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Job choice in academia

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ABSTRACT

The asymmetric international mobility of talented scientists is well documented, yet there is little evidence about the reasons why scientists choose particular jobs. Building on an extended human capital model of science, we unify a dispersed literature relevant for job choice to formulate hypotheses which we test in a unique international quasi-experiment among more than 10,000 researchers. We find that attractive jobs satisfy researchers' "taste for science" and increase their expected scientific productivity, responding to both intrinsic and extrinsic motivations. In particular, while salaries, research funding and working with stimulating peers matter, we provide unique estimates of the importance of organisational and institutional factors: early stage researchers are willing to trade off a substantial amount of salary for early independence and tenure perspectives; later stage researchers favour jobs which make it easy to take up new lines of research. Research-only positions are considered as less attractive than jobs with a moderate amount of teaching. Our findings have important implications for the organisational design of research universities and the competitiveness of European science in light of the brain drain of highly talented scientists towards the U.S.

1. Introduction

Empirical evidence shows not only that talented researchers are internationally mobile, but also that this mobility is asymmetrically directed towards prestigious U.S. universities (Hunter et al., 2009; Laudel, 2005; Tritah, 2009; Docquier and Rapoport, 2009). This hints at problems in scientific knowledge production, as asymmetric mobility implies that the prevailing conditions for research are limiting the potential of researchers in many countries and hence the progress of science overall. Especially for Europe, which is struggling to keep up with its transatlantic counterpart in terms of scientific knowledge creation (Dosi et al., 2006; Albarrán et al., 2010), this "exodus of European researchers" (Docquier and Rapoport, 2012) is problematic since science-based innovation becomes more important for firms in countries close to the technological frontier (Aghion and Howitt, 2006; Narin et al., 1997).

But despite these stylised facts at the aggregate level, research on the academic labour market and the main drivers that make researchers choose one academic job over another at the individual level, contributing to these asymmetric flows, has so far been dispersed and limited to selective aspects of job choice such as the role of research funding and the quality of peers.

This paper contributes to the literature by analysing the characteristics that determine how researchers choose between different jobs within academia in a systematic and comprehensive way. Building on an extended human capital model for science we unify a dispersed literature relevant for job choice in academia and formulate hypotheses as to which job factors matter for researchers to satisfy both intrinsic and extrinsic motives, taking account of potential non-linearities. To test these hypotheses, we construct hypothetical job offers in academia that are then used in a unique stated choice quasi-experiment embedded in a large-scale international survey of more than 10,000 researchers in all fields of science and at various career stages. Empirically, we not only assess the importance of a comprehensive range of various factors for job choice, but also analyse the trade-offs between different job characteristics and attach monetary values to non-monetary job characteristics in order to assess their relative importance across different groups of researchers and organisational settings.

We find not only that the level of remuneration and research funding or the quality of peers matter. Our unique estimates of

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institutional and organisational job characteristics also show that tenure perspectives as well as research and financial autonomy are particularly attractive for early stage researchers, while later stage researchers prefer jobs where their line of inquiry is not bound to the research of previous job- or chair-holders, speaking in favour of a departmental organisation rather than a chair-based system. These preferences do not vary across country groups, which explains the international mobility of scientists towards countries where jobs with these characteristics are more common. Furthermore, research-only jobs are considered less attractive than jobs involving a moderate amount of teaching, which adds new insights to the discussion on the locus of basic research. Our results thus shed light on both the asymmetric mobility of researchers, and on the academic labour market and the organisation of academic research in general.

The remainder of this paper is organised as follows: in Section 2 we review the literature and develop a theoretical framework for job choices in academia. Section 3 outlines our quasi-experiment, Section 4 presents the empirical results. Section 5 concludes.

2. Job choice in academia

2.1. Review of the previous literature

To identify factors which are driving job choice in academia, we review three strands of the sociological and economics literature which are especially relevant to our research.[1]

The first strand examines the motives for engaging in academic research (compared to working in industry). There is widespread evidence that the supply of academic researchers responds to market signals such as relative earnings, job availability, the amount of stipends and the total time required for training (Blank and Stigler, 1957; Arrow and Capron, 1959; Stephan, 2012; Philippon, 2010), suggesting that the choice of becoming a researcher is partly driven by extrinsic, pecuniary motives.

There are however indications that the choice is also driven by intrinsic motives related to the satisfaction derived from the activity of research itself—the joy of puzzle-solving, freedom to pursue curiosity-driven discovery of knowledge, etc.—and that researchers have a "taste for science" (Stephan, 1996; Roach and Sauermann, 2010). Researchers are thus willing to "pay" (in terms of opportunity costs) for the privilege of being able to pursue science (Stern, 2004; Agarwal and Ohyama, 2013). Teaching, which can be considered to be at the heart of academia (Ben-David, 1971), may also be an intrinsic motive for becoming a researcher for those who derive satisfaction from imparting knowledge or training promising young colleagues.

Job choice is also affected by non-pecuniary extrinsic motives such as establishing "priority of discovery" (Merton, 1957), i.e., being the first to publicly document new knowledge. The fact that all the recognition for a scientific discovery accrues only to the first author having made the discovery can turn science into a "winner takes all" contest where small differences in initial performance lead to big differences in academic career perspectives (Dasgupta and David, 1994). Scientists who manage an early track record of scientific findings may benefit from cumulative advantages in obtaining funding for research projects (called the "Matthew effect", see Merton, 1968; Petersen et al., 2011).

The second strand of the literature focuses on the international mobility of academic researchers (Docquier and Rapoport, 2012). In accordance to the well-known push–pull framework of migration (Lee, 1966), researchers are pushed abroad by the low quality of the higher education system, a lack of job openings or low salaries at home and are pulled into countries providing an attractive academic labour market, high quality peers, career prospects, differential earnings, etc. In order for migration to occur, the benefits must outweigh the costs including the loss of access to the academic network in the home country (which makes return migration difficult), the loss of family and social ties or the costs of adaptation to the destination country's language, culture and lifestyle.

Stephan et al. (2013) find that PhD-students and post-docs come to the U.S. to train as a result of the prestige of the offered programmes and the career prospects associated with PhD-studies or post-doctoral research in the U.S. Some studies also show that it is particularly the "potential elite" of young talented researchers that is moving and staying abroad (Laudel, 2005); stay rates of European PhD-students in the U.S. are as high as approximately 70% (Finn, 2010), and of the foreign PhD-students in the U.S. it is the most able who are more likely to stay (Van Bouwel and Veugelers, 2012; Grogger and Hanson, 2013a,b).[2] Other papers identify the level of R&D spending in a country as a reason to move, which is related to funding and job opportunities in the academic labour market (Hunter et al., 2009; Docquier and Rapoport, 2009).

Finally, the functionalist–structuralist sociology of science and comparative higher education literature link the relative competitiveness of European science to differences in the organisation of the working units of universities, which condition career prospects and freedom of research of early stage researchers (e.g., Ben-David and Zloczower, 1962; Ben-David, 1968; Clark, 1983): A chair concentrates the authority over the operating unit in one person, the chair-holder, while other members of the organisational unit work as subordinates. By contrast, a department spreads responsibilities and powers among a number of professors of similar rank and hence allows for a collegial basis of academic work.[3] These differences are still relevant today, as shown by recent sociology of science studies (Hackett, 2005; Felt et al., 2012; Lam and de Campos, 2015) and anecdotal evidence on the determinants of job choice from published interviews with researchers and science policy papers which point to the importance of early independence and clear perspectives for research careers (see e.g., Arnold and Freyschmidt, 2011; European Commission, 2012; Bosch, 2003; Janger and Pechar, 2010).

2.2. Conceptual framework

We now bring together these various strands of the literature in a unified framework for job choices in academia to generate hypotheses that can be tested empirically. To conceptualise job choice decisions, we use the human capital model of science pioneered by Diamond (1984, see also Levin and Stephan, 1991; Thursby et al., 2007; Agarwal and Ohyama, 2013): researchers maximise their utility by maximising their life-time monetary and non-monetary rewards subject to constraints. They have to optimally allocate time between immediate sources of income, such as teaching or administrative work, or investing in human capital to build up their stock of knowledge which can later be turned into a source of income through publications, patents, etc. As a consequence, researchers face a trade-off between investing in

[1] See also Stephan (1996, 2010) for surveys of the economic literature on the behaviour of scientists.

[2] In a similar vein, Van Bouwel et al. (2011) find that European researchers move to the U.S. for career reasons, and come (back) to Europe for personal or family reasons.

[3] In 1962, Ben-David and Zloczower noted that the "exodus of European scientists [was] motivated not only by higher income but often by better conditions for and greater freedom of research" (p. 157); Ben-David observed in 1968 (p. 88) that "The ossification of European science organization [. . .] has created a scientific gap between the U.S. and Western Europe."

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accumulating knowledge and pursuing activities which generate immediate income.

Eqs. (1)–(5) describe the basic features of our human capital model of science. We assume that researcher i's utility of working in academic job j at time $t=0$ (U_{ij0}) is a linear function of income in period $t=0$ (m_{ij0}), the present value of future income in periods $t>0$ (M_{ij0}), non-monetary benefits in period $t=0$ (n_{ij0}) and the present value of future non-monetary benefits (N_{ij0}):[4]

$$\begin{aligned} U_{ij0} &= \alpha m_{ij0} + \alpha M_{ij0} + \gamma n_{ij0} + \gamma N_{ij0} \\ &= \alpha m_{ij0} + \alpha \sum_{t=1}^{T} m_{ijt}\rho_i^t + \gamma n_{ij0} + \gamma \sum_{t=1}^{T} n_{ijt}\rho_i^t \end{aligned} \tag{1}$$

where $\rho<1$ is a discount factor, α is the importance of monetary rewards (the marginal utility of income) and γ is the researcher's "taste for science".

Looking first at income, we assume that researchers' earnings are a function of their time spent on teaching and administrative tasks, δ_j and ζ_j. As in Agarwal and Ohyama (2013), we also assume that income depends on time τ_{ijt} spent on converting human capital H_{ijt} into observable research outputs (i.e., publications, patents, etc.):

$$m_{ijt} = w_j(\delta_j + \zeta_j + \tau_{ijt}H_{ijt}) \tag{2}$$

where w_j is the remuneration per unit of time. Human capital develops according to:

$$H_{ijt} = (1-\sigma)H_{ijt-1} + R_{ijt-1} \tag{3}$$

where σ is the rate at which human capital depreciates and R_{ijt-1} is the scientific knowledge produced in period $t-1$, which we define following the previous literature (cf. Stephan, 2010, p. 225ff):

$$R_{ijt-1} = \Omega_i \psi(f_j, e_j, \delta_j)(\lambda_{ijt-1}H_{ijt-1})^{\eta} \tag{4}$$

where $\eta<1$. Knowledge production depends on time invested in accumulating human capital λ_{ijt-1}, the stock of human capital H_{ijt-1}, as well as on the researcher's ability, creativity, and serendipity Ω_i.

Our scientific knowledge production function (4) expands on, for example, Agarwal and Ohyama's (2013, p. 6) as time invested in accumulating human capital λ_{ijt-1} in Eq. (4) is not scaled by physical capital alone, but by a more general scaling function $\psi(\cdot)$. We use $\psi(\cdot)$ to introduce the factors discussed in Section 2.1 that have barely been specified in the literature so far as driving the productivity of time allocated to research. Eq. (4) suggests that funding f_j, the research environment e_j and time spent teaching δ_j determine monetary benefits m_{ijt} through knowledge production. It also shows that they are crucial for any researcher to implement her research agenda, and thus key characteristics for deciding between jobs.

Although the importance of funding f_j varies across fields of science, researchers in all fields of science require at least a minimal amount of funding to cover the costs of personal computers, access to databases and scientific literature, etc. A larger amount or better availability of funding will thus make knowledge production more efficient.

Knowledge production is also affected by the multidimensional "research environment" e_j, which captures not only features of the academic organisation (such as hierarchies, research autonomy or career perspectives) or institutional aspects of the national system of higher education,[5] but also other factors such as the quality of peers. The relevance of these factors is highlighted by the literature in Section 2.1.[6] Teaching may also affect knowledge production: it may contribute to establishing priority if it helps to keep research interests broad (Martin, 2003) or provides an opportunity to employ graduate students as research assistants.

λ_{ijt} and the characteristics that affect the scaling function $\psi(\cdot)$ in Eq. (4) are however not only relevant for scientific productivity, but also for satisfying intrinsic motives: time for research λ_{ijt} enables researchers to engage in the joy of puzzle solving, while research funding f_j and a stimulating research environment e_j may be just as relevant for the enjoyment of science as for expected scientific productivity: Each job characteristic which furthers own research is likely to enhance utility both from an intrinsic and a non-pecuniary extrinsic perspective.

The non-monetary benefits n_{ijt} in Eq. (1) are therefore assumed to increase with time for research λ_{ijt} and are scaled by a function $\phi(\cdot)$ of research funding f_j and the research environment e_j. We also include teaching δ_j if researchers are intrinsically motivated to impart knowledge, as well as the quality of life in country c_j, as we are interested in cross-country job decisions:

$$n_{ijt} = \delta_j c_j \lambda_{ijt} \phi(f_j, e_j) \tag{5}$$

We therefore extend the previous literature by modelling non-monetary benefits as functions of job characteristics rather than as being constant.

We now consider a researcher's choice between two job offers. Apart from ability Ω_i, which does not change over job offers and can therefore be ignored,[7] the variables that enter Eqs. (1)–(5) can be divided into two groups: (i) variables that are predetermined by the job offer (starting wage m_{ij0}, wage rate w_j, teaching load δ_j, administrative tasks ζ_j, funding f_j, research environment e_j, quality of life c_j), and (ii) variables whose optimal paths over time are determined by the model parameters, subject to an overall time constraint

$$\Upsilon_{ijt} \geq \tau_{ijt} + \lambda_{ijt} + \delta_j + \zeta_j, \tag{6}$$

and the variables in group (i) (time spent on converting human capital into observable research outputs τ_{ijt} and time allocated to building up human capital λ_{ijt}, which determine the stock of human capital H_{ijt}). The variables that are most important for a researcher's choice between two jobs are thus the job characteristics m_{ij0}, w_j, δ_j, ζ_j, f_j, e_j and c_j.

f_j, e_j and c_j have an unambiguously positive effect on (non-)monetary benefits.[8] Conversely, the effect of an increase

[4] The model is written in discrete time for ease of exposition, but could easily be extended to a model in continuous time.

[5] Which aspects of the organisational structure can be determined by the university and which aspects are predetermined by the system of higher education will differ across countries, and even differ within countries between private and public universities.

[6] Note that there is also a vast amount of sociological literature on the socially constructed nature of academic knowledge production (e.g., Knorr-Cetina, 1981; Traweek, 1988; Owen-Smith, 2001). Many of the features discussed in this literature, such as the role of collaboration and access to funding, are similar to the concept of knowledge production in the economic literature and are reflected in our extended production function. For others, such as e.g., the role of scientific scepticism in coordinating multidisciplinary research teams (Owen-Smith, 2001), further research would be needed, as it is not known how varying degrees in these categories would affect the quantity or quality of knowledge production.

[7] Ω_i depends on the researchers, not on the job; job characteristics influence to which extent a researcher can fully exploit her creative potential.

[8] The indirect effects of f_j and e_j on the values of λ_{ijt} and τ_{ijt} are however ambiguous. For example, it is not clear whether an increase in research funding is met by an expansion of the researcher's investment in human capital λ_{ijt} (because it increases the enjoyment of producing knowledge) or an increase in the time spent on transforming knowledge into observable outputs τ_{ijt} (because a given level of human capital can now be attained with less time spent accumulating human capital). In any case, an increase in f_j or e_j always enhances utility.

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in teaching δ_j is ambiguous: on the one hand it can increase monetary benefits (both directly and indirectly through ψ) as well as non-monetary benefits. On the other hand, given the time constraint (6) an increase in δ_j must be offset by a lower τ_{ijt} and/or λ_{ijt}, which decreases (non-)monetary benefits. Similarly, a change in administrative tasks ζ_j has an ambiguous effect.

We assume that researchers decide between job offers j and k based on their expected utility levels. Researcher i prefers job k to job j if:

$$U_{ik0}|_{m_{ik0},w_k,\delta_k,\zeta_k,f_k,e_k,c_k} - U_{ij0}|_{m_{ij0},w_j,\delta_j,\zeta_j,f_j,e_j,c_j} > 0 \quad (7)$$

From this model, we can generate several hypotheses. First, as few jobs will offer a perfect mix of characteristics, we expect that researchers maximise utility by trading off job characteristics. E.g., researchers may be willing to forego initial salary in favour of job characteristics that promise a higher expected productivity in the future, and a job with low starting wage m_{ij0} but "good" characteristics (i.e., a high scaling factor ψ) may be more attractive than a job with high m_{ij0} but "bad" characteristics (a low ψ) because the former allows the researcher to accumulate human capital more effectively and thus has a higher present value of future income.

Second, the human capital model implies that the return on productivity-enhancing investments diminishes as time advances, so that later stage researchers should show a reduced willingness-to-pay for job characteristics which are beneficial for knowledge production, favouring current-income producing activities relative to early stage researchers. However, such differences could turn out to be small if non-monetary benefits are more important than monetary benefits (if $\gamma \gg \alpha$ in Eq. (1)).

Third, a small amount of teaching or administration may increase utility because it increases income, but too much of it may decrease utility because it limits the time available to build up or convert human capital: the effects of teaching and administration on utility are possibly non-linear and the optimal level of teaching should be higher than the optimal level of administration because teaching increases monetary benefits not only via income, but also via scientific productivity through $\psi(\cdot)$. In addition, it increases non-monetary benefits through $\phi(\cdot)$.

Overall, our extension of the human capital model consolidates the three literatures in Section 2.1 by considering characteristics of jobs in academia as factors which affect the productivity and the enjoyment of the time allocated to research, helping us to generate testable hypotheses on how job characteristics impact on job choice. The model is a general specification accounting for both monetary and non-monetary benefits which in principle allows for integrating a wide range of factors relevant for knowledge production, including teaching—which is often neglected—and insights from sociological constructivist approaches.

3. Stated choice experiment

To test our hypotheses, we conduct a stated choice experiment embedded in an international survey of more than 10,000 researchers in all fields of science. The survey respondents are confronted with three hypothetical job offers randomly drawn from two sets of hypothetical jobs depending on the respondent's current position. The first set contains job offers for early stage researchers (ESR), the second job offers for later stage researchers (LSR).[9] ESR are PhD-students, post-docs and PhD-holders who have not yet attained tenure (R1 and R2 researchers according to the definition of the European Commission, 2011, i.e., up to the level of a non-tenured assistant professor in a U.S. research university). LSR have successfully entered an academic career and are distributed over the professorial ranks (R3 and R4 researchers, i.e., associate or full professors). The respondents were then asked: "Assuming all job attributes not mentioned in the job offers are equal, which job do you consider to be the most attractive, irrespective of your current job?"

3.1. Stated choice experiment

The use of intentions data has both potential benefits and drawbacks. A potential drawback is that intentions need not coincide with actual behaviour. They are therefore sometimes viewed with scepticism, although Manski (1990, p. 940) noted that information from stated choice experiments can be used to analyse differences in expected utilities of choice alternatives.[10]

The potential benefits of stated choice data are linked to the difficulties involved in creating large-scale datasets of real job offers.[11] First, to empirically analyse the factors that made researchers choose one job over another using discrete choice models the choice set must be exhaustive, i.e., it must contain all job alternatives the researchers were considering at the time they chose their current job. However, this is difficult in practice, especially if researchers are asked in retrospect.

Second, even if the surveyed researchers could define an exhaustive choice set, it would be difficult to cover all relevant attributes of all choice alternatives; it would probably be all but impossible for the researchers to report the values of all the characteristics for all the jobs they were considering, especially if they are asked in retrospect. A comparison of real job choices would therefore be prone to omitted variable bias and/or missing information.

Third, researchers who had only a single job offer could not be considered in an empirical analysis because no within-person comparisons are possible.[12] Using real data, one would therefore have to deal with a smaller number of researchers, and those who had multiple job offers to choose from can be considered a selected group with special characteristics. This in turn engenders a selection problem in the empirical analysis if the characteristics of the jobs offered to these researchers are not independent of the researcher's characteristics. For example, having multiple job offers may be a function of ability, and more able researchers may also receive more favourable job offers (for example, longer term contracts or jobs at more prestigious institutions).

Our stated choice approach therefore offers three main benefits: it presents the respondents with an exhaustive choice set that contains more than one alternative; it allows us to control the information available for each choice alternative so that there are no unobserved job attributes; and it allows us to make the characteristics of the job offers independent of the respondents' characteristics, avoiding selection bias.[13] To conclude, the potential

[9] Our jobs do not differentiate between fields of science. The survey by Janger and Pechar (2010) has shown very little variation between disciplines, with the exception of funding for research equipment so that we expect researchers from disciplines which require costly research infrastructure to place a higher value on job attributes related to funding and the availability of grants.

[10] In Manski's terminology, our stated choice experiment contains a "forced-choice" question: respondents are asked to state the option they would choose if they had to commit themselves now, based on the information available at the time they take the survey.

[11] An attempt to create a small-scale dataset was made by Stern (2004) who compiles a sample of job offers made to 164 post-doctoral biologists in the U.S. He looks at the impact of a single job characteristic—the scientific orientation of private R&D organisations—on job choice and wages and finds that researchers who are allowed to pursue an individual research agenda trade this off against a lower salary.

[12] It also excludes the possibility of using researcher fixed effects in the empirical analysis that were shown to be highly important by Stern (2004).

[13] See for related work the small-scale experiment by Segalla et al. (2001), who however do not propose jobs to respondents, but job candidates for a specific position to be filled in private sector financial institutions.

benefits of using stated choice data largely outweigh their potential drawbacks.

3.2. Creating hypothetical job offers

The definition of the set of relevant job attributes is central to the validity of the stated choice approach. On the one hand, the list of job characteristics should not be too short to avoid leaving out relevant job factors. On the other hand, overly complex descriptions would put too much cognitive burden on the respondents (Hensher et al., 2005) and make a balanced comparison of jobs based on all the job attributes impossible. Drawing on Section 2.2 we singled out 12 job characteristics for both ESR and LSR that we classified into three broad categories to ease the cognitive burden: (i) remuneration and fringe benefits (4 attributes), (ii) country characteristics (1 attribute) and (iii) working conditions (7 attributes), reflecting key requirements of a research job in academia, such as time for research, funding and aspects of the research environment. Appendix A in the online supplementary material shows the full list of the job attributes and their corresponding levels.[14] Our jobs focus on research universities but are also relevant for pure basic research organisations and within them, on the role of principal investigator.[15] From the job characteristics, it is also obvious that the jobs available are not located within the current organisation of the researcher and does not involve a change in field.

The first category corresponds to pecuniary motivations and contains net salary p.a. Our salaries range from $25,000 to 65,000 p.a. for ESR and from $45,000–85,000 for LSR (see, e.g., Altbach et al., 2012).[16] To make remuneration internationally comparable we also consider the patient contribution rate to health care expenditures (from 0% to 10% of annual salary) as well as the expected pension net replacement rate on entry into retirement (from 70% to 85% of net pre-retirement earnings). The remuneration package is also assumed to contain one of the following seven fringe benefits: “relocation support”, “parking at university”, “availability of childcare facilities”, “company car”, “guaranteed place at nearby quality school for children”, “university housing” and “job offer for partner” (base category: “parking at university”).

The second category (“country characteristics”) contains the quality of life in the country of the job relative to the current country of residence. Because there is no globally accepted index and we are only interested in the relative importance of quality of life as a non-pecuniary factor compared to other job attributes, the relative quality of life is measured by dummy variables stating that quality of life is either “worse”, “equal to” or “better” than in the country where the respondent is currently working.[17]

The third category (“working conditions”) contains job characteristics which impact on scientific productivity and satisfy researchers' taste for science: time for own research, teaching and administrative tasks, funding, and aspects of the research environment.

To proxy early stage researchers' time for own research we include research autonomy defined as the percentage of research time which can be devoted to one's own research (compared to non-autonomous research for e.g., the research group leader; 0–100%); to proxy later stage researchers' time for own research we define research continuity as the amount of research time the researcher has to devote to the work of the previous chair-holder instead of being able to follow new lines of research (0–100%). We also control for the time later stage researchers must devote to administrative tasks (0–15% of total time). The share of teaching in combined teaching and research time (from “research only” to “75% teaching, 25% research”) applies to both ESR and LSR jobs.

As regards funding, the availability of university-external grants (“availability of both short- and long-term grants good”, “short-term good and long-term poor”, “both poor”) applies to both ESR and LSR. LSR research can also be funded by university-internal funds (from 25% and the remainder via grants, to 100%) which is also intended to capture university provision of research equipment and infrastructure as well as the size of start-up packages. Internal funding for ESR must either be “negotiated with the chairholder or research group leader”, “negotiated with university management based on the quality of the research proposal”, or are “provided by the university without strings attached”, reflecting the availability of a start-up package.

The quality of peers is defined for both ESR and LSR by the ranking of the most prestigious researcher at the department offering the job (from among the top 5 in the respondent's field of science worldwide to not among top 50).

Two variables measure career perspectives for ESR: the first refers to the length of the initial contract (from 2 to 6 years); the second to the possibility of extending this contract (“not possible”, “for 3 years”, “tenure possible contingent on performance and job availability”, and “tenure contingent purely on research performance”). Long-term career perspectives promise a stable stream of income, insuring researchers against income risk as they specialise and increasingly lose outside options (McPherson and Winston, 1983), enable researchers to pursue a long-term research agenda which is likely to impact on chances to establish priority as knowledge production features long-term spillovers (Petersen et al., 2012; Lam and de Campos, 2015) and provide researchers with the opportunity to do what they like intrinsically over a longer time without the end of the next contract looming in front of them.

Finally, for LSR we also included three options for salary advancement: via a public scheme, a public scheme and a possible performance bonus, and via individual research evaluation. The third option is inspired by a tendency towards more autonomous universities in Europe which are more likely to use individual research evaluation for promotion and salary decisions (Musselin, 2013a,b) and a change in university funding modes from block funding to research evaluation systems (Hicks, 2012). The literature (see, for example, Dasgupta and David, 1994) suggests that the second option should be most desirable: if pay is based purely on performance, all the risks associated with knowledge production would be put on the scientists; some “fixed” component is therefore necessary.

Altogether, there are thus 12 attributes for ESR and LSR jobs. Given 3–7 different levels per attribute, we could construct more than 19 million LSR and more than 24 million ESR jobs. For computational simplicity in the survey implementation and to avoid having extremely bad next to extremely good jobs, we ascribe scores to the attribute levels (e.g., 1 for the lowest salary, 2 for the second lowest, etc.). We then sum those scores and sort the jobs according to this sum. For both ESR and LSR 30,000 jobs are drawn from the centre of the resulting distribution.[18] In addition to the

[14] Our jobs are hence less complex than real jobs, but more complex than the selective job aspects discussed in the literature in Section 2.1, or, e.g., in policy discussions of researcher mobility focusing on portability of pensions and social security needs (cf. Council of the European Union, 2010).

[15] See Pavlidis et al. (2014) on the growing importance of team science and the need for a functional specialisation of researcher roles, e.g., in a methods person, a data analyst, a technologist, etc.

[16] Due to an error in the survey, the respondents were not informed about the currency. Results available from the authors however show that there are hardly any significant differences between currency areas.

[17] Depending on the country, health and pension job attributes may also be seen as country characteristics rather than as components of the remuneration package.

[18] An example of how an early stage researcher would have seen the experiment can be found in the supplementary online material.

Table 1
Distribution of respondents by gender, career stage and country of work. European Union: 27 EU member states as of 2012.

	Early stage		Later stage	
	Total	%	Total	%
Female	1884	0.497	2193	0.341
Male	1906	0.503	4232	0.659
First stage researcher (R1)	1619	0.427	–	
Recognised researcher (R2)	2171	0.573	–	
Established researcher (R3)	–		3014	0.469
Leading researcher (R4)	–		3411	0.531
European Union	2643	0.697	2790	0.434
United States	344	0.091	2053	0.320
Rest of world	803	0.212	1582	0.246
Respondents	3790	1.000	6425	1.000
Number of experiments	7077		6425	

jobs themselves, the order of appearance of the three job attribute categories changed randomly in the survey, so that there are not always the same job attributes at the top or the bottom.

3.3. Survey implementation

The stated choice experiment was implemented within the EU-funded "Mobility of Researchers 2" (MORE2) project. Two surveys were conducted in spring and summer 2012, one for researchers in European higher education institutions and one for researchers currently residing outside Europe (see IDEA Consult et al., 2013, for details on sampling).

The first survey aimed at achieving representativeness at the European level. The overall response rate was 21%, 5583 researchers answered the online questionnaire. The second survey was based on online "convenience sampling". From this second survey we gather 7706 responses (response rate close to 4%). Focusing on those who finished the stated choice experiment, 10,215 interviews can be used in the empirical analysis, 3790 from ESRs and 6425 from LSRs. ESR were presented twice with a choice between 3 randomly allocated jobs, while LSR were asked to choose once. In total, the results of 13,502 choices (7077 for ESR and 6425 for LSR) are at our disposal.

Summary statistics are shown in Table 1.[19] While the distribution of respondents by gender is quite balanced for ESR, there are significantly more male than female respondents among LSR. This is in line with gender statistics for high-level researchers (see, for example, Duch et al., 2012). While 32% of all LSR in our sample work in the USA, the share of U.S.-based researchers is only 9.1% among ESR. The higher share of EU-based researchers among ESR is not necessarily a problem: as shown in the next section, individual characteristics that do not vary across alternatives (including the country of residence) do not affect the econometric specification.[20]

[19] Reliable information on the characteristics of researchers across the world is not available. It is therefore not possible to compare the characteristics of the researchers in our sample to the characteristics of researchers on a global scale. However, for the subsample of researchers living in the EU-28 and five candidate and associate countries (Turkey, the FYR of Macedonia, Norway, Switzerland and Iceland) we can compare the sample to the population based on country of residence and field of science or country of residence and gender using data from Eurostat. A comparison shows that researchers in the social and economic sciences are slightly overrepresented in the sample while those in the medical and agricultural sciences are underrepresented. Weighted regressions by gender, field of science, country of residence, as well as by gender and country of residence and by field of science and country of residence however reveal no substantial differences in the estimated parameters. Results are available from the authors upon request.

[20] Regressions by country groups (U.S. vs. EU vs. other countries) that reveal only slight differences by country of work are shown in Appendix C of the online supplementary material. Summary statistics for the job characteristics are shown in Appendix B of the online supplementary material, indicating that job attributes are well balanced across job offers.

4. Empirical analysis

4.1. Conditional logit approach

To implement Eq. (7) econometrically, we apply a random utility framework (Marschak, 1960) and assume that the expected utility of job j is linear in its characteristics $X_j \supset \{m_{ij0}, w_j, \delta_j, \zeta_j, f_j, e_j, c_j\}$ and a random term ε_{ij}:

$$U_{ij0} = \beta' X_{ij} + \varepsilon_{ij} \quad (8)$$

Under the assumption that ε_{ij} is i.i.d. extreme value, the probability of choosing job k from the choice set $J_i = \{1, 2, 3\}$ can be estimated using a conditional logit (CL) model (McFadden, 1974):

$$P(y_{ik} = 1) = \frac{\exp(\beta' X_{ik})}{\sum_{j=1}^{3} \exp(\beta' X_{ij})} \quad (9)$$

where y_{ik} is an indicator variable with $y_{ik} = 1$ if individual i chose job k (zero otherwise). One feature of this approach is that all variables which do not change across alternatives cancel out in Eq. (9). As a consequence, we can consistently estimate the coefficients β even if our sample were selected on observed or unobserved individual characteristics as long as they are constant over alternatives and enter U_{ij0} linearly.[21] Because it cannot be excluded that the respondents attached a higher or lower utility to specific alternatives (for example because of similarities to their current job), we include alternative-specific constants in order to capture the average effect of these unobserved factors on the choice probabilities and to ensure that ε_{ij} has a zero expected mean.

4.2. Regression results

Tables 2 and 3 show the results of the CL model of job choice estimated for early and later stage researchers, containing all job characteristics as well as quadratic terms for teaching load and time devoted to administration to capture nonlinear effects of these variables on job choice.[22] The tables also report exponentiated coefficients (that can be interpreted as multiplicative effects on the odds of choosing a job offer) as well as marginal effects on $P(y_{ik} = 1)$.[23]

We also calculate the "willingness to pay" (WTP), or the change in salary that would keep the overall probability of job choice unchanged relative to a one unit increase in another job characteristic x_{mk}. This allows us to attach monetary values to non-monetary job characteristics (see Train, 2009, p. 39). Because the WTP may

[21] Just like fixed effects regression controls for time-invariant individual characteristics, the conditional logit controls for alternative-invariant individual characteristics. Note also that the jobs in J_i were chosen randomly from a large pool of possible job alternatives regardless of the respondent's characteristics: the job characteristics X_{ij} are therefore orthogonal to Ω_i and other individual characteristics.

[22] The conditional logit requires the well-known independence of irrelevant alternatives (IIA) assumption; Hausman tests (Hausman and McFadden, 1984) however find no evidence that IIA is violated in our data. We also estimated the model using multinomial probit and mixed logit but found the results (available from the authors upon request) to be similar. To assess the goodness of fit we calculated the percentage of correctly classified observations. Among ESRs, 54.4% of the chosen alternatives are also assigned the highest choice probability by our econometric model, and 85.1% of the chosen alternatives are either assigned the highest or second highest choice probability. Among LSRs, these percentages are slightly higher (56.0 and 85.4%).

[23] If all three job offers had the same characteristics, the expected probability of choosing each job offer is 1/3. The marginal effects in Tables 2 and 3 were therefore calculated at $P(y_{ik} = 1) = 1/3$ and can be interpreted as the effect of an increase in variable x_{mk} on the probability of choosing job offer k if all other job characteristics were the same.

Table 2
Conditional logit regressions of job choice for early stage researchers. Standard errors in parentheses. Standard errors corrected for clustering within respondents. Marginal effects calculated at choice probability $P(y_{ik}=1)=1/3$. Marginal effects of salary and teaching load calculated at average values.

Variable	β	e^{β}	Marg. eff.
Net salary p.a. (in 1000)	0.106***	1.111***	0.008***
	(0.009)	(0.010)	(0.000)
Net salary p.a. (in 1000)^2	−0.001***	0.999***	
	(0.000)	(0.000)	
Health care patient contribution (in %)	−0.013***	0.987***	−0.003***
	(0.005)	(0.005)	(0.001)
Retirement pension net replacement rate (in %)	0.007**	1.007**	0.001**
	(0.003)	(0.003)	(0.001)
Relocation support (=1)	0.255***	1.291***	0.057***
	(0.060)	(0.078)	(0.013)
Childcare facility (=1)	0.241***	1.273***	0.054***
	(0.060)	(0.076)	(0.013)
Company car (=1)	0.091	1.095	0.020
	(0.061)	(0.067)	(0.014)
Quality school for children (=1)	0.314***	1.369***	0.070***
	(0.060)	(0.082)	(0.013)
University housing (=1)	0.183***	1.201***	0.041***
	(0.062)	(0.075)	(0.014)
Job offer for partner (=1)	0.492***	1.636***	0.109***
	(0.062)	(0.101)	(0.014)
QoL worse than in country of residence (=1)	−0.723***	0.485***	−0.161***
	(0.042)	(0.020)	(0.009)
QoL better than in country of residence (=1)	0.129***	1.138***	0.029***
	(0.038)	(0.043)	(0.008)
Teaching load (in %)	0.019***	1.019***	−0.002***
	(0.002)	(0.002)	(0.000)
Teaching load (in %)^2	−0.000***	1.000***	
	(0.000)	(0.000)	
Short/long-term ext. funding poor/poor (=1)	−0.397***	0.672***	−0.088***
	(0.041)	(0.027)	(0.009)
Short/long-term ext. funding good/poor (=1)	−0.158***	0.854***	−0.035***
	(0.039)	(0.034)	(0.009)
Most prestigious peer among top 50 (=1)	0.270***	1.310***	0.060***
	(0.045)	(0.059)	(0.010)
Most prestigious peer among top 25 (=1)	0.382***	1.465***	0.085***
	(0.047)	(0.068)	(0.010)
Most prestigious peer among top 5 (=1)	0.606***	1.833***	0.135***
	(0.047)	(0.086)	(0.010)
Length of initial contract (in years)	0.076***	1.079***	0.017***
	(0.011)	(0.012)	(0.002)
Extension: 3 years (after evaluation) (=1)	0.540***	1.715***	0.120***
	(0.047)	(0.081)	(0.010)
Extension: tenure (availability and perf.) (=1)	0.681***	1.976***	0.151***
	(0.047)	(0.093)	(0.010)
Extension: tenure (performance) (=1)	0.768***	2.155***	0.171***
	(0.049)	(0.106)	(0.011)
Research autonomy (in %)	0.006***	1.006***	0.001***
	(0.000)	(0.000)	(0.000)
Internal funds to be neg. with chair holder (=1)	−0.190***	0.827***	−0.042***
	(0.040)	(0.033)	(0.009)
Internal funds to be neg. with university (=1)	−0.130***	0.878***	−0.029***
	(0.039)	(0.034)	(0.009)
Alternative specific constant: 2nd job in list (=1)	0.158***	1.171***	0.035***
	(0.032)	(0.038)	(0.007)
Alternative specific constant: 3rd job in list (=1)	−0.053	0.948	−0.012
	(0.033)	(0.031)	(0.007)
Observations		21,231	
Pseudo-R^2		0.139	
Log-likelihood		−6695.107	

* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

Table 3
Conditional logit regressions of job choice for later stage researchers. Standard errors in parentheses. Marginal effects calculated at choice probability $P(y_{ik}=1)=1/3$. Marginal effects of salary, teaching load and time devoted to administration calculated at average values.

Variable	β	e^{β}	Marg. eff.
Net salary p.a. (in 1000)	0.119***	1.127***	0.009***
	(0.013)	(0.015)	(0.000)
Net salary p.a. (in 1000)^2	−0.001***	0.999***	
	(0.000)	(0.000)	
Health care patient contribution (in %)	−0.024***	0.976***	−0.005***
	(0.005)	(0.005)	(0.001)
Retirement pension net replacement rate (in %)	0.015***	1.015***	0.003***
	(0.003)	(0.003)	(0.001)
Relocation support (=1)	0.177***	1.193***	0.039***
	(0.064)	(0.076)	(0.014)
Childcare facility (=1)	0.143**	1.153**	0.032**
	(0.063)	(0.073)	(0.014)
Company car (=1)	−0.015	0.985	−0.003
	(0.065)	(0.064)	(0.014)
Quality school for children (=1)	0.192***	1.211***	0.043***
	(0.062)	(0.076)	(0.014)
University housing (=1)	0.230***	1.258***	0.051***
	(0.064)	(0.080)	(0.014)
Job offer for partner (=1)	0.341***	1.407***	0.076***
	(0.064)	(0.090)	(0.014)
QoL worse than in country of residence (=1)	−0.923***	0.397***	−0.205***
	(0.044)	(0.017)	(0.010)
QoL better than in country of residence (=1)	0.114***	1.121***	0.025***
	(0.039)	(0.044)	(0.009)
Teaching load (in %)	0.021***	1.021***	−0.001***
	(0.002)	(0.002)	(0.000)
Teaching load (in %)^2	−0.000***	1.000***	
	(0.000)	(0.000)	
Short/long-term ext. funding poor/poor (=1)	−0.470***	0.625***	−0.105***
	(0.042)	(0.026)	(0.009)
Short/long-term ext. funding good/poor (=1)	−0.212***	0.809***	−0.047***
	(0.041)	(0.033)	(0.009)
Most prestigious peer among top 50 (=1)	0.337***	1.400***	0.075***
	(0.048)	(0.067)	(0.011)
Most prestigious peer among top 25 (=1)	0.385***	1.469***	0.086***
	(0.049)	(0.072)	(0.011)
Most prestigious peer among top 5 (=1)	0.503***	1.653***	0.112***
	(0.049)	(0.081)	(0.011)
Research continuity (in %)	−0.004***	0.996***	−0.001***
	(0.000)	(0.000)	(0.000)
University research funding (in %)	0.006***	1.006***	0.001***
	(0.001)	(0.001)	(0.000)
Time devoted to administration (in %)	0.022**	1.023**	−0.004***
	(0.011)	(0.011)	(0.000)
Time devoted to administration (in %)^2	−0.003***	0.997***	
	(0.001)	(0.001)	
Public salary scheme (=1)	−0.064	0.938	−0.014
	(0.042)	(0.040)	(0.009)
Public salary scheme with bonus (=1)	0.147***	1.158***	0.033***
	(0.041)	(0.048)	(0.009)
Alternative specific constant: 2nd job in list (=1)	0.109***	1.115***	0.024***
	(0.033)	(0.037)	(0.008)
Alternative specific constant: 3rd job in list (=1)	−0.069**	0.933**	−0.015**
	(0.034)	(0.032)	(0.008)
Observations		19,275	
Pseudo-R^2		0.149	
Log-likelihood		−6007.771	

* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

depend on the level of income, we include a squared salary term among the regressors and calculate the WTP as:

$$\left.\frac{\mathrm{dSalary}}{\mathrm{d}x_{mk}}\right|_{\mathrm{d}P(y_k=1)=0} = -\frac{\beta_m}{\beta_{\mathrm{Salary}} + 2\beta_{\mathrm{Salary}^2} \times \mathrm{Salary}} \tag{10}$$

where β_m, β_{Salary} and $\beta_{\mathrm{Salary}^2}$ are the estimated coefficients of x_{mk}, salary, and salary squared. Given a positive effect of salary on job choice, the ratio will be negative (positive) if $\beta_m > 0$ ($\beta_m < 0$): if an increase in x_{mk} raises (reduces) the attractiveness of job k, salary must be reduced (increased) to keep the probability of choosing job k unchanged.

Table 4 reports the WTP calculated at the respective average salaries (about \$45,000 for ESR and about \$65,000 for LSR). Because a comparison of the WTP between early and later stage researchers at these values would be affected by the difference in salary levels, the last column of Table 4 shows the difference between the WTP for ESR and the WTP for LSR evaluated at a salary of \$55,000. It thus tells us whether ESR have a higher WTP than LSR given that both groups would earn the same income.

As expected, the attractiveness of a job offer increases with salary: at average wages, a \$1000 wage increase raises the probability of choosing a job offer by about 0.8–0.9 percentage points (pp). At any level of salary, the marginal effect of an increase in salary is always higher for LSR than for ESR, in line with the human capital model.[24] The significantly negative coefficients of salary squared indicate that the combined effects of a decreasing marginal utility of income and the intrinsic motivation to carry out research give rise to a threshold effect: once a certain minimum level of net income has been reached, the importance of salary declines compared to other job characteristics.

Various characteristics of the remuneration package including fringe benefits also matter; a job offer for the partner for example increases the probability of job choice by 10.9 pp for ESR and by 7.6 pp for LSR, which emphasises the importance of taking the special requirements of dual-career couples into account. We also find that childcare facilities and quality schools for children are important, especially for ESR.

But job choice is not driven by the remuneration package alone: almost all coefficients are highly significant, suggesting that both early and later stage researchers are—consistent with our conceptual framework—willing to trade off income against other desirable job characteristics. For example, researchers must be compensated with an additional salary of about \$19,800–22,700 to accept a job offer in a country where the quality of life is worse than in the current country of work, but are willing to forego only \$2800–3500 for working in a country where the quality of life is better. Quality of life is therefore a factor that is necessary, but not decisive for job choice as long as it is not worse than in the current country of work, consistent with the notion of loss aversion (see Kahneman and Tversky, 1979).

The coefficient of the teaching load is significantly positive, while the coefficient of the squared teaching load is significantly negative, supporting our hypothesis that teaching has a non-linear effect on job choice. Fig. 1 shows the predicted probabilities of choosing a job offer k at various values of the teaching load while keeping all other variables at their respective mean. The probability of choosing a job initially increases with teaching and reaches a maximum at 26.9% of total time for ESR. This corresponds to 10.8 h if 40 h per week are spent on teaching and research (disregarding

[24] For example, at a salary of \$45,000 the marginal effect of an additional \$1000 is 0.8 pp for ESR, but 1.4 pp for LSR.

Table 4
Willingness to pay (WTP) in \$1000 calculated from conditional logit regressions of job choice for early stage researchers (ESR) and later stage researchers (LSR). WTP for ESR and LSR calculated at respective average salaries. Difference between ESR and LSR calculated at salary of \$55,000. For example, the value of −8.662 indicates that ESR are willing to pay \$8662 more for relocation support than LSR if both would earn \$55,000. All standard errors computed using the delta method.

Variable	ESR	LSR	ESR−LSR
Health care patient contribution (in %)	0.354***	0.601***	0.144
	(0.125)	(0.121)	(0.243)
Retirement pension net replacement rate (in %)	−0.185**	−0.361***	−0.039
	(0.080)	(0.076)	(0.153)
Relocation support (=1)	−6.993***	−4.346***	−8.662***
	(1.663)	(1.571)	(3.313)
Childcare facility (=1)	−6.609***	−3.509**	−8.650***
	(1.641)	(1.559)	(3.254)
Company car (=1)	−2.498	0.378	−4.589
	(1.678)	(1.591)	(3.164)
Quality school for children (=1)	−8.611***	−4.707***	−11.165***
	(1.661)	(1.538)	(3.416)
University housing (=1)	−5.008***	−5.647***	−4.241
	(1.709)	(1.568)	(3.278)
Job offer for partner (=1)	−13.478***	−8.384***	−16.688***
	(1.730)	(1.577)	(3.912)
QoL worse than in country of residence (=1)	19.810***	22.687***	16.506***
	(1.249)	(1.230)	(4.112)
QoL better than in country of residence (=1)	−3.533***	−2.808***	−3.902*
	(1.036)	(0.971)	(2.033)
Teaching load (in %)	0.206***	0.151***	0.230***
	(0.018)	(0.016)	(0.048)
Short/long-term ext. funding poor/poor (=1)	10.877***	11.558***	9.758***
	(1.145)	(1.069)	(2.820)
Short/long-term ext. funding good/poor (=1)	4.321***	5.217***	3.393
	(1.080)	(1.005)	(2.144)
Most prestigious peer among top 50 (=1)	−7.396***	−8.277***	−6.312**
	(1.260)	(1.198)	(2.682)
Most prestigious peer among top 25 (=1)	−10.464***	−9.457***	−10.675***
	(1.308)	(1.223)	(3.041)
Most prestigious peer among top 5 (=1)	−16.594***	−12.352***	−18.975***
	(1.350)	(1.233)	(3.765)
Length of initial contract (in years)	−2.084***		
	(0.306)		
Extension: 3 years (after evaluation) (=1)	−14.781***		
	(1.347)		
Extension: tenure (availability and perf.) (=1)	−18.659***		
	(1.385)		
Extension: tenure (performance) (=1)	−21.026***		
	(1.443)		
Research autonomy (in %)	−0.177***		
	(0.014)		
Internal funds to be neg. with chair holder (=1)	5.215***		
	(1.098)		
Internal funds to be neg. with university (=1)	3.557***		
	(1.063)		
Research continuity (in %)		0.089***	
		(0.011)	
University research funding (in %)		−0.139***	
		(0.015)	
Time devoted to administration (in %)		0.483***	
		(0.076)	
Public salary scheme (=1)		1.583	
		(1.039)	
Public salary scheme with bonus (=1)		−3.607***	
		(1.024)	
Observations	21,231	19,275	40,506

* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

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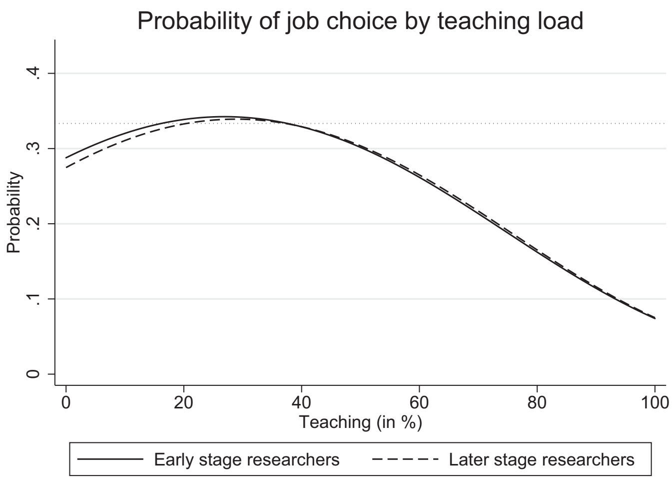

Fig. 1. Predicted probabilities of job choice for early and later stage researchers at various levels of teaching load (in % of total time). All other variables and teaching load for all other job offers at mean values. Maximum probabilities at teaching load of 26.9% for early and 28.9% for later stage researchers. Dotted line represents baseline probability of job choice $P(y_{ik} = 1) = 1/3$.

time spent on other tasks for the sake of simplicity). For LSR, the probability reaches a maximum at 28.9% (11.5 h) of total time.[25]

A teaching load of zero is therefore not the optimum, and even early stage researchers prefer a moderate amount of teaching which supports our interpretation that there are extrinsic and intrinsic motivations for teaching. Although the distributions of the choice probabilities appear to be relatively similar across career stages in Fig. 1, we find that ESR have (ceteris paribus) slightly higher preferences for lower teaching loads than LSR. This is corroborated by the evidence in table Table 4 (which shows that ESR would be willing to pay $230 more for a 1 pp reduction in the teaching load than LSR) and compatible with our human capital model, in that less time available for building up human capital matters less to LSR: the yardstick for measuring young researchers' performance is the quantity and quality of peer-reviewed publications, not excellence in teaching. The teaching load therefore weighs heavier on ESR than on LSR.

LSRs' WTP for a 1 pp reduction in the time devoted to administrative tasks (about $480) is more than three times higher than their WTP for a 1 pp reduction in the teaching load. Furthermore, the "optimal" time devoted to administrative tasks of 4.0% corresponds to only 1.6 h per week. Time spent teaching is thus considered less burdensome than time spent on administrative tasks, consistent with our hypothesis.

The availability of external funds for research has a significant effect on job choice for both ESR and LSR: compared to a situation where the availability of both short-term (up to 3 years) and long-term funding (up to 5 years) is good (the base category), the probability of choosing a job is 3.5–4.7 pp lower if only the availability of short-term grants is good but there is stiff competition for long-term funds and 8.8–10.5 pp lower if the availability of both long- and short-term funds is poor. In accordance with our human capital model, compared to later stage researchers ESR are willing to "invest" more for working in an environment that provides them with easy access to funding that enables them to establish priority early.

ESR find jobs more attractive if university-internal funds are available without strings attached (the base category), rather than having to negotiate with a research group leader/chair holder or university management, again pointing to the importance of control over one's research agenda.[26] For LSR, a 1% increase in the provided funds increases the probability of job choice by 0.1 pp; the probability of choosing a job where 25% of research is funded by the university is a substantial 4.8 pp larger than the probability of choosing an otherwise equivalent job with no internal funding.

As regards the quality of peers, especially ESR have a substantial WTP for working in a department where the most prestigious peer is among the top 5 worldwide (about $16,600). For LSR, the WTP is significantly lower, but still substantial ($12,400). Given the same income level, ESR are willing to forego a sizably larger amount of salary than LSR, as shown by the last column of Table 4. One explanation for this is that the expected benefit of joint research and publications with highly prestigious peers is higher for ESR than for LSR who have already established a scientific track record: working at an institution with highly prestigious peers is seen as an investment into research productivity and future earnings opportunities, in line with the human capital model.

Significant effects can also be found for research autonomy and research continuity, our proxies for ESRs' and LSRs' time for own research. Considering the large variation of autonomy and continuity (0–100%), cumulative effects can be quite substantial: for example, ESRs' probability of choosing a job where only 25% of the time can be devoted to autonomous research is 14.7 pp lower than the probability of choosing a job with full research autonomy.

In line with our theoretical model, career perspectives are an important aspect of the research environment e_j for ESR: an additional year of initial contract length increases the probability of choosing a job by 1.7 pp (WTP about $2100). But even more important is the possibility that the initial contract can be extended: compared to a situation where no extension is possible (the base category), the possibility of tenure raises the probability of job choice by 17.1%, especially if it is contingent on research performance alone, and ESR are willing to forego up to $21,000 for the possibility of tenure.[27] An ESR would for example rather choose a job with tenure than an otherwise equally attractive job at a prestigious department where one of the top 5 researchers in the same field is working.

Our findings on the salary advancement scheme are consistent with the hypothesis by Dasgupta and David (1994): relative to salary advancement according to individual research performance alone (the base category), established researchers prefer a public salary scheme with a bonus for research or teaching performance (WTP: $3800).

To conclude, our results support the three hypotheses generated from our human capital model and are in line with the findings of the literatures discussed in Section 2, while providing unique estimates of the role of teaching and the importance of job characteristics related to organisational and institutional factors. In online supplementary material, we further support the robustness of our results by looking at various subgroups of our sample, including gender, country groups, career stage and fields of science. In particular, our results suggest that researchers in different countries share similar preferences. There thus seems to be a "global" view on which jobs are attractive, explaining the international mobility of

[25] Note that the teaching load is measured as the percentage of time devoted to teaching, not the percentage of time where the researcher is actually in the classroom. It inter alia includes the time devoted to prepare lectures and exams, grade exams, etc.

[26] A Wald test cannot reject the null hypothesis of no difference between the latter two coefficients at the 5% significance level: $\chi^2(1) = 2.489$, p-value: 0.115.

[27] The difference between the coefficient of tenure contingent on performance evaluation and job availability and tenure contingent on performance evaluation alone is statistically significant at the 5% level: $\chi^2(1) = 3.845$, p-value: 0.050.

scientists towards countries where jobs with these characteristics are more common.

5. Summary and conclusions

This research examines determinants of job choices in academia. Using the human capital model of science, we suggest a new "lens" through which to look at job characteristics relevant for job choice: treating job characteristics as factors which affect the productivity or the enjoyment of time invested in research, we consolidate the existing literature and formulate hypotheses about the building blocks researchers require to implement their research agenda. Motivated by the difficulty of obtaining (and the shortcomings of) real data, we test these essential job characteristics in a unique quasi-experimental stated choice approach.

Our results show that researchers are willing to trade off salary in favour of aspects of the research environment that increase expected productivity or non-monetary benefits. Researchers are thus "willing to pay" for a better research environment that satisfies their intrinsic and non-pecuniary extrinsic motivations for carrying out research and that increases the probability of establishing "priority".

We provide unique estimates of the role of organisational and institutional factors in job choice. For example, early stage researchers are particularly attracted to research environments where they can spend most of their time on their own research which can then in turn lead to a tenured position based on research performance. This is in line with accounts of researchers' intrinsic and extrinsic motivations which may be closely connected: the possibility of early freedom to follow an individual, long-term research agenda confers an early start to attempts to establishing priority, in turn triggering processes of cumulative advantage that are inter alia related to advantages in applying for external funding. In a nutshell, research autonomy allows early stage researchers higher returns on investment in human capital, in particular when the researcher does not have to convert her investment into observable research outputs within a short time frame due to fixed-term contracts. These results are especially strong for PhD holders and post-docs, where job choices involving a change of country are most likely. In support of the human capital model of science, we find evidence that later stage researchers who are on average older than early stage researchers favour job characteristics which increase current income, and that they show a smaller willingness-to-pay for characteristics which enhance future productivity.

Taking into account that teaching may have a non-linear effect on job choice we also find that research-only jobs are not as attractive as jobs featuring a balance between teaching and research, supporting the hypothesis that there are intrinsic and extrinsic motives for teaching. Our results thus weigh in on the debate whether basic research should be located in research universities or in basic research institutes such as the Max Planck or CNRS institutes in Germany and France (Ben-David, 1978; Clark, 1995). Too much of a strong bias towards teaching (as in some European "mass universities") would push researchers towards pure basic research institutes because it restricts the time for their research and hence the probability of establishing priority. University jobs should therefore feature only a moderate amount of teaching, especially for early stage researchers whose opportunity costs of teaching are higher than for later stage researchers because academic success is measured by the quantity and quality of research rather than of teaching. The results of this research suggest that the optimal teaching load (including the time devoted to the preparation of lectures, exams, etc.) is around 27% (29%) of the combined teaching and research time for ESR (LSR), which corresponds to 11–12 h if 40 h are spent per week on teaching and research.

The way early and later stage researchers view organisational and institutional job attributes (research autonomy, tenure track career structure, research continuity, etc.) favours a departmental organisation at the working unit level of universities, as compared with a chair-based organisational structure. In the latter, having only one researcher at the top necessarily limits career perspectives as well as research and financial autonomy, while the replacement of the chair is more likely to be directed by the university authorities as to the contents of her research and teaching: taking up new fields of research depends on the formal decision by the university to set up a new chair, restricting the differentiation of science (Ben-David and Zloczower, 1962), which may in turn reduce the chances for establishing priority, and leads European researchers to publish and collaborate in narrow sub-disciplines within their field in order to gain scientific recognition (Youtie et al., 2013, p. 1350). In a more team-based department structure, several researchers of similar rank can work together, allowing for more career options, research autonomy and ease of taking up new lines of research.

Departmental organisation, tenure track career models and an attractive research-teaching balance, among others, are commonplace in U.S.-style research universities, so that these universities not only enjoy advantages regarding the quality of peers and funding/salaries,[28] but also with respect to their research environments that satisfy researchers' taste for science and increase their expected scientific productivity. Our results thus also provide some explanation as to the observation of asymmetric mobility of talented scientists to the U.S. and underline the necessity to widen the policy debate on the determinants of researcher mobility, from social security issues (such as portability of benefits) to scientific productivity.

From a European perspective, if job choice was merely related to the quality of peers, turning a situation of brain-drain into a more balanced brain circulation would be a difficult endeavour, as top researchers attract top researchers. However, our results also show the crucial importance of other organisational and institutional factors that have been discussed since the 1960s, but were so far difficult to empirically substantiate. European universities could for example offer attractive career perspectives and working environments to attract (or keep) highly skilled researchers, especially since the tenure track model of U.S. universities has come under a lot of strain recently. Our results also show that fringe benefits could help European universities create an attractive academic environment, for example by offering perspectives for dual-career couples. The competitiveness of European science is of course affected not only by the question of "how to get (or keep) the best", but also by different research funding models (Aghion et al., 2010). Our results indicate that merely increasing research funding without looking at the determinants of job choice in academia in more detail could turn out to be inefficient.

An evolution of European jobs incorporating structures which reflect our findings would also lead to a deeper integration of academic labour markets in Europe, boost the efficiency of job matching, increase competition and hence raise the profile of European science, improving its contribution to worldwide scientific knowledge production.[29] As our results can be seen as a general statement by researchers on what is required to allow the only limiting factor

[28] The strong focus on project-based grant funding in the U.S. is only attractive as long as success rates are not too low; researchers in our analysis indicate willingness to pay for university-provided research funding. A companion paper (Janger et al., 2013) investigates cross-country differences in university organisation more fully. Also note that tenure-track positions are increasingly becoming the minority among new job openings in the U.S. (Stephan, 2012; Petersen et al., 2014).

[29] Musselin (2004) finds that in particular heterogeneous career structures at the level of national higher education systems and recruitment procedures prevent further integration of European national academic labour markets.

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in their productivity to be their own ability, they can potentially be useful for research policy and organisation worldwide. This is supported by our finding that the determinants of job choice do not significantly differ at an international level (see Appendix C in the online supplementary material). Our results could also be used by both universities in the design of attractive job packages and by researchers as a yardstick what to look out for in job offers.

Of course our methodology also has its limitations: first, the complexity of choice situations is reduced compared with real life choices, although they are more complex than in existing studies based on observed data. Second, we can only test the importance of choice determinants which have been considered at the conception stage of our quasi-experiment. Even though we comprehensively reviewed different strands of the literature from the economics and sociology of science, it cannot be excluded that there are additional job characteristics some researchers would have considered important; however, any missing characteristics do not affect our results for the factors that we did include.

We see several avenues for further research. First, we focused on jobs in basic research; further research could investigate job choice in more applied settings where industry collaboration is a feature of varying intensity. Second, our jobs were designed for the role of principal investigator; as team-based science leads to a differentiation of roles, our experiment could be repeated for these different researcher roles. Third, our stated choice methodology could be used in similar contexts in innovation and science studies, where choice analysis is faced with serious difficulties in obtaining comprehensive observational data.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.respol.2016.05.001.

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