

Financing for Commercialization of Research Work and Implications for National and Regional Trade— Experiences from Eritrea

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Abstract

This paper explores issues related to commercialization of research work. The paper highlights that although improved research outcomes emerged in Eritrea over the last four years, fine-tuning research and innovation policies is needed to link it with industries to create research-based start-up businesses that would contribute to employment creation, economic growth and enhance competitiveness in national and regional markets. The paper reveals that commercialization efforts result in substantial benefits such as increased industrial growth in revenues, net income, and number of employees; better health and environment and improved quality of life by obtaining certain health and safety products, services, and processes; and more general economic growth leading to lower taxes and greater individual wealth overall. The paper further argues that commercialization could lead to an improvement in a country's competitive position regionally or globally. However, there should be a defined process and collaborative knowledge between research centers and industries to effectively enhance commercialization efforts.

Keywords: Research, Commercialization, Socio Economic Transformation, Eritrea



**Journal of Business
Management and
Economic Research**

Vol.2, Issue.9, 2018
pp.25-35

Doi: 10.29226/TR1001.2018.59

1. Introduction

Commercialization of research is, in effect, the process of converting the output of research and development into products that can be exposed to consumer markets, aiming to increase their odds of capturing demand in those markets and thereby generating sales and revenue. The sales and distribution of these new innovative products ultimately generate economic benefits not only for the developers and marketers of the new products, but also the end user, and for

the overall economy (Nordicity and The Evidence Network, 2012). More specifically, Downie and Herder (2007: 25) define commercialization of research work as “the conversion of research results into products, services, and processes that can be the object of commercial transactions”.

Transferring the knowledge and skills between universities and business and the wider community increases the economic and social returns from this investment. Academic knowledge is essentially a global public resource, and highly educated workers are the primary source of application of global academic knowledge to the domestic economy. This knowledge may be used to generate innovation, and that this innovation leads to productivity improvements in the economy. These productivity improvements translate directly into economic growth, and, hence, standards of living (O'Carrollet *al.*, 2006).

Several studies suggest that when research and development expenditures increase, they create spillover effects in the localities in which they occur and local firm formation increases. These findings suggest that economic development strategies that focus on supporting research at the university level can be an important contributor to the economic growth of a region. For regions (such as Common Market for Eastern and Southern Arica) seeking to boost economic growth and development, support for local research efforts can play an important role.

This paper explores issues related to commercialization of publicly funded research and development in Eritrea. It focuses on public funding of research because in Eritrea nearly all of research funding is provided by the government (Eritrean Research Fund) in collaboration with its partners such as the African Development Bank and UNDP. Though improved research outcomes in the areas of business, agricultural, natural and social sciences emerged over the last four years, fine-tuning research and innovation policies is needed to link it with sectors and industries to create a sizable number of research-based start-up businesses that would contribute to employment creation, economic growth and thereby enhance competitiveness in national and regional markets such as Common Market for Eastern and Southern Arica (COMESA).

In Eritrea, financing research work for commercialization is almost non-existent. Although the Eritrean government has identified education and research as a key component for the country's growth, what is clearly missing is a set of policy instruments to incentivize the commercialization of research results. Efforts to create national innovation system, developing legal framework for intellectual property rights, providing public funds for venture capital, and targeting specific economic sectors and industries, while also increasing overall public participation in research expenditures are some of the critical issues that need to be addressed the soonest possible.

A focus of research has been so far research stemming from Eritrean Higher Education Institutions. Accordingly, a large number of research proposals have been publicly funded and many more are in the process of launching them. Nevertheless, most of researches conducted are interdisciplinary and not specifically linked to a particular company or start-ups other than being published on peer-reviewed academic journals. Research departments in higher education institutions are not better endowed for research; not getting research budgets; lacking clear guideline and policies of research. Generally, the research institutes are not affiliated with spinoffs.

Thus, the central research question of this study is: *“how effective is the current level of research to innovation and socioeconomic transformation thereby its contributions to trade both at national and regional level.”*

2. Empirical Literature

Generally universities and research institutions facilitate the creation and commercialization of research products or commercialization of intellectual property (Siegal and Wright, 2007). The topic for research commercialization becomes a critical issue, and it is especially relevant for the university-based technology (Rothaermel *et al.*, 2007). Thus, policy maker has perceived universities and research institutions as an engine for economic growth through commercialization tools (Markman *et al.*, 2008). Furthermore, how well companies manage to create value from technology commercialization depends very much on what happens before the product is developed (Hamzah, 2011). There are various functions of research product commercialization including for example that products should be based on industrial needs and relevant to private sector (see Powers and McDougall, 2005; Agrawal and Henderson, 2002; Nicolaou and Birley, 2003), to boost economic activities (Dietz and Boseman, 2005) and to create new jobs (Di Gregorio and Shane, 2003; Perez and Sanchez, 2003).

Enormous evidence shows the relationship between research and development and productivity growth, one of the most complex yet vital issues in today's business world (see for example, Jaffe and Trajtenberg, 1996; Mohnen, 1996; Blomström and Kokko, 1998; Cincera and van Pottelsberghe, 2001). Academic research and development is now seen as one of the key drivers of economic growth. If COMESA countries create academic institutions performing large amounts of research they will be more able to attract and grow technology orientated companies that will successfully compete in the global market. Academic research and development is an integral part of the innovation economy, with contributions in the form of patents, new commercial products, skilled employees, new companies, job creation, and tax revenues.

Research within universities also has the potential to produce breakthrough advances that can fundamentally alter country's economic growth and quality of life through productivity impacts either at the regional level or at the national level, which establishes the contribution of university research and development to GDP. Although not all research leads to such world-changing results, it does produce a steady stream of new ideas and technologies. These, in turn, lead to innovation and continuous improvements in productivity. Research and development is widely recognized to be one of the most important factors in the innovation process. Lichtenberg and Siegel (1991) have shown a direct link between investment in research and development and future improvements in productivity.

Berman (1990) examined the economic impact of industry-funded university research and development and found that university-funded research increased the industry research and development expenditures. The funded research resulted in technological innovation in industry. Thus, it seems plausible to argue that financing for commercialization of research work will result greatly in socio-economic transformation even across COMESA member countries.

Moreover, the literature on university/research institution-based technology transfer is clear to point out that the success of a research institution's licensing and spinoff program depends on its institutional structure, organizational capability, and incentive systems to encourage participation by researchers (Phan and Siegel, 2006). The incentives systems include both pecuniary and non-pecuniary rewards, such as credit towards tenure and promotion.

3. Analytical Framework and Methodology

The framework to analyze the factors affecting commercialization of research work and its impact on socio-economic transformation is based on a number of factors. First, the state of the research base of Eritrea including the governance of research institutions and the role of performance based budgeting is paramount to assess the critical mass that may generate discoveries; incentivize commercialization efforts and increase the quality of research (Gianella and Tompson, 2007; OECD, 2003). Second, the availability of human capital (specifically in Higher Education Institutions) for research and the resources at their disposal, as well as incentives for career development are key for increasing the likelihood to successfully bring research to the marketplace (Aldridge and Audretsch, 2011). Third, the analysis framework relates to the vast literature on market failures for funding of ideas, especially in the early stage of the commercialization process (for example, Branscomb and Auerswald, 2003). Finally, the intellectual property rights legislation is the frame that could incentivize commercialization by regulating the ownership and royalty distribution of publicly funded research (Phan and Siegel, 2006).

The analytical framework of this study is given in Figure 1. The analytical framework used here is an embedded approach. In the model (analytical framework), we suggest that the purpose (financing for commercialization of research work and national and regional economic development) and availability of knowledgeable and skilled human resources and research grants (financing/funding) influence business, research, science, and technology relationships. These outputs in turn result in increased enterprise performance, employment, and investment. Finally, the ultimate purpose is socioeconomic benefits (sustainable regional growth, economic development and social wellness, and improved environment and health care). Of course, it is worth noting that socioeconomic transformation is more complex than the sum of research outputs.

The model is not simply a checklist of procedures that should be followed. It merely aims to spell out what we would expect to see changes in society (socioeconomic transformation) if governments and other stakeholders invest in financing research for commercialization purposes. It is not suggested here that these are the things governments or research institutes should necessarily be doing. Now we turn on to an exploration of each level in our analytical framework to give a theoretical basis.

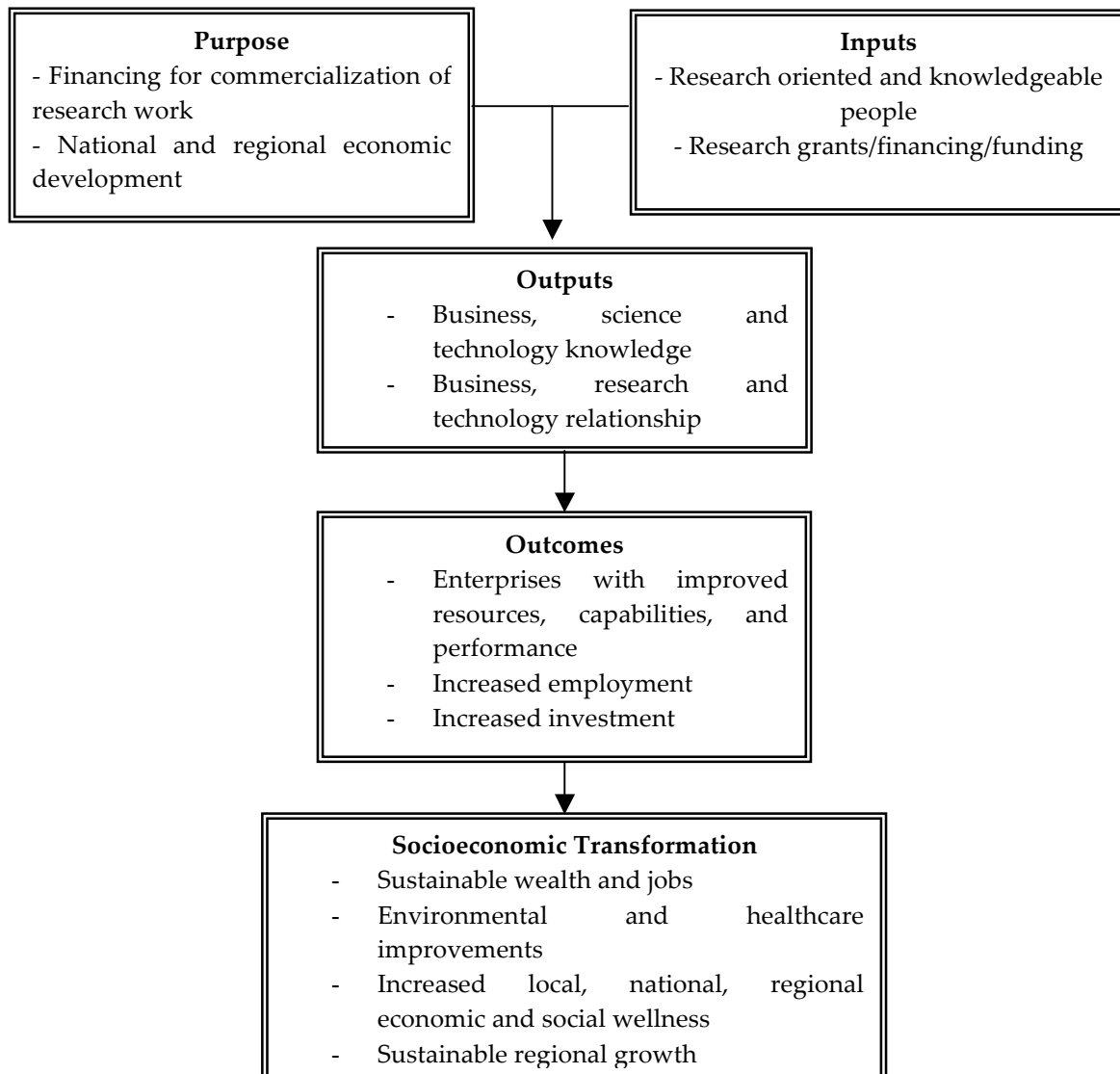


Figure 1: An Analytical Framework for Commercialization of Research Work and Socio-economic Transformation

Source: based on literature review

The above framework shows logical flow; that is, how different types of impacts are achieved. Working bottom to top, the achievement of socioeconomic transformation (social benefits such as sustainable wealth and jobs, better health care and environment, economic and social wellness, and regional growth) depends on outputs and outcomes. For example, an innovation intermediary that seeks to create economic growth in a region does so by facilitating commercialization of research through improvements in the performance of local companies, either by facilitating company growth and the creation of new ventures or by facilitating improvements in the resources and capabilities of local companies.

To achieve the above stated specific purposes, it is suggested here that inputs such as human and financial capital, to effect changes in companies through activities that include financial offerings such as funding for commercialization support, as well as non-financial offerings such as mentoring, linkages to business services, and facilitation of funding. Through these offerings, companies benefit on their resources and capabilities. For example, companies gain access to

information and advice, and business and research linkages; enabling for example, improved business models or strategies, linkages to suppliers or channel partners, or access to technical services provided by other organizations. These are achieved through financing of research work for commercialization.

With improved resources and capabilities, the logic is that companies will achieve superior market performance, for example, increased market share, revenues, or investment and exporting them to regional markets at an affordable price or create a network of channel partners in the region. It then follows that companies with improved market performance will create impact on the economy that would not otherwise readily occur, helping to realize the ultimate policy impact: improved socio-economic conditions in Eritrea and beyond in the COMESA regional market.

In conducting this study, we mainly used operational data and we interviewed the concerned people from the office of the Directorate of Research and International Linkages of Higher Education of Eritrea. We also consulted some of the Research and Graduate Study Offices of Higher Education Institutes. Several face-to-face interviews have also been conducted with concerned respondents who are actively engaged in research work. The interviews were conducted using semi-structured interview questions for in-depth understanding of the elements for a research products commercialization. The structure of the interview questions were designed specifically to capture the respondents' real experience, opinions and expectations (Patton, 2002) related to successful research products commercialization. In this regard, we interviewed 6 researchers hereafter named as Researcher 1, 2, 3, 4, 5, and 6 for anonymity reasons. Generally, a qualitative research method has been adopted.

Secondary data has been extracted from several relevant academic articles, documents, as well as other references that we used as a benchmark for making economic and social impact analysis of commercialization of research work.

Due to the gap in the current literature related to financing of research for commercialization purposes, case study was employed in this study.

4. Findings and Discussions

This study has developed a general framework for a sustainable socioeconomic transformation through financing of research work commercialization. Socio-economic transformation as commonly defined is a process in which an increasing proportion of economic output and employment are generated by sectors other than agriculture. This process of transformation connotes the shift from agricultural-based societies to urban, industrial and/or service-based economies with sustained high GDP growth rates. GDP growth combined with a reduction in the population's growth rate—resulting from improvements in educational access and quality—increases GDP per capita, which, in turn, reduces poverty (Mpango, 2013).

The above definition explains that socio-economic transformation entails fundamental changes in both the way a country does business and in the character of the country itself, that is, in the qualities and characteristics that make a country different.

Having a highly educated population has enormous economic and societal impacts (higher wages, higher levels of civic participation, and better health status). Since education is now a global industry, COMESA member countries have the opportunity to create an extensive knowledge base and become highly competitive players in the knowledge society/economy. For example, survey results show a unique conception of the role of the university in the knowledge based economy not just as a creator of knowledge, a trainer of young minds and a transmitter of culture, but also as a major agent of economic growth: the knowledge factory, as

it were, at the centre of the knowledge economy (David, 1997). The commonly held perception of universities as merely institutions of higher learning is gradually giving way to the view that universities are important engines of economic growth and development (Chrisman *et al.*, 1995).

In Eritrea, public fund for research is granted only to Institutes of Higher Education through Eritrean Research Fund (ERF). Nevertheless, this is excluding researches and consultancies directly funded by respective ministries, other government agencies, and non-governmental organizations in collaboration with their partners. Each higher education institute and its stakeholders are expected to conduct research scoping workshops to identify areas of research priorities. Then fund is given to research proposals based on importance at the national level and scientific product.

Over the last five years, the Government of the State of Eritrea sponsored several research projects. The government allocated roughly 6.5 million Eritrean Nakfa (equivalent to 433, 500 US dollar) for research. Researchers from various government colleges submitted their research projects for funding. According to Head of Research Unit of National Higher Education and Research Institute, a total of 120 research projects have been submitted of which 41 proposals funded (31 of them are already completed); the review process for 40 proposals is currently completed, and the remaining 39 proposals are not accepted. The research projects focus on business, agriculture, marine science and technology, engineering and other natural sciences.

Regarding the outcomes of the research and its impact on social and economic conditions, Researcher 1, who studied handcraft products development, stated that: *“handcraft production as an industry has to be perceived as a potential business opportunity for sustainable income generation that involves more artisans, traders and exporters. Eritrea, with its abundant archeological/historic and cultural attraction and natural endowments such as over 1,000 k. m. coastlines and its geographical proximity to major tourist markets in Europe and the Middle East has a large potential to become tourists’ hub in the region. If meticulously planned, effectively organized and skillfully managed, tourism related products can contribute to the economic development in Eritrea.”*

There are other researchers who in their area of expertise and experience conducted various researches. However, the concern is that nearly all of them lack entrepreneurial, managerial and marketing skills. For instance, Researcher 2 who studied Salt as the would pillar of Eritrean industrystated that: *“my research output can be very ideal for companies that depend on salt as the pillar of their operations. Salt is as important as gold. It is very useful in chloroalkaline industry and companies can generate millions of dollars because their products can be exported to other countries in general and Asian countries such as Japan, in particular. The problem is commercializing research work. I am trained as a chemist and I should know about how to be an entrepreneur.”*

Thus, it is evident that research is not linked to businesses. If socioeconomic transformation is to be realized due attention should be given to commercializing research work and protecting intellectual property rights. On the importance of linking research to businesses and producing highly demanded and competitive products nationally, regionally, and globally Researcher 3 highlighted that: *“the marketing/management and engineering people should work closely. The first are well versed in researching about the products that customers want, but lack the skill to design them; and the later have the ability to design the product but they lack the knowledge of identifying, producing, and promoting the product (marketing ideas).”*

On similar instance, a Director of Research and Graduate Studies (Researcher 4) in one of the Institutions of Higher Education underlines that: *“you know follow-up and implementation is very important if the output of research work is to bear fruit. Here we have a research work on entrepreneurship and innovation. This research calls for the establishment of entrepreneurship center under the umbrella of the Chamber of Commerce. In addition, there is also the issue of intellectual*

property rights, which may be dealt with the Chamber of Commerce or Ministry of Justice. Unless an office is established which is specifically tasked with follow-up and implementation, commercialization of research work may have very little impact on socioeconomic transformation."

In addition, Researcher 5 reflecting the view on the importance of research works on environmental improvement based on his research stated that: *"coral reef monitoring is highly essential because if the reef is destroyed there will be a decrease in stock and a decline in fish reproduction and consequently a decrease or no fish export at all. The research work indicates that by monitoring the reef, ecology and environment will be improved resulting in substantial tourist attraction thereby contributing to economic growth and better health and improved standard living of the people."*

Finally, Researcher 6 said that *"to come up with viable research for commercialization, researchers should be discipline and motivated. A platform should also be created where ideas can be generated and shared to facilitate commercialization efforts."*

Financing research work for commercialization is of paramount importance especially if that work results in innovation. Indeed, manufacturing can create employment opportunity. However, for African countries in general, it is time to echo innovation, innovation, and innovation. Of course, there should be enough resources devoted to innovation activities in both public and private sector.

Much more could have been done to link commercialization of research work with spinoffs and new product development. However, the institutional structure of the Eritrean research system is highly hierarchical and centralized which makes it inefficient in bringing research results into the marketplace. As most of the funding for research institutions is still allocated in a headcount basis, the incentives to increase performance in terms of research productivity are not in place. Moreover, the budgetary organization status of research institutions of higher education is not conducive for engaging in joint research and development with private firms, as it is difficult to formalize those partnerships.

5. Conclusions and Recommendations

Publicly funded research provides research results for the public domain, and this can be adopted by the business sector so that research results from public institutions can be translated into new production processes and products. In this regard, COMESA member countries (proximity or nearness is an advantage) can offer regional companies new markets, more value-added and innovative activities.

Research that results in the development of new technologies (processes) coupled with information and communications technologies can change regional business practices, as well as emphasizes international collaboration to go beyond regional partnerships. However, governments in member countries need to prioritize industrial reconstruction and job creation as well as identify opportunities for knowledge-based advantages.

For COMESA countries, rising standards of living can only come through productivity growth reinforced by innovation, which by and large innovation itself is the result of investment in research and development. This; of course, is without ignoring the importance of financing research work for commercialization purposes. If they are unable to assemble the financing, management and sales skills needed to quickly commercialize and exploit regional markets, companies in other countries or continents will surpass them, which may result in the loss of economic benefits.

Financing research work for commercialization can result in substantial industrial and social benefits. Through increased public fund support for commercializable research in public

institutions, industry may realize increased growth in revenues, net income, and number of employees. This could in turn benefit the companies' employees, shareholders, and other stakeholders. The requirements for partnering with industry may increase the number of academics willing to work with industry, which may ultimately lead to more and better research results and, through these results increased industry profits. Finally, the public reputation of industry may be enhanced by its partnership with public institutions and contribution to economic growth.

Commercialization of research may also result in better health and environment and improved quality of life of the population. Society can reap several benefits by obtaining certain health and safety products, services, and processes that, without commercialization, would never have been developed or may never appear in the market. Thus, it seems plausible at this juncture to conclude that an increase in commercialization could push researchers in public institutions to become increasingly involved with industry.

Furthermore, the commercialization of research may have a number of economic implications. Not only will individuals, public institutions, and companies directly involved in research profit from commercialization, but consumers may enjoy lower prices resulting from greater competition in the market place. Besides, more general economic growth can be achieved leading to lower taxes and greater individual wealth overall. In addition, research-led improvements in technology may increase productivity, in turn boosting the general standard of living and per capita income.

The commercialization of research may result in an increased number of preferable and higher quality jobs for skilled workers. Similarly, commercialization could lead to an improvement in a country's competitive position regionally or globally.

To sum up, if publicly funded research is linked with demand-driven research from start-ups and other established businesses, and focuses on innovation, why not a Silicon Valley in COMESA countries.

However, there should be a defined process and collaborative knowledge between universities and industries to effectively enhance commercialization efforts. Hence, attempts must be made to ensure that a proper framework exist to ascertain the smooth interaction and communication between these two entities if research institutes are to play their role of local economic growth. If commercialization effort is to be sustainable, there should be a well functioning research center with clear research policies and strategies.

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