Policy dimension - capacity building in the era of globalisation

Migration and mobility in PhD candidates
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Overview of the literature findings

Migratory trends in graduate students and fledgling academics are mainly guided by three characteristics bearing influence on the researchers' careers: international networking, career perspectives and high-quality peers (European Union, 2018). The measured trends in mobility for international PhD student currently follow the typical patterns observed across educational levels, from South to North and East to West, with the strongest receiver of doctoral candidates being the United States (Bokova, 2015; OECD, 2018). Of all internationalised doctoral students, candidates are more predominantly enrolled in science and engineering programs, with a 130% growth in those enrollments between 2005 and 2012 (Bokova, 2015: 77). This trend can be explained by the active recruitment of STEM graduate students by greying countries across the world (Nerad & Evans, 2014). While legitimate concerns persist surrounding the potentiality of 'brain drain', the UNESCO report on the future of graduate education sustains the continuing benefits brain circulation. It is estimated that 2% of all current university students abroad are international students, a figure which is set to double by 2025 (Bokova, 2015). While this percentage is not enough to pose a threat to the national development of individual countries, it is undeniable that this growing globalization entangles universities in both highly valuable collaborations and fierce academic competition (Bokova, 2015). Outbound migratory trends of graduate students (or brain drain) is of particularly high concern to countries in the midst of their economic development.

A noteworthy change in mobility pattern however is slowly being observed at a global scale, as international enrollments in Asia (China, Korea, Japan, Singapore, Qatar, the United Arab Emirates) are on the rise. Yet the number of students going to North American, Western European, and Australian/New Zealand universities has increased as well, maintaining the general migratory trends of international education from South to North and East to West (Kritz & Gurak, 2018). This evolution can be explained by the fact that tertiary public expenditures and academic supply at home are the greatest determinants of a country's outbound mobility ratio (Kritz & Gurak, 2018). This indicates that given the growing higher education investments of Asian and Middle Eastern countries, migratory trends for international students may change in the coming decade in favor of these regions.

As student migration ratios rise, international mobility is increasingly expected of doctoral candidates (Bauder, 2015; Bilecen & Van Mol, 2017; European Union, 2018). While the literature has long favoured the discussions around the benefits of international mobility, recent articles have started focusing on the civic issues inherent to these expectations (Ackers, 2008; Bauder, 2015; Bilecen & Van Mol, 2017; Garhards, Hans & Drewski, 2018). As Bilecen and Van Mol (2017) argue, the transnationalisation of education both creates and reproduces social inequalities between student bodies, faculty members, and, more largely, their spaces of education. Garhards, Hans & Drewski (2018) contribute to this discussion by empirically demonstrating how national scientific reputation (a doctoral student's country of origin) and symbolic capital (the university's prestige) affect a doctoral student's chance to complete an international mobility outside their objective credentials and the quality of their department. These discrepancies are now a central focus of the discussion on migration and mobility at all levels of studies in hopes of bettering the future of international academic mobility on the basis of its current shortcomings (Bauder, 2015).

Further, concerns have been raised with regards to international mobility being a prelude to international migration and, ultimately, a non-returning trajectory in doctoral candidates (Reale, Morettini & Zinilli, 2018). Low investments in research and development of the home country paired with the budgetary rollbacks of social sciences and humanities funding are identified as strong determinants of non-returns in researchers (*Ibid*.). Overall, age appears to be a strong determinant of international mobility and relocation. In a review of the GlobSci survey, Van Noorden (2012) finds that within new doctoral graduates across regions, only 10% would not consider international relocation in comparison to 40% of those who had completed their PhDs 16 years ago.

Of course, upon closer inspection of the available literation in distinct regions across the globe, singular trends emerge that provide a better understanding of the particular challenges, gains and ambitions of specific regions with regards to the mobility of their doctoral pool. A brief overview of these particularities is essential to provide perspective on the interactions between countries and the effect that policies, economic and academic contexts bear on the development and exchange of knowledge worldwide.

Region specific conclusions on the migratory patterns of transnationalised doctoral students

To start, North America displays a strong inbound mobility ratio, strongly skewed in favour of the United States with Canada competing heavily to attract stronger numbers of international researchers (Bokova, 2015). An overview of mobility motivations across nationalities show that the prestige of a North-American education paired with the enticing career opportunities offered within the continent strongly factor into the migration trends from East to West and South to North (Zhou, 2015). Current obstacles to a greater outbound mobility include language barriers outside Western Europe and the reduced career options in this latter setting (Knight & Madden, 2010). The economic downturn faced by the United States, however, is said to have slowed its inbound migration trend along with reducing the stay rates of foreing-born researchers however (Van der Wender, 2015).

South America is establishing itself as an emerging influence within the international scientific community by rethinking their academic infrastructure at the benefit of their countries' development (Munoz-Garcia & Chiappa, 2017). That being said, much remains to be done for its national academic landscapes to find balance on the matter of student mobility. Fledgling academics rely heavily on foreign training to complete their education and struggle with steady funding at home (Bokova, 2015). As such, South America still faces challenges with regards to "brain drain" both in terms of attracting foreign scholars and ensuring the return of their doctoral graduates. A hindrance to finding viable solutions is the lack of broad statistics on PhD candidates and international students broadly.

Doctoral mobility within Africa remains rather isolated to the continent (DHET, 2013: from Lee & Sehoole, 2015). Efforts are being made to attract future faculty members to prestigious institutions on the continent, particularly in South Africa. However, inbound mobility ratios outside the African continent continue to be low at this time, with foreign students being attracted to the continent on vastly different bases than doctoral candidates in the United

States or Western Europe (Lee & Sehoole, 2015). As of now, the African Higher Education Landscape has focused on building international networks by sending their academics abroad to exchange knowledge, good practices and information, building the eventual attractiveness of national institutions in the global market (Woldegiorgis & Doevenspeck, 2015).

Scandinavia in general is actively recruiting international candidates to the PhD with an emphasis on research in the STEM fields (Nerad & Evans, 2014). In general however, there is limited information on the mobility of doctoral candidates in Scandinavia, with even less data surrounding international PhDs pursuing their education in the territory.

With regards to Western Europe, PhD mobility trends are more extensively surveyed in European Union reports and OECD statistics. Globally, Western Europe is, after the United States, the grand favorite for international student mobility, PhD included (Bokova, 2015; OECD, 2018; Veugelers & Van Bouwel, 2015). This trend can be attributed to 3 broad factors: the English-speaking majority, the prestige of the education and tertiary academic investments within the European Union (Veugelers & Van Bouwel, 2015). Policies for EU nationals greatly facilitates exchanges between institutions within the Schengen area, establishing a greater balance than anywhere else worldwide in terms of inbound and outbound mobility ratios (European Union, 2018).

Eastern Europe, on the other hand, knows a very different academic context. Our findings around two case studies (Bulgaria and Russia) indicate that the 1990's 'brain drain' afflicting Eastern Europe is now settling, with the region now regaining its intellectual infrastructure by effectively managing to both maintain and attract doctoral candidates from abroad (Berezina et al., 2018; Bokova, 2015; Chepurenko, 2015). The creation of international networks from home appears to be a key factor in the current 'brain circulation' that is coming to define Eastern Europe's scientific mobility pattern (Berezina et al., 2018).

Further East, we observe a steady rise in international enrollments on the Asian continent (China, Korea, Japan, Singapore, Qatar, the United Arab Emirates) (Kritz & Gurak, 2018). However, with it, the outbound mobility ratios of the United States and other Western countries have also increased, maintaining the continent within stronger outbound mobility trends. The prime example of this inclination is India which has the strongest contributor of foreign scientists abroad but consequently suffers a heavy "brain drain", with 40% of its home-born researchers working overseas and facing little inbound mobility (Van Noorden, 2012). The observations that can be made from overseeing the mobility trends of Asian PhD holders is that, while economic "push" factors are decreasing as its countries develop and gain prestige within the scientific community, there is yet to be a significant reversal of its emigration tendencies within the intellectual elite.

Lastly, we turn to Oceania, which has become an increasingly inciting destination for international students, particularly for PhD candidates (Bokova, 2015; Choi, Nieminen &Townson, 2012; Education Counts, 2019). Indeed, they are being actively recruited by governments, either through scholarships, facilitated migration policies or jointly coordinated international programs. Having previously suffered from brain drain, active efforts are made to reverse the tides and mobilize the intellectual elites to boost the economic development of Australia and New Zealand (Ziguras & Law, 2006). The countries have a definite advantage migration-wise in having English as their main language and currently attract growing numbers of researchers in commerce and the natural sciences.

Recommendations

One of the greatest challenges we are faced with when assessing the current mobility trends of doctoral candidates relates to the lack of a standardized measure across regions and the disparity in the available information. Western Europe and the United-States, along with a few other OECD countries, provide great data on the matter of graduate mobility and the transnationalisation of its intellectual force. When investigating other regions however, the scarcity of data and its limited availability in English compound our difficulties in clearly assessing the doctoral context worldwide and drawing representative conclusions. A first recommendation would thus have to pertain to this very issue. As suggested by Dr Conor O'Carroll, a mobility index for the benefit of international students (in a similar fashion to the GDP or other demographic measures) could be established in academic institutions worldwide. While the method of measuring is up for discussion, we propose that a value of less than 0 could mean a country is a net sender of PhD candidates where a value greater than 0 could mean they are a net receiver. The factors that would be used to calculate the index could include, among other things: Quality of research; International reputation; Availability of funding; Career opportunities; Salary; Availability of academic positions; Openness of recruitment system; Administrative Issues (visas, work permits, access to social security); and Political stability. From an individual's perspective, one could also think of an index of mobility for a researcher. In a similar fashion, this could include: Access to funding; Family situation; Career ambition; Track record; and Country of origin and residence.

Outside knowledge-based considerations and improving our surveying of mobility trends, practical concerns should be addressed in light of the skewed migration patterns of certain regions and the precariousness that it reproduces worldwide. Indeed, of great concern is the predominantly outbound mobility ratios of developing countries, particularly in the Southern hemisphere (ex: Chile, Mexico, South Africa, etc.). It has prompted worries surrounding non-return migration trends and debates concerning the policy changes necessary to address them. While it could be tempting to impose an obligation to return, it should be noted that a mandatory convergence (return) to avoid a definitive divergence (departure) of a nation's doctoral pool is in itself a false imperative: many other policy initiatives can be introduced to encourage the return of new researchers without constraining their freedom of choice and limiting their careers. Reale, Morettini and Zinilli (2018) explore this particular question in the case of Social Sciences and Humanities scholars and reveal the factors involved in the return of doctoral graduates: research and development funding in the home country, the job opportunities of their host country, their family situation, etc. Steps towards improving the academic infrastructure and valuing the doctoral candidates' expertise (through adequate research funding) should be considered ahead of restrictive policies. More specifically, fledgling researchers should be provided with incentives to return home rather than a restriction of their movements. Funding should also not be considered the 'end all' of the problem: there needs to be real opportunities for returning PhD emigrants along with a stable home environment tied to the structural conditions of their native country (Kritz & Gurak, 2018).

Finally, following our literature review, we also propose that a strong outbound mobility ratio is not exclusively problematic and should be encouraged, even in the case of an 'intellectual exodus'. Indeed, scientific mobility encourages international collaboration (Bokova, 2015: 74). While it does not immediately solve the issue of brain drain, expatriated doctoral candidates can be encouraged to work with universities from home to raise the quality of the education provided and build national competencies while nurturing academic relations abroad. As an example, Indian expatriates that have gained valuable knowledge overseas have continued to collaborate with their counterparts at home, raising the quality of education and technological capacities of universities and enterprises alike (Pande, 2014: from Bokova, 2015). As per the report, these global initiatives further persist after graduation as researchers with international experience continue to collaborate globally throughout their careers (Bokova, 2015).

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Capacity Building Policies

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Research capacity-building is the process by which one builds, individually and institutionally, skills and ability useful to conduct higher-level research (Trostle, 1992). Individually, it can be seen as a process by which someone transitions from a PhD student to an independent researcher. Collectively, capacity-building can examine a number of factors, including the demographic diversity and inclusivity in a particular field.

The aim of building doctoral capacity is to provide structured supervision during PhD, training in advanced disciplinary and transferable/generic skills, career mentoring outside academia, and mentoring for mobility across borders, disciplines and sectors. Structured approach to doctoral training presumably leads to benefits in terms of student experience and research output (Delaney et al., 2009). Between 2007 and 2010, a three-year longitudinal study of PhD candidates in Irish universities showed that, in contrast to those with a single supervisor, doctoral candidates in structured programmes were more likely to present at international conferences and publish in internationally peer reviewed journals (O'Carroll, 2012).

A traditional PhD emphasizes on research with an average training time between 4-6 years. However, doctoral training is not monolithic; there are several kinds of doctoral degrees other than a traditional PhD, and each would entail unique training procedures. There is the scholar-practitioner approach (e.g., EdD, DrPH, and JD) where the emphasis is on practice. The scientist-practitioner training (e.g., MD-PhD dual degree training) emphasizes on both research and practice in medicine and biomedical research with an average training time of 8-10 years.

General structure of traditional doctoral (PhD) training

Doctoral education typically consists of a dependent phase characterized by course taking, mastering content knowledge, performing supervised research, and developing professional relationships with the advisor, other faculty, and peers (Lovitts, 2005). This is followed by the transition to an independent phase where doctoral students learn to become producers from consumers of knowledge by producing original research (Lovitts, 2005). The transition between these phases is the most crucial and individual capacity building plays a role in the sense that a novice researcher integrates oneself into the research environment and learns to work independently (Etzkowitz, Kemelgor, & Uzzi, 2000).

This transition is governed by the way a doctoral program is organized and structured, varying from highly structured programs with defined benchmarks to informal programs with loosely defined benchmarks (Etzkowitz, Kemelgor, & Uzzi, 2000). However, satisfactorily performing the tasks in the independent phase require skills that are complex and those students are vaguely familiar with (Lovitts, 2002; Lovitts, 2005). Successfully transition as independent researchers also require psycho-social transformation where students acquire social and personal resources to perform research independently and creatively (Etzkowitz, Kemelgor, &Uzzi, 2000; Lovitts, 2002).

General challenges of capacity building through PhD training

Literature examining transition of doctoral students from the dependent to independent phase is sparse and also assumes that independence is attained after successfully completing a dissertation (Lovitts, 2005). Other studies argue that attaining this independence takes time and additional skills and in fields requiring practical training in laboratories, mastering those skills may not happen with the completion of PhD and require postdoctoral training (Golde & Dore, 2001). This leads to a mismatch between doctoral training for academia and student aspiration of becoming faculty. This issue is complicated by the decreasing number of tenure-track positions, complexities of getting tenure, heavy research expectations, competitiveness in research funding, lower salaries in many fields, and an idealized, misleading vision of faculty life some students have (Golde & Dore, 2001). The minoritized sections (e.g., women and students of colour) are less likely to aim for or obtain a faculty position compared to their peers, leading to reduced gender and racial/ethnic diversity. For example, in the US, women and men from the underrepresented minority (URM) groups are 54% and 40% less likely to report interest in pursuing faculty positions respectively at research-focused universities compared to well-represented men (Gibbs *et al.*, 2014).

With the increasing complexities of doctoral training including increasing research expenses and shortage in research funding, universities are now leaning on to organizational supports to enhance individual research productivity (Dundar & Lewis, 1998). The complexities are more in fields like biosciences where training time is longer and postdoctoral training is obligatory, though it does not always guarantee securing employment as an independent researcher (Goldman & Marshall, 2002). Overall, doctoral training is a complex process requiring capacity-building and the pooling of resources and skills to allow students to develop a professional identity (Zemlo, Garrison, Partridge, & Ley, 2000).

The other challenge of capacity building that is somewhat counter-intuitive is the disproportionate rise in numbers of PhDs. For example, the number of science PhDs have risen by 40% between 1998-2008 in Organisation for Economic Co-operation and Development (OECD) countries without suitable employment opportunities for everyone (Cyranoski et al., 2011). While countries like the USA have an excess of PhDs than can the labor market employ, PhD training may not be consistent and internationally competitive in many countries like China and India. As a result, many PhDs take up jobs that do not require a PhD at all. Additionally, countries like India are not producing enough PhDs in science, technology, and engineering who can serve the needs of a booming economy. There is no quality control, PhD best practices, or standards consistent across countries. Due to a long and often unstructured training with fewer financial benefits, many leave the PhD program (attrition) or are not motivated to join at all. Even when they finish, they may not be employable in academia, or employable at all. Research training in some countries might be sub-par. There is not as much focus on teaching skills such as networking and academic writing, that can help PhD students to be employable in a wide variety of positions and sectors. PhD continues to be a time-intensive and labor-intensive process with no assured returns. The following sections summarize some of the major challenges.

Programmatic challenges

Programmatic challenges include inadequate mentoring and professional development and lack of role models (Powell, 2007; Butts *et al.*, 2012). Morehouse and Dawkins (2006) stressed the importance of matching mentors with doctoral students based on research interests. Student experiences are vastly guided by their perceptions of faculty advising, behavior, and diversity, emphasizing the important role of faculty-student mentoring relationships in undergraduate minority (URM) student success (Felder, 2010). Specifically, same-race connections (as faculty advisors and mentors) are essential for the overall success of URM PhD students (Barker, 2011).

Additionally, campus-wide mentoring programs can address the leaky pipeline for women by increasing their advancement and retention, reducing isolation, and providing informational and psychosocial support (Chesler *et al.*, 2010). The role of mentoring during doctoral training has been widely discussed (Johnson *et al.*, 2007; Wadman, 2012), underscoring the importance of culturally sensitive faculty-student relationships among Black students. Felder & Barker (2013) stated that student identity (professional, personal, and racial) has a bearing on their relationship and interactions with faculty, advisor, department, or institution. Self-confidence and belonging are key to adjusting in a field (Carlone & Johnson, 2007; Cole & Espinoza, 2008), that would contribute to capacity-building.

Financial challenges

Financial challenges included inadequate salary, seeking competitive grant funding, and influence the ability to succeed. Funding has historically played an important role in doctoral-student retention rates, as students are more likely to be retained through research fellowships (Ampaw & Jaeger, 2011; van der Haert *et al.*, 2014). Students with research fellowships in Science, Engineering, and Mathematics (SEM) are 67% more likely to graduate than students who do not (Ampaw & Jaeger, 2011). In the current funding climate, it is likely that receiving research funding will continue to be a challenge for scientists at all levels in their career. Institutions can provide support through grant-writing workshops to enable individuals to successfully obtain funding. A recent study of a diversity-focused, mentored, research-skills training program showed great success in terms of grant submissions and awards among URM participants in cardiovascular research (Fabris *et al.*, 2016). Such mentored-training programs can be used as a model.

Diversity challenges

Diversity challenges include the challenges faced due to minority status, which could be related to immigration status, gender, and race/ethnicity, among others. While immigrant minorities voluntarily move to a country due to better life opportunities compared to their home country, non-immigrant minorities have a history of being forcibly conquered, colonized, or enslaved by the society permanently against their will. Historically, some of the barriers for women in science and medicine have been attributed to their personal characteristics rather than social constructions of gender-role stereotypes (Keller & Dauenheimer, 2003). Women take longer to advance their careers and face far more career-related barriers than men (White *et al.*, 2012), especially after having children due to traditional female roles of being the primary caregiver (Mason & Goulden, 2004). Time devoted to childcare precludes women from focusing on career benchmarks like tenure and promotion (Yedidia & Bickel, 2001). Lack of institutional support makes women unable to balance their family and career, with inadequate on-site childcare facilities and stringent and inflexible leave policies (McPhillips *et al.*, 2007). However, departments can better support women's success by identifying peer support groups, mentors, and advisors (Hodgson *et al.*, 2000).

Minority students often experience stereotype threat where they sensed being at the risk of conforming to a negative stereotype about their social group (Keller & Dauenheimer, 2003) and feared being judged by others based on such stereotypes (Shih *et al.*, 1999). Differences in socializing experiences based on race/ethnicity often have been discussed in terms of stereotype threat, first described by Steele and Aronson (1995). While a strong academic background is fundamental to post-secondary STEM persistence, Black people's self-confidence in themselves, self-efficacy in their ability to engage in scientific work, and identification as a scientist may be even more important to their success in science careers (Russell & Atwater, 2005; Carlone & Johnson, 2007). There is an evident need for programs geared specifically for URMs such as: mentor programs, work-life programs, family integrated activities and supports, and social support groups on campuses (Taylor & Antony, 2000).

Communication challenges

Developing effective communication skills is important for PhD students (Harris *et al.*, 2002). As a result of the dominance of English in scientific publications, non-native writers struggle with writing, publishing, and seeking linguistic support (Cameron *et al.*, 2012). The number of publications is widely used as an indicator of individual and institutional productivity that is imperative to seeking funding for future research and promotion and tenure (McGrail *et al.*, 2006). For example, people of Latino background report inadequate preparation in English writing and presentation skills for publications and conferences, meeting academic expectations, and their general acculturation experiences as barriers to success in science programs (Snyder & Bunkers, 1994).

Emerging conclusions

Overall, the main issues in doctoral capacity building include a combination of intrinsic and extrinsic challenges. While intrinsic challenges pertain to skill building, program challenges, and diversity issues, extrinsic challenges include the lack of enough employment options within and outside academia, and not producing globally competitive PhDs. Overall, it comes down to issues of numbers and quality. After all, doctoral workforce capacity is a function of research outputs and research quality. The challenges around capacity building also relate to the country-specific migratory trends. For example, countries like India experience the problem of "brain drain" where a large proportion of Indians move out to pursue PhD training and do not return, yet there are fewer PhDs training in India proportional to the population, especially in fields like science, technology, and engineering.

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Politics Governing Doctoral Education
Dr Jing QI

In the wake of the global financial crisis 2007-8, research capacity and innovation is increasingly perceived as key drivers of economic growth (Hartley, Pearce, and Taylor, 2017, p.361). Building capacity in research and innovation requires quality doctoral education that provides the human capital for knowledge economy and society. Policy initiatives in many counties have been oriented towards rapidly increasing the number of doctorate holders with a short turnaround time. In Chile, graduate programs form the bulk of human capital for scientific advancement (Besnier, 2012). Australia's most recent review of doctoral education regarded its Higher Degree by Research (HDR) training system as critical to its future economic strength. Doctoral education "provides a highly qualified research workforce, enabling research and innovation across the academic, industry, government and not-for-profit sectors, as well as contributing substantially to Australia's and the world's body of knowledge" (ACOLA, 2016, vii). In Asia[1], many governments consider developing graduate education as a strategy to enhance the national research capabilities, and thereby economic competitiveness (UNESCO-UIS, 2014). Many Asian countries such as Malaysia, Thailand and China require doctoral students to publish before graduation to improve the high rankings of universities (UNESCO-UIS, 2014).

Governance of doctoral education

The responsibility for doctoral education varies between countries as PhD programs sit at the interface between education and research. Usually the degree aspect is first the responsibility of the awarding university under regulations from the Ministry of Education (or devolved Higher Education body). However, in general, the bulk of funding that supports PhDs is provided by funding agencies that are linked to Ministries of research, business and enterprise. A good example is European policy for doctoral training which is shared between the DG Education & Culture and DG Research & Innovation, including many of the constructs for doctoral education (structured programmes, requirements for thesis supervisory committees, generic/transferable skills training). Higher education policy for the PhD is through the Bologna Third Cycle. In parallel, the PhD is seen as the first stage in the European Framework for Research Careers (R1). The Innovative Principles for Doctoral Training were developed in 2011 to provide a framework for best practice in doctoral education and training.

In many countries[2], national research policies and frameworks are implemented by a Ministry of Education or equivalent which oversees specialised higher education agencies that govern doctoral education programs (See Appendix 1 for the example of New Zealand). In Australia, universities are autonomous and receiving most of the funding from federal agencies. The prime policy responsibility for higher education is usually within the Federal Department of Education and Training. In the case of doctoral education, a role is sometimes played by Departments of Research and Innovation, although this varies from state to state.

[1] In Asia, "Currently almost all countries or territories (22 out of 26) across East and South Asia are implementing graduate programmes. However, doctoral-degree programmes which provide advanced research training are currently absent in Bhutan, Lao People's Democratic Republic and the Maldives (UNESCOUIS, 2013b). This suggests that there is a growing divide between countries able to locally staff the expansion of their higher education systems and those that are relegated to outsourcing instruction to expatriate instructors or alternatively accepting less qualified instructional staff" (UNESCO-UIS, 2014, p.11).

[2] Canada has no national policy nor framework as education is a provincial responsibility. However, the federal government provides most of the research funding in Canada.

Public universities are main drivers in doctoral education in most countries with a varied level of autonomy (See for example a report of European university's autonomy here https://www.university-autonomy.eu/). The EUA University Autonomy Tool compared 29 higher education systems in Europe through comparing the four areas of organizational, financial, staffing and academic autonomy. For example, in Mexico, public universities are autonomous from state and free from religious affiliations. However, the National Council on Science and Technology (CONACyT) has been fundamental in promoting postgraduate training. In Dutch, policy is shaped by the state government (Ministry of Education, Culture and Science) in consultation with actors such as the research universities (VSNU), the Royal Academy of Sciences (KNAW) and the Dutch Research Council (NWO). In Mainland China, the policy on doctoral education is mainly formulated by the Ministry of Education. However, colleges and universities have greater autonomy in how to evaluate doctoral students' quality. HKSAR's research universities are government funded institutions with doctoral programs that are driven by each university's autonomously created vision and objectives. Each research university in Hong Kong has a high degree of autonomy from the HK SAR government. In Japan and Malaysia, doctoral education policies are set and approved by the Ministry of Education. In Bulgaria, every university develops its own strategy, but the Ministry of Education and Science approves the number of paid-by-state fellowships in different disciplines.

The view of research innovation for short-term economic gain is a double-edged sword. Whilst more funding is available, more control is exerted. Further politicisation of science impacted upon many countries, where research governance and policy making was relocated to ministries of economy, business or industry. This often reduces the significance of science policy and relative independence of scientific research (Besnier, 2012). Increasingly research policies are tied up with government agendas that limit the objectives and approaches to scientific advancement. This is when research policy making is compromised by 'politics-based evidence' instead of 'evidence-based policy' (Henderson, 2013)".

In Chile, for example, the National Commission for Scientific and Technological Research (CONICYT) was relocated from the Ministry of Education to the Ministry of Economy when there was "a persistent lack of industrial R&D and a low private investment on research and innovation" (Besnier, 2012, n.p.). However, this situation has changed in mid-2018 with the creation of a dedicated science ministry to replace CONICYT which was established in 1968. The Ministry of Science and Technology is expected to "give science more prominence and better- coordinated policies" that brings together government, industry and universities (Rabesandratana, 2018). Similarly, Australian government is also building up the scheme of industry-led PhDs (See Appendix 1 for more details). This is pointing to the increasing importance of Industry partners in the shaping of doctoral education policies.

Research funding

Increase in research and development spending, and the number of researchers is a key target in the 2030 Sustainable Development Goals (SDGs). Countries stimulate investment in private and public sectors by setting national R&D spending targets as a percentage of GDP. The UNESCO Institute for Statistics (UIS) estimated the global spending on R&D as almost US$ 1.7 trillion, and 10 countries account for 80% of spending. The UIS evaluates countries and regions' commitment to R&D through spending as a percentage of GDP, and spending on

R&D in PPP$, or purchasing power parity dollars. A switch from GDP to total spending in PPP$ impacts significantly on the ranking.

Figure 1 below from the the UNESCO Institute of Statistics shows the share of funding of the GDP. North America and Western Europe takes the lead with an average of 2.5% of the country GDPs. This is followed by East Asia and the Pacific region (2% on average). The top 15 spenders on R&D in PPP$ include Korean, Israel, Japan, Finland, Switzerland, Austria, Sweden, Denmark, Germany, US, Slovenia, Belgium, France, Singapore, and Australia.

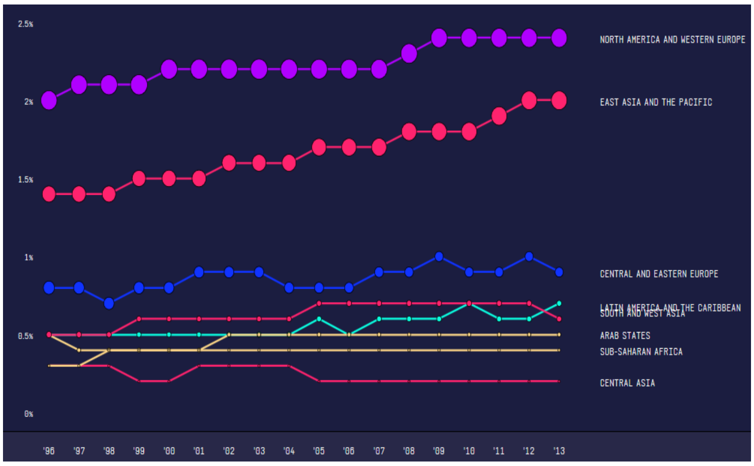

Figure 1 Research and Development funding Regional trends and rankings (UIS, n.d.)

Universities in many regions are underfunded despite the increasing enrolments in higher education and HDR programs (there are exceptions such as Japan which has a shrinking university sector due to decreasing number of eighteen-year age cohort. The number of doctoral students has been decreasing since 2008). In Europe since 2000 and the establishment of the European Research Area (ERA) there has been an agreed EU target of 3% of GDP on R&D. However, due to the economic crisis, budgets did not increase in accordance with increasing student numbers, “for various reasons including scarce public budgets and increasing demands from other education sectors as well as from other political fields” (Dohmen, 2018). Academics in some countries protested cuts to research findings, but only in some instances governments have returned funds towards science and evidence-based policy making (Besnier, 2012).

In Chile, in spite of the scholarship programs developed by the government since 2008, the rate of research and development personnel per one thousand people in Chile (less than 1) remains much lower than the OECD average of 7.6 (Comisión 2015, 32). In spite of the enormous need for more people trained at the doctoral level in Chile, the budget for scholarships has decreased 15% in the National Program, and 19% in the Becas Chile program for study abroad, from 2013 to 2017 (CONICYT 2018, 18). In Brazil, Jair Bolsonaro’s government froze 42% of the research budget for the country's science and communications ministry (MCTIC) in March 2019. The country has been losing young researchers who are moving abroad (Claudio, 2019). This will reinforce the current knowledge hierarchy.

In Canada for the 15 largest universities on average only 13% of funding are federal scholarships, 28% of funding is from internal scholarships, 22% from supervisor grants and 17% from teaching assistantships. In most countries, International students are not eligible for most national fellowships, and so are more likely to be funded through internal means. In the US, in the arts and humanities, for example, a teaching assistantship is the modal type of support. In the “bench” sciences, project funding is the major source of support, through a research assistantship.

East Asian countries such as China are exceptions, with increasing government funding for research in colleges and universities where doctoral students are one of the main forces of scientific research. Government scholarships cover the tuition and basic living expenses of students. Doctoral students particularly in social and natural sciences also receive some research assistantship from supervisors.

Therefore, increasingly ccountries are subscribing to a funding framework for doctoral education in which source revenues diversify to go beyond the government fellowships, university project-based funding to include industries and self-funded international students. For example, public investment in the Australian higher education sector has drastically declined in recent years to the point where it is now 0.7% of GDP, which is 40% below the OECD average of 1.1% (OECD, 2017). The remainder of funding for Australian universities comes from increasingly high student fees especially for international students and from non-government sources. In the case of PhDs, Australian domestic students (including Aotearoa New Zealand students) do not pay tuition fees but instead are granted a Research Training Place, while international students pay between $AUD14,000 to $37,000 pa (FindAPhD, 2018). Across Europe, one can see the impact with the increase in the number of undergraduate and graduate courses offered in English to attract international students. This is reinforcing the status of English as the global language.

Similarly, in South Africa the government’s block grant system is supplemented by fees from the students. A report by Universities South Africa (USAF, 2016) indicates that government subsidies to universities have declined by over 30% in the last two decades. This decline has put pressure on the other two sources of income available to universities, namely, tuition fee income, which has been contested by the “fees must fall” movement in South Africa, and third-stream income (typically research grants, contract income, donations etc.).

In Malaysia, as is the case in Europe, funds to support doctoral research is usually through research grants obtained by the supervisor. In the current economic climate, where funded projected are limited, most Malaysian doctoral candidates are either sponsored by their potential employer or self finance their studies. The MyBrain15 programme was introduced in 2007 with the objective to increase the number of Malaysian doctoral degree holders to 160,000 by 2020. This programme provided funding to cover tuition fees, stipend and examination fees. The MyBrain 15 program was suspended due to unfavourable economic climate.

The completion-based funding model is used in many countries such as the UK and Australia. The UK Research Councils allocate block funding for PhDs but with the condition of completion time in 4 years – otherwise penalized.

Universities (and polytechnics) in New Zealand receive two types of government funding for PhD students: student achievement funding, which is an amount paid annually upon enrolment for up to 4 years per student; and performance-based research funding, for completion of the research degree, which is paid to the institution over about three years following completion. PhD candidates must pay fees (but international students can pay domestic fees), and each university offers scholarships to top students that can cover their fees and provide a living stipend. Some PhD candidates are supported by funding from research grants or from industry collaborations (NZQA, n.d.) See Appendix 2 for information of more countries.

Strong spending by the business sector is an increasingly important contributor to GERD. In Europe, the economic recession had a significant impact on the funding of universities in some countries. Also, governments have put pressure on universities to diversify funding sources. For example, in Ireland there have been proposals to have industry co-fund courses thereby giving more external influence over course content and direction. Figure 2 shows the top 15 R&D spenders's share of expenditure by the business sector. The inner circles show the strength of the business sector in terms of total spending on R&D in ppp$. Despite industry funding being a new growth area, the number of Industry PhDs remains small. For example, in Bulgaria it is less than 1%. Most countries reported that the traditional PhDs and professional doctorate still take up the majority of doctoral cohorts.

Figure 2 Top 15 R&D spenders's share of expenditure by the business sector.

A clear emphasis on STEM is perceived in many countries as is available in higher levels of funding when compared to HSS. The Mexico CONACyT is strongly oriented towards STEM. In the US, the National Academies of Sciences, Engineering, and Medicine provide a vehicle for advancing doctoral education and establishing agreement about standards and best practices (National Academies of Sciences, Engineering, and Medicine, 2018). Students in the hard sciences have better chances of obtaining graduate teaching assistantships (a main source of funding for doctoral students in the U.S.) than others. Boyce, Curtner-Smith & Sinelnikov (2016) argue that potential reasons for this include privileging of science over other forms of knowledge, including pedagogical knowledge, and, reflecting entrenched support of mind-body dualism (Descartes, 1641/1984), and the privileging of academic over practical subjects" (XXXX).

Geopolitical influence on doctoral education

Global higher education faces the challenges of a 'wholly different political environment' driven by recent geopolitical events (Van Damme and Van der Wende, 2018, p.81) that challenges the principles of capacity building in doctoral education. These include 'the need for a critical mass of research, reciprocity, exposure to other ways of thinking, and university autonomy' (JøRGENSEN, 2012). Current mobility of international students has been shaped by major trends and events such as the slowdown of the Chinese economy, Brexit, and the 2016 American presidential election (Choudaha, 2017). In Europe, the Brexit, continued terrorist attacks, refugee crisis, and the coup attempt in Turkey seemed to have "promot[ed] a turn away from internationalism, global collaboration and an open society" (p.91). Meanwhile, China's Belt and Road Initiative "could potentially span and integrate major parts of the world across the Euro-Asian continents, but likely under new and different conditions" (Van Damme and Van der Wende, 2018, p.91). China's economic presence in Africa also increased the number of African students studying in China (Anthony, 2017). Amidst these waves of uncertainty, the higher education sector is confronted with "potential threats to international cooperation, the free movement of students, academics, research funding, scientific knowledge and ideas" (Van Damme and Van der Wende, 2018, p.92). Figure 1 below outlines how political instability may have influenced the capacity building of both academics and doctoral students.

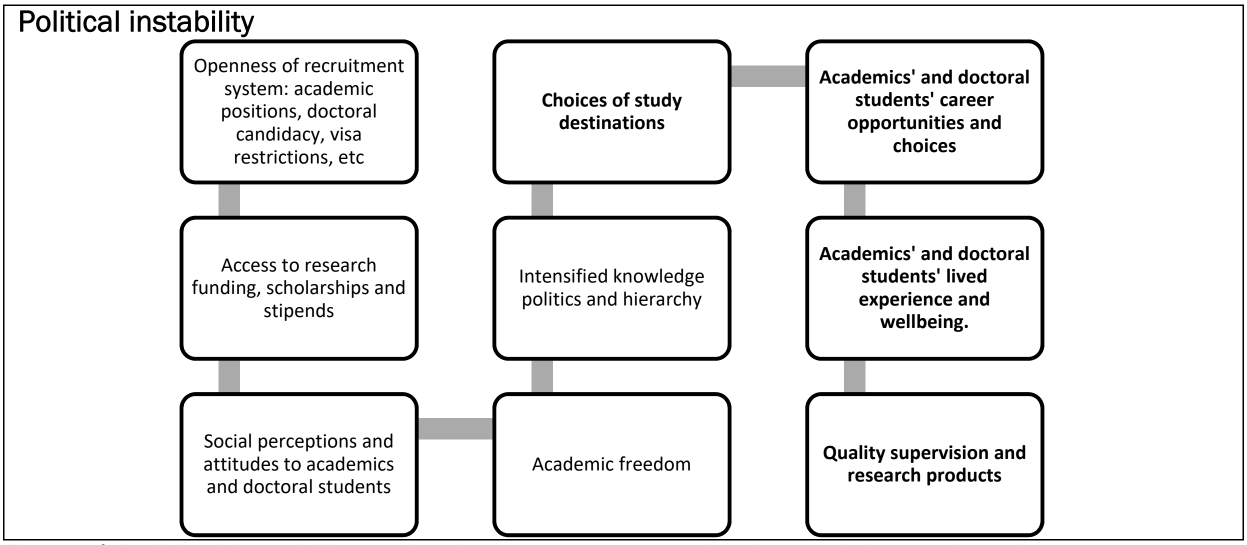

Figure 1 Political instability and its impacts upon academics and doctoral students

The UK universities are experiencing "consequences of the Brexit vote on international student mobility and in the international collaboration among researchers and at a strategic level" (Van Damme and Van der Wende, 2018, p.92). The Trump administration's immigration crackdown in the US has turned international students to other destinations (Leiber, 2019). International student enrolment in the U.S. dropped by 6.6 percent in the 2017-18 academic year, doubling the decline rate in the year before (the Institute of International Education, 2018). This makes it increasingly difficult for universities to continue to attract talented research candidates from abroad. Todoran and Peterson (2019) examined how international doctoral students made sense of the U.S. political climate on their experiences. They found *that* the U.S. government's executive orders restricting travel in January 2017 has affected not only international doctoral students from the six banned countries including Iran, Libya, Somalia, Sudan, Syria, and Yemen. Doctoral students from other countries also perceived the US political climate as "stressful, confusing, and hostile" (p.1).

Australia has been ranked as the safest and most welcoming country for international students by the Hobsons International Student Survey (Australian Embassy, n.d.). Safety was considered as a key factor by 93 percent of international students (out of the 65,000 survey participants) for choosing to study in Australia. An increasing number of postgraduate students seek to understand research higher degrees and fellowships in Australia. For example, there was a "14.2 per cent increase in visa applications from Chinese students intending to study in the postgraduate sector for the period 1 July 2017 to 31 January 2018, compared with the same period last year" (Australian Embassy, n.d.). However, increasing political tension between China and Australia in early 2016 was perceived to have influenced Australian visa restrictions for some postgraduate research students and research scholars, particularly those on Chinese government scholarships in sensitive science and technology fields (Munro, 2018).

In Turkey, current political pressure over universities has immense impact on existing PhD programs and students. Following the failed coup attempt in July 2016, the government declared a state of emergency and decreed the closure of 15 Turkish universities (among other institutions) and seize their assets. Allegedly these universities supported the Gulen movement which Turkish authorities suggested were behind the attempted coup. "Authorities have taken a range of actions against the members of the higher education community — among others — allegedly intended to identify those parties involved with the coup attempt, or to eliminate the Gulen movement's influence within several Turkish institutions. In addition to university closures, these actions reportedly include restrictions on travel, mass suspensions, and arrest and detention of university personnel" (Scholars at Risk, 2016, n.p.). A total number of 66,000 students were relocated in order to continue their education (TurkeyPurge, 2017). A 2019 survey with PhD students from Turkey also revealed that the new political pressure has implications for quality of PhD education as well as academic freedom. For lack of supervisors (as some were dismissed on forced on leave), research students were transferred to supervisors of different research areas, transparency of scholarship application processes, gender discriminations, etc. (Turkey Country profile, 2019).

Conclusions and Recommendations

1. Doctoral education is considered valuable for providing human capital for knowledge economy and society. Policy initiatives in many counties have been oriented towards rapidly increasing the number of doctorate holders with a short turnaround time. However, this short timeframe does not take into disciplinary and individual differences.

2. The governance of doctoral education is increasingly co-shared by educational and economic industrial/business ministries. Public universities are main drivers in doctoral education in most countries with a varied level of autonomy.

3. Research innovation is increasingly linked to short-term economic gains. This also explains why STEM disciplines are prioritized than HSS disciplines.

4. The global spending on research and development is far from an even distribution. The

UNESCO Institute for Statistics (UIS) estimated the global spending on R&D as almost US$ 1.7 trillion, and 10 countries account for 80% of spending. The top 15 spenders on R&D in PPP$ include Korean, Israel, Japan, Finland, Switzerland, Austria, Sweden, Denmark, Germany, US, Slovenia, Belgium, France, Singapore, and Australia.

5. Universities in many regions are underfunded despite the increasing enrolments in higher education and HDR programs (there are exceptions such as Japan which has a shrinking university sector due to decreasing number of eighteen-year age cohort. The number of doctoral students has been decreasing since 2008).

6. Developing countries continue to lose their young talents to developed countries, thereby reinforecing the global knowledge hierarchy.

7. Increasingly ccountries are subscribing to a funding framework for doctoral education in which source revenues diversify to go beyond the government fellowships, university project-based funding to include industries and self-funded international students.

8. Global higher education faces the challenges of a 'wholly different political environment' driven by recent geopolitical events (Van Damme and Van der Wende, 2018, p.81) that challenges the principles of capacity building in doctoral education. These include 'the need for a critical mass of research, reciprocity, exposure to other ways of thinking, and university autonomy' (JøRGENSEN, 2012). Current mobility of international students has been shaped by major trends and events such as the slowdown of the Chinese economy, Brexit, and the 2016 American presidential election (Choudaha, 2017). In Europe, the Brexit, continued terrorist attacks, refugee crisis, and the coup attempt in Turkey seemed to have "promot[ed] a turn away from internationalism, global collaboration and an open society" (p.91). Meanwhile, China's Belt and Road Initiative "could potentially span and integrate major parts of the world across the Euro-Asian continents, but likely under new and different conditions" (Van Damme and Van der Wende, 2018, p.91).

9. Geopolitical instability have influenced the capacity building of both academics and doctoral students in the following ways:
    1) Openness of recruitment system: academic positions, doctoral candidacy, visa restrictions, etc
    2) Access to research funding, scholarships and stipends
    3) Social perceptions and attitudes to academics and doctoral students
    4) Academic freedom
    5) Intensified knowledge politics and hierarchy
    6) Choices of study destinations
    7) Academics' and doctoral students' career opportunities and choices
    8) Academics' and doctoral students' lived experience and wellbeing.
    9) Quality supervision and research products

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