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How and what knowledge do universities and academics transfer to industry in African low-income countries? Evidence from the stage of university-industry linkages in Mozambique

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ABSTRACT

Drawing from the Mozambican case, this paper addresses the stage of university-industry linkages (UILs) in Sub-Saharan Africa, from the perspective of universities. The paper examines the kind of knowledge universities transfer to industry, the knowledge channels used, the incentives and barriers faced, including influencing contextual conditions. The findings suggest that UILs in Mozambique weak and informal, and that academics engage with companies mainly through DUI-innovation model and exchange of embodied knowledge, particularly ideas in informal meetings, internship/employment for students, consultancies for academics, rather than through disembodied knowledge, such as patents and technology prototypes, embedded in R&D and STI-innovation model.

1. Introduction

After decades of marginalisation, higher education (HE) in Sub-Saharan Africa (SSA) was repositioned, from 1990s, as relevant to development. Both international community and national governments posited that, if SSA wanted to catch-up, it needed to strengthen its HE (World Bank, 2009). The emergence of the knowledge-based economy accounted significantly for HE revitalisation; as a consequence, trends of expansion, privatisation and emergence of new funding channels were experienced in African HE (Mohamedbhai, 2014; World Bank, 2010). While at policy level, the idea that HE may contribute to Africa's development sounds reasonable, empirical evidence for backing this claim is inconsistent. Overall, the socio-economic contribution of HE is measured through the kind of human capital and science-technology produced and societal benefits therefrom resulting (Oketch et al., 2014; Castells, 2001). For SSA, Cloete et al. (2015, p.12) highlighted two prevailing conceptions concerning the socio-economic relevance of HE: firstly, HE as "service provider", as repository of expertise to solve problems like poverty and diseases; secondly, HE viewed as "engine of development", as serving to produce science and technology to boost economic/technological competitiveness. While, as Cloete et al. (2015, p.13) argue, the "service provider" conception seems to be dominant, how these conceptions impact the way African HE contribute to development needs further research.

Overall, five kinds of studies have produced evidence on socio-economic relevance of HE in Africa. Firstly, scientometric studies, which document the weak stage of knowledge production in African HEIs and its implications for Africa's participation into the knowledge economy (Cloete et al., 2015; Pouris and Pouris, 2009). Secondly, econometric studies, which consistently demonstrate that HE yield higher private returns to university graduates (Barouni and Broecke, 2014; Schultz, 2004), but concerning societal benefits, findings are nuanced. Bloom et al. (2014) and Gyimah-Brempong (2010) found positive econometric relationship HE-economic growth, thus contradicting the previous low-social-rate-of-return hypothesis (Psacharopoulos, 1994). Nevertheless, other scholars consider that econometric studies are biased: by using proxy variables, such as HE attainment and expenditure, econometric studies measure the propensity but not the effectiveness of HE contribution (Glewwe and Maïga, 2014; Hanushek and Woessman, 2008). Thirdly, studies demonstrating that HE yields positive externalities in, e.g., health, civic participation and longevity (McMahon and Appiah, 2002). Fourthly, studies targeting structural conditions demonstrate that these conditions impact (often negatively) the potential relevance of HE (Teal, 2011; Bennell, 1996). Fifthly, university-industry

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linkages (UILs) studies, which demonstrate the weak stage of universities-companies collaboration in SSA, except in South Africa (Kruss et al., 2015, 2012; Mihyo, 2013; Ssebuwufu et al., 2012).

These studies call for caution and demonstrate that the relevance of HE to African development should not be taken for granted. This is the case in Mozambique. Boosted by this revitalisation "movement", Mozambique's HE has expanded rapidly. During 1995–2014, HEIs increased from 3 to 46 (Langa, 2014), and students' enrolment from 4000 to about 130,000 (UNESCO Institute for Statistics, 2015). In its HE and innovation policy documents, the government has favoured policies emphasising the socio-economic relevance of HE (MINED, 2012; Conselho de Ministros, 2006). This role is witnessed by available literature. Bailey et al. (2011) found that the main stakeholders' narratives recognise the socio-economic relevance of HEIs. Langa (2010, p. 244) claimed that Mozambican politicians ascribe to HEIs a socio-economic agenda of fighting poverty, undermining the possibility of pursuing conventional science of knowledge for its own sake. This political-ethical objective has mainly resulted in politicians distinguishing useless and useful sciences for fighting poverty. Politicians' complained about the overrepresentation of "useless" humanities/social sciences against "useful" engineering/natural sciences in Mozambican HEIs (Langa, 2010). This overrepresentation, which prevails (in 2012, 68,3% of total students were enrolled in humanities/social sciences, MINED, 2014), is also present and criticised at African level (World Bank, 2009, p. 48). However, it seems that the (political) claim that HE is economically relevant is nuanced by evidence. This paper presents part of findings of ongoing research on the socio-economic relevance of Mozambican HE. Based on survey and interviews from university lecturers and administrators from 6HEIs, the paper examines the stage of UILs in Mozambique. Besides the above-described background, its underlying rationale is that, while UILs studies have emerged across SSA, Mozambique has hardly been targeted. Four specific questions are addressed, namely: how university academics and managers view the stage of their collaboration with companies? What kind of knowledge, if any, is transferred and what channels are used? What factors and challenges constrain academics to collaborate with companies? Are there differences across disciplines?

2. Literature review on UILs

UILs' literature emerged from the 1970s' crisis, which forced universities and companies to build strong partnerships for their mutual survival (Cooper, 2011, p. 91–95). Companies approached universities, particularly research-intensive universities, to get innovations to sustain their competitiveness. Universities, facing financial constraints, commodified their knowledge to serve companies, in what has been christened as *academic capitalism* (Slaughter and Leslie, 2009) or *entrepreneurial universities* (Clark, 1998). Governments reinforced the partnership, through legislations and funding policies. The new economy's reliance on knowledge has transformed HEIs into key institutions and has fostered scholarly debates on the possibility of HEIs accomplishing, besides teaching and research, a third mission of promoting economic competitiveness (Etzkowitz, 2002; Etzkowitz et al.1998; Rosenberg and Nelson, 1994; Gibbons et al., 1994). In his seminal work, Gibbons et al. (1994) have argued that knowledge production has evolved from mode 1 to mode 2. In mode 1, knowledge was produced within academic disciplines and assessed through peer-reviewing. In mode 2, however, knowledge is produced by heterogeneous entities and assessed through its social and commercial value. Gibbons et al. (1994)'s concerns were later theorised as *triple helix* (Leydesdorff, 2012; Etzkowitz, 2002) to account for the way universities (U) interact with industry (I) and government (G), to produce, use and commercialise knowledge. Other scholars have added the civil society in the U–I–G helix, to form quadruple/quintuple helixes (Ivanova, 2014).

Thus, UILs research emerged to test empirically the idea of HE's third mission and to examine the interactions between universities and companies' activities (Etzkowitz et al., 1998). Since their inception, UILs studies have influenced academic and political debate. In their scientometric study, Teixeira and Mota (2012) have found that, from 1986 to 2011, 534 papers had been published on UILs and had produced around 15,682 citations, demonstrating their significant influence (p. 720–721). Teixeira and Mota (2012) have identified four main topics addressed by UILs' literature. Firstly, *characteristics* of *universities* (size, resources, type of knowledge produced, type of academic departments), *firms* (strategy, size of business, sector of activity, nature of R&D) and *scientists* (profile and research experience) and on how these characteristics incentivise or hinder UILs (p. 721–723). Secondly, the nature of *knowledge transfer channels*, the knowledge transferred, the breadth or depth of UILs, including incentives and barriers to UILs (Wang et al., 2015; Ramos-Vielba and Fernadez-Esquinas, 2012). Thirdly, *science and technology policies* (Seppo et al., 2014). Fourthly, studies concerned with *spin-offs* (Teixeira and Mota, 2012, p. 723). This literature has mainly targeted developed and emerging countries and it has often demonstrated strong UILs and their positive contribution to economic competitiveness (Veugelers and Rey, 2014 for Europe; D'Este and Patel, 2007; for UK; Hershberg et al., 2007; for Asia; Branscomb et al., 1999; for USA and Japan).

UILs research is also a part of a more general scholarly endeavour labelled "innovation studies" (Fagerberg et al., 2012). Rooted in neoclassical economics, innovation studies' literature has shifted from a linear model of innovation, according to which technology is first developed by science and, thereafter, transformed into marketable products, towards evolutionary approaches in which innovation is viewed as a systematic, interactive and non-linear process (Lundvall, 1992; Nelson, 1993; Freeman, 1995; Lundvall et al., 2002, 2009). Bound by the concept of '*National Innovation System*' – a set of heterogeneous agents interacting for the generation, adoption and use of technology for socioeconomic purposes – innovation literature is however not consensual. Proponents of narrow approach, particularly those addressing science-technology practices and policies in developed countries, regard innovation in what is known as Science-Technology Model (STI-Innovation), i.e., as a systematic relationship of R&D activities of and among firms, research centres, universities and public policy (Mowery and Oxley, 1995). Opponents to the narrow approach argue for a broader perspective that considers innovation as a technical and social process, i.e., as being a process embodied in individuals working in organisations, who learn and innovate through Doing, Using and Interacting (DUI-Innovation). From this debate, two models of innovation emerge: STI-innovation, also labelled *science-based* (Lundvall et al., 2002), involves exchanging *disembodied/non-rivalrous knowledge* products (e.g. patents), whose usage exempts the bodily presence of their producers (Romer, 1990); the DUI-innovation, also labelled *experience-based*, involves innovating through *embodied/rivalrous knowledge*, through personal skills and capabilities. Although both modes view HEIs as essential, their role in the innovation process is viewed as different. Proponents of STI-model view HEIs as serving to produce codified knowledge or *"hardware"*, such as patents, technology prototypes, usable and marketable to firms. Proponents of DUI-innovation challenge this view, by conceiving HEIs as mainly aiming to train critical and skilled knowledge workers, capable of using their competence and interactive capabilities to innovate within organisations. The DUI-innovation is even viewed as relevant in developing countries, where R&D infrastructure is undeveloped and where only appropriation of innovations rather