Academic careers: a cross-country perspective

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Socio-economic Sciences and Humanities Europe moving towards a new path of economic growth and social development - Collaborative project

Academic careers: a cross-country perspective

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Contribution to the Project

Many studies point to the fact that the quality of academic research matters for economic growth. Building on Milestone MS63, this Milestone aims at identifiying several key features of university research organization which impact on the quality of academic research. These features would be one element or framework condition for a future sustainable European growth path which will also condition Europe's ability for breakthrough innovations dealing with climate change, population ageing, etc

Keywords: Academic careers, academic labour market, university organisation, brain drain

Jel codes: I23, I25, I28

Abstract

Asymmetric international mobility of highly talented scientists is well documented. We try contributing to the explanation of this phenomenon, looking at the “competitiveness” of higher education systems in terms of being able to attract talented scientists in their field. We characterise countries’ capability to offer attractive entry positions into academic careers using the results of a large scale experiment on the determinants of job choice in academia. Examined areas refer to the level of salaries, quality of life, PhD-studies, career perspectives, research organisation, balance between teaching and research, funding and probability of working with high quality peers. Our results indicate that overall, the US research universities offer the most attractive jobs for early stage researchers, consistent with the asymmetric flow of talented scientists to the US. Behind the US is a group of well performing European countries, the Netherlands, Sweden, Switzerland and the UK. Austria and Germany are next, closely followed by France, which in turn is followed by Italy. Spain and Poland are, according to our results, least able to offer attractive entry positions to an academic career.

1. Introduction[1]

Highly talented scientists are likely to be internationally mobile (Hunter - Oswald - Charlton, 2009). Moreover, this international mobility is often asymmetric, as substantial migration flows by scientists from many regions of the world, not only Europe, to American research universities is well documented (Docquier - Rapoport, 2009; Grogger - Hanson, 2013; Laudel, 2005). This is likely to impact on university research performance, and more generally on the European economy and society (see Foray - Lissoni, 2010; Mowery - Sampat, 2005; Salter - Martin, 2001, for surveys of the role of universities in national innovation systems). It reduces the capability of European societies to come up with breakthrough ideas for dealing with "grand challenges" such as climate change or resource scarcity.

In this study, we use the results of a stated choice experiment on the determinants of academic career choice (see Janger and Nowotny, 2013) to classify national higher education system according to their capability to offer attractive jobs to academics in higher education, focusing on early stage academic positions and research universities. We use a structured qualitative-statistical framework which assigns scores to each area of relevance for the capability to offer attractive jobs, culminating in a summary index for career attractiveness. We do this to be able to compare the countries in a very homogeneous way, rather than to establish a "ranking" between countries. We are thus aiming at an explicitly comparative endeavour, structured around common themes for all the countries (see for a discussion of comparative higher education, e.g., Teichler, 2006). However, due to the information on what makes for attractive careers, our comparison has also a normative layer; note though that we do not set one country as the benchmark a priori, but that our benchmark criteria follow from the job attributes in Janger and Nowotny, 2013, which do not correspond to a job in a specific higher education system. As a result, we compare countries to a fictitious idealised academic career.

Our assessment will be necessarily broad and involving qualitative judgement as higher education systems are very peculiar. We take account of this by using possible ranges for the "true" values. While there are considerable difficulties in comparing higher education systems, our advantage is that we use a limited set of criteria which were confirmed as relevant in a large-scale experiment (Janger and Nowotny, 2013). Our comparison should not be seen as comparing all the relevant aspects of a higher education system which may impact on university research quality, but rather those aspects which are directly relevant for the attractiveness of jobs. In particular, we do not look at issues of university governance such as the autonomy they have got. As such, we complement earlier literature on comparative higher education which focuses on the competition between autonomous universities as a determinant of university research performance (Aghion et al., 2007, 2008, 2010). While this literature could be

[1] We are very grateful to the country experts who have reviewed our classification of countries (see Table 17 in the annex), as well as to Hans Pechar and Falk Reckling for valuable comments and advice. Kathrin Hranyai performed excellent research assistance. Any mistakes and errors are our responsibility.

interpreted as “getting the best out of the researcher-teachers a university has got” our endeavour is more oriented towards investigating the conditions for “getting the best in the first place”. While we definitely acknowledge our from “birds eye”-perspective, we think that there are valuable insights to be gained from comparing higher education systems in such a structured, but also “experimental” way.

Our results indicate that the US overall seems to be most able to offer attractive jobs in particular as regards early stage jobs. The US is followed by a group of countries reaching similar values for the summary index, including the UK, the Netherlands, Switzerland and Sweden. Next is a pair of countries quite similar in their higher education structures, i.e. Austria and Germany; they are followed at some distance by another pair of countries showing structural similarities, France and Italy. Spain is a little bit behind France and Italy. Poland comes out as being least able to offer attractive jobs to researchers. The correlation of our index with measures of university research quality is high. Basically, the US offers a triplet of advantages which are difficult to emulate in the short term: attractive salaries, attractive working conditions and high quality peers. Especially the latter works as a factor of inertia, as good researchers will attract good researchers. Change will need time and certainly not less attractive working conditions than in the US, accentuating the need for urgent reforms.

From the assessment of the capability to offer attractive jobs to academics, we identify some options for improvement in academic career structures and in areas which matter for career choice in academia at the national level. What can country-level policies contribute towards fostering the availability of internationally attractive university researcher jobs? We focus on early stage jobs – e.g. on assistant professors, consistent with asymmetric scientist mobility occurring mainly at an early stage of a researcher’s career (see Laudel, 2005, Van Bouwel, 2012). However our results are not irrelevant for later stage researchers.

The remainder of this paper is structured as follows: Section 2 describes our methodology. Section 3 presents our main results and some robustness analysis. Section 4 looks at options for the countries to improve their capability to offer attractive jobs for academics.

2. Assessing the capability of countries to offer attractive jobs

The main thrust of our analysis is that we try to mirror the results by Janger and Nowotny (2013) at the level of national higher education systems. We take the elements identified as important and try to describe structural features of national higher education systems which impact on the capability to offer attractive jobs. However, we complement the results of their analysis by preconditions for the transferability or for the success of a career system as sketched in Janger and Nowotny (2013). We first briefly summarise their results before we describe how we arrive at a structured framework for comparing countries, using identical criteria.

2.1 Survey results

Janger and Nowotny (2013) carried out a stated choice experiment, asking more than 10.000 early and later stage researchers (ESR and LSR) worldwide to choose a job among three

randomly allocated job offers. The job offers were built following identical criteria derived from the previous literature. ESR correspond to researchers in the career stages R1 (PhD-students) and R2 (PhD-holders, post-docs) as defined by the European Commission (2011), featuring little autonomy in what they are doing. LSR correspond to researchers in the career stages R3 (e.g., associate professors in the US) and R4 (full professors, leading researchers) who have developed research autonomy and are established researchers.

The jobs consisted of 12 attributes, split in 3 broad categories: remuneration, country characteristics and working conditions. From the chosen jobs, one can estimate the impact of the job attributes on the probability of job choice. Table 1 summarises the findings verbally; basically all attributes were significant. Table 2 shows the impact of a selection of various job attributes – those which serve as a basis for our comparison of countries – on the odds of choosing a job in percent.

Table 1: Impact of job attributes on the probability of job choice, early stage vs. later stage researcher

Early stage	Later stage
Remuneration	
Net salary p.a. (incl. bonuses): the more the better	
Health care: the higher patient contributions, the less attractive the job	
Retirement pension: the higher net expected replacement, the better	
Fringe benefits covered: depends on individual characteristics (schooling for children, job offer for partner…)	
Country characteristics	
Quality of life: must not be worse in country of new job	
Working Conditions	
Career perspectives I: Length of initial contract: the longer, the better (up to 6 years)	Ease of starting new lines of research: the more research has to be in line of previous chair-holder, the less attractive
Career perspectives II: Extension of initial contract: tenure track contingent only on research performance very attractive	Quality of administrative support: the less time for administration required, the better
Research autonomy: Time for own research (independence) - the more, the better	Salary advancement scheme: Public scheme including a performance bonus
University-internal funds for research (accessibility - financial autonomy): funds provided by university without strings attached very attractive	University-internal funds for research (how much of research can they fund): the more research can be funded via university-internal funds, the better
University-external funds for research - good availability of short-term and long-term basic research grants important feature of attractive jobs	
Quality of peers (research reputation): the better, the more attractive a job	
Split between teaching and research tasks: a fruitful balance including approx. 10h of weekly total teaching load in a 40h week	

Source: Janger and Nowotny (2013)

Table 2: Impact of job attributes on the odds of job choice, early stage vs. later stage researcher, in %

	Early Stage	Later Stage
Net salary p.a. (10.000 Euro)	36	40
Quality of life worse	-51	-60
Quality of life better	13	12
Peers among top-50 worldwide	30	40
Peers among top-25 worldwide	45	45
Peers among top-5 worldwide	82	62
Availability of short-term grants good, of long-term grants poor	14	20
Availability of short- and long-term grants good	32	37
Balance between teaching and reserach (+20 percentage points teaching)	-14	-12
Career prospect I: length of initial contract (+ 2 additional years)	17	
Career prospects II: 3 years contract extension after positive evaluation	72	
Career prospects II: tenure based on research performance and on availability of position	97	
Career prospects II: tenure based on research performance only	115	
Research autonomy (+ 50 percentage points)	38	
Research autonomy (+ 100 percentage points)	76	
Financial autonomy (funding by university relative to negotiation with chair-holder)	-12	
Financial autonomy (funding by quality proposal to university relative to negotiation with chair-holder)	-18	
Ease of setting up new lines of research (from 25 to 75% research continuity necessary)		-17
Share of research which can be funded from university-internal sources (+25percentage points)		15
Share of administrative tasks in total working time (+5 percentage points)		-9

Source: Janger and Nowotny (2013)

According to these results, what higher education systems need to be able to offer attractive early stage researcher (ESR) jobs is the option to offer jobs with career perspectives and research as well as financial autonomy, in brief early independence with a career path purely dependent on research performance. In terms of financial autonomy, ESR prefer jobs where they can obtain funding by the university without strings attached to jobs where they have to negotiate funding with their chair-holder and where they to write a proposal for obtaining university funding.

Both ESR and LSR jobs require a fair sharing between teaching and research to be attractive; the results of the experiment suggest a weekly total of 10 hours teaching for ESR, which is lower than the teaching load for LSR. This is plausible, as early stage researchers are mostly evaluated against their research performance, so that they focus more on research tasks at the beginning of their career. ESR and LSR want attractive grants systems and cooperation with high-quality peers, the quality of life in the country of the chosen job must not be worse than in the current country of residence. Attractive LSR jobs have a higher material component,

salaries matter more, which does not mean that salaries do not matter for ESR; and LSR prefer pay schemes which complement public schemes with a performance element; LSR prefer to be able to fund their research out of university-internal sources and to spend little time on administrative tasks. LSR also like jobs where it is easy to set up new lines of research. This is more difficult when they have to follow up on previous research by the chair-holder they are intended to replace. For a detailed discussion of the results, we refer the reader to Janger and Nowotny (2013).

2.2 Building a classification scheme

To translate the survey results into an assessment of the capability of national higher education systems to offer attractive jobs, we have developed a structured framework allowing for the calculation of a summary index. Due to data availability issues, we have decided not to include data on the health and pension system, as well as on possible fringe benefits, on the salary advancement scheme and on the quality of the administrative support.[2] We have complemented the job attributes in one important aspect: to be able to offer jobs featuring early independence, candidates must have gone through appropriate PhD-training. In many countries, PhD-training is or was not geared towards preparing for an independent scientific career; while this is changing, substantial differences between countries persist. If doctoral training is not regarded as a sufficient research training this may have as consequence that an additional training phase (such as a habilitation) is added with the consequence of delaying the independence of academics. Another characteristic we try to mirror in our classification is the ability to teach in English, as this is a precondition in all non-English speaking countries to be able to offer jobs to academics worldwide. Jobs which would require an academic to first learn a language other than English to be able to get a job are certainly much less attractive than a job where teaching in English is possible. This may be regarded as unfair, but it is certainly a major advantage of English speaking countries for their potential recruitment pool.

Furthermore, a system which puts the focus on tenured jobs needs mechanisms to safeguard scientific productivity over the lifecycle of researchers. We will only provide a list of such mechanisms when we turn to policy recommendations for the countries and have for the moment not undertaken research on the implementation of such mechanisms at the country level.

What we are looking out for is the typical job R2 researcher – PhD-holders or post-docs –who would apply to a first entry position into an academic career, e.g. an assistant professor in the US (which would already be rated at R3 due to its high research autonomy). Our focus is on job attractiveness for ESR, but insofar as our results are relevant also for LSR, the position would typically be a position of full professor. Table 3 shows the criteria retained to compare countries' higher education systems and their sources. Some criteria are based on purely statistical data, others are based on qualitative analysis using the existing comparative higher education literature, own desk research (e.g. university websites) and country experts. A full wording of

[2] We leave this for further research.

the criteria, as well as of sources used to describe the countries is in the annex, can be found in the appendix.

Table 3: Components of the structured framework (summary index) to compare countries' higher education systems with a view to assess the capability to offer attractive jobs

Area	Components	Source
Salary	Net salary p.a., in USD PPP	Statistical
Quality of life	Quality of life Index	Statistical
PhD-studies	• Recruitment of PhD-students • Structure of PhD-studies: Supervision • Structure of PhD-studies: Coursework • Research career orientation of PhD-studies	Qualitative
Career Perspectives	• Share of tenured researchers below the level of full professor • Ability to teach in English • Existence of tenure track model • Characteristics of tenure track model • Recruitment for tenure track positions	Statistical/Qualitative Qualitative
Research Organisation at working unit level	• Research autonomy of assistant professor/first position of academic career • Accessibility of university internal funding for ESR (financial autonomy of ESR) • Organisation of working units (departmental vs. Chair-based) • Recruitment of assistant prof./entry position in academic career vs. recruitment full professor	Qualitative
Balance teaching research	• Average teaching load in hours per week • Mechanism to adjust student numbers to teaching capacity • ESR vs. LSR teaching load	Statistical/qualitative Qualitative
Funding	• Higher education funding per student in US PPP • Acceptance rates of basic research grant proposals • Predominance of university-internal sources of funding for research	Statistical
Quality of peers	• Probability of working with high quality peers – aggregation of Leiden university ranking to national level	Statistical

In the following, we will shortly describe the rationale for choosing the items intended to capture the results of the study by Janger and Nowotny (2013). Details on the sources and methodological background are given in the appendix.

- Salaries

The inclusion of salary ranges is straightforward. We use among other sources salary data recently collected by the MORE2-project (Reinstaller et al., 2013). We have separate data for ESR and LSR; as we focus on ESR, we use the ESR data for the calculation of the index.

- Quality of life

As regards quality of life, we use the OECD Better Life Index which consists of the categories housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance. We take the simple, unweighted average of all of these categories. This is only an imperfect proxy, as each country and within each country each individual will attach different weights to the individual categories, not to mention measurement issues of the categories themselves. The OECD Better Life Index is supposed to be an objective assessment of the quality of life in a country. However, the experiment by Janger and Nowotny (2013) relied on the subjective assessment by respondents of the importance of quality of life for job decisions. As a result, our use of this OECD index is necessarily imperfect.

- PhD-studies

Concerning the structure of PhD-studies, we want to know whether PhD-Studies are preparing students to conduct independent research and whether PhD graduates would in principle be able to apply for, e.g., the position of assistant professor at a US research university (the first position on the academic career ladder which comes with research autonomy). There is ample literature on the importance of well supervised PhD-studies, embedded in graduate schools/research teams and of coursework (Clark, 1995, 1997, EUA, 2005). The recruitment procedure of PhD students serves as a proxy for the structure of PhD-studies: formal selection procedures are much more likely to be associated with professional PhD-training rather than with one-on-one thesis writing (the “master-apprentice-model”) as was/is the old model in some European countries (see Rhoades, 1991, for a conceptual background). The research career orientation is another proxy trying to establish how well PhD-studies prepare for a scientific career – whether it is the last training step or further training is required, e.g. in the form of a habilitation. We use this as a safeguard in case our structural elements on the supervision and coursework nature of PhD-studies are not conclusive. Implicitly, the quality of PhD-studies can also be seen as a proxy for the attractiveness of first jobs, as universities will tend to offer more independent positions to PhD-graduates who come from high quality PhD-studies. More broadly, it can be argued that jobs providing early career prospects need early quality signals: in the US, the quality of PhD-training serves as a first screening element for offering tenure track positions.

- Career perspectives

To assess career perspectives, we are interested in the prevalence of continuous employment or tenured employment contracts in the academic career positions below the position of full

professor (which is usually tenured in all higher education systems). We refer to “tenure” from the perspective of a continuous employment contract (as opposed to a fixed-term contract) rather than from the perspective of the strength of protection against dismissal.

An important determinant of career perspectives is the simple availability of jobs, whatever their characteristics. The analysis by Janger and Nowotny (2013) assumes the possibility of choice between jobs; often, researchers will have no such choice but be grateful for any job opening. We have unfortunately no data on job openings relative to the number of job seeking researchers (e.g., PhD-holders or post-docs). As proxies for this we interpret our funding data (see below): high expenditures per student are likely to be negatively correlated with teacher-student ratios and hence the number of higher education teacher-researchers (in fact, this amounts to expenditure per teacher-researcher); however, this is a stock measure, not a flow measure and as such imperfect: it is well known that cohort effects matter for research careers, i.e. that the academic labour market conditions at the time of entry of a cohort of academic researchers significantly impact on that cohort’s chances to make it to a tenured position (see, e.g., Stephan, 2012). Our results on the capability of national higher education systems to offer attractive jobs should thus also be regarded under the premise that there are actual job openings: our results are more relevant for the quality than for the quantity of jobs offered; we look at structural characteristics of jobs rather than at the fluctuating tide of job openings.

Another important characteristic is the potential pool of candidates for university jobs. This is in non-English speaking countries determined to a considerable extent by the possibility to teach in English. This is hence a measure of whether attractive jobs can be offered to international researchers who do not speak the language of the country in which they are applying for a job.

Moreover, we want to know if there is a tenure-track model in the countries under review and what the characteristics of such a model are, including the recruitment of candidates and whether tenure track is the dominant career path in research universities. This follows from the strong impact of this career extension option in the job choice experiment by Janger and Nowotny (2013), where the option of tenure track increased the odds of job choice by 115% for ESR. The recruiting element is again a proxy for the “quality” of tenure track model, as best-practice tenure-track models will usually be accessible only via strict selection among suitable candidates. We define a “best-practice” tenure track model as the option for early stage researchers (R2 researchers) to be able to get a job e.g. as assistant professor and to move up all the way to full professor, solely based on his/her (research) performance evaluation. That means that young researchers, after their PhD and maybe some post-doc experience, have the perspective of a permanent contract at a research university, given that their research performance is evaluated positively. It is important to differentiate this tenure track-model from the overall “tenure”-characteristic of higher education systems described above. The latter refers just to whether academics predominantly enjoy a tenured position at university or not, independent of how they achieved such a position; the first to a particular career model, whereby fixed-term researchers can enjoy clear career perspectives all the way up to full professor based on their research performance only.

- Research organisation at the working unit level

In terms of research organisation, we look at the level of research and financial autonomy of ESR (assistant professors or equivalent), in particular compared with full professors, as these levels of autonomy were significant determinants of job choice in the work by Janger and Nowotny (2013). This is likely to be substantially determined by research organisation at the working unit level, where we differentiate between a chair-based system where the chair (full professor) has some form of authority over members of his chair (younger researchers, assistant professors etc.) or a US-style department system, where assistant professors enjoy in principle levels of research autonomy similar to full professors (see Clark, 1983; Ben-David, 1968, for differences in organisation at the working unit level). We use the similarity (or dissimilarity) of recruitment procedures between assistant (or equivalent) and full professors as a proxy for levels of autonomy, as similar recruitment procedures (in terms of selection standards) are likely to be chosen if the assistant professor can conduct independent research and contributes to the reputation of the university. This is intended to provide more robustness to our qualitative assessment of the organisational models of research at the working unit level. For financial autonomy, we try to ascertain how ESR can access university internal funding – are they dependent on a hierarchically superior chair-holder, do they have to write a proposal for funding or does the university provide them with funding without strings attached?

- Balance between teaching and research

The balance between teaching and research significantly affects the chances in particular of early stage researchers to successfully enter priority contests, i.e. to be the first to publish results of research activities, bolstering claims to a tenured position and boosting career prospects (see Dasgupta - David, 1994, on the concept of contests for priority). We collect data from the MORE2-survey (IDEA Consult, 2013) on average teaching load in hours per week to assess whether teaching commitments are disproportionately restricting potential research activities. The results by Janger and Nowotny (2013) suggest non-linearity, i.e. some teaching is an attractive job characteristic presumably because researchers are genuinely interested in imparting their knowledge on students interested in research and because teaching keeps the interests of researchers' broad, as well as giving access to PhD-students who may be potential research contributors. The way we calculate the data however leads to an average number of hours which is always clearly above 0: the MORE2 project asked researchers on their average teaching load per week by providing five intervals for the split between teaching and other tasks: 76-100%, 51-75%, 26-50, 25 or less, none. Assuming a 40h workweek, we calculate a mean as well as minima and maxima from these data.

To assess whether there are big differences between disciplines, we use as a proxy the right by universities to adjust student numbers to teaching capacity (admit students according to "seats"). In several European countries, universities cannot limit student intake. As a consequence, there are several study fields showing very poor teacher-student ratios, severely limiting research time (mostly popular fields such as political sciences, psychology etc.).

We also verify how teaching loads differ between ESR and LSR jobs, as especially for ESR on fixed-term contracts – e.g. assistant professors trying to make a mark – it is important to contain teaching load, whereas for LSR on tenured contracts teaching load can increase, also due to the higher LSR experience (as is the outcome of Janger and Nowotny, 2013).

- Funding

First, we want to assess the overall funding of higher education systems as a proxy for total available research funding, for the opportunities to do research. We choose OECD data on overall funding per student in PPP. There is OECD data available on the split between research and teaching funds; however we have found these data to be very unreliable as they are based on surveys of researchers rather than on statistical data. We judge overall expenditure data to be a more robust indicator of funding possibilities. An alternative would be total expenditure per higher education researcher; however this also depends on correct measurement of full time equivalents. We have examined these data and find them unreliable. Overall funding per student is also intended as an imperfect proxy for job availability (job openings relative to job seekers, see above).

Another important component significantly impacting on job choice is the generosity of the grant system in each country, i.e. the availability of grants for basic research: good availability of short- and long-term grants increased the odds of job choice by around 35% in the job experiment by Janger and Nowotny (2013). We use acceptance rates of principal investigator grant proposals reviewed by peers, i.e. based on scientific quality only. We collect this data from the principal funding agencies of such grant types in each country.

Last, in particular later stage researchers showed a preference for university internal funding for their research. Hence, we include the share of General University Funds as a measure of the share of research funding which can be allocated based on mechanisms internal to a university.

- Quality of peers

Finally, the probability of working with high quality peers is a significant attractor in particular for early stage researchers. Working with a top 5 peer would increase the odds of job choice by 82% for an ESR, following the results by Janger and Nowotny (2013). To proxy the probability of working with high quality peers, we use a modified measure of university research quality suggested by Aghion et al. (2008): they take the top 500 in the Shanghai Ranking and assign a score equivalent to the rank of each university in this ranking. They divide the sum of these scores for each country and divide this measure by population size to control for country size. Instead of the Shanghai ranking, we take the ranking by the CWTS institute from Leiden university (Leiden ranking), which is based purely on bibliometric indicators and controls for university size, unlike the Shanghai ranking which favours big universities and has a few other drawbacks (such as taking into account nobel prize winners, which have mostly done the research leading to the award decades before the prize award). We use their indicator of the share of articles by a university placed among the top 10% cited articles in a field and multiply this share with the number of publications by each university. We sum the resulting measure

over all the universities of a country and relate it to the number of higher education researchers as measured by the OECD (for details, see appendix).

To summarise, we look at the following characteristics or areas of higher education systems/early stage academic jobs to assess the potential attractiveness of a job: the level of salaries, the structure of PhD-studies as a proxy for whether early independence is possible, career prospects in terms of how likely continuous employment is at an early career stage and what the options are to get there; research organisation at the working unit level to ascertain research and financial autonomy aspects of early stage jobs, the balance between teaching and research as a measure of how much time can be devoted to entering contests of priority and the probability of working with high quality peers.

- Overall methodology for arriving at scores for the individual items

We proceed as follows to assign scores for areas based on qualitative assessment (some or all items of PhD-studies, career prospects, research organisation, balance teaching research). For each item in each area, e.g. research autonomy of assistant professors or equivalent, we set five levels of possible answers which are intended to be equidistant, mirroring a Likert-scale, assigning scores from 1 (poor levels of autonomy) to 5 (high levels of autonomy), with 3 referring to an intermediate level. In percentage terms, one could think of the five levels as referring to 0-20%, 21-40%, 41-60%, 61-80% and 81-100%. Each item is brought to a range from 0.2 to 1 by dividing through the number of intervals. Taking account of uncertainty when assigning scores to qualitative phenomena such as higher education systems, for each score we build an interval with a width of +/- 0.5 before dividing through the number of intervals. This makes the scores commensurable with items based on statistical data, which we normalise using a standard rescaling method. It adjusts the original scale on one interval (0,1) that is constant for all indicators:

$$\bar{Y}_{i,j} = \frac{Y_{i,j} - \min\{Y_{i,j}\}}{\max\{Y_{i,j}\} - \min\{Y_{i,j}\}}$$

Where $Y_{i,j}$ refers to the value of indicator *j* for country *i* before rescaling and $\bar{Y}_{i,j}$ to the value after rescaling. To avoid changes in the normalized value whenever new countries with outlier values join the set under investigation (to reduce sensitivity to outliers), we take a fixed set of countries for normalizing the data. This means that there can be values below 0 or above 1. The fixed set we use consists of 10 countries (Austria, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland, United Kingdom, USA). We chose to exclude Poland from the fixed set because values for Poland are extreme for most of our statistical items.

The score of the total area, composed of several items, is simply the average of the items, with the exception of the item tenure track, which is weighted by the characteristics of and the

recruitment for the tenure track position. We have introduced weights for each item, but for the presentation of the main results we leave them simply at 1. When there are a lot of items in an area, individual items get lower weight, so that in some cases, some items may merit a higher weight (e.g., overall funding, ability to teach in English...). We explore the impact of different weights on the summary index in our robustness analysis (section 3.3.).

- Level of analysis

As already outlined, we examine 11 countries: the US as a benchmark or as a main benefactor of asymmetrical scientist mobility; the five biggest EU countries Germany, France, Italy, Spain, UK; the biggest Central Eastern European and former transition country Poland; a number of small, well-performing European countries – the Netherlands, Sweden and Switzerland; and Austria simply because we know it well as our home country.

We focus on research universities and look neither at public research organisations nor at colleges or universities of applied sciences. Within research universities, we focus on the group ranked in university rankings such as the Leiden Ranking (www.leidenranking.com). Whenever there is ambiguity in assessing a given country with respect to certain features of its higher education system, we thus choose those features which can be found in the top-tier research universities, where “top-tier” means within the usually top-500 as ranked by the Leiden Ranking. This concerns in particular countries with a very strong vertically differentiated higher education system such as the US.

Our time reference is usually the most recent available. For the qualitative assessment, it is the system as currently in place (as verified by our country experts); for statistical data, the year of reference depends on the source used, e.g. 2010 for OECD expenditure data on higher education. In general, the year used is consistent across the countries examined so that there should be no distortion from using different years for different countries.

As stated, we look at the national level as we are interested in what national policymakers could change to increase the attractiveness of academic careers in their respective countries. We are fully aware of the issue of heterogeneity at the university level. The latter is going to be less an issue in countries with very autonomous universities which are subject to intense competition, such as the US. There, the competitive pressure should lead all research universities to adopt the most attractive structures (see Clark, 1983; Ben-David - Zloczower, 1962 on this point). It should also be less an issue at the other end of the spectrum, in very centralised, state-led higher education systems such as Italy. University level heterogeneity is going to be more of a problem of our analysis in systems in between, which have embarked on the road towards autonomy and more competitive steering of universities such as Austria or Germany. In all cases, we try to focus on the dominant mode, disregarding small exceptions to the rule such as, e.g., in Austria the elite institution IST Austria which is completely modelled on US research universities. For each question where university level variation could play a role, we try to take account of it in our desk research and by asking country experts.

3. Assessment of countries

In the following we present the results of our work. We begin with a discussion of the overall results, the summary index and its components, pointing out strengths and weaknesses of countries. In the next step we provide a more detailed account of the countries' higher education systems discussing each area of the summary index separately. The section concludes with a robustness analysis.

3.1 Overall results: summary index and components

Figure 1 presents the summary index, showing the mean of the scores as well as the minimum and the maximum. As outlined above, this is of course partly based on qualitative assessment the potential inaccuracy of which is reflected by a range of values of +/- 0.5 score points around the means of the items based on qualitative assessment. Taking account of the possible range of values, the US seems to be most able to offer attractive jobs in particular for early stage researchers. The US is followed by a group of comparison reaching similar values for the summary index, including the UK, the Netherlands, Switzerland and Sweden. Next is a pair of countries quite similar in their higher education structures, i.e. Austria and Germany; France's mean is a bit behind them, but taking account of the range of uncertainty, it could be on par with Austria and Germany. Italy in turn is significantly different from Austria and Germany, but not from France. Spain follows, with Poland coming out as being least able to offer attractive jobs to researchers.

Figure 1: Summary index of job attractiveness

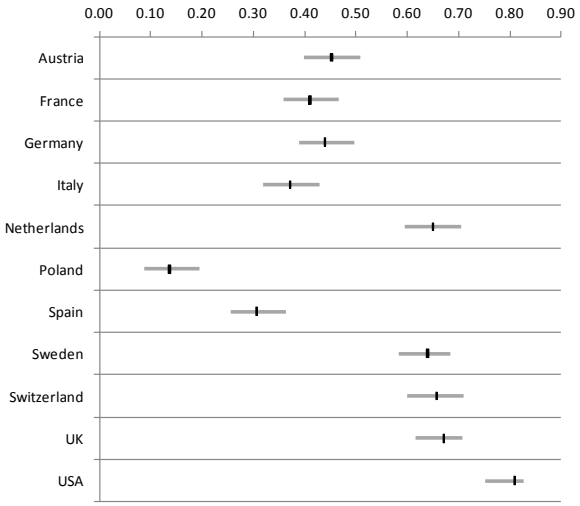


Table 4: Summary index and its constituting components

	Summary classification early stage			ESR, net salary	Quality of life	PhD-Studies			Career perspectives			Research organization at working unit level			Average teaching load			Funding	Quality of peers
	mean	min	max	mean	mean	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	mean
Austria	0.45	0.40	0.51	0.58	0.71	0.53	0.43	0.63	0.33	0.23	0.43	0.45	0.35	0.55	0.71	0.48	0.95	0.39	0.05
France	0.41	0.36	0.47	0.48	0.41	0.70	0.60	0.80	0.40	0.33	0.50	0.65	0.55	0.75	0.61	0.39	0.84	0.10	0.04
Germany	0.44	0.39	0.50	0.63	0.59	0.40	0.30	0.50	0.33	0.27	0.43	0.40	0.30	0.50	0.54	0.30	0.78	0.33	0.21
Italy	0.37	0.32	0.43	0.71	0.00	0.65	0.55	0.75	0.33	0.27	0.43	0.56	0.46	0.66	0.37	0.10	0.65	0.07	0.16
Netherlands	0.65	0.60	0.70	0.58	0.83	0.88	0.78	0.98	0.63	0.53	0.73	0.60	0.50	0.70	0.74	0.53	0.95	0.35	0.76
Poland	0.14	0.09	0.19	0.08	-0.19	0.38	0.30	0.48	0.35	0.30	0.45	0.38	0.28	0.48	0.08	-0.21	0.36	-0.09	-0.14
Spain	0.31	0.26	0.36	0.23	0.20	0.50	0.40	0.60	0.35	0.30	0.45	0.48	0.38	0.58	0.27	0.00	0.53	0.26	0.00
Sweden	0.64	0.58	0.68	0.44	1.00	0.99	0.89	1.00	0.65	0.55	0.75	0.74	0.64	0.84	0.75	0.52	0.98	0.37	0.39
Switzerland	0.66	0.60	0.71	0.73	0.95	0.58	0.50	0.68	0.42	0.27	0.52	0.65	0.55	0.75	0.77	0.55	1.00	0.65	0.50
UK	0.67	0.62	0.71	0.59	0.80	0.96	0.86	1.00	0.63	0.53	0.70	0.86	0.76	0.91	0.69	0.47	0.92	0.18	0.55
USA	0.80	0.75	0.83	0.70	0.87	1.00	0.90	1.00	0.87	0.77	0.93	0.89	0.79	0.93	0.77	0.55	1.00	0.31	1.00
Mean	0.50	0.45	0.55	0.52	0.56	0.69	0.59	0.76	0.48	0.39	0.57	0.60	0.50	0.69	0.57	0.33	0.81	0.27	0.32

We now turn to a description of countries in terms of main strengths and weaknesses at the aggregate area level, before we go to the details of each item in each area in the next section.

The US shows above average values in almost all of the components of the summary index: Salaries are high, quality of life is high (as measured by the OECD index), PhD-studies enable early independent careers, career perspectives for early stage researchers are relatively strong (for those whose research performance is evaluated positively), the research organisation at the working unit level allows for an attractive organisational work environment which is supported by better than average funding for research; the balance between teaching and research is fair and the probability of working with high quality peers is very high. The US does seems to enjoy a triplet of attractive career features: high salaries (responding to extrinsic economic motivation), working conditions which foster clear career perspectives and an early entry into contests for priority, potentially giving early stage researchers in US research universities a headstart at the beginning of their career which may set in place processes of cumulative advantage (see the discussion in Janger and Nowotny, 2013), leading to a “Matthew” effect in science, meaning that past success fosters success in the future, inter alia related to better chances for obtaining external funding (see for a discussion of the concept Merton, 1968, and for an empirical confirmation in several disciplines Petersen et al., 2011). Success in the contest for priority is furthermore supported by a high probability of working with high-quality peers. Although the quality of life as measured by the OECD-Better Life-Index seems to be high in the US (inter alia related to relatively low unemployment, high shares of tertiary education etc.), other empirical evidence reports that foreign PhD-students who come to the US for study dislike the US style of life (Stephan - Franzoni - Scellato, 2013).

Sweden, the Netherlands, the UK and Switzerland show similar summary scores, but achieve this score owing to different strengths: the first countries mentioned are more similar to the US in terms of PhD – studies, career prospects and research organisation, while Switzerland compensates for this via very attractive funding and high salaries. Sweden and the Netherlands show less attractive research organisation than the UK, however funding is much more attractive in these countries than in the UK. The probability of working with high quality peers is above average in all of the four countries.

Germany and Austria are close to, if somewhat below the average of the summary index. Austria and Germany show high salaries at the early stage level as well as above average positions for the quality of life and funding. The probability of working with high-quality peers is in both countries below the average; it is biased in particular for Germany due to its Max Planck institutes not included in our measure of peers; however, we do want to capture research universities’ capabilities of attracting able researchers rather than Public Research Organisations’ capabilities. Particularly in the following component areas, Germany and Austria are positioning themselves below average: PhD studies, career perspectives and research organization. This is linked to the similar organisational structure of these two higher education systems, which are still partly based on the chair-system.

France and Italy are both clearly below the average of the summary index (although, as stated France may not be significantly different from Austria and Germany). Areas in which France shows strengths as regards the capability of its higher education system to offer jobs which

researchers find attractive include its research organization; this is mainly due to the fact that the first job in the academic career enjoys substantial academic autonomy. Areas in which France is close to the average include its system of PhD studies and the balance of teaching and research. Areas in which France is below the average of the countries investigated here include salaries, funding for research, career perspectives, rather surprisingly the quality of life and university research quality as a measure of the "quality of peers". This last measure is biased for France, as the basic research centres run by CNRS are not included in the Leiden Ranking; however, we do want to capture research universities' capabilities of attracting able researchers rather than Public Research Organisations' capabilities. The low score concerning the quality of life is due to low scores for jobs, civic engagement and safety. As explained above, this measure should not be over interpreted. However, most people think of quality of life probably in more "touristic terms" such as the quality of food, attractive landscapes... Living in a particular country, the probability of being employed, safety etc. are likely to matter more for the perception of the "quality of life" than more tourism-oriented country properties.

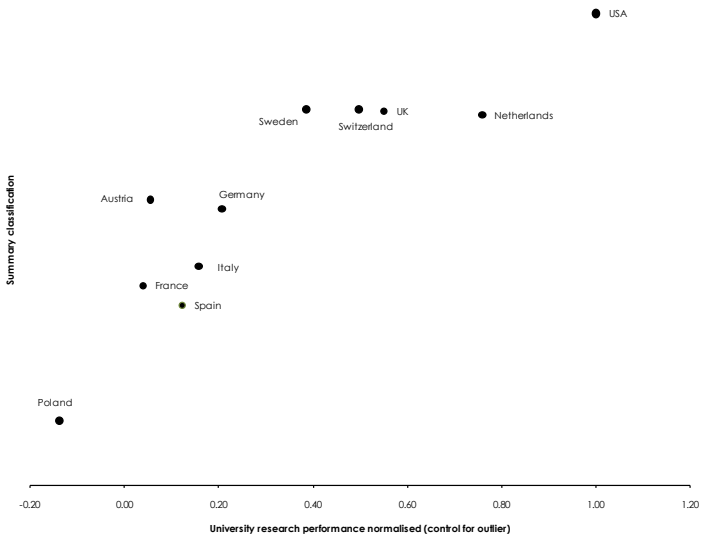
With the exceptions of salaries and the teaching load, Italy shows elements of job attractiveness below average, in particular, the quality of peers, funding and career perspectives as well as the quality of life. Spain is quite substantially below average in most of the areas investigated, with the exception of funding, where it is close to average. Poland represents the country with the lowest scoring on the summary index. Poland scores the lowest on funding, the teaching balance, peer quality and salaries; most of this is related to Poland's catching up status as an economy, where salaries and funding cannot yet compete with the levels seen in very rich countries such as the US and Switzerland. The below average scoring in the components of PhD studies, career perspectives and research organization relate to Poland's system being modelled on the German one.

- Correlation analysis

In principle, we should do a correlation of the summary score with the share of foreigners on academic career positions in the national system, possibly weighted by research performance. Currently, we don't have this data. This is a line of further research. So we take a – poor – proxy for this, which is our own measure of research quality (the probability to work with high quality peers). Of course there is circular causality; we like to think of it in the spirit of an economic growth regression, where lagged GDP enters the right-hand side of the equation as an explanatory variable. As outlined above, top researchers will attract top researchers. However, in our case, we don't have the panel data available which would allow for correcting such a relationship between the data, by means e.g. of dynamic panel data estimators. There is little difference however if we exclude the peers measures from the summary index and correlate it with the peers. In addition, there is of course omitted variable bias as we don't control for other factors impacting on research quality such as competition between universities and the level of university autonomy. The correlation is very strong, and shows a value of 0.93 (other measures

of research quality (see appendix) lead to similar results, with the weakest correlation observed at 0.77). We take this as an indication that our approach is not completely wrong footed.

Figure 2: Correlation of measure of university research quality (aggregation of Leiden Ranking) to summary index



3.2 Detailed results for components of index

We now discuss the various areas in detail, focusing however on the qualitative areas. Purely statistical details such as sources used and calculation methods are reported in detail in the appendix. The area quality of life is only reported in the appendix.

- Salaries

Salary data can vary significantly, in particular in countries, where there is no pay scale determining the salaries of academics. The problem is however attenuated for early stage research jobs, as salary negotiations are mainly a feature of higher level academic jobs (see appendix for a range of salaries for LSR jobs). Looking at the average of our salaries, it comes as no surprise that Switzerland and the US pay among the highest salaries. According to our data, average salaries are also relatively high for Italian ESR jobs. After these three countries, there is a group of countries with little differences in terms of salaries: Germany, the UK, Netherlands and Austria. A bit further behind are France and Sweden. Spain and in particular Poland are at the bottom of the distribution of salaries shown here. This is also in line with our expectations about a correlation between salary levels for academics and general, economy-wide salary levels.

Table 5: Salary data for early stage researchers (ESR)

	ESR, annual gross salaries			ESR, normalised		
Country	Minimum	Average	Maximum	Minimum	Average	Maximum
Austria	14188.00	33924.66	37604.08	0.10	0.58	0.67
France	12709.50	29797.26	34953.40	0.06	0.48	0.60
Germany	33691.33	36165.06	42724.00	0.57	0.63	0.79
Italy	29788.00	39317.49	50440.20	0.48	0.71	0.98
Netherlands	25119.50	34098.50	43079.00	0.36	0.58	0.80
Poland	10283.00	13717.75	17152.50	0.00	0.08	0.17
Spain	18892.20	19620.80	21488.40	0.21	0.23	0.27
Sweden	25643.33	28438.67	31345.91	0.37	0.44	0.51
Switzerland	29576.00	40170.00	50764.00	0.47	0.73	0.99
UK	24675.43	34545.45	34545.45	0.35	0.59	0.59
USA	31082.75	39142.50	51338.75	0.51	0.70	1.00

Source: see appendix, section 7.1

- PhD-studies

In the area of PhD-studies, countries differ in how they set up PhD-studies basically along the lines of the US-inspired structured, professional PhD-training (combining teaching and research within a team-based supervisory structure) and the "master-apprenticeship" model more prominent in Europe (Rhoades, 1991). The US model was interestingly inspired by the old German Humboldt-style university, which for the first time professionalised research training. Research training in the Humboldt-university was however a by-product of the system, rather than an explicit goal as in the modern two-tier US-research university, which aims at training young scientists for independent research careers (Ben-David, 1978, Clark, 1995). Without such a qualification, young researchers will not be able to pursue independent academic careers from an early age, but will have to undergo further training or at least demonstrate such capability through passing another academic barrier for an independent carrier as in the shape of the Habilitation. Note though that for e.g. in Germany, many students do not aim at an academic career after their PhD: PhD-study is in their case undertaken for labour market signalling reasons (see, e.g. Teichler - Bracht, 2006). PhD-holding assistant professors in for e.g. US-style systems have much higher levels of autonomy than academics awaiting their habilitation (see below), contributing to differential degrees of job attractiveness.

Our assessment of PhD-studies shows that there has been a lot of change in Europe recently, with several European countries switching fully or partly to structured doctoral training (see, in addition to our detailed sources indicated in the appendix, e.g. EUA, 2005). Italy has undertaken a very recent reform which will make modern training programmes mandatory; Sweden has done so already in the 70ies. Germany and Austria still train many PhD-students in master-apprenticeship relationships, but structured doctoral training programmes are on the rise, even if often not firmly anchored within the university in the form of a graduate school, but rather made possible through external funding from science funds.

As is obvious from Table 6, the PhD-studies in the US, Sweden and the UK are most in line with the requirements for attractive academic careers. The Netherlands cannot be statistically

excluded from this group of countries. These countries feature a competitive recruitment of PhD students, a team-based supervision of dissertations, well-developed coursework, and a clear orientation of the PhD towards training and preparing for an academic research career. Our motivations for including these items into our summary index have already been explained in section 2.2.

France and Italy score close to the average for the PhD-index, however, already below the group of countries just described. France displays relative strengths in recruitment, PhD supervision, and research orientation, however scores not so high in the coursework aspect. Italy, respectively, scores high on recruitment, supervision, and coursework, but falls behind concerning the research orientation of PhD studies, as both a further training step (habilitation) and an exam are necessary to get on the list of researchers eligible for a position entailing independent research activities.

Switzerland, Austria, Poland, Spain and Germany have an index score of PhD studies below average in common. They may be commonly characterized by stronger master-apprenticeship relations between PhD supervisors and the PhD students: in these countries it is less clear that a PhD graduation should prepare for early independence, for which working and researching in team-based structures is essential. In Switzerland, Austria and Germany doctoral studies are changing however: more and more structural doctoral training programmes are offered, even if they represent a clear minority by comparison with more traditional master-apprentice models.

Figure 3: Index for PhD-studies

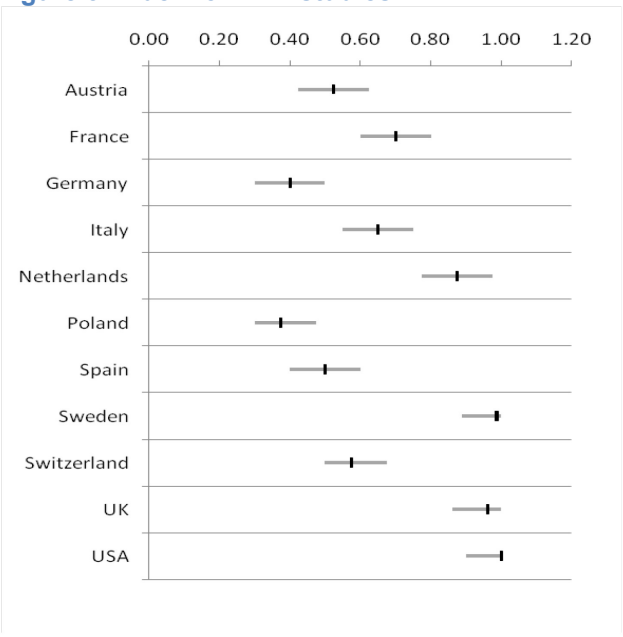


Table 6: PhD-studies index and its constituting components

	Index phd Studies			Recruitment of PhD-students			Structure of PhD-studies: Supervision			Structure of PhD-studies: coursework			Research career orientation of PhD			Result - what can PhD-students do?		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Austria	0.53	0.43	0.63	0.50	0.40	0.60	0.50	0.40	0.60	0.70	0.60	0.80	0.40	0.30	0.50	0.40	0.30	0.50
France	0.70	0.60	0.80	0.70	0.60	0.80	0.80	0.70	0.90	0.50	0.40	0.60	0.80	0.70	0.90	0.80	0.70	0.90
Germany	0.40	0.30	0.50	0.50	0.40	0.60	0.50	0.40	0.60	0.30	0.20	0.40	0.30	0.20	0.40	0.50	0.40	0.60
Italy	0.65	0.55	0.75	0.90	0.80	1.00	0.70	0.60	0.80	0.70	0.60	0.80	0.30	0.20	0.40	0.30	0.20	0.40
Netherlands	0.88	0.78	0.98	0.90	0.80	1.00	0.80	0.70	0.90	0.90	0.80	1.00	0.90	0.80	1.00	1.00	0.90	1.00
Poland	0.38	0.30	0.48	0.50	0.40	0.60	0.20	0.20	0.30	0.50	0.40	0.60	0.30	0.20	0.40	0.30	0.20	0.40
Spain	0.50	0.40	0.60	0.60	0.50	0.70	0.60	0.50	0.70	0.50	0.40	0.60	0.30	0.20	0.40	0.30	0.20	0.40
Sweden	0.99	0.89	1.00	0.95	0.85	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00
Switzerland	0.58	0.50	0.68	0.70	0.60	0.80	0.80	0.70	0.90	0.20	0.20	0.30	0.60	0.50	0.70	0.80	0.70	0.90
UK	0.96	0.86	1.00	0.95	0.85	1.00	1.00	0.90	1.00	0.90	0.80	1.00	1.00	0.90	1.00	1.00	0.90	1.00
USA	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00
Mean	0.69	0.59	0.76	0.75	0.65	0.83	0.72	0.63	0.79	0.65	0.56	0.74	0.63	0.53	0.70	0.67	0.57	0.74

Note: Original data in section 7.3 in the appendix

- Career perspectives

Academic labour markets are crucially important for career prospects in academia. The comparative literature has hitherto singled out several types of academic labour markets, with varying results for the career prospects of early stage researchers. Enders - Musselin (2008) differentiate between three types, the “up or out”-tenure system of the US, with strict selection of candidates for tenure-track positions and equally strict tenure evaluation; the “survivor”-model typical for countries where the chair-based system is strong, such as in Germany, the Czech Republic or Poland. Here, there is a long period without continuous employment contracts and only a few survive to become eventually tenured professors. The third model is called “protective pyramid” and is according to Enders-Musselin (2008) still typical for many countries. In this model, there is an early access to a permanent position following a strict competition; the way further up is then organised in hierarchical steps, depending on job availability. As Lissoni et al., 2011 and Pezzoni - Sterzi - Lissoni, 2012, document for the highly centralised academic systems of Italy and France, criteria for academic promotion in such protective pyramids are not limited to scientific productivity, but include also issues such as social and political capital, seniority, gender and the tides of centralised recruitment policies leading to pronounced cohort effects (i.e., whereas job seekers arrive at a rather regular pace on the academic labour market, job openings follow a stop and go pattern).

In a similar vein, Kreckel (2008, 2010) differentiates between tenure systems such as in England and the Netherlands, where quite a high share of academics gets a continuous employment contract relatively quickly; and within this tenure system the more specific tenure track-system of the US, where tenure is contingent on strict tenure evaluation. If academics get evaluated positively, however, there is almost an automatic escalator to full professor (“up or out”). In Germany however, and to a lesser extent in Switzerland and Austria, as well as the Czech Republic, there is the Habilitationssystem, where there is a high share of early stage academics on fixed-term contracts and relatively few make it to tenured professorship (“survivor” model). France is a mixed system in that it features a tenure system for junior staff and a Habilitationsmodel for senior staff, according to Kreckel (2010).

What differentiates career systems generally with a view to career prospects for early stage academics is the share of academics below the level of full professor with a continuous employment contract and the path to the top, i.e. which criteria must be met for promotion. The unique feature of the tenure track model is that academics on a fixed-term contract have the prospect not only of a tenured position, but of making it all the way to the top based on their performance only; their career does not depend on some arbitrary job opening in the future. Further advantages of the tenure evaluation compared with the habilitation are that no change in university is necessary to become a professor at a different university once the habilitation has been obtained; this is certainly not only much more attractive in terms of career prospects, but also much more efficient for the university which does not suffer from a significant sunk cost as a result of investing into the habilitand who then has to move somewhere else.

A general condition, as noted above, for an academic job to be able to be "attractive" to an international pool of candidates, is the ability to teach in English (as opposed to the native language) in non-English speaking countries.

As table 7 indicates, of the countries covered, the US represents clearest a "tenure-track model" for career perspectives showing attractive job features in all of the components of the index, such as the availability of tenure track positions (whether tenure track is the dominant career path) and the characteristics of the tenure track model. The share of tenured researchers below full professors – without regard to tenure track - is also high for the US (only second behind France). Of course, it is possible in the US to teach in English, a major advantage of all English-speaking countries when it comes to academic careers.

The UK, the Netherlands and Sweden follow as a group of countries where the tenure system is prevalent, coupled with good abilities to teach in English. The tenure track option as such however exists more explicitly in the Netherlands and in Sweden. After this group of countries, all the others cannot be statistically differentiated, but the overall score hides some interesting details. One group of countries features rather low shares of tenured researchers, consisting of Switzerland, Germany and Austria, with Germany being an extreme case. However, these countries are more open to international career applicants not speaking German (or French). And while far from being the dominant career path, a few universities have introduced US-style tenure tracks (e.g., TU München, see Technische Universität München, 2012, for a description; and in Switzerland the ETH Zürich. Austria has its own tenure track system, which falls however far short of the international best practice model, in that it does not lead up to full professor; once one is tenured as an associate professor, there has to be a separate promotion to become a full professor at a different university.

So clearly, people in charge of universities and higher education systems in Germany and Switzerland, and partly in Austria, have understood the powerful role a well-designed tenure track-system can play in career decisions of academics (see for the case of Germany, e.g. Borgwardt, 2010). It remains to be seen whether the tenure track can become the typical career path though, as it ill at ease with research organisation at the working unit level as chairs (see below).

The other countries France, Italy, Spain and Poland feature relatively high shares of tenured academics, classifying them as tenure systems (the protective pyramid), but the tenure track is as of yet inexistent to the best of our knowledge. A clear career path towards the top, based on research performance only, for researchers on fixed-term contracts is missing. Furthermore, these countries are also less open to international career applicants.

Figure 4: Career perspectives index

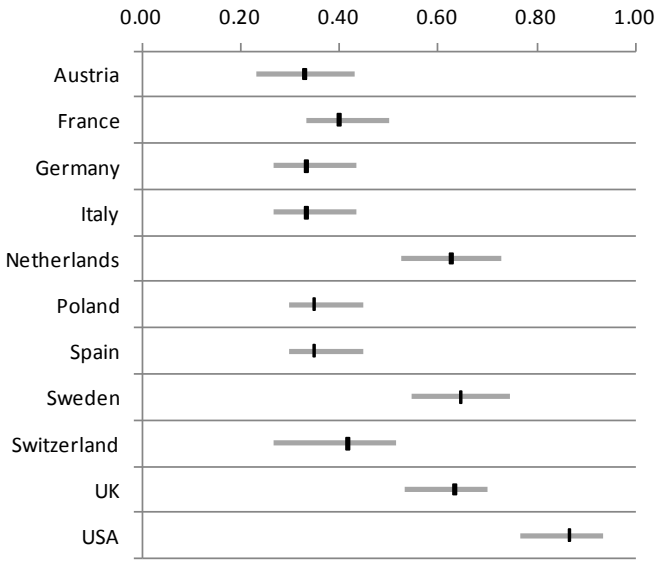


Table 7: Career perspectives index and its constituting components

	Index career perspectives			Share of tenured researchers below full professor			Ability to teach in English			Existence of tenure-track model			Characteristics of tenure-track model			Recruitment procedure for tenure track positions		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Austria	0.33	0.23	0.43	0.40	0.30	0.50	0.50	0.40	0.60	0.09	0.00	0.19	0.25	0.00	0.35	0.90	0.80	1.00
France	0.40	0.33	0.50	0.80	0.70	0.90	0.40	0.30	0.50	0.00	0.00	0.10	0.00	0.00	0.10	0.00	0.00	0.10
Germany	0.33	0.27	0.43	0.20	0.20	0.30	0.50	0.40	0.60	0.30	0.20	0.40	1.00	0.90	1.00	1.00	0.90	1.00
Italy	0.33	0.27	0.43	0.70	0.60	0.80	0.30	0.20	0.40	0.00	0.00	0.10	0.00	0.00	0.10	0.00	0.00	0.10
Netherlands	0.63	0.53	0.73	0.60	0.50	0.70	0.80	0.70	0.90	0.48	0.38	0.58	0.80	0.70	0.90	1.00	0.90	1.00
Poland	0.35	0.30	0.45	0.80	0.70	0.90	0.25	0.20	0.35	0.00	0.00	0.10	0.00	0.00	0.10	0.00	0.00	0.10
Spain	0.35	0.30	0.45	0.80	0.70	0.90	0.25	0.20	0.35	0.00	0.00	0.10	0.00	0.00	0.10	0.00	0.00	0.10
Sweden	0.65	0.55	0.75	0.70	0.60	0.80	0.90	0.80	1.00	0.34	0.24	0.44	0.80	0.70	0.90	0.60	0.50	0.70
Switzerland	0.42	0.27	0.52	0.40	0.30	0.50	0.60	0.50	0.70	0.25	0.00	0.35	1.00	0.90	1.00	1.00	0.90	1.00
UK	0.63	0.53	0.70	0.60	0.50	0.70	1.00	0.90	1.00	0.30	0.20	0.40	0.60	0.50	0.70	1.00	0.90	1.00
USA	0.87	0.77	0.93	0.70	0.60	0.80	1.00	0.90	1.00	0.90	0.80	1.00	1.00	0.90	1.00	1.00	0.90	1.00
Mean	0.48	0.39	0.57	0.61	0.52	0.71	0.59	0.50	0.67	0.24	0.17	0.34	0.50	0.42	0.57	0.59	0.53	0.65

Note: Original data in section 7.4 in the appendix

- Research organisation at the working unit level

This area affects the attractiveness of jobs directly via its link with research autonomy of early stage researchers and indirectly via its impact on career prospects. The main types of organisation of the operating units of universities are the chair-based system and the department system (Clark, 1983; Neave - Rhoades, 1987). A chair concentrates the academic, financial and administrative authority over the operating unit in one person, the chair holder, while other members of this organisational unit work as subordinates. This type is based on medieval guild structures and spread, e.g., via the success of the German research university in the 19th century to other countries (e.,g. to Japan, Eastern European countries such as Poland, etc.).

Departmental organisation of the working unit spreads responsibilities among a number of professors of similar rank, allowing more readily for the participation by early stage academics in the running of the operating unit and hence for a collegial basis of academic work. The division of labour among members of the faculty is functional rather than hierarchic: ``departmentalism'' was developed in the U.S. as a functional bureaucratic response to the challenge of administrative control over growing individual colleges and emerging universities in the 19th century and has also been adopted by a variety of countries such as England, the Netherlands or France, to name just a few (although in France departments serve mainly as the coordinating unit for teaching, not for research).

A chair-based model will make it more difficult to offer attractive jobs for ESR, as the organisational structure of having only one position at the top of the operating unit, the chair-holder, sets boundaries for early research autonomy and career perspectives. High real levels of research autonomy are possible in a chair-based system, but will depend on the chair-holder's discretion, rather than being a systemic feature in a department-style model. Offering tenure track-positions is difficult in chair systems, as it would be equivalent to hiring people to which the chair-holder promises that they can replace him or her. Even if there was one such position, for many other researchers interested in academic careers moving to the top would not be possible in such a setting. The options for a growing number of independent researchers at the same rank are very limited in chair-based systems, restricting career options.

A chair-based model makes it also more difficult to take up and pursue new research fields: the official recognition of new research fields which allows for the allocation of resources to this field depends on a formal decision by the university to set up a new chair. Ben-David - Zloczower (1962) observed that this potentially restricts the differentiation of science, which may in turn reduce chances for establishing priority, impacting negatively on one's academic career.

In reference to the overall index of research organization (table 8), the US and the UK feature a research organisation which seems to be very conducive to attractive job environments. In fact, the typical US research university offers very high research autonomy to the first position of the academic career, related inter alia to the departmental organization of its working units. This is corroborated by very similar recruitment procedures for junior and senior faculty, indicating that

assistant professors are “potential” full professors which have to be selected accordingly; this is also a result of the tenure track-system (see above), where assistant professors have the prospect of moving up to the top based on research performance only. Assistant professors get a start up package and can resort to university internal funding for the first years of their employment, should they not succeed in obtaining external grants. Sweden cannot be statistically differentiated from the US and the UK; Sweden is similar to the US and to the UK as regards the autonomy of the first entry position into an academic career, but shows different recruitment procedures for junior and senior staff, so that we are cautious about the interpretation of our results. Departmental organisation and a high share of university funding (see below, area funding) also contribute to a high financial autonomy.

Switzerland, France the Netherlands and Italy all show higher levels of departmental organisation (in Switzerland, in particular the French-speaking part). However, the autonomy levels of the first position on the academic career ladder differ. While France and the Netherlands show a high autonomy, for Switzerland and Italy there are rather low levels. In France, this is mainly due to the fact that the first job in the academic career – the maitre de conference – enjoys substantial academic autonomy. Italy features relatively little financial autonomy for ESR jobs. France is also peculiar in that it organisationally separates the organisation of academic labour into research and teaching; departments are for teaching, while there are separate research units for the organisation of research (in case that there is a co-operation between universities and basic research institutes such as CNRS, there are so-called unités mixtes de recherche, UMR).

The next group of countries contains Austria, Spain, Germany and Poland. In particular the latter two are at the bottom as very strong chair systems with implications for research and financial autonomy, and also recruitment modes for ESR jobs. Austria’s universities are free to choose between chair- or departmental organisation since the university reform of 2002, however in practice the majority of working units are still organised as chairs. While Spain features departmental organisation, autonomy levels for ESR jobs are low, showing that the stylised comparison between the chair-based and the department-based system on its own is not sufficient to explain differences between career attractiveness in a comparative perspective (the same holds true for the tenure track positions of some German universities, see above), confirming our approach of using several items to describe an area of relevance for career attractiveness, rather than just simply concluding from single, highly stylised items.

Figure 5: Research organisation index

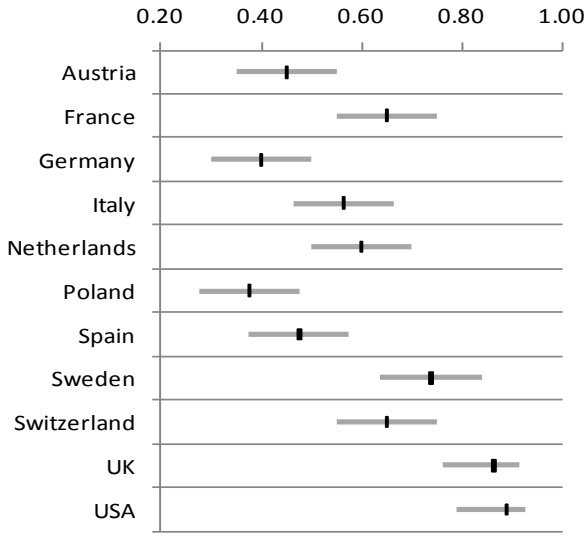


Table 8: Research organisation index and its constituting components

	Index research organisation			Research autonomy of first position of academic career			Accessibility of university funds to ESR (financial autonomy)			Organisation of working units			Recruitment of researchers for first position in academic career vs. recruitment of full professor		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Austria	0.45	0.35	0.55	0.50	0.40	0.60	0.50	0.40	0.60	0.40	0.30	0.50	0.40	0.30	0.50
France	0.65	0.55	0.75	0.80	0.70	0.90	0.40	0.30	0.50	0.70	0.60	0.80	0.70	0.60	0.80
Germany	0.40	0.30	0.50	0.50	0.40	0.60	0.40	0.30	0.50	0.30	0.20	0.40	0.40	0.30	0.50
Italy	0.56	0.46	0.66	0.45	0.35	0.55	0.30	0.20	0.40	0.80	0.70	0.90	0.70	0.60	0.80
Netherlands	0.60	0.50	0.70	0.60	0.50	0.70	0.60	0.50	0.70	0.80	0.70	0.90	0.40	0.30	0.50
Poland	0.38	0.28	0.48	0.40	0.30	0.50	0.30	0.20	0.40	0.40	0.30	0.50	0.40	0.30	0.50
Spain	0.48	0.38	0.58	0.40	0.30	0.50	0.30	0.20	0.40	0.80	0.70	0.90	0.40	0.30	0.50
Sweden	0.74	0.64	0.84	0.90	0.80	1.00	0.75	0.65	0.85	0.80	0.70	0.90	0.50	0.40	0.60
Switzerland	0.65	0.55	0.75	0.50	0.40	0.60	0.70	0.60	0.80	0.80	0.70	0.90	0.60	0.50	0.70
UK	0.86	0.76	0.91	0.85	0.75	0.95	0.60	0.50	0.70	1.00	0.90	1.00	1.00	0.90	1.00
USA	0.89	0.79	0.93	1.00	0.90	1.00	0.60	0.50	0.70	1.00	0.90	1.00	0.95	0.85	1.00
Mean	0.60	0.50	0.69	0.63	0.53	0.72	0.50	0.40	0.60	0.71	0.61	0.79	0.59	0.49	0.67

Note: Original data in section 7.5 in the appendix

- Balance between teaching and research activities

As evidenced by the results in Janger and Nowotny (2013), some teaching is actually seen as an attractive feature of an academic career, while too much teaching inhibits contests for priority which can lead to unsuccessful academic careers. Particularly for ESR, the balance between teaching and research is important, as the yardstick for their academic career is often research performance rather than teaching evidence, also borne out statistically in the experiment by Janger and Nowotny (2013). Moreover, there may be big differences between disciplines. Accordingly we examine three different items. One regarding the average teaching load as

indicated by academics in response to the MORE2-survey, the other aiming at shedding more knowledge on disciplinary differences and on differences between ESR and LSR. Universities which cannot adjust student numbers to teaching capacity (as is the case in several European countries) are likely to feature poor student-teacher ratios, overly inhibiting research activities. ESR have yet to make their mark in terms of a publication record and have less experience teaching, so that an attractive ESR position should at least not contain a higher teaching load than an LSR position.

As evidenced in table 9, the UK, the US and Switzerland achieve the most attractive balance between teaching and research activities. The UK and the US are different from Switzerland in that universities have much more power to adjust student intake to teaching capacity, while teaching load for ESR positions relative to LSR positions is lower in Switzerland. Austria, Germany, the Netherlands and Sweden cannot be statistically differentiated from the three top countries; they achieve their scores due to varying mixes of teaching load, student intake adjustment mechanisms and ESR/LSR teaching relations. France, Italy, Spain and Poland form the group of countries which is significantly behind the top three countries. Teaching loads are particularly high in Poland, Spain and Italy; universities in France and Poland have little means to adjust the student intake to their student capacity; and Spain as well as France put relatively more teaching duties on the shoulders of ESR than on those of LSR positions.

Figure 6: Balance teaching-research index

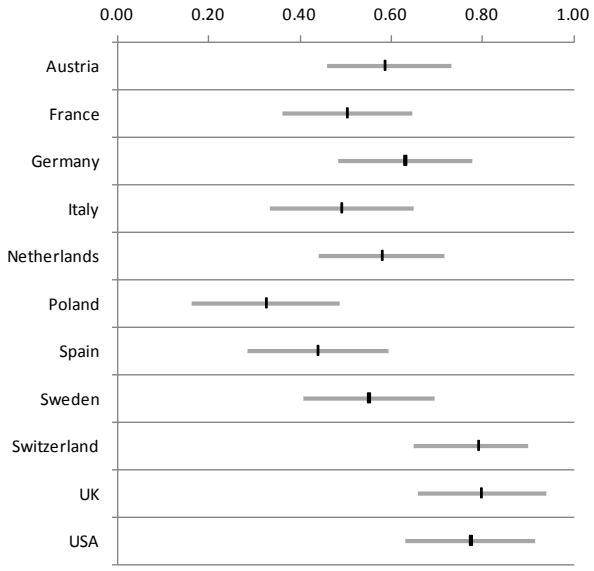


Table 9: Balance teaching-research index and its constituting components

	Index balance teaching			Average teaching load (hours/week), normalised			Mechanism to adjust student numbers to teaching capacity			ESR vs. LSR teaching load		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Austria	0.59	0.46	0.73	0.71	0.48	0.95	0.25	0.20	0.35	0.80	0.70	0.90
France	0.50	0.36	0.65	0.61	0.39	0.84	0.40	0.30	0.50	0.50	0.40	0.60
Germany	0.63	0.48	0.78	0.54	0.30	0.78	0.55	0.45	0.65	0.80	0.70	0.90
Italy	0.49	0.33	0.65	0.37	0.10	0.65	0.50	0.40	0.60	0.60	0.50	0.70
Netherlands	0.58	0.44	0.72	0.74	0.53	0.95	0.40	0.30	0.50	0.60	0.50	0.70
Poland	0.33	0.16	0.49	0.08	-0.21	0.36	0.30	0.20	0.40	0.60	0.50	0.70
Spain	0.44	0.28	0.59	0.27	0.00	0.53	0.65	0.55	0.75	0.40	0.30	0.50
Sweden	0.55	0.41	0.69	0.75	0.52	0.98	0.50	0.40	0.60	0.40	0.30	0.50
Switzerland	0.79	0.65	0.90	0.77	0.55	1.00	0.60	0.50	0.70	1.00	0.90	1.00
UK	0.80	0.66	0.94	0.69	0.47	0.92	0.90	0.80	1.00	0.80	0.70	0.90
USA	0.77	0.63	0.92	0.77	0.55	1.00	0.90	0.80	1.00	0.65	0.55	0.75
Mean	0.59	0.44	0.73	0.57	0.33	0.81	0.54	0.45	0.64	0.65	0.55	0.74

Note: Original data in section 7.6 in the appendix

- Funding

Opportunities for research funding are certainly a major determinant of career attractiveness, in particular in scientific disciplines which need a lot of physical equipment. We use overall tertiary spending per student as an indicator of funding, the acceptance rate of principal investigator grants and the share of funding which can be covered from university-internal sources, proxied by the share of general university funds in a country. As we got quantitative data for these items, we do not show possible interval ranges in a figure but limit ourselves to a table.

Overall, Switzerland offers the most attractive funding conditions for academics. While the US features the by far highest overall tertiary spending per student, Switzerland both can offer a good availability of grants and a high share of general university funds. Behind Switzerland, a group of countries achieves similar overall, above-average scores which mask differences however, namely Austria, Sweden, the Netherlands, Germany and the US. The first three feature high shares of internal funding, while Germany shows good availability of grants. Overall expenditure per student is above average in Sweden and the Netherlands. Behind this group of countries, Spain and the UK are already clearly below the average, with Spain being noteworthy for a good availability of external grants. France, Italy and in particular Poland are least attractive as regards the area of funding. Poland and Italy show particularly low overall expenditure per student.

The area of funding shows that the US-system is not without problems as regards its attractiveness for academic careers: while in other areas, it offers very attractive conditions (career prospects, research organisation, teaching, ...), in funding the US is a tough system. While overall funding is very high, researchers face stiff competition for external grants to which they have to turn to as university internal sources are quite low.

Table 10: Funding index and its constituting components

	Index funding	Expenditure per student	Availability of external grants (data-based)	General University Fund (GUF) share
	mean	mean	mean	mean
Austria	0.39	0.24	0.42	0.89
France	0.10	0.26	0.15	0.00
Germany	0.33	0.31	0.54	0.46
Italy	0.07	0.00	0.00	0.28
Netherlands	0.35	0.42	0.30	0.69
Poland	-0.09	-0.09	0.27	-0.55
Spain	0.26	0.21	0.77	0.07
Sweden	0.37	0.53	0.13	0.80
Switzerland	0.65	0.61	1.00	1.00
UK	0.18	0.35	0.23	0.14
USA	0.31	1.00	0.17	0.07
Mean	0.27	0.35	0.36	0.35

Note: Original data in section 7.7 in the appendix

- Quality of peers

The probability of working with high quality peers is a major determinant for career choice in academia. An aggregated probability at the country level can be calculated in various ways (for formulas, see the appendix). Note that once one controls for country size or the size of higher education, the eminence of the US is less clear when taking into account all the 500 universities of the Leiden Ranking. This assumes linearity in difficulty to make it to any of the ranks among the top 500; in reality, the top 50 and even more so the top 20 will be disproportionately more difficult than the group of top 400-500. Our first two measures take account of this, as we use the share of publications of a university in the top 10% of a field. Here, the distance between the first 25 is much larger than for a group of universities in the group 400-500. Given our focus of contributing to the explanation of asymmetric flows of talented scientists to prestigious universities, the first way of measuring the probability of working with high quality peers is our preferred option.

The US always fares better when the number of higher education researchers is used for controlling for country size rather than the total population (see the appendix for details). See below, robustness analysis, for an investigation of the impact of using different measures of the quality of peers on the summary index.

Table 11: Different measurement methods for quality of peers

	University research performance I	University research performance I, normalised	University research performance II, normalised	University research performance III, normalised	University research performance IV, normalised
Austria	9.06	0.05	0.07	0.23	0.27
France	8.36	0.04	0.00	0.10	0.19
Germany	15.67	0.21	0.16	0.23	0.39
Italy	13.53	0.16	0.01	0.02	0.18
Netherlands	39.76	0.76	0.76	0.70	1.00
Poland	0.62	-0.14	-0.16	-0.11	-0.13
Spain	6.67	0.00	0.00	0.00	0.00
Sweden	23.48	0.39	0.65	0.55	0.48
Switzerland	28.33	0.50	1.00	1.00	0.74
UK	30.65	0.55	0.46	0.49	0.82
USA	50.27	1.00	0.45	0.30	0.95
Mean	20.58	0.32	0.31	0.32	0.45

Note: Different measurement methods see Appendix; Original data in section 7.6 in the appendix

3.3 Robustness analysis

Here we present some robustness analysis for our results. In essence, we look at the impact on the summary index of the following changes:

- We increase the range of the interval around the qualitative scores from 0.5 to 1 (Table 12, figure 8). This does not affect the mean, only the boundaries of the range around the mean. An interval of +/- 1 point is quite large – it means that when a country gets 3 for a specific item, it could be assessed at 2 or 4 as well. The results show that our grouping of countries essentially holds; in particular, Austria, Germany France and Italy cannot be differentiated anymore, with Spain not statistically different from France and Italy.
- We use different calculation methods for the quality of peers (Table 13, see appendix for calculation); in essence, Switzerland and Sweden could be boosted, while the Netherlands and the UK lose (they just move within this group of four countries, however). Our core groupings remain unaffected and the US stays at the top.
- We change the weights for some particularly important areas/items, based on Table 2, in Table 14. A particular high impact on the odds of job choice was registered for the option of tenure track (+115%) and for peers among the top 5 worldwide (+82%); to these items we attach a weight of 3 instead of 2. In addition, we look at overall expenditure per student, as this is crucial for job availability and overall research opportunities (again weight of 3 instead of 2); and at the possibility to teach in English, as this is a pre-condition for being attractive to non-natives (weight of 2 instead of 1). Table 15 shows that the changes of the overall summary index are very limited. Usually countries close to each other swap positions, for e.g. in the group of four countries behind the US – Switzerland, UK, Netherlands, and Sweden – there is some change affecting the rank of these countries

within their group, reflecting the strengths and weaknesses of the countries. Also Germany and Austria change position between themselves. Table 16 shows the combined impact of changing the weight of all of these items on the summary index: This yields a similar picture, with the US unaffected in terms of rank, but moving further ahead of everybody else; and changes of rank within the group of four followers favouring in particular the Netherlands. Germany and Austria also change position.

Table 12: Changing the interval around the mean for qualitative items from 0.5 to 1

	Summary classification early stage		PhD-Studies		Career perspectives		Research organization at working unit level	
	min	max	min	max	min	max	min	max
Austria	-0.04	0.05	-0.10	0.10	-0.07	0.10	-0.10	0.10
France	-0.04	0.05	-0.10	0.10	-0.07	0.10	-0.10	0.10
Germany	-0.04	0.05	-0.05	0.10	-0.10	0.10	-0.08	0.10
Italy	-0.03	0.04	-0.08	0.08	-0.03	0.10	-0.08	0.10
Netherlands	-0.05	0.04	-0.10	0.03	-0.10	0.10	-0.10	0.10
Poland	-0.02	0.05	-0.05	0.10	-0.03	0.10	-0.08	0.10
Spain	-0.03	0.05	-0.08	0.10	-0.03	0.10	-0.08	0.10
Sweden	-0.05	0.03	-0.10	0.00	-0.15	0.07	-0.10	0.08
Switzerland	-0.04	0.04	-0.07	0.10	-0.07	0.10	-0.10	0.10
UK	-0.05	0.02	-0.10	0.00	-0.13	0.07	-0.10	0.04
USA	-0.05	0.01	-0.10	0.00	-0.10	0.03	-0.10	0.02
mean	-0.04	0.04	-0.08	0.06	-0.08	0.09	-0.09	0.09

Figure 7: Changing the interval around the mean for qualitative items from 0.5 to 1

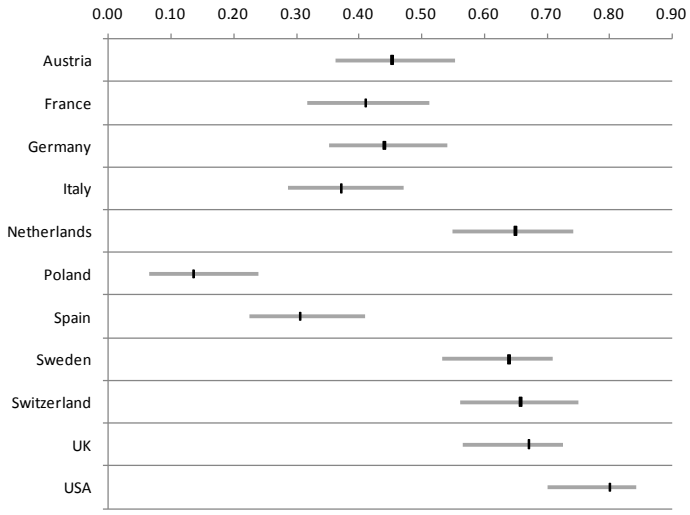


Table 13 Impact on summary index of using different measurements for peers

	Summary classification early stage (university research method II)	Change of rank	Summary classification early stage (university research method III)	Change of rank	Summary classification early stage - (university research method IV)	Change of rank
	mean		mean		mean	
Austria	0.00	0	0.02	0	0.03	0
France	0.00	0	0.01	0	0.02	0
Germany	-0.01	0	0.00	0	0.02	0
Italy	-0.02	0	-0.02	0	0.00	0
Netherlands	0.00	-1	-0.01	-1	0.03	0
Poland	0.00	0	0.00	0	0.00	0
Spain	0.00	0	0.00	0	0.00	0
Sweden	0.03	+2	0.02	+1	0.01	0
Switzerland	0.06	+1	0.06	+2	0.03	0
UK	-0.01	-2	-0.01	-1	0.03	0
USA	-0.07	0	-0.09	-1	-0.01	0
Mean	0.00		0.00		0.02	

Table14: Impact of different weights of selected items on summary and area indices

	Summary classification early stage (exp=3)	Funding (expenditure=3)	Summary classification early stage (peers=3)	Summary classification early stage (tenure track=3)			Career perspectives (tenure track=3)			Summary classification early stage (english teaching=2)	Career perspectives (english teaching=2)
	mean	mean	mean	min	mean	max	min	mean	max	mean	mean
Austria	0.01	0.12	0.01	0.00	0.03	0.01	0.00	0.24	0.06	0.02	0.17
France	0.02	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13
Germany	0.02	0.16	0.05	0.03	0.10	0.03	0.20	0.80	0.20	0.02	0.17
Italy	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10
Netherlands	0.03	0.21	0.19	0.04	0.16	0.02	0.32	1.28	0.14	0.03	0.27
Poland	-0.01	-0.05	-0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08
Spain	0.01	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08
Sweden	0.03	0.26	0.10	0.03	0.11	0.02	0.22	0.90	0.19	0.04	0.30
Switzerland	0.04	0.31	0.12	0.03	0.08	0.02	0.22	0.67	0.17	0.03	0.20
UK	0.02	0.17	0.14	0.03	0.10	0.02	0.20	0.80	0.20	0.04	0.33
USA	0.06	0.50	0.25	0.08	0.30	0.00	0.60	2.40	0.00	0.04	0.33
Mean	0.02	0.17	0.08	0.02	0.08	0.01	0.16	0.64	0.09	0.02	0.20

Table 15: Change of rank (for weights used in Table 14)

	Summary classification early stage (exp=3)	Funding (expenditure=3)	Summary classification early stage (peers=3)	Summary classification early stage (tenure track=3)	Career perspectives (tenure track=3)	Summary classification early stage (english teaching=2)	Career perspectives (english teaching=2)
Austria	0	-3	-1	-1	+4	0	+3
France	0	+2	0	0	-2	0	0
Germany	0	-3	+1	+1	+4	0	+2
Italy	0	+1	0	0	-2	0	-2
Netherlands	0	0	+2	+2	+2	+1	0
Poland	0	0	0	0	-2	0	-2
Spain	0	-3	0	0	-2	0	-2
Sweden	0	0	0	+1	-1	0	-1
Switzerland	+1	0	-1	-2	-1	-1	0
UK	-1	+2	-1	-1	-1	0	+1
USA	0	+5	0	0	0	0	0

Table 16: Impact of simultaneous change of weighting on summary index: Expenditure=3, English=2, tenure track=3, peers=3

	Summary classification early stage			Change of rank
	min	mean	max	
Austria	0.01	0.05	0.01	-1
France	0.02	0.04	0.02	0
Germany	0.02	0.09	0.02	+1
Italy	0.00	0.05	0.00	0
Netherlands	0.03	0.25	0.03	+2
Poland	-0.01	-0.03	-0.01	0
Spain	0.01	0.02	0.01	0
Sweden	0.03	0.17	0.03	0
Switzerland	0.04	0.19	0.04	-1
UK	0.02	0.20	0.02	-1
USA	0.06	0.35	0.06	0

4. Some options for improving the attractiveness of academic career structures at the country level

The results of our effort at describing some elements of selected countries' higher education systems with particular relevance for the attractiveness of academic careers can be used to outline a few options where countries can improve the general attractiveness of their academic careers, possibly turning a situation of brain drain into one of brain circulation. It is not a question of copying a single country, as we have seen that also the US and Switzerland have elements regarded as unattractive by academics. Note that our entire approach was also not geared towards benchmarking career attractiveness against a single country, but against a set of generic job attributes which turned out to be very important in a job choice experiment among more than 10.000 academics. For each country, it is thus important to develop its career attractiveness starting from the existing set-up. We now discuss some options for improvement within the individual areas examined above.

- Funding&salaries

We start with funding, as it is quite a basic requirement for attractive careers. The amount of spending per student on tertiary education in the US is measured at purchasing power parities (correcting for, e.g. much lower price levels in Poland) 4 times higher than in Poland, 3 times higher than in Italy, and twice as high as in several advanced, high-income middle European countries such as Austria, France and Germany. Note that these are average figures: due to the strong vertical differentiation of the US system, comparative spending levels per student are going to be even more favourable for the US when looking at the top research universities only (e.g., those featuring in the Leiden Ranking). Without a clear commitment to increased funding of higher education relative to the amount of students enrolled, higher education systems will simply not be able to be "competitive", in terms of universities not being able to attract the most talented scientists in their field.

The availability of grants – as measured by principal investigator grants awarded by peer review of scientific promise – is another important issue academics look out for when deciding between jobs. Our results indicate that Italy, Sweden, France, the US, the UK and Poland could increase acceptance rates relative to such countries as Austria, Germany, Spain and in particular Switzerland. We want to discuss the role of university internal funding in relationship with the issue of career perspectives.

The level of salaries is certainly linked to overall funding, but not necessarily, as the relatively high salaries granted to ESR positions in Italy show. Countries which could increase their relatively low salaries to average levels, thereby increasing the attractiveness of their careers, are particularly Poland and Spain; Sweden and France feature below average salaries.

- PhD-studies

The quality of PhD-training plays an important role for enabling early independent positions of academics. There is now a Europe-wide effort to improve the quality of doctoral training (see, e.g., the Salzburg principles). In particular Germany and Poland could further improve doctoral

training, followed Austria, Spain and Switzerland. Accepting the PhD as the final training stage of academics, enabling them for independence, would of course also make the “habilitation” redundant. Note that improving the quality of PhD-training can also lead to an increased outflow of talented young academics when career prospects and generally the attractiveness of academic careers do not follow suit, as better trained PhD-holders are then in a better position to access the global market for scientists. This is even something which can be observed in Europe, quite strong efforts at improving doctoral education, while not changing or not changing very much the rest of the career edifice. This also shows that improving the attractiveness of careers needs to look at several areas in parallel rather than at targeting isolated areas.

- Research organisation at the working unit level

A departmental organisation would make it easier to have both a larger share of independent academics of the same rank in one operating unit, improving career prospects; and more research and financial autonomy, also improving job attractiveness, as academics are particularly motivated by the perspective of being able to autonomously carrying out their research. Countries which could change in terms of granting higher levels of research and financial autonomy to the first position on their academic career ladder are in particular Germany and Poland, but also Spain and Austria.

- Career paths

Both the probability of getting tenure and the path to the top of the career ladder matter a lot to job choice of academics. The tenure track-model is very attractive in that it combines a very clear career perspective already from the position of a fixed-term researcher with clear criteria for promotion to a tenured position, in the shape of scientific productivity only. The “up or out” characteristics of this model make it also more fair to young academics because they know at an early stage whether a career in academia is possible or not. Particularly for women, the earlier option to stay at a university may be beneficial in terms of work life balance. The compulsory change of university follows in the US after the PhD-studies; academics on a tenure track position can then stay at the university, rather than having to switch to another university in the “habilitationssystem”. Currently, the tenure track-model is the dominant career path in the US only; Sweden and the Netherlands use it also more extensively, while there are a few attempts at introducing it in a couple of universities in Germany and Switzerland.

Turning it into the dominant career model would both increase the share of tenured academics below the level of full professor and provide clear career paths in countries currently characterised by the “survivor” model, such as Germany, and partly Austria and Switzerland. For countries already showing high shares of tenured academics (the “protective pyramid”), such as France, Italy and Spain, the tenure track option would bring a clearer transition from the status of fixed-term researcher to tenured researcher, with transparent criteria in the form of research productivity; and the path to the top of full professor would also be much clearer in terms of conditions for promotion.

However, from a system wide perspective aiming at improving overall research quality of universities, there are potential problems arising out of large shares of tenured academics, in that incentives for continuous scientific productivity over the life cycle might be diminished (for a discussion, see Levin - Stephan (1991).[3] This may be create negative feedback effects for the ability to attract highly talented scientists via the role of the quality of peers: while it may be possible to get lots of talented scientists in a first round, as they age and do not face incentives to uphold research productivity, it is possible that their research productivity diminishes, so that their role as attractor for other, early stage scientists will be reduced. To make high shares of tenured academics compatible with incentives for continuous scientific productivity (to avoid long-term negative effects on career attractiveness through high shares of tenured researchers), there are several options practiced in higher education systems, which have advantages and drawbacks.

First, a strict selection of tenure track-candidates is necessary, based on transparent, meritocratic criteria. An international call – which for non-English speaking countries would imply that candidates are allowed to teach in English – widens the potential pool of candidates.[4] The selection according to quality only is often difficult at this stage as early stage researchers usually lack long publication lists. In the US, the quality and reputation of the PhD-programme plays an important role; in other countries, successful grant proposals, where the proposal has been reviewed by peers for its scientific merit only, are used as quality signals. Tenure evaluation should be equally strict; anecdotic evidence suggests that in higher education systems without the experience of US departments in assessing whether tenure is merited, there are considerable problems associated with saying “no”. As a result, rather than offering a tenure track perspective, people in charge of recruitment only offer fixed-term contracts which end anyway without anyone having to say “no” explicitly. This seriously undermines career attractiveness, as shown above. Vertical differentiation of higher education systems may help saying “no” also easier, as candidates then can go to different, less prestigious universities where there is a higher probability of getting tenure. In settings of such strictly selected academics, there may also be changes in culture taking place: when all peers in the operating unit work hard all the time, peer effects may be sufficient to keep up research productivity.

Second, other practices relate mainly to funding or the way funding is allocated. The first regards grant funding. In the US, e.g., it is common practice, in particular in science and engineering, to only pay a 9 months’ salary; the academic can earn another 3 months through, e.g., summer teaching, but also through applying for grants to fund research. In the US, it is possible to put the professor’s salary on the list of items which are funded by the science funds. This is an important condition, as otherwise an increase in external grant funding leads to full

[3] Note that low shares of tenured academics - or few tenure-track positions – not only reduce the attractiveness of jobs, reducing the probability of being able to hire the most talented, but also leads to incentive problems on the part of scientists on short-term contracts: short-term contracts may reduce the incentives for a young scientist to invest in human and social capital accumulation; it leads them to favour quantity over quality and may even be detrimental to the institution of “open science” (for a thorough discussion of this, see Petersen et al., 2012).

[4] It goes without saying the practice of exams to become eligible for professorship, such as in some disciplines in France or in Italy, is also inimical to a wide pool of international candidates.

professors just writing grant proposals and employing lots of PhD-students which then don't have further career options. Of course, paying only 9 months of salary is a tough system which may only be easy for very talented scientists.[5] Non-tenured researchers on tenure track awaiting their evaluation should by contrast be able to benefit from university internal funding, as they have less experience in grant writing and no or only a short track record of research achievements which may serve as a basis for awarding grants.

A high share of tenured researchers and a high share of general university funds which are allocated without strings attached, or without differentiating among the quality of universities, may be particularly problematic in terms of incentives. This is why some countries perform research evaluation exercises of universities (such as the UK), the results of which are used to allocate base funding to universities (see Hicks, 2012, for an overview). Note though that there may be negative side-effects from the interaction between research organisation and funding modes (Whitley - Gläser - Engwall, 2010; Whitley, 2003). E.g., when a system of research evaluation meets hierarchical chair structures, there is a risk that the chairs abuse their hierarchical power over subordinates in the operating unit.

In general, funding allocation mechanisms which lead to a differentiation according to the quality of research create strong incentives for competition based on quality. In particular, autonomous universities which are competing against each other have been shown to feature higher research quality (Aghion et al., 2010); it is likely that such universities will try to ensure continuous life-cycle productivity, e.g. through university-internal allocation mechanisms. There is a difference between universities funding operating units mostly as a consequence of past spending patterns, or based on the scientific quality of proposals written by members of the operating units.

Judging from the results of Janger and Nowotny, 2013, there is an increasing clash of preferences of academics who prefer funding without strings attached, whereas science funds and governments more and more attach "strings" to the money (Whitley, 2007). Resolving this is certainly not easy.

Third, other practices relate to a change in tasks by the academics following an evaluation of research performance, e.g. a shift to increased teaching duties as a result of diminished research productivity. Universities in France and Germany can adjust the teaching load of academics following recent reforms (see Musselin, 2013).

The three broad options outlined above are purely a list of options currently practiced; they all have advantages and drawbacks, in particular as regards the attractiveness of jobs. There is empirical evidence lacking as to which option is most compatible with the preferences of academics and with the requirements of open, curiosity-driven science. However, in spite of its tough system, the US seems to manage a high inflow of talented scientists, suggesting that (highly talented?) academics are willing to accept this in exchange for other, attractive job

[5] Another tough option in the US is to freeze salaries of researchers with diminished research productivity.

features. But there is definitely a need for further research to find ways to combine high shares of tenured academics with continuous lifecycle productivity.

5. Conclusions

We complement the literature of comparative higher education with a view to shed more light on the asymmetric mobility of highly talented scientists. We have a look at the "competitiveness" of higher education systems in terms of being able to attract talented scientists. We use a structured framework to be able to compare countries following a clear set of criteria, derived from the results by Janger and Nowotny (2013) who estimated determinants of job choice in academia based on a large-scale experiment among more than 10.000 academics. This allows for putting a normative perspective on differences between countries which are not arising from setting one country to be the benchmark. All countries are compared neutrally against our set of criteria for job attractiveness.

While we adopt necessarily a broad perspective of countries' higher education systems, we think that our approach pinpoints a few main issues impacting on the attractiveness of academic careers. We classify countries according to their characteristics in the areas salaries, quality of life, PhD-studies, career perspectives, research organisation, balance between teaching and research, funding and probability of working with high quality peers. Our results indicate that overall, the US research universities offer the most attractive jobs for early stage researchers, consistent with the asymmetric flow of talented scientists from all over the world towards the US. The US does not only have strengths however, in particular as regards some aspects of funding. Behind the US is a group of well performing European countries, the Netherlands, Sweden, Switzerland and the UK. Austria and Germany are next, closely followed by France, which in turn is followed by Italy. Spain and Poland are, according to our results, least able to offer attractive entry positions to an academic career.

Attempts at improving career attractiveness should always be undertaken first from the perspective of the status quo in a country, i.e. building upon the strengths while addressing weaknesses; and second attempts should not be made for isolated areas only. There is an interaction between many areas in terms of career attractiveness. E.g., improving doctoral education only without improving career perspectives is bound to intensify asymmetric mobility of talented scientists. A thorny issue is also safeguarding the compatibility of high shares of tenured academics with incentives for life-cycle research productivity. There are many practices around, each with advantages and drawbacks; here, countries certainly have to tread carefully and examine closely various options before embarking on changes. This is certainly a worthwhile topic for further research. Other options to expand on this paper are of course the inclusion of more countries; our effort was very limited in terms of budget, while detailed comparative analysis requires substantial resources. There is of course also the possibility to improve on the data, and to build, e.g. time series which would allow for more empirical analysis options. The data could also be complemented by a measure of competition intensity between universities and exogenous variations in the indices of the countries such as university reforms

could be used to more closely examine the impact on migration flows of scientists, or on research quality.

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Table 17: References used to assess countries

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Teichler, Ulrich / Ester Ava Höhle (eds.) (2013): The Work Situation of the Academic Profession in Europe: Findings of a Survey in Twelve Countries. Dordrecht: Springer.	A, CH, DE, TT, NL, PL, UK
Reinstaller A. (Coord.), Unterlass, F. (Coord.), Hranyai K., Huber P. 2013. MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Remuneration Cross-Country Report (WP4). European Commission, DG Research and Innovation	A, CH, DE, F, IT, NL, PL, SE, UK, US
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7. Annex: Full range of classification data including questionnaire

This annex contains the original data used for comparing countries' higher education systems with a view to assessing the attractiveness of academic careers they can offer. Note that for each country and each item based on qualitative assessment, a short text was written. For reasons of space we have not reproduced this text here; however it is available from the authors.

7.1 Salary levels

Salaries and Stipends in national currency are converted into PPP US-Dollar (2011) and the resulting PPPs are converted into EURO using the currency exchange rate of Eurostat (1,3920$ = 1EURO); if the year of the salary or the stipend is not 2011, the amount for 2011 was calculated using the unit labour costs index of the AMECO database. Poland and Switzerland salary averages are WIFO calculations.

The main source for salary data was Reinstaller A. (Coord.), Unterlass, F. (Coord.), Hranyai K., Huber P. 2013. MORE2 - Support for continued data collection and analysis concerning mobility patterns and career paths of researchers, Remuneration Cross-Country Report (WP4). European Commission, DG Research and Innovation; exceptions are salary data for France (ESR, avg&max) and Italy (ESR: avg, max; LSR: avg, max), for which we used Altbach, P.G. / Reisberg, L. / Yudkevich, M. / Androushchak, G. / Pacheco, I.F. (2012): Paying the Professoriate. A Global Comparison of Compensation and Contracts. New York , London: Routledge; for Austria (ESR: avg&max, LSR: avg&max) and Germany (ESR: avg, LSR, avg) we used the Academic careers observatory (European University Institute): http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/About.aspx , for UK ESR we used Teichler, Ulrich; Höhle, Ester Ava (Eds.) (2013): The Work Situation of the Academic Profession in Europe: Findings of a Survey in Twelve Countries. Dordrecht, Heidelberg, New York, London: Springer.

Below, we also show the salary levels for LSR researchers. For the summary index, we only used ESR salary levels.

Table 18: Salaries, 2011

	LSR, annual gross salaries			LSR, normalised		
Country	Minimum	Average	Maximum	Minimum	Average	Maximum
Austria	44880.00	49042.27	59950.56	0.36	0.41	0.55
France	21796.00	36827.50	44747.00	0.07	0.26	0.36
Germany	41315.20	45738.87	54773.60	0.31	0.37	0.48
Italy	45027.50	64666.93	82887.48	0.36	0.61	0.84
Netherlands	53051.00	67838.00	82625.50	0.46	0.65	0.83
Poland	16395.00	26331.50	36268.00	0.00	0.13	0.25
Spain	32826.33	44875.33	55254.00	0.21	0.36	0.49
Sweden	34210.67	40479.33	48234.00	0.22	0.30	0.40
Switzerland	48998.50	72394.25	95790.00	0.41	0.71	1.00
UK	58544.00	52365.50	65579.96	0.53	0.45	0.62
USA	58544.00	70378.00	85180.33	0.53	0.68	0.87

7.2 Quality of life

The OECD Better life Index contains several items, which were normalised and simply averaged.

Table 19: Quality of life, 2013

	Housing	Income	Jobs	Community	Education	Environment	Civic Engagement	Health	Life Satisfaction	Safety	Work-Life Balance	mean	OECD Better Life Index, normalised (control for outlier)
Austria	5.9	5.2	7.9	8.4	6.2	7.8	6.4	7.6	8.7	9.2	7.2	7.32	0.71
France	6.3	5.1	6.1	8	5.5	7.9	4.4	7.9	6.3	8.2	8.1	6.71	0.41
Germany	6.2	5.1	7.4	7.7	7.6	8.8	3.9	7.1	6.6	8.9	8.5	7.07	0.59
Italy	5.1	4.7	5.5	5.2	4.8	5.9	5.2	7.8	3.7	8.4	8.2	5.86	0.00
Netherlands	6.9	5.5	8.1	8.4	7.1	6.9	5.2	8.3	9	8.3	9.4	7.55	0.83
Poland	3.1	1	5.2	7.1	7.8	5.3	5.5	4.9	3.8	9.6	7	5.48	-0.19
Spain	6.7	2.9	3.9	8	4.8	6.2	5.1	8.6	5.1	8.6	9	6.26	0.20
Sweden	6.1	4.6	7.1	7.6	8.2	9.7	8.7	8.8	9.3	8.2	8.7	7.91	1.00
Switzerland	5.9	7.8	8.9	8.5	7.3	8.2	3.6	9.2	10	8.6	7.9	7.81	0.95
UK	6.1	5.5	7.7	8.8	5.9	9.5	7	8.3	6.9	9.5	7.2	7.49	0.80
USA	7.7	10	7.4	6.8	6.9	7.9	5.8	8.4	7.5	8.9	6.7	7.64	0.87
mean	6.00	5.22	6.84	7.68	6.55	7.65	5.53	7.90	6.99	8.76	7.99	7.01	0.56

Source: OECD Better Life Index: www.betterlife.org [downloaded 23.05.2013]

7.3 PHD studies

Table 20 contains the data for the item "Recruitment of PhD-students" in Table 6 (index for PhD-studies). A text assessment of each country describing why we chose the specific value is available from the authors.

Table 20: Recruitment of PhD-students

	1	2	3	4	5
	Undergraduate degree sufficient, no selection procedure	Some PhD studies require formal application (with selection among suitable candidates), many not	Approx. half of PhD studies require formal application (with selection among suitable candidates), half not	Many PhD studies require formal application (with selection among suitable candidates), some not	Competitive selection for most or all students
Austria		2.5			
France			3.5		
Germany		2.5			
Italy				4.5	
Netherlands				4.5	
Poland		2.5			
Spain			3		
Sweden				4.75	
Switzerland			3.5		
UK				4.75	
USA					5

Source: see Table 17

Table 21 contains the data for the item " Structure of PhD-studies: Supervision" in Table 6 (index for PhD-studies). A text assessment of each country describing why we chose the specific value is available from the authors.

Table 21: Structure of PhD-studies: Supervision

	1	2	3	4	5
	Work on PhD thesis is fully done under supervision of one professor; students just research their topic (master - apprentice relationship)				Work on PhD thesis within firmly established graduate school (structured doctoral training programme); supervision by several professors/senior researchers
Austria		2.5			
France				4	
Germany		2.5			
Italy			3.5		
Netherlands				4	
Poland	1				
Spain			3		
Sweden					5
Switzerland				4	
UK					5
USA					5

Source: see Table 17

Table 22 contains the data for the item " Structure of PhD-studies: coursework" in Table 6 (index for PhD-studies). A text assessment of each country describing why we chose the specific value is available from the authors.

Table 22: Structure of PhD-studies: coursework

	1	2	3	4	5
	No coursework, students just research their thesis topic				Substantial coursework before student starts researching his thesis topic
Austria			3.5		
France		2.5			
Germany	1.5				
Italy			3.5		
Netherlands				4.5	
Poland		2.5			
Spain		2.5			
Sweden					5
Switzerland	1				
UK				4.5	
USA					5

Source: see Table 17

Table 23 contains the data for the item "career orientation of PhD" in table 5 (index for PhD-studies).

Table 23: Research career orientation of PhD

	1	2	3	4	5
	PhD studies don't prepare for independent scientific research; further training steps necessary (such as Habilitation, agrégation etc.)				PhD studies prepare well for independent scientific research, no further training steps or exams necessary
Austria		2			
France				4	
Germany	1.5				
Italy	1.5				
Netherlands				4.5	
Poland	1.5				
Spain	1.5				
Sweden					5
Switzerland			3		
UK					5
USA					5

Source: see Table 17

Table 24 contains the data for the item „Result - what can PhD-students do?" in Table 6 (index for PhD-studies).

Table 24: Result - what can PhD-students do?

	1	2	3	4	5
	Most Graduates are not able to carry out research independently; further post-doc stage, additional qualifications necessary (e.g. Habilitation, agrégation)	Some graduates are close to carrying out research independently, most are not	Approx. Half of graduates are close to carrying out research independently, half are not	Most Graduates are close to carrying out research independently; some post-doc experience necessary, but no additional qualification	Most Graduates are able to carry out research independently; can apply for position of assistant professor in US university (autonomous research)
Austria		2			
France				4	
Germany		2.5			
Italy	1.5				
Netherlands					5
Poland	1.5				
Spain	1.5				
Sweden					5
Switzerland				4	
UK					5
USA					5

Source: see Table 17

7.4 Career perspectives

Note that the assessment in the table below is mostly based on the figures from Kreckel, 2008, updated by Kreckel, 2010. Table 25 contains the data for the item "Share of tenured researchers below full professor" in Table 7 (Career perspectives index).

Table 25: Share of tenured researchers below full professor

	1	2	3	4	5
	Most positions for university researchers below full professor are fixed term; only permanent - continuous employment - position at university is usually full professor	Majority of positions for university researchers below full professor are fixed term; most permanent positions are for full professor	Half of positions for university researchers below full professor are fixed term, half are permanent (or continuous employment)	Majority of positions for university researchers below full professor are permanent (continuous employment), some are fixed term	Most positions for university researchers below full professor are permanent or continuous employment
Austria		2			
France				4	
Germany	1				
Italy			3.5		
Netherlands			3		
Poland				4	
Spain				4	
Sweden			3.5		
Switzerland		2			
UK			3		
USA			3.5		

Source: see Table 17

Table 26 contains the data for the item "Ability to teach in English" in Table 7 (Career perspectives index).

Table 26: Ability to teach in English

	1	2	3	4	5
	Candidates must be able to teach in language of recruiting university				Candidates can teach in English (even if English is not mother tongue in country of recruiting university)
Austria		2.5			
France		2			
Germany		2.5			
Italy	1.5				
Netherlands				4	
Poland	1.25				
Spain	1.25				
Sweden				4.5	
Switzerland		2			
UK					5
USA					5

Source: see Table 17

Table 27 contains the data for the item “Existence of tenure-track model” in Table 7 (Career perspectives index).

Table 27: Existence of tenure-track model

	1	2	3	4	5
	Tenure-track model does not exist		About half of assistant professors in research universities get tenure-track position, half not		Tenure-track model represents the typical academic career path within research universities for assistant professors
Austria		2			
France	1				
Germany	1.5				
Italy	1				
Netherlands			3		
Poland	1				
Spain	1				
Sweden			3.5		
Switzerland	1.25				
UK		2.5			
USA				4.5	

Source: see Table 17

Table 28 contains the data for the item “Career perspectives (weighted)” in Table 7 (Career perspectives index). The data in table 27 get weighted by the data in table 29 and 30.

Table 28: Career perspectives (weighted)

weighted	1	2	3	4	5
	Tenure-track model does not exist		About half of assistant professors in research universities get tenure-track position, half not		Tenure-track model represents the typical academic career path within research universities for assistant professors
Austria		0.45			
France	0				
Germany	1.5				
Italy	0				
Netherlands			2.4		
Poland	0				
Spain	0				
Sweden			1.68		
Switzerland	1.25				
UK	1.5				
USA				4.5	

Source: see Table 17

Table 29 contains the data for the item “Characteristics of tenure-track model” in Table 7 (Career perspectives index).

Table 29: Characteristics of tenure-track model

	1	2	3	4	5
	There are permanent contracts for assistant professors, but they do not lead necessarily to full professor				Best-practice - permanent contract at university for assistant prof. which leads to full professor, provided research performance is evaluated positively
Austria	1.25				
France	na				
Germany					5
Italy	na				
Netherlands				4	
Poland	na				
Spain	na				
Sweden				4	
Switzerland					5
UK			3		
USA					5

Source: see Table 17

Table 25 contains the data for the item “Recruitment procedure for tenure track positions” in Table 7 (Career perspectives index).

Table 30: Recruitment procedure for tenure track positions

	1	2	3	4	5
	There is no selection among several candidates for tenure track positions (i.e. no public advertising for position - positions are granted e.g. by discretion of university/professors of department etc.)	Some tenure track positions are subject to competitions, most not.		Most tenure track positions are subject to competitions, some not.	All tenure track positions are subject to competition among several candidates
Austria				4.5	
France	n.a.				
Germany					5
Italy	n.a.				
Netherlands					5
Poland	na				
Spain	na				
Sweden			3		
Switzerland					5
UK	na				5
USA					5

Source: see Table 17

7.5 Research organisation

Table 31 contains the data for the item “Research autonomy of first position of academic career” in Table 8 (research organisation index).

Table 31: Research autonomy of first position of academic career

	1	2	3	4	5
	Assistant professors (or equivalent) are fully dependent on chairholder / institute or department head for research activities				Assistant professors (or equivalent) have same autonomy as full professors, can pursue their research in complete autonomy
Austria		2.5			
France				4	
Germany		2.5			
Italy		2.25			
Netherlands			3		
Poland		2			
Spain		2			
Sweden				4.5	
Switzerland		2.5			
UK				4.25	
USA					5

Source: see Table 17

Table 32 contains the data for the item “Accessibility of university funds to ESR (financial autonomy)” in Table 8 (research organisation index).

Table 32: Accessibility of university funds to ESR (financial autonomy)

	1	2	3	4	5
	ESR (assistant professors or equivalent) depend on chairholder/institute or department head for access to university funding		ESR (assistant professors or equivalent) can obtain university funding based on quality of research proposal		ESR (assistant professors or equivalent) receive funding from university without strings attached
Austria		2.5			
France		2			
Germany		2			
Italy	1.5				
Netherlands			3		
Poland	1.5				
Spain	1.5				
Sweden			3.75		
Switzerland			3.5		
UK			3		
USA			3		

Source: see Table 17

Table 33 contains the data for the item “Organisation of working units” in Table 8 (research organisation index).

Table 33: Organisation of working units

	1	2	3	4	5
	Chair-based system (e.g. one (full) professor per working unit of the university, hierarchial power over assistants) is common to all universities	Most universities feature chair-based system, some feature departmental organisation (several professors, assistant or full, per working unit of the university, no hierarchy between them)	Half of universities feature chair-based, half of department-style model	Some universities feature chair-based system, most feature departmental organisation	Departmental organisation is common to all universities
Austria		2			
France			3.5		
Germany	1.5				
Italy				4	
Netherlands				4	
Poland		2			
Spain				4	
Sweden				4	
Switzerland				4	
UK					5
USA					5

Source: see Table 17

Table 31 contains the data for the item “Recruitment of researchers for first position in academic career vs. recruitment of full professor” in Table 8 (research organisation index).

Table 34: Recruitment of researchers for first position in academic career vs. recruitment of full professor

	1	2	3	4	5
	Recruitment procedures for Full Professors are very different from recruitment procedures for Assistant Professors (or equivalent)				Recruitment procedures for Full Professors are very similar to recruitment procedures for Assistant Professors (or equivalent)
Austria		2			
France			3.5		
Germany		2			
Italy			3.5		
Netherlands		2			
Poland		2			
Spain		2			
Sweden		2.5			
Switzerland			3		
UK					5
USA				4.75	

Source: see Table 17

7.6 Balance teaching research

We got survey data at the country level to arrive at an average teaching load from the MORE2 project (IDEA Consult, 2013). Basically, respondents to the survey could indicate their teaching load by indicating one of five intervals

j= 1: 40-30.4 hours/week

j= 2: 30-20.4 hours/week

j= 3: 20-10.4 hours/week

j= 4: <10 hours/week

j=5: none

We use this information to calculate the average teaching load T_{avg} in country *k* using minimum and maximum teaching hours in each interval

$$T_{kavg} = \sum_{j=1}^{5} (\frac{max_j + min_j}{2} * T_{jk})$$

where T_{jk} is share of respondents of country *k* in interval *j*.

The maximum teaching load is calculated as follows:

$$T_{kmax} = \sum_{j=1}^{5} (max_j * T_{jk})$$

where *j* is the interval of the percentage of work time used for teaching and T_{jk} is share of respondents of country k in interval j

Minimum teaching load is calculated similarly:

$$T_{kmin} = \sum_{j=1}^{5} (min_j * T_{jk})$$

Table 35 contains the data for the item “Balance teaching research overall, 2012” in table 9 (Balance teaching research index).

Table 35: overall, 2012

	Average teaching load (hours/week), normalised	Maximum teaching load (hours/week)	Minimum teaching load (hours/week)	Maximum teaching load (normalised, control for outlier)	Minimum teaching load (normalised, control for outlier)
Austria	0.71	5.67	13.46	0.95	0.48
France	0.61	7.46	14.90	0.84	0.39
Germany	0.54	8.37	16.30	0.78	0.30
Italy	0.37	10.62	19.71	0.65	0.10
Netherlands	0.74	5.61	12.63	0.95	0.53
Poland	0.08	15.35	24.78	0.36	-0.21
Spain	0.27	12.53	21.33	0.53	0.00
Sweden	0.75	5.02	12.65	0.98	0.52
Switzerland	0.77	4.77	12.30	1.00	0.55
UK	0.69	6.15	13.50	0.92	0.47
USA	0.77	4.77	12.30	1.00	0.55

Source: Idea Consult, 2013.

Table 36 contains the data for the item “Mechanism to adjust student numbers to teaching capacity” in table 9 (Balance teaching research index).

Table 36: Mechanism to adjust student numbers to teaching capacity

	Universities have no autonomy to adjust student intake to teaching capacity				Universities have full autonomy to adjust student intake to teaching capacity
Austria	1.25				
France		2			
Germany			2.75		
Italy		2.5			
Netherlands		2			
Poland	1.5				
Spain			3.25		
Sweden		2.5			
Switzerland			3		
UK				4.5	
USA				4.5	

Source: see Table 17

Table 37 contains the data for the item “ESR vs. LSR teaching load” in table 9 (Balance teaching research index).

Table 37: ESR vs. LSR teaching load

	1	2	3	4	5
	ESR (assistant professors) face much higher teaching commitments than LSR (full professors)	ESR (assistant professors) face somewhat higher teaching commitments than LSR (full professors)	ESR (assistant professors) face same teaching commitments as LSR (full professors)	LSR (full pofessors) face somewhat higher teaching commitments than ESR (assistant professors)	LSR (full professors) face much higher teaching commitments then ESR (assistant professors)
Austria				4	
France		2.5			
Germany				4	
Italy			3		
Netherlands			3		
Poland			3		
Spain		2			
Sweden		2			
Switzerland					5
UK				4	
USA			3.25		

Source: see Table 17

7.7 Funding

Table 38 contains the data for the item “Expenditure per student” Table 10 in (Funding index).

Table 38: Expenditure per student, 2010

	Expenditure per student p.a., in USD PPP (2010)	Expenditure per student p.a., in USD PPP, normalised
Austria	14257.40	0.24
France	14641.83	0.26
Germany	15711.07	0.31
Italy	9561.53	0.00
Netherlands	17849.34	0.42
Poland	7776.13	-0.09
Spain	13613.84	0.21
Sweden	19960.96	0.53
Switzerland	21577.20	0.61
UK	16337.95	0.35
USA	29200.65	1.00

Source: OECD (2012), Education at a Glance 2012: indicator B1 annual expenditure all tertiary education (2010) OECD Indicators, OECD Publishing.

Table 39 contains the data for the item “Availability of external grants (data based)” Table 10 in (Funding index).

Table 39: Availability of external grants (data based)

	Success rates	Success rates normalised
Austria	31	0,42
France	20	0,15
Germany	36	0,54
Italy	14	0,00
Netherlands	26	0,30
Poland	25	0,27
Spain	45	0,77
Sweden	19	0,13
Switzerland	54	1
UK	23	0,23
US	21	0,17

Source: Table 40

Table 40: Sources for success rates (Table 39)

	Institute	Calculation method	Kind of grant	Year	Source
AT	FWF - Austrian Science Fund	Percentage of funded projects	Principal Investigator	2012	Fonds für Wissenschaft und Technologie, Jahresbericht 2012, p. 24
CH	SNF - Swiss National Science Foundation	Percentage of awarded projects	Principal Investigator	2012	Schweizer National Fond, 2012 – Forschungsförderung in Zahlen, p. 35
ES	Spanish Ministry of Economic Affairs and Competitiveness, through the State Secretariat of Research, Development and Innovation	Acceptance rate in % of projects	peer-reviewed projects	2012	E-Mail Contact: Marina Villegas Gracia
FR	ANR - The French National Research Agency		ANR does not only fund basic research but also applied research.	2012	E-Mail - Contact: Sophie Ferrand; Project Manager - International Cooperation; for older data see: http://www.agence-nationale-recherche.fr/informations/documents/rapport-d-activite/
GER	DFG - Deutsche Forschungsgemeinschaft	Percentage of funded proposals	Principal Investigator	2011	Deutsche Forschungsgemeinschaft, Jahresbericht 2011, p 173
IT		Funded projects of the PRIN project	Prin Projects are Research projects of national interest and are the main funding for academic research	2009	http://www.attivitaeuropee.cnr.it/sites/default/files/antonella/Luigi%20Fortuna_presentation.pdf; p.10
NL	NOW - Netherlands Organisation for Scientific Research	Percentage proposals funded	No further information about the kind of grant	2011	http://www.nwo.nl/en/funding/funding+process+explained/a+good+proposal+yet+no+funding
PL	NCN - National Science Centre	Success rates for general grants	Average of the general grants for Life Science, Physical Science and Engineering, Social Science and Humanities. The name of the funding scheme for general grants ist OPUS	2011	http://www.ncn.gov.pl/aktualnosci/2011-10-07-wyniki-konkursow?language=en [23.07.2013]
SE	VR - Swedish Research Council	Success rate for applications	Principal investigator research projects	2012	E-Mail - Contact: Jenny Fernebro; general information: http://vr.se/inenglish/researchfunding/fundinggranted/generalcallforapplications.4.ead945b11f699b5085800028099.html

UK		Weighted average: The individual success rates were mulitplied with the number of application. The sum of this values was divided by the total number of applications to get the weigthed average of the different success rates			
	BBSRC - Biotechnology and Biological Sciences Research Council	Success rate by number	The data (2007-2011) downloaded from the homepage agree with the data from the annual report 2011-12, which refer to grant applications without fellowships and so we suppose that the actual success rate from the homepage also excludes fellowships.	2011-12	http://www.bbsrc.ac.uk/funding/apply/success-rates.aspx
	MRC - Medical Research Council	Award rate of grant applications	Average from the Agreement types: Research Grants, Programme Grants, New Investigator Research grants	2011-12	http://www.mrc.ac.uk/Fundingopportunities/Applicanthandbook/Successrates/Applicationsuccessrates/index.htm
	AHRC - Arts & Humanities Research Council	Success rates	Average from: Research Grants (Early Career), Research Grants (Speculative), Research Grants (Standard)	2011-12	http://www.ahrc.ac.uk/Funded-Research/Statistics/Pages/Competition-statistics.aspx (File: Research competition outcomes by Higher Education Institutions and schemes
	EPSRC - Engineering and Physical Sciences Research Council	Calculated from the number of research proposal		2011-2012	Research proposal funding rates 2011-12, p.1 http://www.epsrc.ac.uk/funding/successrates/previous/Pages/201112.aspx
	ESRC - Economic and Social Research Council	Success rate of research grants	Standard and small grants	2011-12	Economic and Social Research Council (2012): Shaping Society. Annual Report and Accounts 2011/12; p.35
	NERC - Natural Environnment Research Council	Success rates	Small grant und responsive standard grant	2011-12	Natural Environment Research Council (2012): Annual Report and Accounts 2011-2012 p.13
	STFC - Science & Technology Facilities Council	Overall Grants Success Rates for applications made in Financial Year 2010/11		2010-11	http://www.stfc.ac.uk/webStatistics.aspx?m=Success_Rates
US		Weighted average: The individual success rates were mulitplied with the number of application. The sum of this values was divided by the total number of applications to get the weigthed average of the different success rates			
	NIH - National Institute of Health	Success rate for research project grants (awarded applications)	Research grants without small business innovation research und small business technology transfer	2012	http://report.nih.gov/NIHDatabook/Charts/Default.aspx?sid=0&index=1&catId=13&chartId=124
	NSF - National Science Foundation	Proposal Success Rates	Competitively Reviewed Proposals, Awards and Proposal Success Rates by Principal investigatior	2012	NSF (2013): Report to the National Science Board on the National Science Foundation´s. Merit Review Process. Fiscal Year 2012; p.8

Table 41 contains the data for the item “GUF share” in Table 10 (Funding index).

Table 41: GUF share 2011

General University Funds (GUF) as a percentage of Civil GBAORD 2011	
Austria	56.20
France	24.41
Germany	41.02
Italy	34.47
Netherlands	49.22
Poland	4.55
Spain	26.94
Sweden	53.24
Switzerland	60.24
UK	29.33
USA	27.00

Source: OECD MSTI - General University Funds (GUF) as a percentage of Civil GBAORD

Year of reference: 2011, except data for Poland (2008)

Note: US data for institutional funding consists of 20% funding by universities and 7% by governmental sources; data retrieved from http://www.nsf.gov/statistics/seind12/c5/c5s1.htm, university and college institutional funds as well as state and local government funds.

7.8 Peers

We calculate our different measures of the probability of working with high quality peers in the following way:

Measurement method I calculated for country *k* in year *t*

$$L_{1kt} = \frac{(\sum_{i=1}^{n} P_{10_{it}} * P_{impact_{it}})}{HER_t}$$

Where *i* is the number of universities listed in Leiden ranking and P_{10} is the proportion of the publications of a university that, compared with other publications in the same field and in the same year, belong to the top 10% most frequently cited. (see definition Leiden Ranking - indicators). P_{impact} number of publications in core journals[6]

The sum of P_{10}*P_{impact} for all the universities of country k is then divided through the number of Higher Education Researchers (HER) in full-time equivalents to correct for country size.

Method II is calculated similarly, the only difference being a different denominator to correct for country size.

$$L_{2kt} = \frac{(\sum_{i=1}^{n} P_{10_{it}} * P_{impact_{it}})}{Pop_t}$$

where *Pop* is size of population

Measurement method III weights by ranking group:

$$L_{3kt} = \frac{\left\{\sum_{j=1}^{7}\left[\sum_{i=1}^{n}\left(U_{i_j}\right) * j\right]\right\}}{Pop_t}$$

Where U_{i_j} is a university in interval *j*, and *j* refers also to the weight of the ranking group

j=1: 401-500

j=2: 301-400

j=3: 201-300

j=4:151-200

j=5: 101-150

j=6: 51-100

j=7: 1-50

[6] The Leiden Ranking excludes from their core journal definition journals that fulfill at least one of the two conditions: (a) "The journal does not publish in English or it does publish in English but authors are concentrated in one or a few countries, indicating that the journal does not have a strong international scope. (b) The journal has only a small number of references to other journals in the Web of Science database, indicating that in terms of citation traffic the journal is only weakly connected to these other journals. This is the case for many journals in the humanities, but also for trade journals and popular magazines." (http://www.leidenranking.com/methodology/indicators)

Method IV is calculated similarly, the only difference being a different denominator to correct for the number of Higher Education Researchers.

$$L_{4kt} = \frac{\left\{\sum_{j=1}^{7}\left[\sum_{i=1}^{n}\left(U_{i_j}\right) * j\right]\right\}}{HER_t}$$

Source for HER higher education researchers: OECD MSTI, Higher Education researchers (FTE), year of reference 2011; for the USA: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations (2011) of the Survey of Doctorate Recipients, Table 5-16: SEH doctorate holders employed in academia, Number of all fields, all time faculty, 2008. Note: HER for UK 2011 were calculated using the average growth rate for years 2005-2011, as OECD data had a break in series and therefore were very low.

Source for population: World Bank, indicator SP.POP.TOTL (total population), 2011

Table 42: Probability of working with high quality peers, 2013

	Measurement method I (L_{1kt})		Measurement method II (L_{2kt})	Measurement method III (L_{3kt})	Measurement method IV (L_{4kt})
	University research performance I	University research performance I, normalised	University research performance II, normalised	University research performance III, normalised	University research performance IV, normalised
Austria	9.06	0.05	0.07	0.23	0.27
France	8.36	0.04	0.00	0.10	0.19
Germany	15.67	0.21	0.16	0.23	0.39
Italy	13.53	0.16	0.01	0.02	0.18
Netherlands	39.76	0.76	0.76	0.70	1.00
Poland	0.62	-0.14	-0.16	-0.11	-0.13
Spain	6.67	0.00	0.00	0.00	0.00
Sweden	23.48	0.39	0.65	0.55	0.48
Switzerland	28.33	0.50	1.00	1.00	0.74
UK	30.65	0.55	0.46	0.49	0.82
USA	50.27	1.00	0.45	0.30	0.95

Source CWTS Leiden Ranking 2013 www.leidenranking.com, calculation see above.

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Project Information

Welfare, Wealth and Work for Europe

A European research consortium is working on the analytical foundations for a socio-ecological transition

Abstract

Europe needs a change: The financial crisis has exposed long neglected deficiencies in the present growth path, most visibly in unemployment and public debt. At the same time Europe has to cope with new challenges ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundations for a new development strategy that enables a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four year research project within the 7th Framework Programme funded by the European Commission started in April 2012. The consortium brings together researchers from 33 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). Project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: www.foreurope.eu

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WWWFOR EUROPE
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