What factors influence PhD students' intentions to work outside academia?

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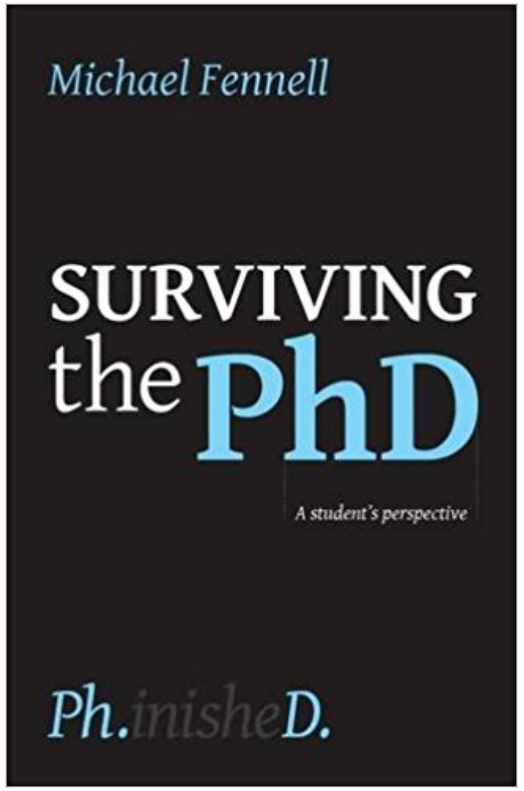
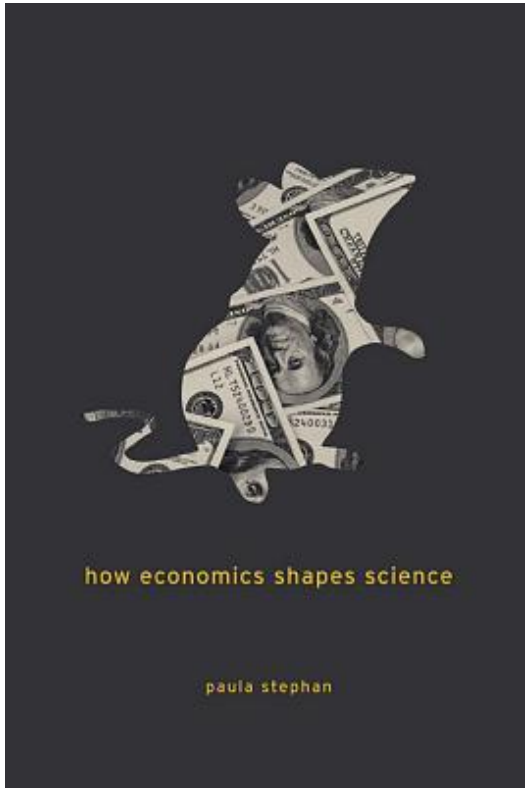
Motivations and framework of the study

- A growing number of studies worldwide about the educational and social experience of PhD students, learning, motivations, career expectations, and other aspects of relevance.
- Most of these studies emerged due to the increasingly important role of highly qualified human resources for knowledge production, dissemination and innovation processes in an increasingly globalized but uncertain economic and social development that relies heavily on intangibles.





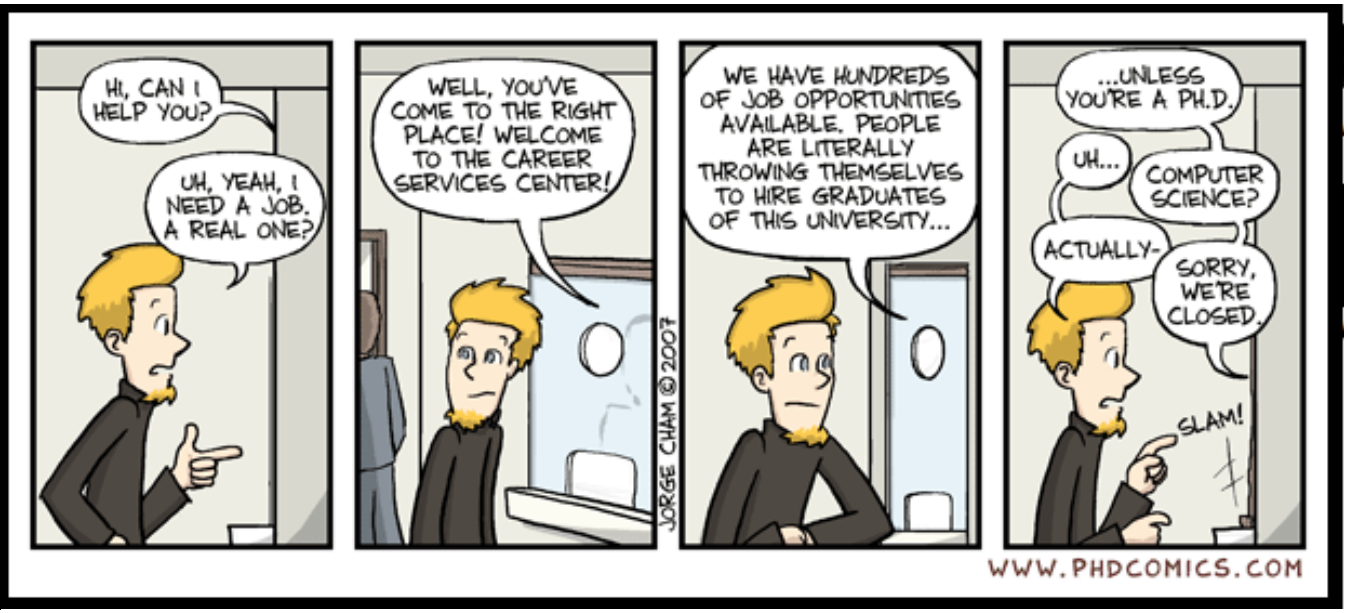
Motivations for the study

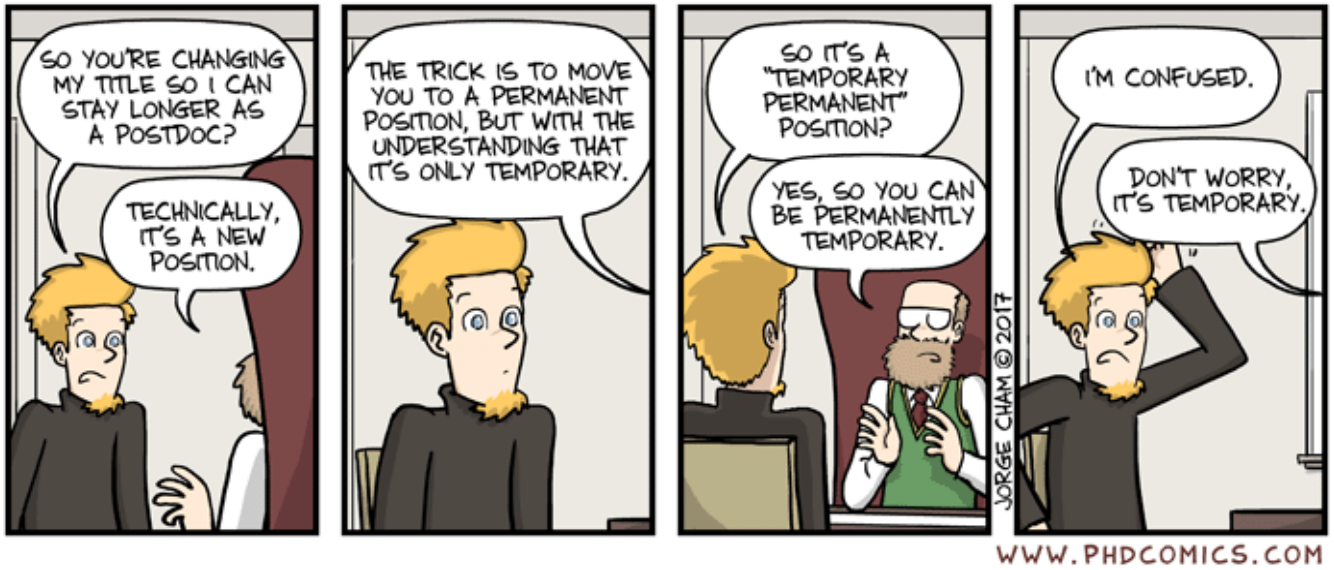
- Most of the existing Studies on doctoral education, experience, stress, networking, employment (several of them published in the higher education literature) are focused on North America and Europe, but few on Asia.

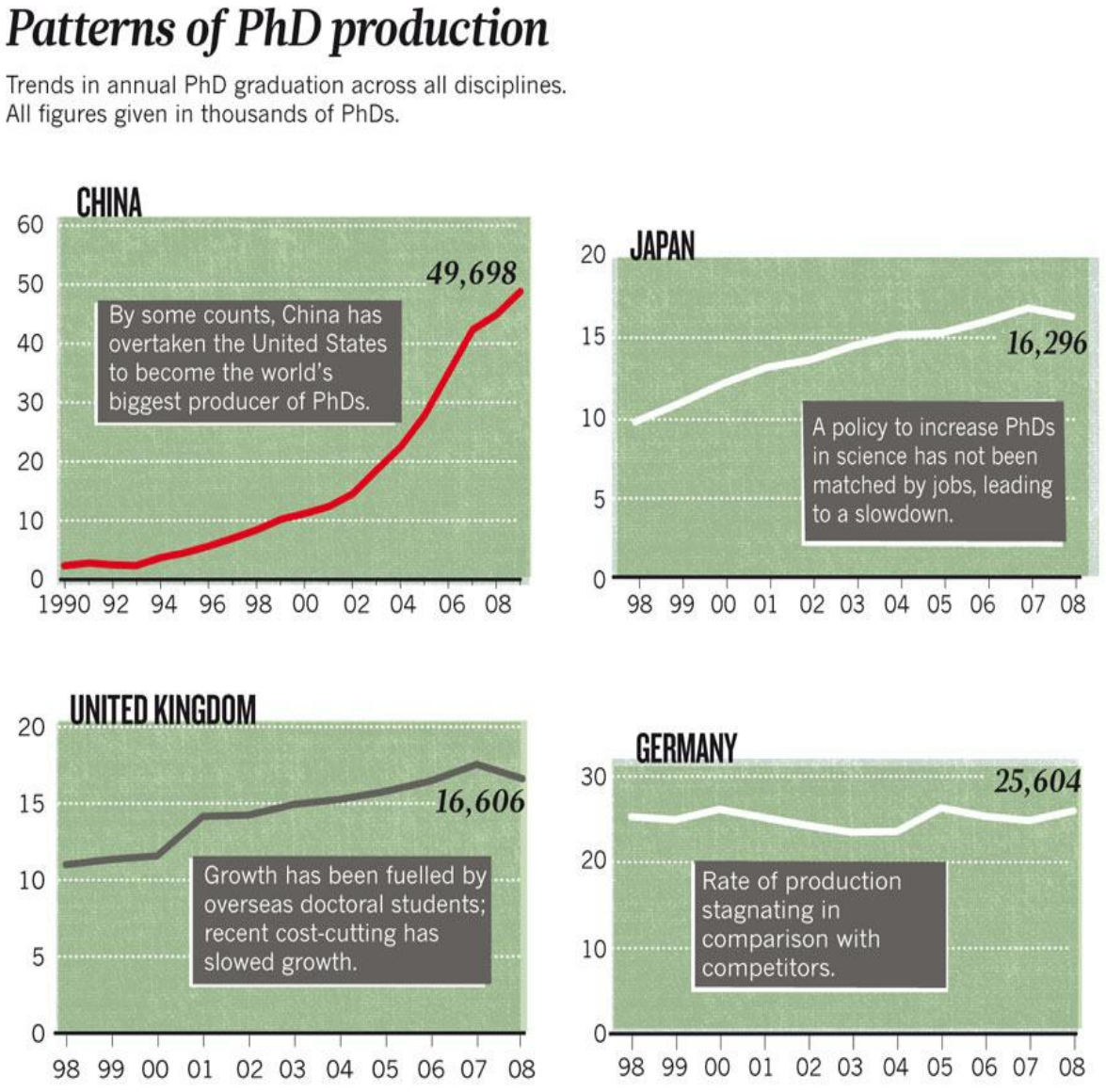
- The idea is to better understand the condition of doctoral education in university flagships in East Asia, at a time when the research mission of these universities is being strengthened, and the contribution of these universities (and countries) to the global pool of knowledge is becoming more evident.
  - Initial team with colleagues from Seoul National University (Jung Cheol Shin), National Singapore University (Ho Kong Chong), and The University of Hong Kong (Gerard Postiglione, Li-fang Zhang, Hugo Horta and Jisun Jung).
  - The project will soon include teams from Chinese (among which Tsinghua University, Peking University and Shanghai Jiao Tong University) and Japanese universities.

When asking about the topic in our own universities, we were surprised with how little it is known about PhD students…even by those units that one would expect they ought to know.

My interest: careers of PhDs a growing concern







What does the literature tells us about the topic?

- Adoption of different PhD education models (apprentice-master, structured model), leading universities worldwide to compromise on a mix (O'Connor, 2012).
- Massification "trickle-up" leading to a more heterogeneous but less well-prepared student body by previous education stages (Craswell, 2007).
- Becoming more, and from the start geared by current academia rules, where collaboration, internationalization, and funding become increasingly important (Nerad, 2010).
- Increased programmatic diversification (sometimes only on paper, sometimes not), including the creation of professionally oriented PhDs (Bao et al., 2016)
- Students motivations to start a PhD not related solely with intellectual growth, but with increasing different reasons (Mueller et al., 2015)

What does the literature tells us about the topic?

- Following human capital tenets, many PhD students believe that they will have adequate private returns to this educational investment, when this is not true – at least if they become employed in the private sector (Pedersen, 2016).
- Growing number of PhDs have difficulty in finding stable jobs, and although they do not become unemployed, they enter in situations of uncertainty and jumping from one to another precariously-qualified positions (Araújo, 2009).
- The post-doc becoming a position susceptible to exploitation (Cantwell, 2011).
- The unbalance between supply and demand of PhDs seems a new trend (but in some countries the rhetoric exists since the 1990s, Geiger, 1997), and has advocates blaming it on the unsustainable funding of science (creation of funding bubbles) and underlining the “too many PhDs” argument (Stephan et al., 2016).
- The latter argument has dangers for developing countries (Santos et al., 2016).

What does the literature tells us about the topic?

- Governments and universities opted for introducing a “skills-push” policy: training PhDs with skills for jobs outside academia (Peters, 2007). **WHY?**
- Professional/vocational PhD programs initiated with varied degrees of success (Kot and Hendel, 2012).
- Mainstream PhD programs started offering specific seminars, courses, and training valuable for securing employment outside academia (even if in research-related jobs) or in non-research-related professions (Pablo-Hurtado, 2015).
- The mantra: the more skills (especially generic, transferable, soft) the better (Platow, 2012)
- But…becoming an academic continues to be a goal for those starting PhDs, and those ending up working in industry reveal to have a lesser “taste for science” (Roach and Saurmann, 2013).
- Experience of the PhDs programs and supervisor influence increasingly considered as relevant – from the view of students (sometimes supervisors) but mostly through qualitative studies (McAlpine and Turner, 2012).

Some assumptions from the literature

1) If one assumes a human capital theory lens, then one could argue that the greater (and broader) the perceived skillset a PhD student has, the more 'available' he or she would be to face a broader set of employment choices (including outsider academia).

2) However, one other argument could be that the more specialized set of skills one PhD student perceives he or she has, the more he or she is inclined to move to a sector of activity where those skills are perceived to be valued (see Roach and Sauermann, 2013 taste for science study).

3) Besides perceived skills, there are elements that are associated to the leaning of PhD students to consider working outside academia after concluding the PhD.

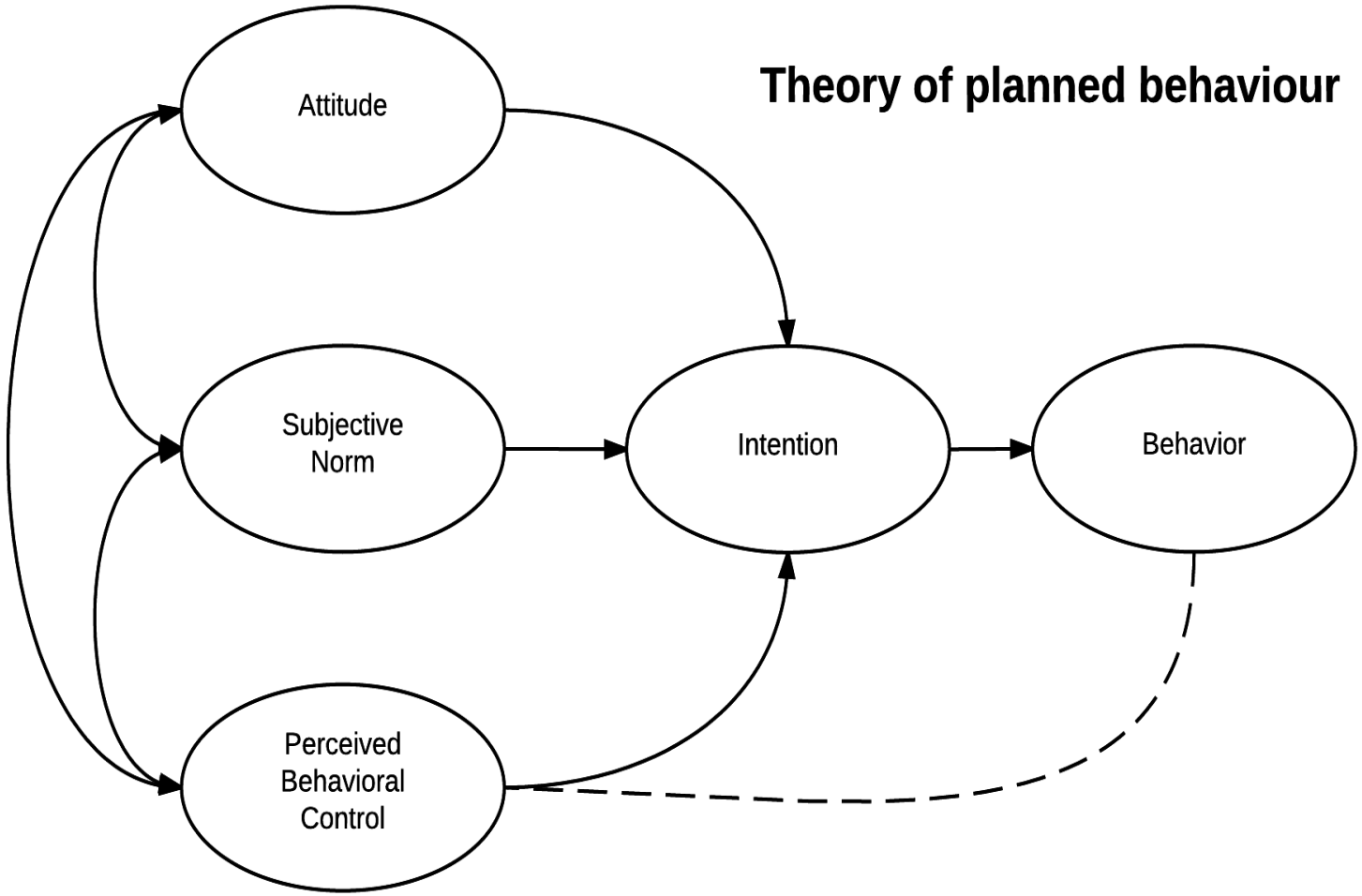
Let us find out if these assumptions make sense

Theory guiding the analysis

- The study will be based on students' perceptions and intentions.
- The study will be quantitative.

- **Theory of Planned Behavior** (TPB) focus on theoretical constructs concerned with individual motivational factors as determinants of the likelihood of performing a specific behavior (Montaño and Kasprzyk, 2008)
- Main premise: assume the best predictor of a behavior is ***behavioral intention***, which in turn is determined by attitude toward the behavior and social normative perceptions regarding it. (individual variables + environmental variables)

Theory guiding the analysis



Source: Adjen, 1991

Attitude is determined by the individual's beliefs about outcomes or attributes of performing the behavior.

A person's **subjective norm** is determined by whether important referent individuals approve or disapprove of performing the behavior.

Perceived control relates to the control the individuals have over the actions to achieve a determined behavior.

Theory guiding the analysis

1) Perception of the skillset (A)
2) Individual characteristics
3) Starting PhD reasons/motivators (A)
4) Characteristics of the PhD program (PC)
5) Influence of the supervisor (SN)
6) Activities of importance for the career after the PhD (A)

Working in vs out of academia (INTENTION)

Attitude is determined by the individual's beliefs about outcomes or attributes of performing the behavior.

A person's **subjective norm** is determined by whether important referent individuals approve or disapprove of performing the behavior.

Perceived control relates to the control the individuals have over the actions to achieve a determined behavior.

A long typical path from design to implementation

- ***February*** 2015: Project started in an informal meeting during CESHK conference taking part in Hong Kong
- ***March-April***: HKU team submitted the ethics proposal to the University Ethics Committee in March (accepted in late April after a few revisions)
- ***May-June***: negotiations with the Graduate School to obtain names, e-mails and Faculty of PhD students to implemented an online survey. Due to privacy issues the access to the general database of e-mails was refused.
- ***July***: Negotiation with Graduate School for a joint implementation of the survey, which did not work leading to the abandonment of the online survey implementation.
- ***September***: A 25 HKD Starbucks voucher was used as an incentive for students completing the survey. PhD students (Edu) helped in the paper implementation of the survey (all teams).
- ***October***: Meeting in Seoul without the participation of HKU team, since there was nothing to report at the time by the HKU team
- ***January*** 2016: Implementation completed in late January 2016; Input and cleaning of the dataset completed in March 2016. – Almost 1,500 complete responses from 3 universities.
- ***May*** 2017: Meeting in Singapore to present initial research ideas; first papers should come out in a special issue at APER in Mid-2018. Reps. from key Mainland China universities present.

The methods

Descriptive statistics – Dependent variables

The dependent variables for the first variable were calculated as follows:

Subtracting a 7-point Likert scale of career choice (of working in business and government sectors or being self-employed) from a 7-point Likert scale of career choice to work in an academic position. This subtraction leads to a range of -6 (the maximum preference for working in academia) to 6 (the maximum preference for working in a given sector outside academia)

- Work in Business (no-R&D): -0.85 (min -6 to max 6)
- Work in Business (R&D): -0.39
- Work in Gov (R&D): 0.33
- Work in Gov (no-R&D): -0.66
- Self-employed: -1.71

- What is your career plan straight after receiving your doctoral degree? (1-7)

The analytical procedure follows 3 steps (the first two to set-up perceived skill clusters as explanatory vars.)

1) Factors Analysis of the basic skills: data were reduced via exploratory factor analysis (EFA) with the goal of identifying the scale's underlying latent dimensions or factors.

2) The factor scores were computed and used in the subsequent TwoStep Cluster algorithm. The TwoStep Cluster is an analytical pipeline where the clustering is conducted in two steps: first, the BIRCH algorithm (Zhang et al., 1996) is used to generate a preliminary cluster structure. Second, the resulting structure is subsequently subjected to a more classical hierarchical agglomerative clustering, where the units of analysis are the pre-clusters rather than the individual subjects.

3) A linear regression analysis (OLS with Robust standard errors).

Explaining the explanatory variables – from basic skills to skill clusters

	How do you assess your current knowledge and attributes acquired so far during your PhD? (7 point-likert scale ranging from 1 (low end) to 7 (high end), N/A option available
1	**Methodology** (e.g. appropriate application of methodologies, tools and research techniques)
2	**Innovation** (e.g. Development of new ideas, embedded in your research)
3	**Critical analysis thinking** (e.g., critical analysis of findings and results)
4	**Problem solving** (e.g. formulate and apply solutions for problems)
5	**Communicating effectively** (e.g. communicate knowledge to audiences)
6	**Creativity** (e.g. ability to be creative, think outside the box)
7	**Flexibility** (e.g. Quick adaptation to challenges and new situations)
8	**Responsibility** (e.g. Work independently; assume responsibility for actions)
9	**Networks** (e.g. development and use of networks and collaborations)
10	**Project management** (e.g. Planning, management of projects)
11	**Pedagogy** (e.g. know how to teach others)
12	**Teamwork** (e.g. develop work with colleagues)

This is adapted from the most recent OECD's Career in Doctorate Holders questionnaire

Factor Analysis results

Component 1 was labelled as **Research-oriented-skills** due to the fact that the strongest basic skills in this component (Innovation, Creativity, Critical Thinking, Problem Solving, Flexibility, Methodology) are also the ones that tend to characterize research minded individuals (Polanyi, 1958)

Component 2 was labelled as **Managerial-oriented-skills** since the strongest basic skills in this component (Teamwork, Project Management, Networks, Responsibility, and Pedagogy) reflect the typical skillset that characterizes managers and individuals engaged in administrative jobs, project management, and leadership of managerial teams (see Kerzner, 2017).

NOT ASKED BUT…PASSION AND HARD WORK SURELY IMPORTANT FOR BOTH AS WELL!!!

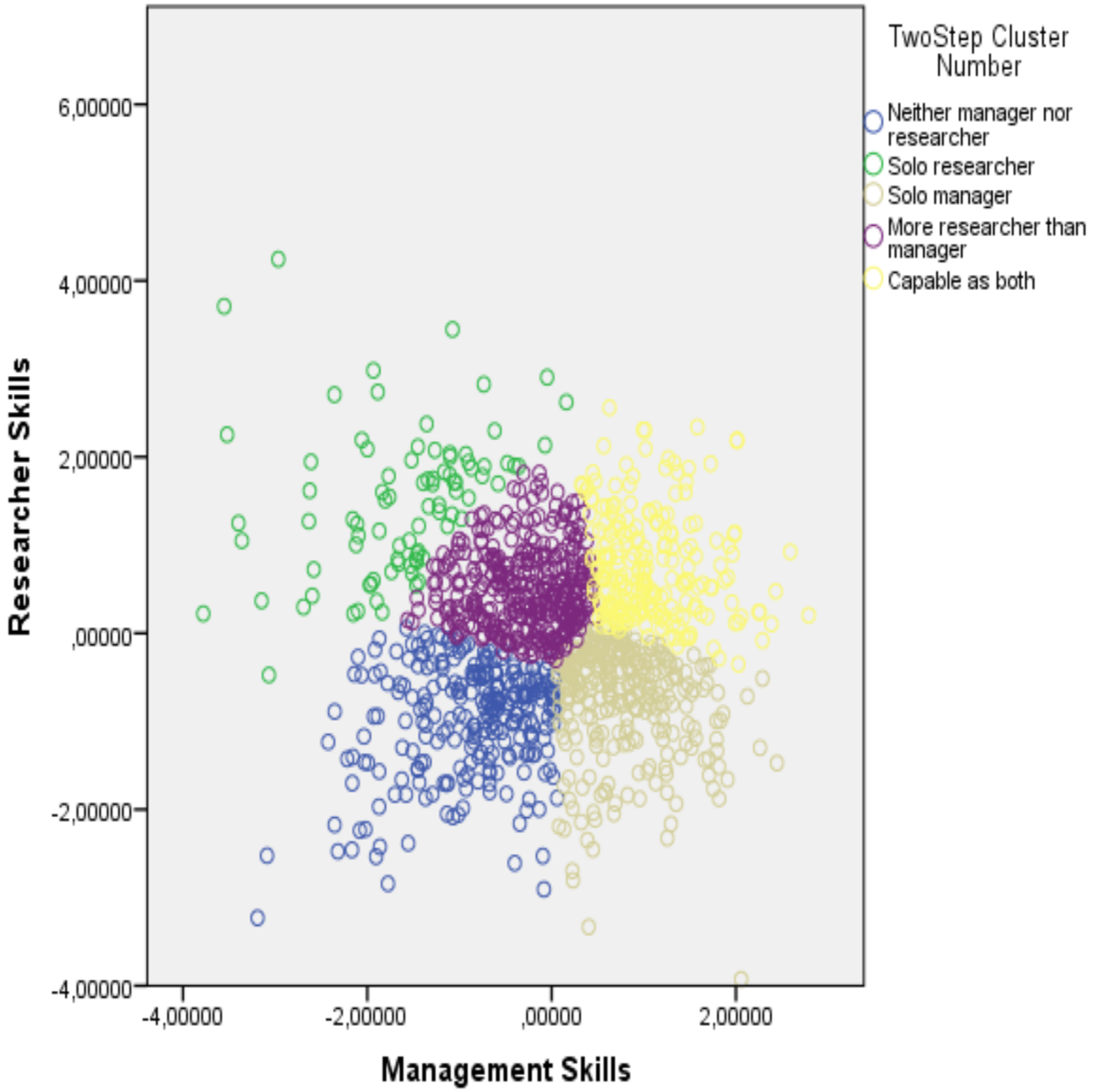
Rotated Component Matrix[a]

Basic Skills	Component	
	1	2
Innovation	**,820**	,131
Creativity	**,791**	,147
Critical Thinking	**,741**	,237
Problem Solving	**,680**	,376
Flexibility	**,617**	,356
Methodology	**,583**	,296
Communicating effectively	,510	,494
Teamwork	,133	**,786**
Project Management	,220	**,752**
Networks	,240	**,727**
Responsibility	,413	**,530**
Pedagogy	,204	**,519**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 3 iterations.

Two Step Cluster analysis results – Explanatory variables

	Management Skills	Researcher Skills	Number (%)
More researcher than Manager	-0,24	0,48	393 (30,6%)
Solo Manager	0,79	-0,75	297 (23,1%)
Neither Manager nor researcher	-0,86	-0,96	279 (21,7%)
Capable as both	1,07	0,76	227 (17,7%)
Solo researcher	-1,63	1,50	87 (6,8%)



Other Explanatory variable:

Skills (mean of 12 basic skills): 4.64 (1.08 to 7)

Regression analysis

- Ordinary Least Squares Regression is used as it is the best fit for the dependent variables.
- Robust standard errors are used to assure that unbiased standard error of OLS coefficients are not presente due to the potential effects of heteroscedasticity.
- Other than skills as explanatory variables, sets of variables controlling for individual level (6), motivations to start a PhD (4), supervisor characteristics (5), program characteristics (9), and issues perceived career (6), were included as controls (which provide also analytical insights).
- Such amount of variables could originate issues of multicollinearity, and therefore a Variance Inflation Factor was run, leading to a mean VIF score of 1.59, and only two variables above 2.5 (NUS with 3.26 and HKU with 3.24), but below the usual cut-off of 5 and 10 (see Craney and Surles, 2002).

Descriptive statistics – individual level controls

- Female students: 48%
- Mean age of the students:30 years old
- International students: 36%
- Did bachelor degree abroad: ~34% did so.
- Did Bachelor and Master program (versus did only bachelor): ~67% did so.
- Parents are academics: 14%

Descriptive statistics – starting PhD controls

- Desire higher salary: 4.48 (Median 4, 1 to 7)
- Benefit others with research: 4.78
- Work as an academic: 5.16
- Lack of employment prospects: 2.62

Descriptive statistics – supervisor characteristics controls

- Superv. Good prof. relat: 5.21
- Superv. Good pers. relat: 4.52
- Superv. Gives career advice: 4.30
- Superv. national: 62%
- Superv. PhD abroad: 79%

Descriptive statistics – program level controls

- Program emphasises international publications: 4.89 (median is 4, 1 to 7)
- Program allows students to register in any class of interest (4.68)
- Program conductive to free discussion with academics (4.13)
- Program fosters students to compete for resources (3.51)
- Academics more concerned with furthering their own career (3.64)

- HKU students: 37%; NUS students: 24%; SNU students: 39%
- Students in STEM fields: 65%
- Year of study: 1st: 21%; 2nd: 27%; 3rd: 21%; 4th: 21%; 5th and longer: 10%.
- Professional PhD: 22%

Descriptive statistics – important for career controls

- Importance career (nat. journals pubs): 4.34 (Median 4, 1 to 7)
- Importance career (inter. journal pubs): 5.99
- Importance career (quality dissertation): 5.30
- Importance career (do non-R&D exper.): 4.10
- Importance career (concern employability): 4.46

- Plan doing post-doc: 4.33

Findings

Skills

Note: Neither Manager or Researcher as the baseline

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
Solo researcher	0.190	0.156	0.178	0.332	-0.149
	(0.317)	(0.313)	(0.286)	(0.276)	(0.257)
Solo Manager	0.340	**0.374****	**0.461****	**0.364****	0.083
	(0.211)	(0.186)	(0.182)	(0.173)	(0.188)
More researcher than manager	0.214	0.266	**0.339***	**0.314***	-0.006
	(0.208)	(0.181)	(0.180)	(0.169)	(0.175)
Capable in both	-0.049	0.356	0.307	0.206	-0.053
	(0.249)	(0.222)	(0.207)	(0.196)	(0.222)

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
Skills aggregate	0.067	0.133	0.074	0.071	-0.015
	(0.105)	(0.086)	(0.098)	(0.090)	(0.0965)

Individual level controls

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
female	-0.026	-0.204	0.130	-0.027	0.028
	(0.152)	(0.134)	(0.127)	(0.122)	(0.127)
age	-0.012	0.004	0.024	-0.009	0.020
	(0.023)	(0.023)	(0.021)	(0.019)	(0.020)
International Student	-0.205	-0.277	-0.818***	-0.368**	0.176
	(0.230)	(0.195)	(0.186)	(0.168)	(0.206)
Did bachelor abroad	0.088	-0.209	-0.209	-0.070	0.230
	(0.227)	(0.184)	(0.178)	(0.167)	(0.195)
Has Bachelor and Master	-0.389**	-0.401**	-0.267*	-0.206	-0.068
	(0.185)	(0.160)	(0.146)	(0.137)	(0.148)
Parents are academics	-0.160	-0.267*	-0.460***	-0.307**	-0.140
	(0.181)	(0.157)	(0.145)	(0.149)	(0.159)

Starting PhD controls

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
Higher Salary	**0.084***	**0.102****	0.061	**0.082***	-0.006
	(0.05)	(0.048)	(0.045)	(0.043)	(0.049)
Benefit others (with R&D)	0.008	0.033	-0.01	-0.002	0.077
	(0.056)	(0.051)	(0.047)	(0.045)	(0.047)
Work in academia	-0.384***	-0.331***	-0.178***	-0.175***	-0.357***
	(0.062)	(0.056)	(0.051)	(0.048)	(0.053)
Lack of job prospects	0.031	-0.024	0.052	0.001	-0.015
	(0.051)	(0.045)	(0.042)	(0.039)	(0.044)

supervisor characteristics controls

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
Good professional relationship	0.091	0.035	0.040	0.069	0.019
	(0.079)	(0.070)	(0.070)	(0.062)	(0.073)
Good personal relationship	-0.201***	-0.186***	-0.159***	-0.110**	-0.102**
	(0.061)	(0.056)	(0.054)	(0.051)	(0.052)
Gives career advice	0.021	0.035	0.039	0.017	0.003
	(0.054)	(0.049)	(0.045)	(0.042)	(0.047)
National (yes)	-0.189	-0.036	0.084	-0.230	0.029
	(0.198)	(0.176)	(0.165)	(0.156)	(0.190)
PhD abroad	-0.108	0.109	-0.046	0.064	-0.067
	(0.176)	(0.160)	(0.150)	(0.147)	(0.149)

program level controls (1)

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
Focus on international pubs.	0.071	-0.030	0.059	0.015	-0.015
	(0.055)	(0.051)	(0.046)	(0.045)	(0.046)
Free register any course	-0.020	0.023	0.034	0.003	-0.034
	(0.054)	(0.050)	(0.048)	(0.044)	(0.047)
Students comment academics	**0.127****	**0.114****	0.004	-0.005	**0.143*****
	(0.064)	(0.057)	(0.054)	(0.048)	(0.053)
Students compete resources	0.049	0.027	0.068	-0.059	0.004
	(0.050)	(0.043)	(0.043)	(0.037)	(0.042)
Academics more concerned selves.	-0.035	0.014	0.014	0.023	**0.109****
	(0.049)	(0.045)	(0.043)	(0.041)	(0.045)

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
NUS	-0.406	-0.161	0.071	-0.321	0.219
	(0.322)	(0.286)	(0.262)	(0.239)	(0.296)
HKU	-0.716**	-0.536**	-0.577**	-0.610***	-0.102
	(0.281)	(0.241)	(0.230)	(0.219)	(0.243)
STEM students	**1.819*** **	**1.452*** **	**1.054*** **	**0.982*** **	**1.414*** **
	(0.183)	(0.169)	(0.161)	(0.158)	(0.167)
year_2	0.155	0.264	0.252	0.154	0.0719
	(0.208)	(0.191)	(0.181)	(0.170)	(0.178)
year_3	-0.205	-0.219	-0.045	-0.206	-0.010
	(0.236)	(0.220)	(0.199)	(0.194)	(0.197)
year_4	-0.183	-0.109	-0.214	-0.331*	0.109
	(0.237)	(0.222)	(0.195)	(0.191)	(0.207)
year_5 and plus	-0.062	-0.213	-0.389	-0.168	-0.263
	(0.301)	(0.270)	(0.246)	(0.255)	(0.237)
Professional PhD	-0.076	-0.166	-0.255*	-0.053	-0.054
	(0.188)	(0.159)	(0.148)	(0.143)	(0.164)

important for career controls

VARIABLES	Business	Business R&D	Govern.	Govern. R&D	Self-emp.
Publish. Inter. journals	-0.124	0.016	-0.092	0.043	-0.107
	(0.077)	(0.069)	(0.063)	(0.06)	(0.0675)
Publish. Nat. journals	-0.074	-0.091**	-0.036	-0.033	-0.084**
	(0.050)	(0.043)	(0.041)	(0.038)	(0.041)
Quality PhD	**0.109***	0.064	0.026	0.016	0.080
	(0.063)	(0.059)	(0.057)	(0.051)	(0.054)
Do non-R&D activities	0.074	-0.049	0.006	-0.082**	0.029
	(0.050)	(0.045)	(0.042)	(0.039)	(0.043)
Concern career after graduation	-0.016	0.024	**0.107*****	0.034	-0.068*
	(0.044)	(0.040)	(0.039)	(0.036)	(0.040)
Do a post-doc	-0.169***	-0.080*	-0.068	-0.046	-0.115***
	(0.048)	(0.044)	(0.042)	(0.041)	(0.043)

Nested analysis for STEM / Non-STEM

- STEM students: (Skills) Solo Manager and More manager than researcher predict leaning towards business R&D, Government R&D, and Government. Aggregated skills: non-statistically significant.
- Non-STEM students: (Skills) Solo Researcher predict leaning towards government. Aggregated skills: non-statistically significant.
- Higher salary – positive to work outside academia for both, but STEM for business and Non-STEM for government
- Wanting to become an academic: strong predictor for both to lean towards academic jobs.

Nested analysis for STEM / Non-STEM

- Relationship (personal) with supervisor predicts working in academia but for STEM students only.
- Publishing in national journals strong predictor of leaning towards academia for Non-STEM students, non-statistically significant for STEM students.
- Doing Post-doc strong predictor for STEM students to lean towards academia, not so much for Non-STEM students (statistically not significant except for business).
- Involvement in non-related R&D activities during the PhD predicts STEM students to lean towards business, same for Non-STEM but concerning quality of PhD.
- Professional PhD: non-statistically significant for both.

Conclusion

- The two starting assumptions of the paper are not met:

1) If one assumes a human capital theory lens, then one could argue that the greater (and broader) the perceived skillset a PhD student has, the more 'available' he or she would be to face a broader set of employment choices (including outsider academia). – **NOT REALLY.**

2) However, one other argument could be that the more specialized set of skills one PhD student perceives he or she has, the more he or she is inclined to move to a sector of activity where those skills are perceived to be valued (see Roach and Sauermann, 2013 taste for science study). – **ARGUABLY AT BEST**

So is this all discourse emphasizing skills and skill push really matters? Is this the solution?

So is this all discourse emphasizing skills and skill push really matters? Is this the solution?

Conclusion

- ***Something more on the third assumption***: Besides perceived skills, there are elements that are associated to the leaning of PhD students to consider working outside academia after concluding the PhD.

- Initial motivations to start a PhD matter (working in academia, higher salary).
- Personal relationship with the supervisor matters, and mainly drawing students towards academia (professional/personal links of the supervisor – cultural explanation).
- Program characteristics matter: freedom to engage in academic dialogue, but also perceptions of academia (academics more concerned with themselves).
- Students in professional PhDs show no differences; Same for students in different years of study (initial motivations to start a PhD perhaps do not change during the doctoral studies socialization process?)

Conclusion

- Publications matter to some extent as well as perceptions of quality of the PhD to engage in jobs outside academia.
- Interesting fact: concern with career leads one to further avoid entrepreneurship ideas (some policymakers will be dismayed with this) but rather reinforce entrenchment tactics (government job as a good “plan B”).
- Decision to do a post-doc seems to lead students to definitely prefer the academic job path.

- All the dimensions of the Planned Behavior Theory seem relevant, but attitude and perceived control seem to be the most important in this case, subjective norm (influence of the supervisor) perhaps less relevant than initially expected.