 2020). The strategic research position of the universities highlights the importance of the measurement tool to improve ranks, resources, and decision-making power in attracting and retaining research talent. University leaders could use this scale to develop strategies and methods that enhance ability, motivation, and opportunities to help researchers improve individual scientific performance. Further, university managers should be alert about calls for new regional, national, and international funding for obtaining funding and human resources, as well as information resources that facilitate research activity. Lastly, universities should consider the perception of incentives of academic researchers to provide the basis for the definition of management systems for universities, as well as tools for the evaluation and monitoring of research capacities and scientific performance. A definition of incentives that takes these perceptions into account could promote research behaviours that reinforce the scientific productivity of institutions as well as motivation in the workplace based on commitment and a feeling of belonging to the university. The management and perception of incentives must be focused on each stage

of the academic career (Levin & Stephan, 1991). We suggest that universities use appropriate incentives at each stage of their academic life cycle and that they perceive it in a satisfactory way to stimulate researchers appropriately and influence their expected performance. To summarise, the configuration of academic human capital may help universities analyse the specific needs of researchers rather than propose homogeneous research policies.

In summary, we understand the proposed scale as a novel and complementary tool to support specific processes in the academic context, as mentioned above. We further explain that this scale can be used as an input of information to guide the set of management policies and to clarify the usefulness of the scale itself. As previously mentioned, the scale cannot be understood as a single measure upon which different decisions are based in an academic context. In fact, as explained, the proposed scale would be useful in supporting the principal investigator, researchers, and even managers, always matching the scale to other objective indicators or measures. As explained, it can be used as an input of information at the micro, group, and organisational levels. What is particularly relevant in this scale from the individual perspective is the extent to which it allows researchers to be more conscious of the real level of their competences. We assume that this kind of scale fosters a realistic and critical view when assessing one's own human capital and offers an integrative assessment of many different human capital attributes that define academic work. In this way, the definition of a system of indicators for the analysis of academic human capital could guide decision-making in the management of scientific equipment that is developed both in universities and public institutions.

## 3. Limitations

The results obtained in the quantitative analysis (empirical studies 1, 2, and 3) should be considered in light of a series of limitations that allow us to

better understand the significance of the conclusions drawn, as well as qualify certain aspects of the investigation. The main limitations derive from the complexity of the research topic with which we initially approached research in academia. The fact that we have focused on the study of the human capital of academics provides multiple considerations of the diverse and complex nature of the topic to be analysed in the field of study itself, as well as its more specific dimensions. Therefore, it is also important to highlight the consideration of this thesis as the beginning of an incipient line of research that offers us the opportunity to develop future research that includes variables in an integrated way in the topic studied. Nevertheless, we present different conceptual issues and restrictions in the empirical research process that must be considered when analysing the scope of the conclusions drawn from this thesis.

However, it is important to note that the breadth with which the present study was initially drawn did not allow us to consider the effects of multiple contingent variables that could have contributed to a better understanding of the determinants of scientific productivity. In the second and third empirical study, variables such as funding (Álvarez-Bornstein & Bordons, 2021; Bloch, 2020; Bloch et al., 2014; Shin et al., 2021), university culture (Fussy, 2019; Kaltenbrunner, 2018), leadership of the principal investigator (Ballesteros-Rodriguez et al., 2020a, 2020c), and specific management policies (Alshaikhmubarak et al., 2020; Amin et al., 2014; Nguyen, 2016; Xia et al., 2020) as drivers of scientific performance were not considered. The inclusion of these variables would have allowed us to improve and specify certain conclusions. However, it should be mentioned that in the second empirical study, only the influence of the university was considered a variable that conditions research opportunities within the AMO framework, without major differences in the significance of the rest of the study variables. Thus, the inclusion of these variables could be the result of future studies that contribute to the field of understanding human capital in the university context.

Similarly, another possible limitation in the research could come from the participation of a single member of the academic researchers studied as an informant. To study the variables of human capital, motivation, and opportunity or their management, individuals were surveyed to respond to questions about their own attributes. Given that information on the dimensions of human capital was provided by a single individual, the bias of the common method could be generated. Therefore, considering this limitation and following different studies (Podsakoff et al., 2003), we have developed different ex ante and ex post procedures to control for possible biases. Based on these procedures, we infer that the common method is not a serious limitation of our study. However, to avoid possible high response or acquiescence biases, as we will reflect in future lines of research, future studies should focus on obtaining data aggregated by the team by a minimum of members of the scientific team.

Another possible limitation can be found in the design of the confirmatory analysis of the proposed measurement scale. We consider that the relationship between the measures and the constructs conforms to a formative model. Considering the nature of Likert scales and the multivariate non-normal distribution of the variables, we used the elliptical least squares estimator in this first empirical study (Brown, 2014). For instance, we considered how the researcher's knowledge, skills, and abilities form the degree of academic human capital they had. The formative construct considered each item to form one of the KSA dimension factors. For example, academic human capital has five different factors (*research ability, research knowledge, alertness skill, work organisation skill, and criticism skills*), and if any academic human capital factor is removed, the construct changes completely. However, this consideration was followed under the criteria of the researcher, without possible alternative methods performed to help clarify the theoretical identity that underlies the relationships between measures and constructs, as advised by

studies such as Jarvis et al. (2003). We have included this aspect as a limitation of our work, considering that future research could evaluate or compare the predictive power of the scales proposed in our work when we consider them constructive or formative versus reflective. It is important to note that some variables can be evaluated using both reflective and formative measurement models (Chin, 1998). Therefore, we considered the evaluation of the scales proposed in our work using the method of the two constructions, allowing the simultaneous evaluation of both considerations to compare the predictivity of both types of constructions.

However, the need to identify the intangible and complex variables of human capital in the academic context, as well as the possible policies for management, decisively influenced the approach of the three empirical studies. This led us to develop a particularly extensive research questionnaire, and in some cases, the complexity of the study made it difficult to understand how to identify all the elements that comprise the construct itself. This can explain why we intend to use measurement instruments that were contrasted in the literature, although previously they had to be contextualised in the academic field to guarantee the quality of the data obtained. This probably explains the low number of responses obtained regarding the global population of the study. According to data from the Spanish Ministry of Education, our sample represents 6.25% of the sample population. This relatively low rate probably reflects the general tendency towards non-response due to the increasing number of online surveys that academic researchers are asked to complete (Kaplowitz et al., 2012; Fan & Yan, 2010). Therefore, this condition does not allow us to generalise, without due caution, the results obtained and the conclusions drawn.

Further, our second and third empirical studies were carried out in a sample of academics with a heterogeneity of demographic variables (university, areas of knowledge, gender, age, length of academic career, number of six-year periods of research positively assessed, and academic

rank). Although these results can be extrapolated to the general population by the sample used, the effect of some of the variables studied may be affected by some of demographic variables, as has been shown in studies such as Abramo et al. (2021; 2018), Kamrani et al. (2021), Goel and Göktepe-Hultén (2020), Leahey et al. (2017), and Bäker (2015). Another limitation that we detected in our second study was the use of the university's permanent academic rank. This subsample caused heterogeneity in the results of the study (academic performance) but did not contemplate the reality of all academic researchers (PhD students, postdoctoral, or assistant professor), for example. Therefore, future studies could analyse the effects of the variables from different academic ranks to understand the research realities of academic researchers. It would also be necessary to carry out more studies to verify the existence of these differences between areas or between other variables of analysis. However, in the second of the empirical studies, as mentioned previously, an analysis categorised by university was carried out without any significant differences between the two analyses. Therefore, we conclude that the results are not biased by the universities in the sample. In the third empirical study, a study based on a single university was also carried out to reduce the dispersion of perceptions among the study variables. Although it is true that this helped to provide some consistency with these findings, it obviously conditioned the possible generalisation of the conclusions obtained.

Another limitation is that the thesis was carried out at a specific moment in time. To enrich the results obtained and to contrast the causality in the relationships proposed in the empirical studies, it would be necessary to propose longitudinal studies. Such analyses allowed for the evolution of research results and scientific productivity in different moments of time. Academics need time to publish their contributions; thus, it would be of special interest to know how these delayed effects contribute to the achievement of future results. This would allow us to draw conclusions about the lagged

effects of academic human capital or incentives on research performance, for example.

Lastly, in the first empirical analysis, where we propose and validate a scale for measuring academic capital in the academic context, it is important to consider some limitations when interpreting the results and using the proposed scale. The empirical analysis was carried out with an initial sample of 2,223 Spanish academics. Scale validation needs to be confirmed in different national contexts with larger datasets. Comparative analyses would be particularly interesting in this regard to explore the possible effects of differences in national scientific systems, as shown by other studies, such as those by Reymert et al. (2020), Capano (2018), Hong (2018), and Lehmann et al. (2018). In some cases, larger datasets would also allow a better factorial solution to be obtained, which would explain the higher variance percentages. Thus, in the third empirical study, two different university contexts can be studied to understand the different incentives of academic researchers and to assess the potential significant differences between them.

In fact, it would be necessary to conduct a more complete study on the variables studied with mediating, moderating, and contextual variables that integrally confirm the results obtained. Therefore, the findings and conclusions obtained in our study invite the development of future research that can expand and contrast the results obtained in this thesis.

## 4. Future research lines

Considering the conclusions and the limitations exposed so far, we conclude this work by proposing some lines of research that could help us advance the development and deepening of this work. As previously indicated, this thesis should be seen as the opening of a line of research for the development of important future contributions. The field of research still has certain dimensions that have not yet been explained and that require deeper and more specific study. In fact, the breadth and need for development identified

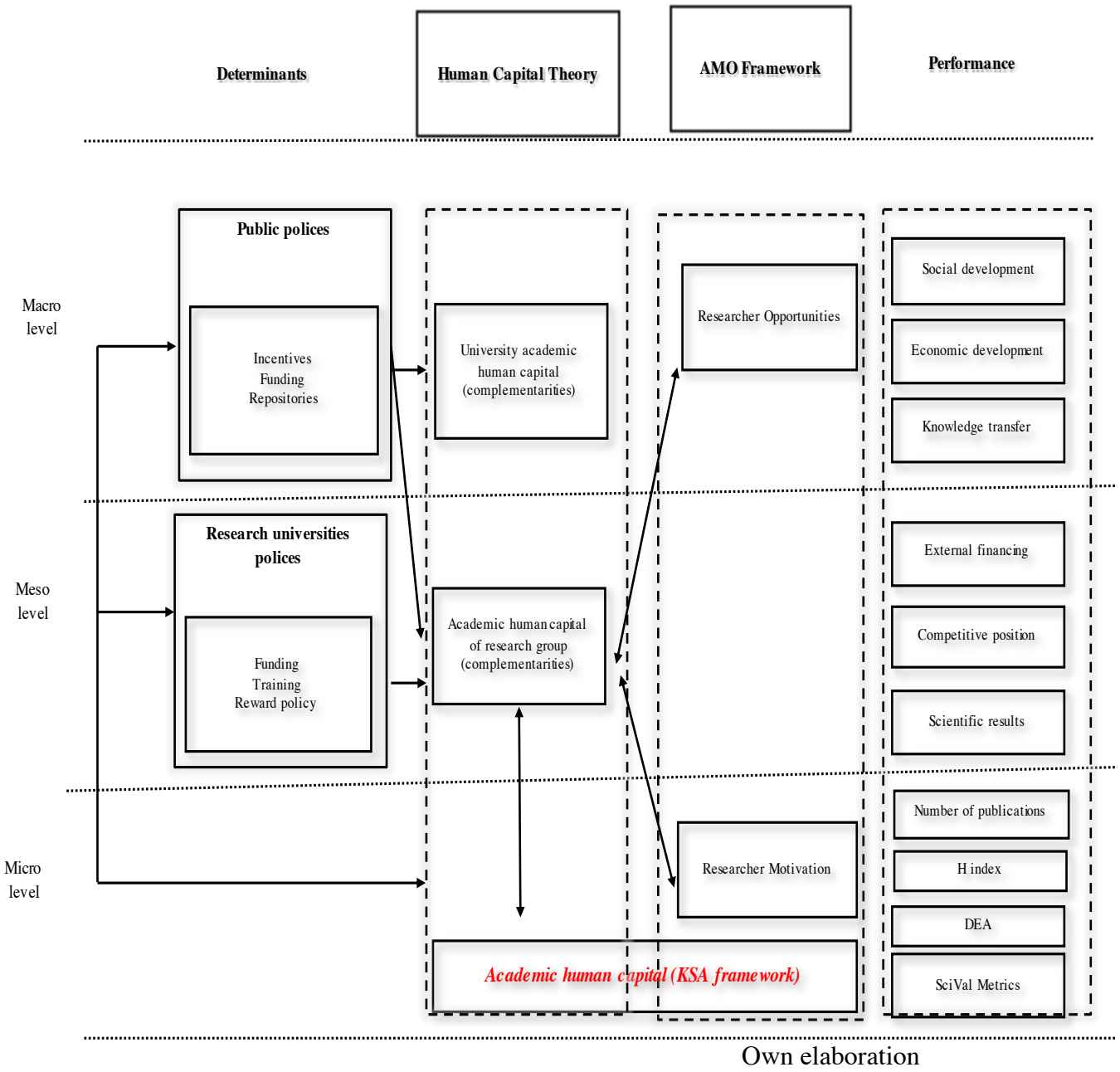
throughout the review of the theoretical framework led us to propose a theoretical model that, from too broad expectations, exceeded the objectives that normally arise in a doctoral thesis.

Therefore, future research could focus on developing the synergistic effect of human capital dimensions. These dimensions of academic human capital are interrelated, and any synergistic effect could lead us to understand that academic human capital factors do not work independently but are related to each other. In the organisational context, the complementarity-synergistic factors of human capital enhance the value that can be derived from a given stock (Ennen & Richter, 2010; Gerhart & Feng, 2021; Ployhart et al., 2014; Wright et al., 2014). In the research context, this approach is especially interesting in clarifying the combination of attributes of academic researchers that are necessary to develop efficient research and how the complement of these attributes adds value to the research activity. As explained in the first empirical study, this framework offers an integrative view of human capital, considering how the interrelationships between human capital dimensions can influence performance and competitive advantage. It is especially interesting to elaborate on how these constructs combine to influence each other.

Future research could also deepen the effect of academic human capital at different levels of the study (multilevel analysis). Specifically, in future work, we intend to focus on studying the effects reviewed in this thesis in an integrated way. Thus, academic human capital and motivation from an individual perspective, as well as research opportunities and incentives at the university level. The literature review highlighted the importance of these variables in the functioning of the research units (Ballesteros et al., 2020b). We analysed the influence of these variables in each of the research units. One of the main gaps in the literature is how management policies in universities influence different fields of study (Beerkens, 2013; Horta & Santos, 2020; Xia et al., 2020). Through different policies, both the management of the scientific

team and the university institution in which it is located, or public bodies interested in promoting research activity, can favour the generation and use of human capital. Public incentive policies and human resource management activities deployed by the research team or the researcher will affect scientific productivity. Therefore, we propose future work that focuses on completing the proposed theoretical model (Figure 3.1), specifying in the analysis each of the dimensions of the human capital construct and the research policies that impact each one of them. One potential study that could be carried out is how human resources policies based on the AMO framework affect academic performance. In the second empirical work, we used the three main dimensions of the AMO framework but not how universities can manage them. Therefore, this study could explain the most appropriate management mechanisms for each dimension of the AMO framework. In short, the dimensions of the AMO framework could be used as mediating variables between management policies and academic performance from a multilevel perspective, as mentioned above. In conclusion, to facilitate the conceptualisation of these factors, future research could develop measures to generate and exploit human capital from a multilevel perspective, since by their nature, they would require differentiated treatment (Kirkland, 2008).

**Figure 3.1. Proposed theoretical model (multilevel academic human capital in universities)**




Own elaboration

Future research could also deepen the effect on other variables from different research units, such as the leadership of the principal investigator (Ballesteros-Rodriguez et al., 2020a, 2020c), the conflict of the research team or the area to which it belongs (Ballesteros-Rodriguez et al., 2020a), and the research results at the individual, group, and university levels (Gerashchenko, 2021). Future investigations could also deepen the effect that the leadership style of the leading researcher has on the application of human capital management mechanisms at the research team level. Although the generation of scientific knowledge has traditionally been described from an individual perspective, most scientific projects and activities are notably collective in nature (Wuchty et al., 2007). These variables are introduced as factors that condition the management mechanisms established by the scientific team, which therefore have an indirect impact on the generation and use of human capital. More specifically, future research could focus on obtaining information from the scientific team by aggregating the data obtained by each member of the team. In the development of this line of research and in obtaining data at the group level, we can address one of the limitations indicated above concerning the respondents. Given this limitation, if we focus our efforts in future research on obtaining data at the group level, it might lead to the collective the opinions of all the members of the same scientific team, obtaining aggregated data at the team level and thus avoiding certain biases, as well as ensuring the quality of the information collected. Thus, the object of the analysis would be the scientific teams based on which how certain factors influence the team's ability to generate and complement human capital could be analysed.

Another line for future research work is the adequate time distribution of the different research functions as debated in the literature (Barham, et al., 2014; Hu & Gill, 2000; Kawaguchi et al., 2016; Van Dalen, 2021; White et al., 2012). It is also proposed that the time available for research activities (not only the individual-level variable of the ability to manage time) affects

academics' research performance. In the initial stages of an academic career, researchers must develop a high research capacity. However, as they continue in their academic careers, they must develop other research management functions that directly and indirectly affect their performance (Barham et al., 2014; Taylor et al., 2006). As a researcher ages, the administrative obligation, both in research teams and in academic institutions, generally increases. Bentley and Kyvik (2013) and Link et al. (2008), for example, showed that promotion to a permanent position leads to less research time and more service time at leading research universities. Future research could be aimed at analysing the efficiency of the use of time in each of the academic careers, which allows researchers to continue encouraging research without reducing the management and responsibility activities required in the course of the academic career of researchers.

Another variable that has generated great interest at the individual level in the development of human capital is the mobility of researchers. In this sense, several studies have analysed the positive effects of mobility on performance (Bäker et al., 2021; Tartari et al., 2020). Research mobility provokes the generation of new scientific knowledge, both the researcher who carries out a research stay at a prestigious university and the researchers from the university itself. Researchers obtain new approaches and perspectives on research topics, as well as the development of knowledge links (Tartari et al., 2020; Wang et al., 2019). Mobility can be considered a moderating variable of human capital and its performance, given the number of national and international collaborations of academic researchers. Following these arguments, researchers can develop a capacity for collaboration that allows for the generation of human capital. The arguments of studies such as McCabe et al. (2021) corroborate the importance of the role of collaborations in the scientific field, whether due to participation in new research (Wang et al.,

2019) or the complementarities of researchers (Bozeman & Corley, 2004), among other reasons.

Thus, the different variables could be studied from a multilevel point of view. At the micro level, we could focus on how each of the dimensions of academic human capital behaves among them at the level of complementarities. At the meso level, future lines of research could delve into the study of the effects of academic human capital at the group level. If the mentioned complementarities at the micro level are produced, to what extent do they promote the human capital of each research group? Must each team member independently develop human capital to make it available to the group itself, or are there synergies between the human capital attributes of the team´s academic researchers that strengthen their specialisation in the process of generating academic knowledge? The effect of variables such as leadership or conflict on academic human capital could also be analysed. As a result of this analysis, the effect of research policies could be addressed as a future line of research on research teams and academic researchers. Although direct coordination of the work of a scientific team affects the way in which human capital is generated and used, many of the human resource management policies applied to its members go beyond this area. Through their policies and their own research plans, universities develop the training of research staff, fostering their research capacity at the individual and group levels. Therefore, university management policies will be especially relevant, since they directly affect the levels of human capital of researchers and scientific teams (Alshaikhmubarak et al., 2020; Amin et al., 2014; Beerkens, 2013; Nguyen, 2016; Xia et al., 2020). The possible incidence of variables in the generation and use of human capital is not limited to the micro and meso levels but is affected by factors of a higher macro level. These factors are external to the university institution, and future research could analyse how they condition its operation, delving into macro-level determinants, such as the incentives provided by different public bodies or public policies aimed at quality

assessment and assurance, as well as the research efficiency of universities. For example, the existence of the European Research Area has favoured the harmonisation of research policies at different levels, following similar research strategies with common objectives and goals. It would be interesting to deepen the analysis of the differences in incentive public policy measures to research activity, or in the guidance of national accreditation and quality assessment agencies. To determine the effect of these variables on the functioning of research teams and their levels of human capital, it would be convenient to propose a comparative analysis in which institutions from different national contexts are contrasted using differentiated research models to understand the similarities and differences in the system itself.

To deepen the study of these factors and their impact on scientific productivity, future research should reconsider the criteria and measures of scientific productivity at different levels of analysis (meso and macro). For example, future work could analyse how research policies or aggregate human capital (research group and university level) affect the performance of university research, as well as other measures of university researcher satisfaction. Therefore, under a strong exploratory nature, studies should be proposed that seek to identify and validate measurement instruments on scientific performance and analyse their effects in the specific context of the set of possible relationships raised in future research. Beyond proposing specific measurement tools for the proposed higher levels of study, it would be necessary to identify new measures of research performance. Although, as we have seen, at the individual level, the traditional means of evaluating scientific productivity make a valid and reliable assessment, they present limitations of an empirical nature that have been highlighted in this thesis. Normally, the criteria used in productivity at the individual level have been publications in high-impact journals, the impact of the journals where they are published, and citations received. In fact, in the second of the empirical studies developed to

measure research performance, we initially used the *H-index*, which is an original indicator provided by SCOPUS. However, the use of the *H-index* as an indicator of scientific productivity has not been without criticism, as pointed out by studies such as Alonso et al. (2009) and Bornmann and Leydesdorff (2018). One of these criticisms has been that the *H-index* does not consider the effect of co-authorship or the quality of the journal (Groot & García-Valderrama, 2006; Alonso et al., 2009), as well as the lack of consideration of the research career of the same author (Alonso et al., 2009; Bornmann & Leydesdorff, 2018). To address these limitations, we calculated the research performance scores using the DEA of each academic researcher (Sagarra et al., 2017). Since DEA allows multiple inputs and outputs, it is a useful and appropriate instrument for measuring scientific performance. This technique allowed us to consider both productivity and impact levels through the *H-index* scores, as output, and the experience in the number of years of the researchers, as input, of the sample of scientists in our study. Another interesting tool for obtaining data on academic performance, as well as institutional variables, is the one developed by SCOPUS called SciVal. This measurement provides access to the research performance of thousands of research institutions and their associated researchers from 231 nations worldwide, allowing researchers to visualize research performance and benchmark relative to peers, develop strategic partnerships, identify and analyse new emerging research trends, and create uniquely tailored reports. SciVal offers an extensive array of simple and more sophisticated metrics, including *Snowball Metrics*, which were defined through an academic–industry partnership to enable their confident and appropriate use in strategic decision making and benchmarking. *Snowball Metrics* were initiated by eight highly successful research universities as a manageable set of metrics that captured the strategic aspects of research performance. The aim is for *Snowball Metrics* to become the global standard for the higher education sector. The agreed-upon and tested definitions are shared free of charge with the research community. To address these limitations, future research could aim to use various performance measures or

compare the measures used in the literature to check their consistency. With this study, the applicability and usefulness of the criteria for choosing a good outcome measure in this type of research can be demonstrated.

# REFERENCES

# REFERENCES

Aagaard, K., Bloch, C., & Schneider, J. W. (2015). Impacts of performance-based research funding systems: The case of the Norwegian Publication Indicator. *Research Evaluation*, 24(2), 106-117.

Abell, D. & Becker, K. (2021). "Enhancing university employer attractiveness for the next generation of academics". *Journal of Higher Education Policy and Management*, 43(5): 457-473.

Abbott, M., & Doucouliagos, C. (2003). The efficiency of Australian universities: a data envelopment analysis. *Economics of Education Review*, 22(1), 89–97.

Abramo, G., Aksnes, D.W., & D'Angelo, C.A. (2021). Gender differences in research performance within and between countries: Italy vs Norway. *Journal of Informetrics*, 15(2), In press.

Abramo, G., Cicero, T., & D'Angelo, C. A. (2011). A field-standardized application of DEA to national-scale research assessment of universities. *Journal of Informetrics*, 5(4), 618-628.

Abramo, G., & D'Angelo, C. A. (2011). National-scale research performance assessment at the individual level. *Scientometrics*, 86(2), 347-364.

Abramo, G., D'Angelo, C.A., & Di Costa, F. (2018). The effects of gender, age and academic rank on research diversification. *Scientometrics*, 114(2), 373–387.

Abualoush, S., Masa'deh, R.E., Bataineh, K. & Alrowwad, A. (2018). The role of knowledge management process and intellectual capital as intermediary variables between knowledge management infrastructure and organization performance. *Interdisciplinary Journal of Information, Knowledge, and Management,* 13, 279-309.

Agasisti, T, Catalano, G, Landoni, P, & Verganti, R. (2012). Evaluating the performance of academic departments: an analysis of research-related output efficiency. *Research Evaluation*, 21, 2-14.

Agasisti, T, Dal Bianco, A, Landoni, P, Sala, A, & Salerno, M. (2011). Evaluating the Efficiency of Research in Academic Departments: an Empirical Analysis in an Italian Region. *Higher Education Quarterly* 65(3), 267-289.

Aguinis, H., Pierce, C. A., Bosco, F. A., & Muslin, I. S. (2009). First decade of Organizational Research Methods: Trends in design, measurement, and data-analysis topics. *Organizational Research Methods*, 12(1), 69-112.

Albert, C., Davia, M. A., & Legazpe, N. (2018). Job satisfaction amongst academics: the role of research productivity. *Studies in higher education*, 43 (8), 1326-1377.

Albert, C., Davia, M. A., & Legazpe, N. (2016). Determinants of research productivity in Spanish Academia. *European Journal of Education*, 51(4), 535-549.

Alegre, J., Chiva, R., & Lapiedra, R. (2009). Measuring innovation in long product development cycle industries: An insight in biotechnology. *Technology Analysis & Strategic Management*, *21*(4), 535–546.

Alegre, J., Lapiedra, R., & Chiva, R. (2006). A measurement scale for product innovation performance. *European Journal of Innovation Management*, *9*(4), 333–346.

Alfawaire, F., & Atan, T. (2021). The Effect of Strategic Human Resource and Knowledge Management on Sustainable Competitive Advantages at Jordanian Universities: The Mediating Role of Organizational Innovation. *Sustainability*, 13(15), 8445.

Almeida, M. V., Ferreira, J.J.M., and Ferrerira, F.A.F. (2019). Developing a multi-criteria decision support system for evaluating knowledge transfer by higher education institutions. *Knowledge Management Research & Practice*, 17 (4), 358-72.

Almubarak, S. A. H. (2020). Promoting Internationally Visible Researchers

through Research Performance Policies: The Case of a Saudi University. *Higher Education Policy*, 34, 1027-1048.

Alonso, S., Cabrerizo, F. J., Herrera-Viedma, E., & Herrera, F. (2009). h-Index: A review focused in its variants, computation and standardization for different scientific fields. *Journal of Informetrics*, *3*(4), 273-289.

Alshaikhmubarak, A., Da Camara, N., & Baruch, Y. (2020). The impact of high-performance human resource practices on the research performance and career success of academics in Saudi Arabia. *Career Development International*, 25 (6), 671-690.

Altamirano-Corro, A., & Peniche Vera, R. (2014). Measuring the institutional efficiency using dea and ahp: The case of a mexican university. *Journal of applied research and technology*, 12(1), 63-71.

Álvarez-Bornstein, B., & Bordons, M. (2021). Is funding related to higher research impact? Exploring its relationship and the mediating role of collaboration in several disciplines. *Journal of Informetrics*, 15(1), 101102

Alvesson, M., & Kärreman, D. (2001). Odd couple: making sense of the curious concept of knowledge management. *Journal of Management Studies*, 38(7), 995-1018.

Amara, N, Rhaiem, M, & Halilem, N. (2020). Assessing the research efficiency of Canadian scholars in the management field: Evidence from the DEA and fsQCA. *Journal of Business Research*. 115, 296-306.

Amaral, A., Tavares, O., & Santos, C. (2013). Higher Education reform in Portugal: a historical and comparative perspective of the New Legal framework for Public Universities. *Higher Education Policy*, 26(1), 5-24.

Amin, M., Ismail, W. K. W., Rasid, S. Z. A., & Selemani, R. D. A. (2014). The impact of human resource management practices on performance: Evidence from a Public University. *The TQM Journal*, 26(2), 125-142.

Anderson, J.C., and Gerbing, D.W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, 103 (3), 411–23.

Andreeva, T, & Sergeeva, A. (2016). The more the better ... or is it? The contradictory effects of HR practices on knowledge-sharing motivation and behaviour. *Human Resource Management Journal*, 26(2), 151–171

Appelbaum, E, Bailey, TT, Berg, P, & Kallenberg, A. (2000). *Manufacturing advantage: Why high-performance work systems pay off. Ithaca*, NY: Cornell University Press.

Arrindell, W. A. & van der Ende, J. (1985). An empirical test of the utility of the observations-to-variables ratio in factor and components analysis. *Applied Psychological Measurement, 9*(2), 165–178.

Asparouhov, T., & Muthén, B. (2009). Exploratory structural equation modeling. *Structural Equation Modeling, 16*(3), 397–438.

Auranen, O, & Nieminen, M. (2010). University research funding and publication performance—An international comparison. *Research Policy* 39:822-834.

Avkiran, N. (2001). Investigating technical and scale efficiencies of Australian Universities through data envelopment analysis. *Socio-Economic Planning Sciences*, 35(1), 57–80.

Ayaita, A, Pull, K, & Backes-Gellner, U. (2019). You get what you 'pay'for: academic attention, career incentives and changes in publication portfolios of business and economics researchers. *Journal of Business Economics*, *89*(3),273-290.

Aziz, N. A.A, Janor, R. M., & Mahadi, R. (2013). Comparative departmental efficiency analysis within a university: A DEA approach. *Procedia-Social and Behavioral Sciences*, 90, 540-548.

Backes-Gellner, U., & Schlinghoff, A. (2004). Careers, incentives, and publication patterns of US and German (business) economists. Available at SSRN 616822.

Bagozzi, R.P., Yi, Y., and Phillips, L.W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly*, 36 (3), 421–458.

Bak, H.J., & Kim, D.H. (2019). The unintended consequences of performance-based incentives on inequality in scientists' research performance.*Science and public policy*, 46(2), 219-231.

Bäker, A., Breuninger, S., & Pull, K. (2021). Pushing performance by building bridges: Human and social capital as mechanisms behind the mobility-performance link. *Journal of Vocational Behavior*, 129, 103613.

Bäker, A. (2015). Non-tenured post-doctoral researchers´job mobility and research output: An analysis of the role of research discipline, department size, and coauthors. *Research Policy,* 44,634-650.

Ballestar, M. T., Doncel, L. M., Sainz, J., & Ortigosa-Blanch, A. (2019). A novel machine learning approach for evaluation of public policies: An application in relation to the performance of university researchers. *Technological Forecasting and Social Change*, 149, 119756.

Ballesteros-Rodríguez, J.L., Díaz-Díaz, N.L., Aguiar-Díaz, I. & De Saá-Pérez (2020a). The Role of Leadership in the Management of Conflict and Knowledge Sharing in the Research Groups of a Spanish Public University. *Public Organization Review*, 20, 421–436.

Ballesteros-Rodríguez, J.L., De Saá-Pérez, P., García-Carbonell, N., Martín-Alcázar, F. and Sánchez-Gardey, G. (2020b). Exploring the determinants of scientific productivity: a proposed typology of researchers. *Journal of Intellectual Capital*, In press

Ballesteros-Rodríguez, J. L., De Saá-Pérez, P., García-Carbonell, N., Martín-Alcázar, F., & Sánchez-Gardey, G. (2020c). The influence of team members' motivation and leaders' behaviour on scientific knowledge sharing in universities. *International Review of Administrative Sciences*. In press.

Bandola-Gill, J. (2019). Between relevance and excellence? Research impact agenda and the production of policy knowledge. *Science and Public Policy*, 46 (6), 895–905.

Barham, B. L., Foltz, J. D., & Prager, D. L. (2014). Making time for science. *Research Policy*, 43(1), 21–31.

Barnacle, R. and Dall'Alba, G. (2014). Beyond skills: Embodying writerly practices through the doctorate. *Studies in Higher Education*, 39: 1139–49.

Barrow, M., & Grant, B. (2019). The uneasy place of equity in higher education: tracing its (in) significance in academic promotions. *Higher Education*, *78*(1), 133-147

Bartram, D., and Roe, R.A. (2005). Definition and assessment of competences in the context of the European Diploma in Psychology. *European Psychologist*, 10, 93–102.

Bashir, N. & Sang Long, C. (2015). The relationship between training and organizational commitment among academicians in Malaysia. *Journal of Management Development,* 34 (10),1227-1245

Bazeley, P. (2010). Conceptualising research performance. *Studies in Higher Educatio*n, 35(8),889-903.

Bearden, W. O., & Netemeyer, R. G. (1999). *Handbook of marketing scales: Multi-item measures for marketing and consumer behavior research*. Sage: Newbury Park, CA.

Becker, G. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economics*, 70 (5), S9–S49.

Beerkens, M. (2013). Facts and fads in academic research management: The effect of management practices on research productivity in Australia. *Research Policy*, 42(9), 1679-1693.

Bell, E., and Bryman, A. (2007). The ethics of management research: an exploratory content analysis. *British Journal of Management*, 18, 63–77.

Bello-Pintado, A. (2015). Bundles of HRM practices and performance: empirical evidence from a Latin American context. *Human Resource Management Journal*, 25(3), 311-330.

Beltrán-Martín, I, & 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 Quaterly,* 21, 99-110.

Benet-Zepf, A., Marin-Garcia, J., & Küster, I. (2018). Clustering the mediators between the sales control systems and the sales performance using the AMO model: A narrative systematic literature review. *Intangible Capital*, 14(3), 387-408.

Benito, M., Gil, P., Romera, R. (2019). Funding, is it key for standing out in the university rankings?. *Scientometrics*, 121, 771-792.

Bentler, P.M. (2006). *EQS 6 structural equations program manual*. Inc. Encino, CA. Multivariate Software. www.mvsoft.com

Bentler, P.M. (1995). *EQS Structural Equations Program Manual*. Encino, CA: Multivariate Software Inc.

Bentler, P. M. & Kano, Y. (1990). On the equivalence of factors and components. *Multivariate Behavioral Research, 25*(1), 67–74.

Bentley, P.J., & Kyvik. S. (2013). Individual differences in faculty research time allocations across 13 countries. *Research in Higher Education*, 54, 329–348.

Berbegal-Mirabent, J., Lafuente, E., & Sole, F. (2013). The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities. *Journal of Business Research,* 66, 2051-2059.

Besnoy, K. D., Dantzler, J., Besnoy, L. R., & Byrne, C. (2016). Using exploratory and confirmatory factor analysis to measure construct validity of the Traits, Aptitudes, and Behaviors Scale (TABS). *Journal for the Education of the Gifted*, *39*(1), 3–22.

Bezhani, I. (2010). Intellectual capital reporting at UK universities. *Journal of Intellectual Capital*, 11(2), 179–207.

Bihari, A., Tripathi, S., & Deepak, A. (2021). A review on h-index and its alternative indices. *Journal of Information Science*. In press.

Bikard, M., Vakili, K., & Teodoridis, F. (2019). When collaboration bridges institutions: The impact of University-Industry collaboration on academic productivity. *Organization Science*, 30(2), 426–445

Bland, C.J, Center, B.A, Finstad, D.A, Risbey, K.R, & Staples, J.G. (2005). A theoretical, practical, predictive model of faculty and department research productivity. *Academic Medicine : Journal of the Association of American Medical Colleges*, *80*(3),225–237.

Bloch, C. (2020). Heterogeneous impacts of research grant funding. *Research Evaluation*, 29(4), 456–468,

Bloch, C., Graversen, E. K., & Pedersen, H. S. (2014). Competitive research grants and their impact on career performance. *Minerva*, 52(1), 77-96.

Blumberg, M, & Pringle, C. (1982). The missing opportunity in organizational research: Some implications for a theory of work performance. *Academy of Management Review*, 7(4),560-569.

Bornmann, L., & Leydesdorff, L. (2018). Count highly-cited papers instead of papers with h citations: use normalized citation counts and compare "like with like"!. *Scientometrics*, *115*(2), 1119-1123.

Bos-Nehles, A.C, Van Riemsdijk, M.J, & Kees-Looise, J. (2013). Employee perceptions of line management performance: Applying the AMO theory to explain the effectiveness of line managers' HRM implementation, *Human Resource Management,* 52(6), 861-877.

Bouwmans, M, Runhaar, P, Wesselink, R, & Mulder, M. (2019). Stimulating teachers' team performance through team-oriented HR practices: the roles of affective team commitment and information processing. *The International Journal of Human Resource Management,* 30(5),856-878.

Boxall, P, & Purcell, J. (2003). *Strategy and Human Resource Management,* Basingstoke: Palgrave Macmillan.

Bozeman, B., & Corley, E. (2004). Scientists' collaboration strategies: implications for scientific and technical human capital. Research Policy, 33(4), 599–616.

Bozeman, B, Dietz, J, & Gaughan, M. (2001). Scientific and Technical Human Capital : An Alternative Model for Research Evaluation. *International Journal of Technology Management*, 22(8),716–740.

Brown, T. A. (2014). *Confirmatory factor analysis for applied research*. Guilford Publications: London.

Browne, M. W. (2001). An overview of analytic rotation in exploratory factor analysis. *Multivariate Behavioral Research*, *36*(1), 111–150.

Bryce, C., Dowling, M., Lucey, B. (2020). The journal quality perception gap. *Research Policy*, 49 (5). In press.

Brymer, R., & Hitt, M. (2019). Agonistic relations, social capital, and (dis)complementarity in the emergence of human capital. In A. Nyberg, & T. Moliterno (Eds.), Handbook of research on strategic human capital (pp. 245–257). Northampton, Mass: Edward Elgar Publishers. Handbook of research on strategic human capital (pp. 245–257). Northampton, Mass: Edward Elgar Publishers.

Buchmueller, T.C, Dominitz, J, & Hansen, W.L. (1999). Graduate training and the early career productivity of Ph. D. economists. *Economics of Education Review*, 18(1),65-77.

Butt, A., Lodhi, R.N. & Shahzad, M.K. (2020) Staff retention: a factor of sustainable competitive advantage in the higher education sector of Pakistan, *Studies in Higher Education*, 45:8, 1584-1604,

Byrne, B.M. (1998). *Structural equation modeling with LISREL, PRELIS and SIMPLIS: Basic concepts, applications and programming*, Mahwah, New Jersey: Lawrence Erlbaum Associates.

Cabrera-Nguyen, P. (2010). Author guidelines for reporting scale development and validation results in the Journal of the Society for Social Work and Research. *Journal of the Society for Social Work and Research*, *1*(2), 99–103.

Calma, A. (2014). Challenges in preparing academic staff for research training and supervision: The case of the Philippines. *International journal of educational management*, 28(6), 705-715.

Capano, G. (2018). Policy design spaces in reforming governance in higher education: the dynamics in Italy and the Netherlands. *Higher Education*, 75, 675–694.

Carayol, N, & Matt, M. (2004). Does research organization influence academic production? Laboratory level evidence from a large European university. *Research Policy*, 33(8),1081-1102.

Castro-Ceacero, D., & Ion, G. (2019). Changes in the University Research Approach: Challenges for Academics' Scientific Productivity. *Higher Education Policy*, 32(4), 681-699.

Cattel, R.B. (1966a). *The 16 personality factor questionnaire*. Illinois: Institute for Personality and Ability Testing.

Cattell, R.B. (1966b). The Scree Test for the Number of Factors. *Multivariate Behavioral Research*, 1,245–276.

Celis, S., & Kim, J. (2018). The making of homophilic networks in international research collaborations: A global perspective from Chilean and Korean engineering. *Research Policy*, 47(3), 573-582.

Chen, Y, Gupta, A, & Hoshower, L. (2006). Factors That Motivate Business Faculty to Conduct Research: An Expectancy Theory Analysis. *Journal of Education for Business*, 81(4),179–189.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern Methods for Business Research*, *295*(2), 295–336.

Chiva, R., Alegre, J., & Lapiedra, R. (2007). Measuring organisational learning capability among the workforce. *International Journal of Manpower*, *28*(3/4), 224–242.

Christensen, M., Dyrstad, J.M. & Innstrand, S.T. (2020). Academic work engagement, resources and productivity: empirical evidence with policy implications. *Studies in Higher Education*, 45(1), 86-99,

Churchill, G. A., Jr. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, 64–67.

Civera, A., Lehmann, E. E., Paleari, S., & Stockinger, S. A. (2020). Higher education policy: Why hope for quality when rewarding quantity?. *Research Policy*, 49(8), In press.

Cocos, M., & Lepori, B. (2020). What we know about research policy mix. *Science and Public Policy*, 47(2), 235–245.

Coff, R, & Kryscynski, D. (2011). Invited Editorial: Drilling for Micro-Foundations of Human Capital-Based Competitive Advantages. *Journal of Management*, 37(5),1429–1443.

Cohen, P., West, S. G., & Aiken, L. S. (2014). *Applied multiple regression/correlation analysis for the behavioral sciences*. Psychology Press.

Conway, J. M., & Huffcutt, A. I. (2003). A review and evaluation of exploratory factor analysis practices in organizational research. *Organizational Research Methods*, *6*(2), 147–168.

Conway, J.M., & Lance, C.E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology*, 25, 325–34.

Cook, W.D, Ramón, N, Ruiz, J.L, Sirvent, I, & Zhu, J (2019). DEA-based benchmarking for performance evaluation in pay-for-performance incentive plans. *Omega*, 84,45-54.

Corley, E., Bozeman, B., Zhang, X. and Tsai, C. (2019) 'The expanded scientific and technical human capital model: the addition of a cultural dimension', *The Journal of Technology Transfer*, 44, 681-699.

Costas, R., van Leeuwen, T. N., & Bordons, M. (2010). A bibliometric classificatory approach for the study and assessment of research performance at the individual level: The effects of age on productivity and impact. *Journal of American Society of Information Science and Technology*, 61(8), 1564–1581.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*, 10(7), 1–9.

Cowman, S. (1993). Triangulation: a means of reconciliation in nursing research. *Journal of advanced nursing*, 18(5), 788-792.

Cropper, P. & Cowton, C.J. (2021). Financial scenario modelling: a study of UK universities. *Journal of Higher Education Policy and Management*, 43:6, 592-606,

Crucke, S., & Decramer, A. (2016). The development of a measurement instrument for the organizational performance of social enterprises. *Sustainability*, *8*(2), 161.

Curtin, N, Malley, J, & Stewart, A.J (2016). Mentoring the Next Generation of Faculty: Supporting Academic Career Aspirations Among Doctoral Students. *Research in Higher Education,* 57,714-738.

Dang, Q.T., Jasovska, P., Rammal, H.G., & Schlenker, K. (2019). Formal-informal channels of university-industry knowledge transfer: the case of Australian business schools. *Knowledge Management Research & Practice*, 17 (4), 384-395.

Davenport, T.H., De Long, D.W., & Beers, M. (1998). Successful knowledge management projects. *Sloan Management Review*, 39(2), 43–57.

David, E. M., Kim, T.-Y., Farh, J.-L., Lin, X., & Zhou, F. (2021). Is 'be yourself' always the best advice? The moderating effect of team ethical climate and the mediating effects of vigor and demand–ability fit. *Human Relations*, 74(3), 437–462.

Deemer, E.D, Martens, M.P, & Buboltz, W.C. (2010). Toward a Tripartite Model of Research Motivation: Development and Initial Validation of the Research Motivation Scale. *Journal of Career Assessment,* 18(3),292-309.

Delaney, A. M. (2001). Institutional researchers' perceptions of effectiveness. *Research in Higher Education*, 42(2), 197-210.

Delamont, S, Atkinson P, & Parry O. (1997). Critical mass and doctoral research: reflections on the Harris report. *Studies in Higher Education*, 22(3), 319-331.

De Frutos-Belizón, J., Martín-Alcázar, F., & Sánchez-Gardey, G. (2019). Conceptualizing academic intellectual capital: definition and proposal of a measurement scale. *Journal of Intellectual Capital*, 20 (3), 306-334.

De Vries, R., Anderson, M.S., and Martinson. B.C. (2006). Normal misbehavior: scientists talk about the ethics of research. *Journal of Empirical Research on Human Research Ethics*, 1(1), 43–50.

De Witte, K., & Rogge, N. (2010). To publish or not to publish? On the

aggregation and drivers of research performance. *Scientometrics*, 85(3), 657-680.

Denzin, N. K. (2017). Critical qualitative inquiry. *Qualitative Inquiry*, 23, 8–16.

Denzin N.K. (1989) *The Research Act: A Theoretical Introduction to Sociological Methods*, 3rd edition. McGraw-Hill, New York.

DeVellis, R.F. (2003). Scale Development: Theory and Applications, Sage Publications, Thousand Oaks, CA.

Diem, A, & Wolter, S.C. (2013). The Use of Bibliometrics to Measure Research Performance in Education Sciences. *Research in Higher education*, 54,86-114

Dietz, J. S., & Bozeman, B. (2005). Academic careers, patents, and productivity: industry experience as scientific and technical human capital. *Research Policy*, 34(3), 349-367.

Ding, J., Liu, C. & Kandonga, G.A. (2020). Exploring the limitations of the h-index and h-type indexes in measuring the research performance of authors. *Scientometrics*, 122, 1303–1322.

Dowsett, L. (2020) Global university rankings and strategic planning: a case study of Australian institutional performance, *Journal of Higher Education Policy and Management*, 42(4), 478-494.

Drake, A., Struve, L., Meghani, S.A., & Bukoski, B. (2019). Invisible Labor, Visible Change: Non-Tenure-Track Faculty Agency in a Research University. *The Review of Higher Education,* 42(4), 1635-1664.

Dugas, D., Stich, A.E., Harris, L.N. & Summers, K.H. (2020). 'I'm being pulled in too many different directions': academic identity tensions at regional public universities in challenging economic times. *Studies in Higher Education*, 45(2), 312-326.

Dundar, H, & Lewis D.R. (1998). Determinants of research productivity in higher education. *Research in higher education*, *39*(6), 607-631.

Duran-Bellonch, M., & Ion, G. (2014). Investigadoras con éxito en la universidad…¿ cómo lo han logrado*?*. *Educación xx1*, 17(1), 39-58.

Durette, B, Fournier, M, & Lafon M. (2016). The core competencies of PhDs. *Studies in Higher Education*, 41(8), 1355–1370.

Dziuban, C.D., & Shirkey, E.C. (1974). When is a correlation matrix appropriate for factor analysis? Some decision rules. *Psychological Bulletin,* 81(6), 358–361.

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

Egghe, L. (2008). Mathematical theory of the h- and g-index in case of fractional counting of authorship. *Journal of the American Society for Information Science and Technology*, 59(10), 1608-1616.

Ellström, P., & Kock, H. (2008). Competence development in the workplace: concepts, strategies and effects. *Asia Pacific Education Review*, 9(1), 5–20.

Ennen, E., & Richter, A. (2010). The whole is more than the sum of its parts – Or is it? A review of the empirical literature on complementarities in organizations. *Journal of Management,* 36, 207–233.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C. & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*(3), 272–299.

Fabrigar, L. R., & Wegener, D. T. (2012). Structural equation modeling. In Applied multivariate statistics for the social sciences (pp. 549-594). Routledge.

Fadda, N., Marinò, L., Pischedda, G. & Ezza, A. (2021). The effect of performance-oriented funding in higher education: evidence from the staff recruitment budget in Italian higher education. *Higher Education*. In press.

Fan, W., & Yan, Z. (2010). Factors affecting response rates of the web survey: A systematic review. *Computers in human behavior*, 26(2), 132-139.

Farooq, R. (2016). Role of structural equation modeling in scale development. *Journal of Advances in Management Research*, *13*(1), 75–91.

Fernández-López, S., Rodeiro-Pazos, D., Calvo, N., & Rodríguez-Gulías, M. J.

(2018). The effect of strategic knowledge management on the universities' performance: An empirical approach. *Journal of Knowledge management*, 22 (3), 567-58

Ferrando, P. J., & Anguiano-Carrasco, C. (2010). El análisis factorial como técnica de investigación en psicología. *Papeles del psicólogo*, *31*(1), 18-33.

Field, A. (2000). *Discovering statistics using SPSS for Windows*. London: Sage Publications.

Finch, H. (2006). Comparison of the performance of varimax and promax rotations: Factor structure recovery for dichotomous items. *Journal of Educational Measurement*, *43*(1), 39–52.

Fleishman, E.A., & Reilly, M.A. (1992). *Handbook of human abilities: Definitions, measurements, and job task requirements*, Palo Alto: Consulting Psychologists Press, Inc.

Flick, U. (2007). What is qualitative research. *Designing qualitative research*, 2-16.

Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological Assessment*, *7*(3), 286.

Fox, M.F. (1983). Publication Productivity among Scientists: A Critical Review. *Social Studies of Science*, 13(2), 285-305.

Franco-Santos, M. & Doherty, N. (2017) Performance management and well-being: a close look at the changing nature of the UK higher education workplace. *The International Journal of Human Resource Management*, 28(16), 2319-2350,

Fulmer, I.S., & Ployhart, R.E. (2014). "Our most important asset": a multidisciplinary/multilevel review of human capital valuation for research and practice. *Journal of Management*, 40(1), 161-192.

Fumasoli, T., Barbato, G. & Turri, M. (2020). The determinants of university strategic positioning: a reappraisal of the organisation. *Higher Education*, 80, 305–334.

Fumasoli, T., & Lepori, B. (2011). Patterns of strategies in Swiss higher education institutions. *Higher Education*, 61(2), 157–178.

Fussy, D.S. (2019). The hurdles to fostering research in Tanzanian universities. *Higher Education*, 77, 283–299.

Fussy, D.S. (2018). Policy directions for promoting university research in Tanzania. *Studies in Higher Education,* 43(9), 1573-1585.

Garfield, E. (1996). What is the primordial reference for the phrase 'publish or perish.' *The Scientist*, 10(12), 11.

Gaughan, M., & Corley, E. A. (2010). Science faculty at US research universities: The impacts of university research center-affiliation and gender on industrial activities. *Technovation*, 30(3), 215-222.

Gaus, N., & Hall, D. (2016). Performance indicators in Indonesian universities: The perception of academics. *Higher Education Quarterly*, 70(2), 127-144.

Gerashchenko, D. (2021). Academic leadership and university performance: do Russian universities improve when they are led by top researchers?. Higher Education. In press.

Gerbing, D. W., & Anderson, J. C. (1988). An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research*, 186-192.

Gerhart, B., & Feng, J. (2021). The resource-based view of the firm, human resources, and human capital: Progress and prospects. *Journal of Management*, 47(7), 1796-1819.

Geuna A & Martin B (2003) University research evaluation and funding: An international comparison. *Minerva*, 41, 277–304

Ghimire, S., Amin, S. H., & Wardley, L. J. (2021). Developing new data envelopment analysis models to evaluate the efficiency in Ontario Universities. *Journal of Informetrics*, 15(3), 101172.

Ghlichlee, B., & Bayat, F. (2021). Frontline employees' engagement and business performance: the mediating role of customer-oriented behaviors. *Management Research Review*, 44 (2), 290-317.

Gilmore, A., Carson, D., & Perry, C. (2006). "Academic publishing: Best practice for editors, guest editors, authors and reviewers". *European Business Review,* 18(6): 468-478.

Goel, R.K., Göktepe-Hultén, D. (2020) Drivers of innovation productivity of academic researchers through career advancement. *Journal Technology Transfer*, 45, 414–429.

Gonzalez-Brambila, C, & Veloso, F.M. (2007). The determinants of research output and impact: A study of Mexican researchers. *Research policy,* 36, 1035-1051

Gourlay, S. (2006a). Conceptualizing knowledge creation: a critique of Nonaka's theory. *Journal of Management Studies*, 43, 1415–1436.

Gourlay, S. (2006b). Towards conceptual clarity for 'tacit knowledge': A review of empirical studies. *Knowledge Management Research & Practice*, 4(1), 60-69.

Grant, D.B., Kovács, G., & Spens, K. (2018). Questionable research practices in academia: antecedents and consequences. *European Business Review*, 30 (2): 101-127.

Griffith, T.L., & Sawyer, J.E. (2010). Multilevel knowledge and team performance. *Journal of Organizational Behavior*, 31, 1003–1031.

Groot, T., & García-Valderrama, T. (2006). Research quality and efficiency: An analysis of assessments and management issues in Dutch economics and business research programs. *Research policy*, 35(9), 1362-1376.

Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin*, *103*(2), 265.

Guarini, E., Magli, F., & Francesconi, A. (2020). Academic logics in changing performance measurement systems: an exploration in a university setting. *Qualitative Research in Accounting & Management*, 17 (1), 109-142.

Hair, J. F. Jr., Black, W. C., Babin, B. J. & Anderson, R. E. (2010). Multivariate data analysis (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L.

(2006). *Multivariate data analysis*. Upper Saddle River, NJ: Prentice Hall.

Hangel, N., & Schmidt-Pfister, D. (2017). Why Do You Publish? On the Tension between Generating Scientific Knowledge and Publication Pressure. *Aslib Journal of Information Management*, 69(5), 529–544.

Hardre, P.L, & Kollmann, S.L. (2012). Motivational Implications of Faculty Performance Standards. *Educational Management Administration & Leadership*, 40(6),724–751.

Harney, B., Monks, K., Alexopoulos, A., Buckley, F., & Hogan, T. (2014). University research scientists as knowledge workers: contract status and employment opportunities. *International Journal of Human Resource Management*, 25(16), 2219–2233.

Harris, C.M, McMahan, G.C, & Wright, P.M. (2012). Talent and time together: The impact of human capital and overlapping tenure on unit performance. *Personnel Review*, 41(4), 408-427.

Hautala, J. (2011). International academic knowledge creation and ba. A case study from Finland. *Knowledge Management Research & Practice,* 9, 4-16.

Hauff, S., Guerci, M., Dul, J., & van Rhee, H. (2021). Exploring necessary conditions in HRM research: Fundamental issues and methodological implications. *Human Resource Management Journal*, 31(1), 18-36.

Hayes, A. (2013). Introduction to mediation, moderation, and conditional process analysis. New York, NY: Guilford.

Hedjazi, Y, & Behravan, J. (2011). Study of factors influencing research productivity of agriculture faculty members in Iran. *Higher education,* 62(5), 635-647.

Hedlund, G. (1994). A model of knowledge management and the N-form corporation. *Strategic Management Journal*, 15, 73–91.

Hendriks, P., & Sousa, C. (2008). Motivating University Researchers. *Higher Education Policy*, 21: 359–376.

Heng, K., Hamid, M., & Khan, A. (2020). Factors influencing academics' research engagement and productivity: A developing countries

perspective. *Issues in Educational Research*, 30(3), 965-987.

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research: Common errors and some comment on improved practice. *Educational and Psychological Measurement*, *66*(3), 393–416.

Henwood, K. (2004). Reinventing validity. *Mixing methods in psychology: The integration of qualitative and quantitative methods in theory and practice*, 37-57.

Hernández-Sampieri, R., Fernández-Collado, C., & Baptista-Lucio, M.P. (2014). *Metodología de la investigación*. Mc Graw Hill.

Herschberg, C., Benschop, Y., & van den Brink, M. (2018). Selecting early-career researchers: the influence of discourses of internationalisation and excellence on formal and applied selection criteria in academia. *Higher Education*, 76(5), 807–825.

Hicks, D. (2012). Performance-based university research funding systems. *Research Policy*, 41(2), 251–261.

Hicks, D. & Katz, J.S. (2011). Equity and Excellence in Research Funding. *Minerva*, 49, 137–151.

Highman, L. (2020) Remapping French higher education: towards a multi-tiered higher education system?. Tertiary Education and Management, 26, 199–214.

Hinkin, T.R. (1998), A brief tutorial on the development of measures for use in survey questionnaires. *Organizational Research Methods*, 1(1): 104-21.

Hirsch, J.E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, 102(46), 16569-16572.

Hinkin, T.R. (1998). A brief tutorial on the development of measures for use in survey questionnaires. *Organizational Research Methods*, 1(1): 104-121.

Hockfield, M. (2008), Accountability and learning assessment in the future of higher education. *On the Horizon*, 16(2), 55-71.

Hong, M. (2018) Public university governance in China and Australia: a comparative study. *Higher Education*, 76, 717–733.

Horta, H., Jung, J., Zhang, L. Postiglione, G. A. (2019). Academics´job-related stress and institutional commitment in Hong Kong universities". *Tertiary Education and Management*. In press.

Horta, H., & Santos, J. M. (2020). Organisational factors and academic research agendas: an analysis of academics in the social sciences. *Studies in Higher Education*, 45(12), 2382-2397.

Horta, H, & Santos, J.M. (2016). The impact of publishing during PhD studies on career research publication, visibility, and collaborations. *Research in Higher Education*, 57(1), 28-50.

Hu, L. & Bentler, P. (1999). Cut off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modelling*, 6(1), 1–55.

Hu, Q. & Gill, T.G. (2000). IS faculty research productivity: influential factors and implications. *Information Resources Management Journal*, 13(2), 15-25.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic Management Journal*, 20(2), 195–204.

Huybers, T., Greene, B. & Rohr, D.H. (2020). Academic research integrity: Exploring researchers' perceptions of responsibilities and enablers, *Accountability in Research*, 27 (3), In press.

Hurley, A. E., Scandura, T. A., Schriesheim, C. A., Brannick, M. T., Seers, A., Vandenberg, R. J., & Williams, L. J. (1997). Exploratory and confirmatory factor analysis: Guidelines, issues, and alternatives. *Journal of Organizational Behavior*, *18*(6), 667–683.

Hussein, A. (2009). The use of triangulation in social sciences research. *Journal of comparative social work*, 4(1), 106-117.

Iglesias, J.E, & Pecharroman, C. (2007). Scaling the h-index for different scientific ISI fields. *Scientometrics*, 73(3), 303-320.

Janger, J, & Nowotny, K. (2016). Job choice in academia. *Research Policy*, 45(8),1672–1683.

Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of Consumer Research*, *30*(2), 199–218.

Jiang, K, Lepak, D.P, Hu, J, & Baer, J.C. (2012). How Does Human Resource Management Influence Organizational Outcomes? A Meta-analytic Investigation of Mediating Mechanisms. *Academy of Management Journal*, 55(6), 1264–1294.

Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly*, *24*(4), 602–611.

Johns, G. (2017). "Reflections on the 2016 decade award: incorporating context in organisational research". *Academy of Management Review*, 42, 577-595.

Jonkers K, Tijssen R. (2008).Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics*, 77(2), 309- 333.

Jönsson, S. (2006). On academic writing. *European Business Review*, 18 (6), 479-490.

Jørgensen, F., & Hanssen, T. E. S. (2018). Research incentives and research output. *Higher Education*, 76(6), 1029-1049.

Kaiser, H.F. (1974). An index of factorial simplicity. *Psychometrika*, 39 (1): 31–36.

Kaltenbrunner, W. (2018). Situated knowledge production, international impact: Changing publishing practices in a german engineering department. *Minerva*, 56(3), 283-303.

Kamrani, P., Dorsch, I. & Stock, W.G. (2021). Do researchers know what the h-index is? And how do they estimate its importance?. *Scientometrics*, 126, 5489–5508.

Kaplowitz, M. D., Lupi, F., Couper, M. P., & Thorp, L. (2012). The effect of invitation design on web survey response rates. *Social Science Computer Review*, 30(3), 339-349.

Käpylä, J, Jääskeläinen, A, & Lönnqvist A. (2010). Identifying future challenges for productivity research: evidence from Finland. *International Journal of Productivity and Performance Management*, 59(7),607–623.

Karasek R.A. (1979). Job demands, job decision latitude and mental strain. Implications for job redesign. *Administrative Science Quarterly*, 24, 285–308.

Kawaguchi, D., Kondo, A. & Saito, K. (2016) Researchers' career transitions over the life cycle. *Scientometrics*, 109, 1435–1454.

Kenny, J. (2017). Academic work and performativity. *Higher Education*, 74, 897-913.

Kenny, J. & Fluck, A.E. (2021). Emerging principles for the allocation of academic work in universities. *Higher Education*. In press.

Khan, T., & Siriwardhane, P. (2021). Barriers to Career Progression in the Higher Education Sector: Perceptions of Australian Academics. *Sustainability*, 13(11), 6255.

Khvatoka, T., & Dushina, S. (2017). To manage or govern? Researching the legitimacy of NPM-based institutional reforms in Russian universities. *Journal of Management Development*, 36 (2), 250-267.

Kim, D.H., & Bak,H.J. (2020) Reconciliation Between Monetary Incentives and Motivation Crowding-Out: The Influence of Perceptions of Incentives on Research Performance, *Public Performance & Management Review*, 43:6, 1292-1317

Kim, K.Y, Pathak, S, & 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(7),784–805.

Kintish, E. (2005). Researcher faces prison for fraud in NIH grant applications and papers. *Science*, 307, 1851.

Kirkland, J. (2008). University research management: An emerging profession in the developing world. *Technology Analysis & Strategic Management*, 20(6), 717-726.

Kishi, N. (2020). How does policy focus influence scientific research?. *Science and Public Policy*, 47 (1), 114–124.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Publications: London.

Knies, E, & Leisink P. (2014). Linking people management and extra-rolebehaviour: Results of a longitudinal study. *Human Resource Management Journal,* 24(1),57-76.

Kumar, A, & Thakur, R.R. (2019). Objectivity in performance ranking of higher education institutions using dynamic data envelopment analysis. *International Journal of Productivity and Performance Management,* 68 (4), 774-796.

Kvale, S. (2007). *Doing interviews*. London: Sage Publications.

Kwiek, M. (2018). Academic top earners. Research productivity, prestige generation, and salary patterns in European universities. *Science and Public Policy*, 45(1),1–13.

Kwiek, M. (2016). The European research elite: a cross-national study of highly productive academics in 11 countries. *Higher Education*, 71(3), 379–397.

Kyvik, S. (2013). The academic research role: enhancing expectations and improved performance. *Higher education,* 65, 525-538.

Kyvik, S. & Aksnes, D.W. (2015). Explaining the increase in publication productivity among academic staff: a generational perspective. *Studies in Higher Education*, 40(8), 1438-1453.

Lafuente, E., & Berbegal-Mirabent, J. (2017). Contract employment policy and research productivity of knowledge workers: an analysis of Spanish universities. *International Journal of Human Resource Management*, 1–27.

Landeta, J. (2006). Current validity of the Delphi method in social sciences. *Technological Forecasting and Social Change*. *Change*, 73 (5), 467–482.

Landeta, J. (1999). *El método Delphi, una técnica de previsión del futuro*. Barcelona: Ariel S.A.

Lariviere, V, Macaluso, B, Archambault, E, & Gingras, Y. (2010). Which scientific elites? On the concentration of research funds, publications and citations. *Research Evaluation*, 19,45–53.

Laudel, G. and Gläser, J. (2008), "From apprentice to colleague: the metamorphosis of early career researchers", *Higher Education*, 55(3), 387-406.

Leathwood, C. & Read, B. (2013) Research policy and academic performativity: compliance, contestation and complicity, *Studies in Higher Education*, 38:8, 1162-1174

Leahey, E, Beckman, C.M, & Stanko T.L. (2017). Prominent but less productive: the impact of interdisciplinarity on scientifist´s research. *Administrative Science Quaterly,* 62(1),105-139.

Lee, H.J. (2021). Relationship between Emotional Labor and Job Satisfaction: Testing Mediating Role of Emotional Intelligence on South Korean Public Service Employees. *Public Organization Review*, 21, 337–353.

Lee, Y. H. (2021). Determinants of research productivity in Korean Universities: the role of research funding. *The Journal of Technology Transfer*, 46(5), 1462-1486.

Lee, S., & Bozeman, B. (2005). The impact of research collaboration on scientific productivity. *Social Studies of Science*, 35(5), 673-702.

Lee, K., Choi, S. & Yang, JS. (2021). Can expensive research equipment boost research and development performances?. *Scientometrics*, 126, 7715–7742.

Lee, H., Miozzo, M., & 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.

Lehmann, E.E., Meoli, M., Paleari, S., & Stockinger, S.A. (2018). Approaching effects of the economic crisis on university efficiency: a comparative study of Germany and Italy. *Eurasian Business Review*, 8, 37–54.

Leitner, KH., Prikoszovits, J., Schaffhauser-Linzatti, M., Stowasser, R. & Wagner, K. (2007). The impact of size and specialisation on universities' department performance: A DEA analysis applied to Austrian universities. *Higher Education*, 53, 517–538.

Leitner, K. H. (2004). Intellectual capital reporting for universities: conceptual background and application for Austrian universities. *Research evaluation*, 13(2), 129-140.

Lepak, D.P, Liao, H, Chung, Y, & Harden, E. (2006). A conceptual review of human resource management systems in strategic human resource management research. *Research in Personnel and Human Resource Management*, 25(1), 217-271.

Lepori, B., Wise, M., Ingenhoff, D., & Buhmann, A. (2016). The dynamics of university units as a multi-level process. Credibility cycles and resource dependencies. *Scientometrics*, *109*(3), 2279-2301.

Levecque, K, Ansell, F, De Beuckelaer, A, Van der Heyden, J, & Gisle, L. (2017) Work organization and mental health problems in PhD students. *Research Policy*, 46, 868-879.

Levin, S., & Stephan, P. (1991). Research productivity over the life cycle: Evidence for academic scientists. *American Economic Review*, 81(1), 114–132.

Leydesdorff, L., & Etzkowitz, H. (1998). The triple helix as a model for innovation studies. *Science and public policy*, 25(3), 195-203.

Lin, J.Y. (2021). Collaboration exploitation and exploration: does a proactive search strategy matter?. *Scientometrics,* 126, 8295–8329.

Lin, M. W., & Bozeman, B. (2006). Researchers' industry experience and productivity in university–industry research centers: A "scientific and technical human capital" explanation. *The Journal of Technology Transfer*, 31(2), 269-290.

Lind, J.K. (2020). Resource environment and hierarchy in universities. *Science and Public Policy*, 47 (2), 184–193.

Lindell, M.K, & Whitney, D.J. (2001). Accounting for common method variance in cross-sectional research designs. *Journal of applied psychology*, 86(1), 114.

Lindberg, O., & Rantatalo, O. (2015). Competence in professional practice: A practice theory analysis of police and doctors. *Human Relations*, 68 (4), 561–582.

Link, K., Müller, B. (2020). Multiple-party funding: tensions and related consequences for academic research in Europe. *Review of Managerial Science*, 14, 417–445.

Link, A., Swann, C., & Bozeman, B. (2008). A time allocation study of university faculty. *Economics of Education Review*, 27(4), 363–374.

Lissoni, F, Mairesse, J, Montobbio, F, & Pezzoni, M. (2011). Scientific productivity and academic promotion: a study on French and Italian physicists. *Industrial and Corporate Change*, 20(1): 253–294.

Litwin, J.M. (2009) The Efficacy of Strategy in the Competition for Research Funding in Higher Education. *Tertiary Education and Management*, 15:1, 63-77,

Lloret-Segura, S., Ferreres-Traver, A., Hernández-Baeza, A., and Tomás-Marco, I. (2014). El análisis factorial exploratorio de los ítems: una guía práctica, revisada y actualizada. *Anales de Psicología,* 30 (3), 1151–1169.

Loomes, S., Owens, A. & McCarthy G. (2019). Patterns of recruitment of academic leaders to Australian universities and implications for the future of higher education, *Journal of Higher Education Policy and Management*, 41(2), 137-152.

Lovitts, B.E. (2005). Being a good course-taker is not enough: a theoretical perspective on the transition to independent research. *Studies in Higher Education,* 30(2), 137-154.

Lu, X. (2021) What drives Chinese scholars to publish in international journals? Motivations and implications, *Higher Education Research & Development*, In press.

Luukkonen, T., & Thomas, D.A. (2016). The 'Negotiated Space' of University Researchers' Pursuit of a Research Agenda. *Minerva*, 54, 99–127.

Ma, L. (2019). Money, morale, and motivation: a study of the Output-Based Research Support Scheme in University College Dublin. *Research Evaluation*, 28 (4), 304–312.

MacCallum, R. C., & Browne, M. W. (1993). The use of causal indicators in covariance structure models: Some practical issues. *Psychological Bulletin*, *114*(3), 533.

MacCallum, R. C., Widaman, K. F., Preacher, K. J., & Hong, S. (2001). Sample size in factor analysis: The role of model error. *Multivariate Behavioral Research*, *36*(4), 611–637.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4*(1), 84–99.

MacDuffie, J.P. (1995). Human resource bundles and manufacturing performance: Organizational logic and flexible production systems in the world auto industry. *Industrial and Labor Relations Review*, 48(2), 197-221.

Maisano, D. A., Mastrogiacomo, L., & Franceschini, F. (2020). Short-term effects of non-competitive funding to single academic researchers. *Scientometrics*, 123(3), 1261-1280.

Marginson, S. (2019). Limitations of human capital theory. *Studies in Higher Education*, 44(2), 287-301.

Marie, J. (2008). Postgraduate science research skills: the role of creativity, tacit knowledge, thought styles and language. *London Review of Education*, 6(2),149–158.

Marin-Garcia, J.A, & Martinez-Tomas, J. (2016). Deconstructing AMO framework: A systematic review *Intangible Capital*, 12(4), 1040-1087.

Martín-Alcázar, F., Romero-Fernandez, P. M., & Sánchez-Gardey, G. (2005). Strategic human resource management: integrating the universalistic, contingent, configurational and contextual perspectives. *The International Journal of Human Resource Management*, 16(5), 633-659.

Martin-Sardesai, A. & Guthrie, J. (2018). Human capital loss in an academic performance measurement system. *Journal of Intellectual Capital*, 9 (1), 53-70.

Matsunaga, M. (2010). How to factor-analyze your data right: Do's, don'ts, and how to's. *International Journal of Psychological Research*, *3*(1), 97–110.

Mayrath, M.C. (2008). Attributions of productive authors in educational psychology journals. *Educational Psychology Review*, 20, 41–56.

McCabe, A., Osegowitsch, T., Parker, R., & Cox, S. (2021). Knowledge co-production in academic-practitioner research collaboration: An expanded perspective on power. *Management Learning*. In press.

McGrath, J. E. (1995). Methodology matters: Doing research in the behavioral and social sciences. In R. M. Backer (Eds.), Readings in human-computer interaction: Toward the year 2000 (pp. 152-169). Burlington, MA: Morgan Kaufman

McNie, E.C, Parris, A, & Sarewitz, D. (2016). Improving the public value of science: A typology to inform discussion, design and implementation of research, *Research Policy*, 45(4), 884–895.

Meerah, T. S. M., Osman, K., Zakaria, E., Ikhsan, Z. H., Krish, P., Lian, D. K. C. & Mahmod, D. (2012). Measuring Graduate Students Research Skills. *Procedia-Social and Behavioral Sciences*, 60, 626–629.

Meyer, B. & Sugiyama, K. (2007). The concept of knowledge in KM: a dimensional model. *Journal of Knowledge Management*. 11 (1), 17-35

Mitchell, T.R. (1982). Motivation: New directions for theory, research and practice. *Academy of Management Review*, 7 (1),80–88.

Mohammadi, S. & Karupiah, P. (2020) Quality of work life and academic staff performance: a comparative study in public and private universities in Malaysia, *Studies in Higher Education*, 45:6, 1093-1107

Mooken, M., & Sugden, R. (2014). The capabilities of academics and academic poverty. *Kyklos*, 67, 588–614.

Morris, N. (2003). Academic researchers as "agents" of science policy. *Science*

*& Public Policy,* 30(5), 359–370.

Moses, I. (1986). Promotion of academic staff. *Higher Education*, 15(1), 135-149

Mudrak, J, Zabrodska, K, Kveton, P, Jelinek, M, Blatny, M, Solcova, I, & Machovcova, K. (2018). Occupational well-being among university faculty: A job demands-resources model. *Research in Higher Education*, *59*(3),325-348.

Mueller, R. O. (1997). Structural equation modeling: Back to basics. *Structural Equation Modeling: A Multidisciplinary Journal*, *4*(4), 353–369.

Mulaik, S. A. (1990). Blurring the distinctions between component analysis and common factor-analysis. *Multivariate Behavioral Research*, *25*(1), 53–59.

Mwesigwa, R., Tusiime, I., & Ssekiziyivu, B. (2020). Leadership styles, job satisfaction and organizational commitment among academic staff in public universities. *Journal of Management Development*. 39 (2), 253-268.

Naeem, A., Mirza, N.H., Ayyub, R.M. & Lodhi, R.N. (2019). HRM practices and faculty's knowledge sharing behavior: mediation of affective commitment and affect-based trust". *Studies in Higher Education*, 44(3), 499-512.

Neumann, A. (2006). Professing passion: Emotion in the scholarship of professors at research universities, *American Educational Research Journal*, 43, 381–424.

Newman, M. E. (2004). Coauthorship networks and patterns of scientific collaboration. *Proceedings of the National Academy of Sciences*, 101(suppl 1), 5200–5205.

Nguyen, T.L.H. (2016). Building human resources Management capacity for university research: The case at four leading Vietnamese universities. *Higher education,* 71, 231-251.

Nguyen, H.V., Phan, T.T.H., Nguyen, H., Nguyen, N., & Nguyen, M.H. (2020). What is a Good Journal? Perceptions of Vietnamese Early-Career and Mid-Career Researchers. *Publishing Research Quaterly*, 36, 296–303.

Nguyen, H.T.L & Van Gramberg, B. (2018) University strategic research planning: a key to reforming university research in Vietnam?, *Studies in Higher Education*, 43(12), 2130-2147

Nimon, K., Zigarmi, D., Houson, D., Witt, D., & Diehl, J. (2011). The work cognition inventory: Initial evidence of construct validity. *Human Resource Development Quarterly*, *22*(1), 7–35.

Nishii, L. H., Wright, P. (2008). Variability at Multiple Levels of Analysis: Implications for Strategic Human Resource Management. In D.B. Smith (Ed.), The people make the place (pp. 225–248). Erlbaum.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: how Japanese companies create the dynamics of innovation,* Oxford: Oxford University Press.

Nonaka, I. and Toyama, R. (2003). The knowledge creating theory revisited: knowledge creation as a synthesizing process. *Knowledge Management Research and Practice*, 1(1), 2-10.

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Planning*, 33, 5–34.

Nonaka, I., & Von Krogh, G. (2009). Tacit knowledge and knowledge conversion: controversy and advancement in organizational knowledge creation theory. *Organization Science*, 20, 635–652.

Numprasertchai, S., & Igel, B. (2005). Managing knowledge through collaboration: multiple case studies of managing research in university laboratories in Thailand. *Technovation*, 25(10), 1173-1182.

Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.

Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory,* New York, NY: McGraw-Hill.

Nyberg, A.J., Moliterno, T.P., Hale, D., & Lepak, D.P. (2014). Resource-based perspectives on unit-level human capital: a review and integration. *Journal of Management*, 40, 316–346.

Obeid, S.M. & Rabea, S. (2016). The impact of knowledge management dimensions in the learning organization from the perspective of the Arab American University's (AAU) faculty–Palestine. *Jordan Journal of Business Administration*, 12 (4), 813-840

O'Loughlin, D., MacPhail, A. & Msetfi, R. (2015). The rhetoric and reality of research reputation: 'fur coat and no knickers'. *Studies in Higher Education*, 40(5), 806-820

Okoli, C., & Pawlowski, S.D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, 42 (1), 15–29.

Onwuegbuzie, A. J., & Daniel, L. G. (2003). Typology of analytical and interpretational errors in quantitative and qualitative educational research. *Current Issues in Education*, *6*.

Oppermann, M. (2000). Triangulation—a methodological discussion. *International Journal of Tourism Research*, 2(2), 141-145.

Osborne, J. W. & Costello, A. B. (2004). Sample size and subject to item ratio in principal components analysis. *Practical, Assessment, Research & Evaluation*, 9(11).

Pak, K., Kooij, D.T., De Lange, A.H. & Van Veldhoven, M.J. (2019), Human Resource Management and the ability, motivation and opportunity to continue working: a review of quantitative studies. *Human Resource Management Review*, 29(3), 336-352.

Panda, A., Sinha, S., & Jain, N. K. (2021). Job meaningfulness, employee engagement, supervisory support and job performance: a moderated-mediation analysis. International Journal of Productivity and Performance Management. In press.

Papadimitriou, M, & Johnes, J. (2019). Does merging improve efficiency? A study of English universities. *Studies in higher education,* 44(8), 1454-1474.

Park, H. S., Dailey, R., & Lemus, D. (2002). The use of exploratory factor analysis and principal components analysis in communication research. *Human Communication Research*, *28*(4), 562–577.

Pedro, E., Leitão, J., & Alves, H. (2019). The intellectual capital of higher education institutions: Operationalizing measurement through a strategic prospective lens. Journal of Intellectual Capital. In press.

Peng, J.E, & Gao X. (2019). Understanding TEFL Academics' Research Motivation and Its Relations with Research Productivity. *SAGE Open*, *9*(3), 2158244019866295.

Pett, M. A., Lackey, N. R., & Sullivan, J. J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. Thousands Oaks, California: Sage.

Pham-Thai, N. T., McMurray, A. J., Muenjohn, N., & Muchiri, M. (2018). Job engagement in higher education. *Personnel Review*, 47(4), 951–967.

Pietilä, M. (2019). Incentivising academics: experiences and expectations of the tenure track in Finland. *Studies in Higher Education*, 44(6), 932-945,

Piro, F. N., Børing, P., Scordato, L., & Aksnes, D. W. (2020). University characteristics and probabilities for funding of proposals in the European Framework Programs. *Science and Public Policy*, 47(4), 581-593.

Ployhart, R. E. (2021). Resources for What? Understanding Performance in the Resource-Based View and Strategic Human Capital Resource Literatures. *Journal of Management*, 47(7), 1771-1786.

Ployhart, R.E., & Moliterno, T.P. (2011). Emergence of the human capital resource: a multilevel model. *Academy of Management Review*, 36 (1), 127–50.

Ployhart, R. E., Nyberg, A. J., Reilly, G., & Maltarich, M. A. (2014). Human Capital Is Dead; Long Live Human Capital Resources!. *Journal of*

*Management*, 40(2), 371–398.

Podsakoff, P. M., MacKenzie, S.B., Lee, J.Y., & Podsakoff, N.P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879-903.

Polanyi, M. (1966). *The tacit dimension*. London, England: Doubleday & Co.

Prakhov, I. (2019). The determinants of academic salaries in Russia. *Higher Education*, 77, 777-797.

Prpić, K. (1996). Characteristics and determinants of eminent scientists' productivity. *Scientometrics*, 36, 185–206.

Pruvot, E.B., Estermann, T., & Kupriyanova, V. (2017). *EUA Public Funding Observatory 2017*. European University Association (EUA). Brussels.

Rahmandad, H., & Vakili, K. (2019). Explaining heterogeneity in the organization of scientific work. *Organization Science*, 30(6), 1125-1145.

Ramírez-Córcoles, Y., Santos-Peñalver, J. F., & Tejada Ponce, Á. (2011). Intellectual capital in Spanish public universities: stakeholders' information needs. *Journal of Intellectual Capital*, 12(3), 356–376.

Reio, T. G., Jr., & Shuck, B. (2015). Exploratory factor analysis: implications for theory, research, and practice. *Advances in Developing Human Resources*, *17*(1), 12–25.

Rentz, J. O., Shepherd, C. D., Tashchian, A., Dabholkar, P. A., & Ladd, R. T. (2002). A measure of selling skill: Scale development and validation. *Journal of Personal Selling & Sales Management*, *22*(1), 13–21.

Reymert, I., Jungblut, J. & Borlaug, S.B. (2020) Are evaluative cultures national or global? A cross-national study on evaluative cultures in academic recruitment processes in Europe. *Higher Education*. In press.

Rietveld, T., & van Hout, R. (1993). *Statistical techniques for the study of language and language behaviour*. Berlin: Mouton de Gruyter.

Rodríguez-Gomez, G.; Gil, J.; García, E. (1999). Metodología de la investigación cualitativa. Málaga: Aljibe.

Rogers, E. W., & Wright, P. M. (1998). Measuring organizational performance in strategic human resource management: Problems, prospects and performance information markets. *Human Resource Management Review*, *8*(3), 311–331.

Roos, J., Roos, G. & Dragonetti, et al. (1997). Intellectual Capital: Navigating the New Business Landscape, Mcmillan Business, London.

Rosewell, K. & Ashwin, P. (2019). Academics' perceptions of what it means to be an academic. *Studies in Higher Education*, 44:12, 2374-2384.

Rorstad, K, & Aksnes, D.W. (2015). Publication rate expressed by age, gender and academic position – A large-scale analysis of Norwegian academic staff. *Journal of Informetrics*, 9, 317-333.

Rowley, J. (2000). Is higher education ready for knowledge management?. *International Journal of Educational Management*, 14(7), 325-333.

Runhaar, P. (2017). How can schools and teachers benefit from human resources management? Conceptualising HRM from content and process perspectives. *Educational Management Administration & Leadership*, 45(4), 639-656.

Ruscio, J., & Roche, B. (2012). Determining the number of factors to retain in an exploratory factor analysis using comparison data of known factorial structure. *Psychological Assessment*, *24*(2), 282

Ryan, J. C. (2014). The work motivation of research scientists and its effect on research performance. *R&D Management*, 44(4), 355-369.

Ryan, J.C., & Berbegal-Mirabent, J. (2016). Motivational recipes and research performance: A fuzzy set analysis of the motivational profile of high performing research scientist. *Journal of Business Research,* 69, 5299-5304.

Sá, C.M., Li, S.X. & Faubert, B. (2011). Faculties of education and institutional strategies for knowledge mobilization: an exploratory study. *Higher Education*, 61, 501–512.

Sá, C. M., & Tamtik, M. (2012). Strategic planning for academic research. *Higher Education Management and Policy*, 24(1), 1-20.

Sabherwal, R., & Becerra-Fernandez, I. (2003). An empirical study of the effect of knowledge management processes at individual, group, and organizational levels. *Decision Sciences*, 34, 225–260.

Sadiq, H., Barnes, K. I., Price, M., Gumedze, F., & Morrell, R. G. (2019). Academic promotions at a South African University: Questions of bias, politics and transformation. *Higher education*, 78, 423-442.

Safavi, M. & Håkanson, L. (2018). Advancing theory on knowledge governance in universities: a case study of a higher education merger. *Studies in Higher Education*, 43(3), 500-523

Sagarra, M, Molinero, C.M, & Agasisti, T. (2017). Exploring the efficiency of Mexican universities: integrating Data Envelopment Analysis and Multidimensional Scaling. *Omega*, 67,123-133.

Sahdra, B., & Thagard, P. (2003). Procedural knowledge in molecular biology. *Philosophical Psychology*, 16 (4), 477–498.

Salas-Vallina, A., Pasamar, S. & Donate, M.J. (2021). Well-being in times of ill-being: how AMO HRM practices improve organizational citizenship behaviour through work-related well-being and service leadership. *Employee Relations*, 43(4), 911-935.

Sandoval-Romero, V., & Larivière, V. (2020). The national system of researchers in Mexico: implications of publication incentives for researchers in social sciences. *Scientometrics*, 122(1), 99-126.

Sandy, W., & Shen, H. (2019). Publish to earn incentives: how do Indonesian professors respond to the new policy?. *Higher Education*, 77(2), 247-263.

Santini, M. A. F., Faccin, K., Balestrin, A., & Martins, B. V. (2021). How the relational structure of universities influences research and development results. *Journal of Business Research*, 125, 155-163.

Sass, D. A., & Schmitt, T. A. (2010). A comparative investigation of rotation criteria within exploratory factor analysis. *Multivariate Behavioral Research*, *45*(1), 73–103.

Sawitri, D.R., Creed, P.A. (2021) Perceived research environment, motivation,

and academic interest in research: a social-cognitive perspective. *International Journal for Educational and Vocational Guidance*, 21, 489–506.

Schmidt, R.C. (1997). Managing Delphi surveys using nonparametric statistical techniques. *Decision Sciences,* 28 (3), 763–774.

Schmitt, T. A., & Sass, D. A. (2011). Rotation criteria and hypothesis testing for exploratory factor analysis: Implications for factor pattern loadings and interfactor correlations. *Educational and Psychological Measurement*, 71(1), 95-113.

Scholten, W., Franssen, T., van Drooge, L., de Rijcke, S. & Hessels, L.K. (2021). "Funding for few, anticipation among all: Effects of excellence funding on academic research groups". *Science and Public Policy. In press.*

Schuelke-Leech, B.A. (2013). Resources and research: An empirical study of the influence of departmental research resources on individual STEM researchers involvement with industry. *Research Policy*, 42(9),1667–1678.

Schultz, T.W. (1963). *The economic value of education*, New York: Columbia University Press.

Schumacker, RE. & Lomax R.G. (2004). *A Beginner's Guide to Structural Equation Modelling*, 2nd ed., Lawrence Erlbaum Associates, London.

Secundo, G., Dumay, J., Schiuma, G., & Passiante, G. (2016). Managing intellectual capital through a collective intelligence approach: An integrated framework for universities. *Journal of Intellectual Capital*, 17(2), 298–319.

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

Sethi, V., & King. W.R. (1994). Development of measures to assess the extent to which an information technology application provides competitive

advantage. *Management Science*, 40 (12), 1601–1624.

Shmatko, N, & Volkora, G. (2017). Service or Devotion?. Motivation Patterns of Russian Researchers. *Foresight and STI Governance,* 11(2),54-66.

Shin, J.C., Jung, H. & Lee, S.J. (2021). Performance-Based Research Funding and Its Impacts on Academics' Publication Patterns in South Korea. *Higher Education Policy. In press.*

Siboni, B., Nardo, M.T. and Sangiorgi, D. (2013). Italian state university contemporary performance plans: an intellectual capital focus?, *Journal of Intellectual Capital*, 14(3), 414-430.

Siemsen, E, Roth, A.V, & Balasubramanian, S. (2008). How motivation, opportunity, and ability drive knowledge sharing: The constraining-factor model. *Journal of Operations Management*, 26(3), 426–445.

Smeenk, S. G. A., Eisinga, R. N., Teelken, J. C., & Doorewaard, J. A. C. M. (2006). The effects of HRM practices and antecedents on organizational commitment among university employees. *International Journal of Human Resource Management*, 17(12), 2035–2054.

Smith, H. W. (1975). *Strategies of social research. the methodological imagination. London: Prentice-Hall.*

Sondari, M., Tjakraatmadja, J.H., Bangun, Y. R. (2016). What motivate faculty member to do research? A literature review. *The Social Science*, 11(1), 5265–5269.

Snook, S. C., & Gorsuch, R. L. (1989). Component analysis versus common factor-analysis - a Monte- Carlo Study. *Psychological Bulletin*, *106*(1), 148–154.

Sousa, C. A. A., & Hendriks, P. H. (2008). Connecting knowledge to management: The case of academic research. *Organization*, 15(6), 811-830.

Steiger, J. H. (2004). Paul Meehl and the evolution of statistical methods in psychology. *Applied and Preventive Psychology, 11*, 69–72.

Steiger, J. H. (1990). Some additional thoughts on components, factors, and factor-indeterminacy. *Multivariate Behavioral Research, 25*(1), 41–45.

Stensaker, B., & Fumasoli, T. (2017). Multi-level strategies in universities: Coordination, contestation or creolisation?. *Higher Education Quarterly*, 71(3), 263-273.

Stroebe, W. (2010). The graying of academia: Will it reduce scientific productivity? *American Psychologist*, 65(7), 660–673.

Stubb, J., Pyhältö, K., & Lonka, K. (2014). Conceptions of research: the doctoral student experience in three domains. Studies in Higher Education, 39(2), 251-264.

Su, X. (2011). Postdoctoral training, departmental prestige and scientists' research productivity. *The Journal of Technology Transfer*, 36(3),275–291.

Sutherland, K.A. (2017). Constructions of success in academia: an early career perspective. *Studies in Higher Education*, 42(4),743-759.

Svetlik, I. & Braček-Lalić, A (2016) The impact of the internationalisation of higher education on academic staff development – the case of Slovenian public universities. *Studies in Higher Education*, 41(2), 364-380

Swanson, R., & Holton, E. F. (2001). Foundations of Human Resource Development. San Francisco: Berrett-Koehler Publishers, Inc.

Szulc, J.M., Davies, J., Tomczak, M.T. & McGregor, F.L. (2021), AMO perspectives on the well-being of neurodivergent human capital. *Employee Relations*, 43(4), 858-872.

Szulc, J.M. & Smith, R. (2021). Abilities, Motivations, and Opportunities of Furloughed Employees in the Context of Covid-19: Preliminary Evidence From the UK. *Frontiers in Psychology*, 12, 635144.

Tabachnick, B. G., & Fidell, L. S. (2013). Using multivariate statistics (6th ed.). Boston, MA: Pearson.

Tan, C.N.L. (2016). Enhancing knowledge sharing and research collaboration among academics: the role of knowledge management. *Higher Education*, 71, 525–556.

Tartari, V., Di Lorenzo, F., & Campbell, B. A. (2020). "Another roof, another

proof": the impact of mobility on individual productivity in science. *The Journal of Technology Transfer*, 45(1), 276-303.

Taylor, W., Fender, B., & Burke, K. (2006). Unraveling the academic productivity of economists: The opportunity costs of teaching and service. *Southern Economic Journal*, 72(4), 846–859.

Thienphut, D., Jiamprachanarakorn, S., Sirasirirusth, J., & Boonloisong, R. (2015). Strategic human capital management for a new University: a case study of Suan Dusit Rajabhat University. *Journal of Knowledge Management*, 19 (1), 108-20.

Thompson B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. Washington, DC: American Psychological Association.

Thunnissen, M., & Van Arensbergen, P. (2015). A multi-dimensional approach to talent. *Personnel Review*, 44 (2), 182–99.

Tiam, J, Nakamori, Y, & Wierzbicki, A.P. (2009). Knowledge management and knowledge creation in academia: a study based on surveys in a Japanese research university. *Journal of Knowledge Management,* 13(2),76-92.

Tien, F.F. (2008). What Kinds of Faculty Are Motivated to Perform Research by the Desire for Promotion?. *Higher Education*, 55,17–32

Tien, F. F. (2000). To what degree does the desire for promotion motivate faculty to perform research? Testing the Expectancy theory. *Research in Higher Education*, 41(6), 723–752.

Timmerman, B.C., Feldon, D., Maher, M., Strickland, D., & Gilmore, J. (2011). Performance-based assessment of graduate student research skills: timing, trajectory, and potential thresholds. *Studies in Higher Education*, 38 (1), 1–18.

Tippins, M. J., & Sohi, R. S. (2003). IT competency and firm performance: is organizational learning a missing link? *Strategic Management Journal*, *24*(8), 745–761.

Tracey, J. B., & Tews, M. J. (2005). Construct validity of a general training

climate scale. *Organizational Research Methods*, *8*(4), 353–374.

Treiblmaier, H., & Filzmoser, P. (2010). Exploratory factor analysis revisited: How robust methods support the detection of hidden multivariate data structures in IS research. *Information & Management*, *47*(4), 197–207.

Tseng, FC., Huang, MH. & Chen, DZ. (2020). Factors of university–industry collaboration affecting university innovation performance. *Journal of Technology Transfer*, 45, 560–577.

Turner, S. F., Cardinal, L. B., & Burton, R. M. (2017). Research Design for Mixed Methods: A Triangulation-based Framework and Roadmap. *Organizational Research Methods*, 20(2), 243–267.

Turner, L, & Mairesse, J. (2003). Individual productivity differences in scientific research: An econometric study of the publications of French physicists. Working Paper.

Ulrich, W., & 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), 1–21.

Van Beurden, Karina Van De Voorde & Marc Van Veldhoven (2020): The employee perspective on HR practices: A systematic literature review, integration and outlook. *The International Journal of Human Resource Management*, 32 (2), 359-393.

Van Dalen, H.P. (2021). How the publish-or-perish principle divides a science: the case of economists. *Scientometrics*, 126, 1675–1694.

Van den Brink, M., Fruytier, B. & Thunnissen, M. (2013), Talent management in academia: performance systems and HRM policies. *Human Resource Management Journal*, 23 (2), 180-195.

Van der Heijde, C.M., & Van der Heijden, B.I.M. (2006). A competence-based and multidimensional operationalization and measurement of employability. *Human Resource Management*, 45 (3), 449–476.

Van der Weijden, I, Belder, R, Van Arensbergen, P, & Van den Besselaar, P. (2015). How do young tenured professors benefit from a mentor? Effects

on management, motivation and performance. *Higher Education*, 69(2), 275–287.

Van der Weijden, I, de Gilderb, D, Groenewegenb, P, & Klasenc, E. (2008). Implications of managerial control on performance of Dutch academic (bio) medical and health research groups. *Research policy*, 37, 1616-1629

Van Waeyenber, T, & Decramer, A. (2018). Line managers' AMO to manage employees' performance: The route to effective and satisfying performance management. *International Journal of Human Resource Management*, 29(22), 3093-3114.

Velicer, W. F., & Jackson, D. N. (1990). Component analysis versus common factor-analysis - some further observations. *Multivariate Behavioral Research*, 25(1), 97–114.

Verbree, M., Horlings, E., Groenewegen, P., Van der Weijden, I., & Van den Besselaar, P. (2015). Organizational factors influencing scholarly performance: a multivariate study of biomedical research groups. *Scientometrics*, 102, 25–49

Veer-Ramjeawon, P. & Rowley, J. (2020) Embedding knowledge management in higher education institutions (HEIs): a comparison between two countries. *Studies in Higher Education,* 45(11), 2324-2340,

Wan, C. D., Chapman, D., Hutcheson, S., Lee, M., Austin, A., & Md. Zain, A. N. (2017). Changing higher education practice in Malaysia: the conundrum of incentives. *Studies in Higher Education*, *42*(11), 2134-2152.

Wang, J., Hooi, R., & Li, A. X., & Chou, M.-H. (2019). Collaboration patterns of mobile academics: the impact of international mobility. *Science and Public Policy*, 46(3), 450-462.

Wang, J., Peters, H.P., & Guan, J. (2006). Factors influencing knowledge productivity in German Research groups: lessons for developing countries. *Journal of Knowledge Management*, 10 (4), 113-126.

Wang, Z, & Xu, H. (2017). How and when service-oriented high-performance work systems foster employee service performance: A test of mediating and moderating processes. *Employee Relations*, 39(4), 523-540.

Way, S. A., Tracey, J. B., Fay, C. H., Wright, P. M., Snell, S. A., Chang, S., & Gong, Y. (2015). Validation of a multidimensional HR flexibility measure. *Journal of Management*, *41*(4), 1098–1131.

Webber, K. (2012). Research productivity of foreign- and US-born faculty: Differences by time on task. *Higher Education,* 64, 709-729.

White, C. S., James, K., Burke, L. A., & Allen, R. S. (2012). What makes a "research star"? Factors influencing the research productivity of business faculty. *International Journal of Productivity and Performance Management*, 61 (6), 584-602.

Whitehill, M. (1997). Knowledge-based strategy to deliver sustained competitive advantage. *Long Range Planning*, 30 (4), 621–627.

Whitelock, D., Faulkner, D., & Miell, D. (2008). Promoting creativity in PhD supervision: tensions and dilemmas. *Thinking Skills and Creativity*, 3: 143–153.

Widaman, K. F. (1993). Common factor analysis versus principal component analysis: Differential bias in representing model parameters? *Multivariate Behavioral Research*, *28*(3), 263–311.

Wollersheim, J, Lenz, A, Welpe, I.M, & Spörrle, M. (2015). Me, myself, and my university: a multilevel analysis of individual and institutional determinants of academic performance. *Journal of Business Economics*, 85(3), 263-291.

Worthington, R. L., & Whittaker, T. A. (2006). Scale development research: a content analysis and recommendations for best practices. *The Counselling Psychologist, 34*(6), 806–838.

Wright, P. M. (2021). Rediscovering the "Human" in strategic human capital. *Human Resource Management Review*, 31(4), 100781.

Wright, P. M., Coff, R., & Moliterno, T. P. (2014). Strategic Human Capital: Crossing the Great Divide. *Journal of Management*, 40(2), 353–370.

Wright, P.M, & McMahan, G.C. (2011). Exploring human capital: putting 'human'back into strategic human resource management. *Human Resource Management Journal,* 21(2),93-104.

Wuchty, S., Jones, B. F., & Uzzi, B. (2007). The increasing dominance of teams in production of knowledge. *Science*, 316(5827), 1036–9.

Xia, J., Zhang, M. M., Zhu, J. C., Fan, D., & Samaratunge, R. (2020). HRM reforms and job-related well-being of academics. *Personnel Review*. 49 (2), 597-619

Xie, B., & Li, M. (2021). Coworker Guanxi and job performance: Based on the mediating effect of interpersonal trust. *Technological forecasting and social change*, 171, 120981.

Xu, X., Oancea, A., & Rose, H. (2021). The impacts of incentives for international publications on research cultures in Chinese humanities and social sciences. *Minerva*, 1-24.

Yeo, B. (2018). Societal impact of university innovation. *Management Research Review*, 41 (11), 1309-1335.

Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in Quantitative Methods for Psychology*, *9*(2), 79–94.

Yu, S. C., & Hsu, W. H. (2013). Applying structural equation modeling methodology to test validation: an example of cyberspace positive psychology scale. *Quality & Quantity*, *47*(6), 3423–3434.

Zawaideh, F.H., Al-Zoubi, M.I., Abualoush, S.H., Masa'deh, R. & Kanaan, R.K. (2018), The impact of knowledge documentation process as an intermediary variable among knowledge acquisition process, organizational culture and human capital. *Modern Applied Science*, 12 (11), 151-168

Zucker, L.G, Darby, M.R, Furner, J, Liu, R.C, & Ma, H. (2007). Minerva unbound: knowledge stocks, knowledge flows and new knowledge production. *Research Policy,* 36, 850–863.