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Imitation and Innovation of Practices in Science and Technology: Lessons from Asia and Europe for Tanzania

[1]NZUNDA E.F.,[1]MAYEKA, J.G.*

[1]Sokoine University of Agriculture (SUA).

***Corresponding Author**: nzundaef@gmail.com, nzunda@sua.ac.tz, emmanuelnzunda@yahoo.com

Abstract

Imitation and innovation are often seen as opposing paths to advancement in science and technology. However, this paper argues that a balanced approach that combines both imitation and innovation could accelerate Tanzania's development in these areas. This study has four specific objectives, namely, to assess: (1) The role of imitation and innovation of practices in science and technology; (2) Challenges that Tanzania faces in imitation and innovation of practices in science and technology; (3) Lessons for Tanzania in imitation and innovation in science and technology from Asia and Europe; and, (4) Strategies that Tanzania may use to benefit from imitation and innovation in science and technology lessons from Asia and Europe. By reviewing the literature on the interplay between imitation and innovation in Asia and Europe, the paper demonstrates how these regions have used both strategies to achieve rapid development in their science and technology sectors. The study found that imitation and innovation are important drivers of economic development for countries. Asia and Europe adapted strategies such as copycat, frugality, social innovation, the role of knowledge and technology transfer, innovation ecosystems, strong institutions, adapted disruption, balancing exploration and exploitation, systems of innovation, and intellectual properties for steering their development. For Tanzania, the paper recommends learning from the success of Asian countries like Japan and South Korea in imitating and improving their technology, as well as European countries like Germany and Sweden in cultivating an education culture that values innovation while taking advantage of the latest technologies and best practices from other countries. However, shortage of funding in the education system, poor infrastructure, lack of skilled workforce, and limited research and development might hamper the imitation and innovation in science and technology in Tanzania. Current government efforts are geared towards removing these bottlenecks.

Keywords: *Development, imitation, innovation, practices, science, Tanzania, technology*

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Introduction

Imitation and innovation are crucial for the development of any country because they enable the uptake and application of new ideas, inventions, principles, and practices (Fagerberg, 1987). In developing countries, imitation can be a potent growth engine as it can assist in quickly catching up to more developed economies by utilizing current technologies and adapting them

(Rodrik, 2005). Yet, innovation is also essential for long-term economic growth because it enables the development of new products, systems, and services that can raise living standards and boost productivity (Acemoglu and Robinson, 2012). Asian and European countries have been at the forefront of imitating and innovating in these areas, resulting in substantial advances in a variety of fields (Hobday, 2003; Uzagalieva *et al.*, 2010). Tanzania, like other developing countries, has been struggling to catch up with the developed world in terms of technological advancement and economic progress (Dellink *et al.*, 2017). While the country has made significant strides in recent years toward modernization, it still faces challenges in terms of adapting to new technologies and practices that can help it achieve its development goals. There are a number of challenges facing Tanzania that are related to limited imitation and innovation in science and technology that limit the countries level of development (Cunningham *et al.*, 2016; Mwantimwa *et al.*, 2021). Therefore, there is a need to explore ways in which Tanzania can learn from Asia and Europe to promote imitation and innovation in science and technology as a means to attain higher level of development that countries in Asia and Europe attained. This study is an attempt to contribute to the knowledge that will fill this information gap. The study has four specific objectives, namely, to assess: (1) The role of imitation and innovation of practices in science and technology; (2) Challenges that Tanzania faces in imitation and innovation of practices in science and technology; (3) Lessons for Tanzania in imitation and innovation in science and technology from Asia and Europe; and, (4) Strategies that Tanzania may use to benefit from imitation and innovation in science and technology lessons from Asia and Europe.

Methodology

Literature review was conducted in order to obtain information to fulfill the objectives of the study. To obtain the relevant research articles, Goggle scholar and Pub med were used as search engines where by the following keywords used: science and technology, imitation, innovation, role of imitation and innovation in science and technology, imitation and innovation in Asia and Europe, challenges face Tanzania in imitation and innovation and lesson that Tanzania can learn from Asian and European countries. Only peer reviewed journal articles, conference proceedings, books or book chapters that were written in English and available in full text were included in the study. The obtained information was analyzed through content analysis to establish similarities and differences of the imitation and innovation in Asia and Europe and lessons that Tanzania can learn.

Results and Discussion

The role of imitation and innovation of practices in science and technology

Imitation and innovation in science

Imitation and innovation are both important aspects of scientific progress. Scientific activity involves building upon previous work, which can be seen as a form of imitation (Kuhn, 1962). However, innovation is also necessary to advance science beyond existing paradigms (Kuhn, 1962). One example of this can be seen in the development of the theory of evolution by natural selection. Darwin's work built upon the earlier ideas of Lamarck and others, but he also introduced novel concepts and evidence that led to a major shift in how scientists understood the natural world (Darwin, 1859). Also in the field of quantum mechanics, where the work of Planck, Einstein, and others built upon earlier ideas but also introduced fundamentally new concepts and theories (Einstein, 1905; Planck, 1900). Furthermore, the development of the periodic table of elements by Mendeleev and others was based on the observation of similar properties and behaviours of different elements (Kaji, 2003; Mendeleev, 2013) Similarly, the discovery of the structure of DNA by Watson and Crick built upon the X-ray crystallography work of Rosalind Franklin and others (Watson and Crick, 1953), as well as the work on genetics and inheritance by Gregor Mendel (Mendel, 1866).

Imitation and innovation in technology

Imitation and innovation are two important factors in the development and diffusion of technology. According to Teece and Pisano "imitation of existing technology plays an important role in the learning process of firms, particularly in the early stages of development, as it allows them to acquire the knowledge and

skills necessary for innovation"(Pisano and Teece, 1994). However, innovation is also crucial for technological progress, as it enables firms to differentiate themselves from their competitors and create new markets. Furthermore, it was argued that, innovation is the driving force of economic growth, as it creates new products and services that meet previously unmet needs (Schumpeter, 1934).

Scholars in different studies have exemplified some imitations which are relevant to technology. A study conducted by Nelson and Winter pointed out that technological progress is cumulative and relies on the replication and modification of existing technologies (Nelson & Winter, 1982). Another study emphasized the role of learning and imitation in the process of technological change (Dosi, 1982). Additionally, Teece discussed the importance of "learning by doing" and "learning by using" in the development of new technologies (Teece, 1986). On the other hand, the role of innovation in technology were substantiated by various researchers such as Christensen, who introduced the concept of "disruptive innovation," which refers to the creation of new technologies or business models that disrupt existing markets (Christensen *et al.,* 2013; Christensen, 2013). Other scholars distinguished between incremental and radical innovation and argued that both types are necessary for technological progress (Abernathy and Utterback, 1978). There has also been more differentiation of innovation in technology into categories including product innovation, process innovation and business model innovation as a means to understand and emphasize the role of innovation in technology (Snihur and Wiklund, 2019).

One way in which imitation can lead to innovation is through reverse engineering (Teece, 1986). Reverse engineering involves taking apart an existing product to understand how it works and how it was designed (Teece, 1986). This process can provide valuable insights into the underlying principles and components of the technology, which can then be used to develop new or improved products (Teece, 1986). In addition to reverse engineering can also facilitate the transfer of technology between countries and regions (Teece, 1986).

Imitation and innovation are not mutually exclusive, and firms often combine both approaches to improve their technological capabilities. In fact, the boundary between imitation and innovation is often blurred, as innovations can be built on existing technologies, and imitations can lead to incremental improvements (Geroski, 1990). One way in which imitation and innovation can interact is through the use of intellectual property (IP) rights. IP rights, such as patents, trademarks, and copyrights, can provide incentives for firms to innovate by granting them exclusive rights over their inventions for a limited period of time (Mazzoleni and Nelson, 1998). At the same time, IP rights can also restrict imitation by preventing others from copying or using the protected technology without permission. However, the effectiveness of IP rights in promoting innovation and limiting imitation is subject to debate. Some scholars argue that overly restrictive IP rights can hinder innovation and reduce access to technology, particularly in developing countries (Maskus, 2000). Others suggest that alternative approaches, such as open innovation and collaborative research, can provide more effective mechanisms for innovation and knowledge transfer (Chesbrough, 2003).

Imitation and innovation can also have different implications for firms in different stages of development. For instance, startups and small firms may rely more on imitation to reduce their costs and enter established markets, while larger firms with greater resources may have more incentives to invest in innovation to differentiate themselves and create new markets (Gans *et al.*, 2000). Moreover, the balance between imitation and innovation can vary across industries and technologies. For instance, industries with high fixed costs and low marginal costs, such as pharmaceuticals and software, may rely more on intellectual property protection to recover their investment in research and development (Cockburn and Henderson, 1998). In contrast, industries with lower fixed costs and higher marginal costs, such as clothing and toys, may be more prone to imitation and price competition

due to less restrictive property rights protection (Gawer and Cusumano, 2002). In sum, the interplay between imitation and innovation is complex and context-dependent, and firms must carefully balance both approaches to succeed in the dynamic and competitive landscape of technology markets.

Challenges that Tanzania faces in imitation and innovation of practices in science and technology

Tanzania faces several challenges in imitation and innovation in science and technology. Some of these challenges including shortage of funding in the education sector, poor infrastructure, shortage of skilled work force and limited resources and capacity for research and development. Shortage of funding in the education sector has significantly affected the quality of education and the development of science and technology (Amos *et al.,* 2021). This has denied many Tanzanians from accessing quality education especially in science, technology, engineering, and mathematics.

Tanzania grapples with a substantial challenge in infrastructure development, which has a direct impact on the country's ability to effectively adopt and implement innovative technologies (Nkwabi and Mboya, 2019). Inadequate infrastructure hampers the diffusion of technological advancements, limiting Tanzania's capacity to keep pace with global trends in science and technology practices, and inhibiting the successful imitation and innovation of practices from Asia and Europe. For example, the country has a limited internet penetration rate which limits access to information and communication technologies (Kessy *et al.,* 2006; Oreku *et al.,* 2013).

Tanzania faces a shortage of skilled personnel in STEM fields (Nartker *et al.,* 2010). This shortage limits the country's ability to effectively engage in the imitation and innovation of science and technology practices (Semali and Mehta, 2012). Tanzania's limited resources and capacity for research and development (R&D) impede its ability to innovate and develop new technologies (Minga *et al.,* 2001). While the government has established policies to promote R&D, challenges persist in their effective implementation (Minga *et al.,* 2001). This constraint hinders the country's progress in science and technology, limiting its capacity for imitation and innovation in science and technology (Minga *et al.,* 2001).

Imitation and innovation in science and technology lessons from Asia for Tanzania

In Asia, imitation has been a common strategy for companies to gain market share and compete with established players. However, as the region's economies continue to mature, innovation is becoming increasingly important for companies to differentiate themselves and sustain long-term growth (KPMG, 2019; Pollari and Ruddenklau, 2018). One example of successful imitation in Asia is China's Huawei, which began as a low-cost imitator of Western telecommunications equipment but has since become a global leader in 5G technology (Fan, 2011; Kavoossi and Ma, 2019; Yip and McKern, 2016). On the other hand, Asian companies are also increasingly focusing on innovation. For example, South Korean tech giant Samsung has invested heavily in research and development, leading to numerous innovative products such as the Galaxy smartphone series (KPMG, 2019; Pollari and Ruddenklau, 2018).

One factor driving the shift towards innovation is the rise of new technologies and changing consumer preferences. For example, the increasing adoption of digital technologies has led to new business models and opportunities for innovation in areas such as e-commerce and fintech (Paul *et al.,* 2020). Asian companies are also increasingly focused on meeting the evolving needs and preferences of consumers, such as the demand for sustainable and eco-friendly products. Another driver of innovation is the growing emphasis on intellectual property rights and protection. As Asian economies become more innovative, there is a greater need for companies to protect their intellectual property and avoid infringement lawsuits (Malkin, 2022; Zhao, 2006).

Despite the shift towards innovation, imitation remains a viable strategy for some companies. For example, many Asian companies have successfully used imitation to enter established markets and gain market share. However, these companies must also be aware of the risks associated with imitation, such as legal

challenges and reputational damage (KPMG, 2019; Pollari and Ruddenklau, 2018). Imitation and innovation are also discussed in the context of the Chinese economy. China has historically been known for its imitation-based strategy, which helped the country achieve rapid economic growth. However, as the economy matures and competition intensifies, there is a growing emphasis on innovation as a way to sustain growth and remain globally competitive (Jung, 2016). One example of China's shift towards innovation is the government's "Made in China 2025" initiative, which aims to upgrade the country's manufacturing capabilities and move towards higher value-added industries (Huimin *et al.,* 2018; Levine, 2020; Liu, 2016; Wübbeke *et al.,* 2016). The initiative emphasizes the development of advanced technologies such as robotics, artificial intelligence, and biotechnology, as well as the protection of intellectual property rights. However, the transition to innovation-based growth is not without challenges. One of the main challenges is the need to develop a supportive innovation ecosystem that includes factors such as strong intellectual property protection, access to financing, and skilled labour (Liang and Li, 2023; Witt, 2010).

Another aspect of the imitation and innovation dynamics in Asia is the role of knowledge and technology transfer (Nabeshima, 2004; Suseno and Dwiatmadja, 2016). Many Asian countries, particularly those in East Asia, have benefited from knowledge and technology transfer from advanced economies such as the United States and Japan. This transfer has allowed Asian firms to rapidly catch up with their counterparts in advanced economies and become major players in industries such as electronics, automotive, and semiconductors (Mathews and Cho, 2000; Nabeshima, 2004; Thorbecke, 2022). However, as Asian firms become more innovative, they are also becoming important sources of knowledge and technology for other countries. For example, South Korean electronics firms such as Samsung and LG have become leaders in the development of advanced displays, while Chinese firms such as Huawei and Xiaomi are emerging as major players in the smartphone industry (Hu and Hsu, 2008; Myers, 2013; Ramaswamy, 2007). This knowledge and technology transfer is facilitated by factors such as strong intellectual property protection, government support for research and development, and skilled labour. In addition, many Asian countries are actively investing in education and training to develop a workforce that can support innovation and technological development (World Economic Forum, 2020).

Another interesting perspective on imitation and innovation in Asia is the concept of "frugal innovation," which refers to the development of low-cost, high-quality products that meet the needs of consumers in emerging markets (Basu *et al.,* 2013; Weyrauch and Herstatt, 2017; Zeschky *et al.,* 2014). Frugal innovation is particularly relevant in Asia, where a large portion of the population is still underserved by traditional products and services. It involves simplifying products and processes, reducing costs, and leveraging existing resources to create products that are affordable, accessible, and effective (Basu *et al.,* 2013; Weyrauch and Herstatt, 2017; Zeschky *et al.,* 2014). One example of frugal innovation in Asia is the development of affordable healthcare solutions. Indian companies such as Narayana Health and Aravind Eye Care have developed innovative models for delivering high-quality healthcare services at a fraction of the cost of traditional hospitals (Basu *et al.,* 2013; Zeschky *et al.,* 2014). Frugal innovation is also being embraced by multinational corporations such as General Electric and Philips, which are developing low-cost products tailored to the needs of emerging markets (Basu *et al.,* 2013; Zeschky *et al.,* 2014).

In addition to the role of frugal innovation, social innovation is also an important aspect of the imitation and innovation dynamics in Asia (Osburg and Schmidpeter, 2013). Social innovation refers to the development of new solutions to social problems that are more effective, efficient, sustainable, or just than existing solutions (Murray *et al.,* 2010). Asian countries are increasingly recognizing the importance of social innovation as a means of addressing social challenges such as poverty, inequality, and environmental degradation. For example, in Japan, the government has established a Social Innovation Council to promote social innovation and support the

development of social entrepreneurs (Murray *et al.,* 2010). In South Korea, the government has launched a number of social innovation initiatives, including the Social Economy Promotion Plan and the Social Impact Bond Program, which aim to support the growth of social enterprises and encourage the development of innovative solutions to social challenges (Cho, 2018; Kim, 2018). Social innovation is also being embraced by the private sector in Asia. For example, many companies are incorporating social and environmental considerations into their business strategies, and some are even developing products and services specifically designed to address social challenges (Murray *et al.,* 2010).

Another interesting perspective on imitation and innovation in Asia is the concept of "reverse innovation." Reverse innovation refers to the process of innovating in emerging markets and then taking those innovations back to developed markets (Govindarajan and Euchner, 2012; Govindarajan and Ramamurti, 2011; Ostraszewska and Tylec, 2015). Reverse innovation is particularly relevant in Asia, where many companies are innovating to meet the unique needs and preferences of local consumers. For example, General Electric developed a low-cost electrocardiogram machine specifically for the Indian market, which it then brought to other emerging markets and eventually to the United States (Govindarajan and Ramamurti, 2011). Similarly, companies such as Unilever and Nestle have developed low-cost products for emerging markets that have become popular in developed markets as well (Govindarajan and Ramamurti, 2011). Reverse innovation is also being embraced by Asian companies. For example, Chinese mobile phone maker Xiaomi has developed a low-cost smartphone that has become popular not only in China, but also in other emerging markets such as India and Indonesia (Govindarajan and Ramamurti, 2011).

Another interesting perspective on imitation and innovation in Asia is the concept of "copycat innovation" (Rein, 2014), which refers to the process of imitating successful products or business models from other countries and adapting them to local markets (Lee and Lim, 2001; Walter *et al.,* 2016). Copycat innovation is particularly common in Asia, where many countries have historically relied on imitation as a means of catching up with more developed economies. For example, South Korea's electronics industry initially focused on imitating Japanese products before developing its own unique products and technologies (Lee and Lim, 2001; Luo *et al.,* 2011; Rein, 2014). Similarly, China's manufacturing sector has been criticized for its widespread practice of copying foreign products and brands, although some argue that this has helped to drive innovation in the country (Dutta *et al.,* 2019; Orr and Roth, 2013). While copycat innovation has been criticized for being unoriginal and lacking in creativity, some argue that it can be a useful starting point for developing more innovative products and services. For example, Chinese companies such as Xiaomi and Huawei have been accused of copying Apple's products, but have also developed their own unique features and technologies (Chen and Wen, 2016; Melnik, 2019)

Therefore, the relationship between imitation and innovation in Asian countries is complex and multifaceted. While imitation has played an important role in the development of many Asian economies, particularly in their early stages of growth, the region is increasingly moving towards an innovation-led model of growth. This shift has been driven by a range of factors, including the availability of human capital, cultural and institutional factors, and external forces such as globalization and technological advancements. Overall, the ability of Asian countries to successfully transition from imitation to innovation will be a key factor in their long-term economic success. While there are certainly challenges to be overcome, such as improving intellectual property protection and promoting greater collaboration between firms, the potential benefits of a more innovation-driven growth model are significant.

Imitation and innovation in science and technology lessons from Europe for Tanzania

Europe's success in innovation is due to its ability to combine imitation with innovation (Mazzucato and Semieniuk, 2017). European firms have been successful in imitating and

adapting existing technologies and products, while also investing in research and development to create new innovations (Mazzucato and Semieniuk, 2017). This approach has allowed European firms to compete with established firms from other regions, particularly the United States and Asia. Apart from the ability of combining imitation and innovation, Europe's success in innovation, also has been steered by the ability to create "innovation ecosystems" that facilitate collaboration among firms, universities and research institutions (Block *et al.,* 2020; Fransman, 2014; Jackson, 2011). These are also referred to as "systems of innovation" (Edquist and Zabala-Iturriagagoitia, 2012; Ergas, 1984). European firms have been able to innovate by tapping into these ecosystems to access new knowledge and resources, and by collaborating with other firms and institutions to develop new products and technologies through interactive learning (Daniels and Walker, 1996; Edquist and Zabala-Iturriagagoitia, 2012; Jurowetzki *et al.,* 2018; Komorowski, 2019; Pietrobelli and Staritz, 2018; Querleu *et al.,* 2017; Saunders and Radicic, 2022). Following the role of interactive learning, European firms have been able to innovate by engaging in collaborative learning processes that involve knowledge sharing and co-creation with other actors in the innovation system (Daniels and Walker, 1996). These innovation ecosystems result in strong institutional framework that supports innovation (Reiljan and Paltser, 2015). The ecosystems also operate at a regional scale resulting in greater combined impact (Huggins and Izushi, 2018; Markkula and Kune, 2015).

Another important perspective on imitation and innovation in Europe is provided by (Bengtsson *et al.,* 2021), who argue that European firms have been successful in innovation by "balancing exploration and exploitation." According to Bengtsson and Raza-Ullah, European firms have been able to innovate by exploring new opportunities and technologies, while also exploiting their existing knowledge and resources to create value for customers. Moreover, Europe's success in innovation is due in part to its long-term investment in education and human capital (Mariana, 2015). Europe's high levels of education and skills have enabled its firms to be competitive in global markets, and that this investment in human capital has been an important driver of innovation and economic growth in the region (Goldin, 2016; Pelinescu, 2015).

European firms have also been successful in innovation by adopting a "disruptive innovation" approach, which involves creating new products and services that initially have limited appeal to existing customers but that eventually disrupt established markets (Christensen and Overdorf, 2000). Thus, the firms have been able to innovate by focusing on niche markets and creating new markets that did not exist before (Christensen *et al.,* 2013).

On the other hand, Europe's success in innovation is due in part to its ability to effectively manage intellectual property rights (IPRs) (Bogers *et al.,* 2019; Muzaka, 2013; Teece, 1986). Accordingly, European firms have been able to innovate by leveraging their intellectual property assets and by using various IPRs such as patents, trademarks, and copyrights to protect their innovations and create value.

Strategies that Tanzania may use to benefit from imitation and innovation in science and technology lessons from Asia and Europe

In Tanzania, policies that promote both imitation and innovation are needed to achieve sustained economic growth and development. This may include measures to improve the business environment, such as reducing the cost of doing business, providing access to finance, and promoting international trade and investment. It may also involve investment in education and skills development, as well as in research and development, to foster innovation and creativity (De Haan *et al.,* 2015; Joshi and Gaddis, 2015; McGrath, 2002; UNCTAD, 2002)

Imitation and innovation are not only important for economic development in Tanzania, but also for social development and poverty reduction. For example, imitation can lead to the adoption of new and more efficient farming practices, which can increase productivity and incomes for smallholder farmers. Meanwhile, innovation can lead to the development of new products and services that address social challenges, such as

healthcare, education, and energy access (UNCTAD, 2002).

Imitation and innovation can also have environmental implications in Tanzania, as the country faces significant environmental challenges, such as deforestation, climate change, and loss of biodiversity. While imitation can help firms adopt more sustainable practices, innovation is needed to develop new technologies and solutions that can address environmental challenges (UNDP, 2015). Therefore, policies that promote both imitation and innovation should also take into account environmental considerations. This may involve measures to incentivize firms to adopt sustainable practices, such as through tax incentives, subsidies, and regulations. It may also involve investing in green technologies and promoting sustainable infrastructure development (UNDP, 2015).

Imitation and innovation can also have social implications in Tanzania, as they can affect the distribution of benefits and opportunities across different groups in society. For example, while imitation can help firms improve productivity and competitiveness, it may also reinforce existing inequalities if certain groups have better access to information and resources. Meanwhile, innovation can lead to the development of new products and services that benefit marginalized groups (Planes-Satorra and Paunov, 2017). However, innovation may also create new forms of inequality if these groups are excluded from the innovation process (Planes-Satorra and Paunov, 2017). Therefore, policies that promote both imitation and innovation should also aim to promote inclusive growth and social equity. This may involve measures to ensure that marginalized groups have equal access to education, training, and financing opportunities. It may also involve promoting social entrepreneurship and community-based innovation, as well as investing in social infrastructure and services (Planes-Satorra and Paunov, 2017).

Imitation and innovation also have implications for international competitiveness and trade in Tanzania (UNCTAD, 2002). While imitation can help firms catch up with international competitors by adopting best practices and technologies, innovation is needed to create new products and services that can compete in global markets. Moreover, innovation can lead to the development of new industries and sectors that can create new export opportunities and diversify the economy (UNCTAD, 2002). Therefore, policies that promote both imitation and innovation should also aim to enhance Tanzania's competitiveness in global markets. This may involve measures to reduce trade barriers and improve access to international markets, as well as investing in export-oriented infrastructure and logistics. It may also involve promoting regional integration and cooperation, as well as investing in strategic sectors that have high potential for export growth (UNCTAD, 2002).

Imitation and innovation also have important implications for job creation and skills development in Tanzania (Sonobe *et al.,* 2012). While imitation can help firms improve productivity and create more jobs, innovation is needed to create new industries and sectors that can generate high-quality employment opportunities such as in small and large manufacturing enterprises (Mahemba and Bruijn, 2003). Moreover, innovation can lead to the development of new skills and competencies that are in demand in the labor market (Parida *et al.,* 2015; Smith, 2006). Therefore, policies that promote both imitation and innovation should also aim to enhance job creation and skills development in Tanzania. This may involve measures to improve the quality of education and training, as well as investing in workforce development programs that provide workers with the skills needed to succeed in the labor market. It may also involve promoting entrepreneurship and self-employment, as well as investing in infrastructure and services that support job creation (Arzeni, 1997; Kinda and Loening, 2010).

Imitation and innovation can also have important implications for the overall economic development and structural transformation of Tanzania (Kinda and Loening, 2010). While imitation can help firms improve efficiency and

competitiveness in existing industries, innovation is needed to create new industries and sectors that can drive economic growth and diversification (Miniaoui and Schilirò, 2017). Moreover, innovation can lead to the development of new business models and value chains that can create new opportunities for economic actors (Carraresi and Bröring, 2021). Therefore, policies that promote both imitation and innovation should also aim to enhance the overall economic development and structural transformation of Tanzania. This may involve measures to promote industrial upgrading and diversification, as well as investing in infrastructure and services that support economic development. It may also involve promoting research and development, as well as fostering a culture of innovation and entrepreneurship (Miniaoui and Schilirò, 2017).

Conclusion

The interplay between imitation and innovation is of paramount importance for the development of any country, particularly in the realm of science and technology. In the case of Tanzania, embracing both imitation and innovation is crucial for driving economic growth and fostering long-term prosperity. Tanzania faces several challenges that hinder its progress in science and technology, including a shortage of skilled personnel, limited research and development capacity, and infrastructure constraints. These challenges can impede the country's ability to keep pace with global advancements and hinder its competitiveness in the global market. However, valuable lessons can be learned from the experiences of Asia and Europe, regions that have successfully addressed similar challenges and achieved remarkable progress in science, technology, and innovation. These regions have implemented strategies to overcome skill shortages by investing in education and vocational training programs. By prioritizing the development of STEM fields, they have nurtured a skilled workforce capable of driving technological advancements and innovation. Furthermore, Asia and Europe have recognized the importance of research and development as a catalyst for innovation-driven economic growth. They have established robust research institutions, promoted public-private collaborations, and incentivized private sector investments in research and development. By creating an environment that fosters knowledge creation and transfer, these regions have been able to leverage innovation as a key driver of economic development. To emulate the success of Asia and Europe, Tanzania must develop comprehensive strategies that address its specific challenges. This includes strengthening the educational system by focusing on STEM education, fostering collaboration between academia and industry, attracting investment in research and development, and improving infrastructure for science and technology. By striking the right balance between imitation and innovation, Tanzania can accelerate its economic development, drive sustainable growth, and enhance its global competitiveness. Therefore, Tanzania stands to benefit greatly from studying the experiences of Asia and Europe in the realm of imitation and innovation in science and technology. By learning from their strategies and successes, Tanzania can adapt and implement effective policies and initiatives that address its specific challenges and pave the way for economic development and technological advancement.

References

Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology review*, *80*(7), 40-47.

Acemoglu, D., & Robinson, J. (2012). The origins of power, prosperity, and poverty. *New York (US): Crown Business*.

Amos, O., Ephrahem, G., & Bhoke-Africanus, A. (2021). Effectiveness of school heads' financial management skills in provision of quality education in secondary school. *Journal of Education, Society and Behavioural Science*, *34*(2), 20-28.

Arzeni, S. (1997). Entrepreneurship and job creation. *OECD Observer*, (209), 18-21.

Basu, R. R., Banerjee, P. M., & Sweeny, E. G. (2013). Frugal innovation. *Journal of Management for Global sustainability*, *1*(2), 63-82.

Bengtsson, M., Manzhynski, S., Stål, H., & Raza-Ullah, T. (2021). Out of the ashes and into

the fire? Organizing mechanisms navigating multiple paradoxes in cross-sectoral collaboration for sustainability. Available at urn:nbn:se:umu:diva-189465.

Block, F., Keller, M. R., & Negoita, M. (2020). Network failure and the evolution of the US innovation system. *Journal of Industry, Competition and Trade*, *20*, 235-247.

Bogers, M., Chesbrough, H., Heaton, S., & Teece, D. J. (2019). Strategic management of open innovation: A dynamic capabilities perspective. *California Management Review*, *62*(1), 77-94.

Carraresi, L., & Bröring, S. (2021). How does business model redesign foster resilience in emerging circular value chains? *Journal of Cleaner Production*, *289*, 125823.

Chen, S.-H., & Wen, P.-C. (2016). The evolution of China's mobile phone industry and good-enough innovation. *China as an innovation nation*, 241-261.

Chesbrough, H. W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.

Cho, Y.-B. (2018). A Study on Social Finance Market in Korea; Focused on Social Impact Bond. *Journal of Digital Convergence*, *16*(4), 11-22.

Christensen, C., Raynor, M. E., & McDonald, R. (2013). *Disruptive innovation*. Harvard Business Review Brighton, MA, USA.

Christensen, C. M. (2013). *The innovator's dilemma: when new technologies cause great firms to fail*. Harvard Business Review Press.

Christensen, C. M., & Overdorf, M. (2000). Meeting the challenge of disruptive change. *Harvard business review*, *78*(2), 66-77.

Cockburn, I. M., & Henderson, R. M. (1998). Absorptive capacity, coauthoring behavior, and the organization of research in drug discovery. *The journal of industrial economics*, *46*(2), 157-182.

Cunningham, P. M., Cunningham, M., & Ekenberg, L. (2016). Factors impacting on the current level of open innovation and ICT entrepreneurship in Africa. *The Electronic Journal of Information Systems in Developing Countries*, *73*(1), 1-23.

Daniels, S. E., & Walker, G. B. (1996). Collaborative learning: improving public deliberation in ecosystem-based management. *Environmental impact assessment review*, *16*(2), 71-102.

Darwin, C. (1859). On the origin of species. *published on*, *24*, 1.

De Haan, S., Kingamkono, R., Tindamanyire, N., Mshinda, H., Makandi, H., Tibazarwa, F., Kubata, B., & Montorzi, G. (2015). Setting research priorities across science, technology, and health sectors: the Tanzania experience. *Health Research Policy and Systems*, *13*, 1-11.

Dellink, R., Chateau, J., Lanzi, E., & Magné, B. (2017). Long-term economic growth projections in the Shared Socioeconomic Pathways. *Global Environmental Change*, *42*, 200-214.

Dosi, G. (1982). Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. *Research policy*, *11*(3), 147-162.

Dutta, S., Lanvin, B., & Wunsch-Vincent, S. (2019). The global innovation index 2017. *Cornell University, INSEAD, & WIPO (Eds.), Global innovation index*, 1-39.

Edquist, C., & Zabala-Iturriagagoitia, J. M. (2012). Public Procurement for Innovation as mission-oriented innovation policy. *Research policy*, *41*(10), 1757-1769.

Einstein, A. (1905). On the electrodynamics of moving bodies. *Annalen der physik*, *17*(10), 891-921.

Ergas, H. (1984). Why do some countries innovate more than others? *Available at SSRN 1430184*.

Fagerberg, J. (1987). A technology gap approach to why growth rates differ. *Research policy*, *16*(2-4), 87-99.

Fan, P. (2011). Innovation, globalization, and catch-up of latecomers: Cases of Chinese telecom firms. *Environment and Planning A*, *43*(4), 830-849.

Fransman, M. (2014). Models of innovation in global ICT firms: The emerging global innovation ecosystems. *JRC Scientific and Policy Reports. Seville: JRC-IPTS*.

Gans, J. S., Hsu, D. H., & Stern, S. (2000). When does start-up innovation spur the gale of creative destruction? In: National bureau of economic research Cambridge, Mass., USA.

Gawer, A., & Cusumano, M. A. (2002). *Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation* (Vol. 5). Harvard Business School Press Boston.

Geroski, P. A. (1990). Innovation, technological opportunity, and market structure. *Oxford economic papers*, *42*(3), 586-602.

Goldin, C. D. (2016). Human capital. In Handbook of Cliometrics, ed. Claude Diebolt and Michael Haupert, 55-86. Heidelberg, Germany: Springer Verlag.

Govindarajan, V., & Euchner, J. (2012). Reverse innovation. *Research-Technology Management*, *55*(6), 13-17.

Govindarajan, V., & Ramamurti, R. (2011). Reverse innovation, emerging markets, and global strategy. *Global strategy journal*, *1*(3-4), 191-205.

Hobday, M. (2003). Innovation in Asian industrialization: A Gerschenkronian perspective. *Oxford development studies*, *31*(3), 293-314.

Hu, J.L., & Hsu, Y.H. (2008). The more interactive, the more innovative? A case study of South Korean cellular phone manufacturers. *Technovation*, *28*(1-2), 75-87.

Huggins, R., & Izushi, H. (2018). UK Competitiveness Index 2008. University of Wales Institute, Cardiff—UWIC: Centre for International Competitiveness—Cardiff School of Management.

Huimin, M., Wu, X., Yan, L., Huang, H., Wu, H., Xiong, J., & Zhang, J. (2018). Strategic plan of "Made in China 2025" and its implementation. In *Analyzing the impacts of industry 4.0 in modern business environments* (pp. 1-23). IGI Global.

Jackson, D. J. (2011). What is an innovation ecosystem. *National science foundation*, *1*(2), 1-13.

Joshi, A. R., & Gaddis, I. (2015). Preparing the next generation in Tanzania: challenges and opportunities in education, 1-163.

Jung, J. (2016). China's Innovation-Driven Development Strategy and Prospects. Korea Institute for International Economic Policy. http://hdl.handle.net/11540/10556.

Jurowetzki, R., Lema, R., & Lundvall, B.-Å. (2018). Combining innovation systems and global value chains for development: Towards a research agenda. *The European Journal of Development Research*, *30*, 364-388.

Kaji, M. (2003). Mendeleev's discovery of the periodic law: The origin and the reception. *Foundations of Chemistry*, *5*(3), 189-214.

Kavoossi, M., & Ma, J. (2019). China's Next Strategic Advantage: From Imitation to Innovation. *Journal of Asia-Pacific Business*, *20*(4), 351-352.

Kessy, D., Kaemba, M., & Gachoka, M. (2006). The reasons for under use of ICT in education: In the context of Kenya, Tanzania and Zambia. Fourth IEEE International Workshop on Technology for Education in Developing Countries (TEDC'06), Iringa, Tanzania, 2006, pp. 83-87, doi: 10.1109/TEDC.2006.31.

Kim, J. (2018). Social finance funding model for animal shelter programs: Public–private partnerships using social impact bonds. *Society & Animals*, *26*(3), 259-276.

Kinda, T., & Loening, J. L. (2010). Small enterprise growth and the rural investment climate: Evidence from Tanzania. *African Development Review*, *22*(1), 173-207.

Komorowski, M. (2019). *Innovation Ecosystems in Europe: First outline of an innovation ecosystem index*. E. Commission. https://orca.cardiff.ac.uk/id/eprint/146649.

KPMG, R. (2019). The Pulse of Fintech 2018: Biannual Global Analysis of Investment in Fintech. *https://home.kpmg/xx/en/home/insights/2019/01/pulse-of-fintech-h22018. html>/. Acessado em*, *29*(10), 2020.

Kuhn, T. S. (1962). The Structure of Scientific Revolutions. Chicago. University of Chicago Press

Lee, K., & Lim, C. (2001). Technological regimes, catching-up and leapfrogging: findings from the Korean industries. *Research policy*, *30*(3), 459-483.

Levine, D. A. (2020). Made in China 2025. *Journal of Strategic Security*, *13*(3), 1-16.

Liang, L., & Li, Y. (2023). How does government support promote digital economy development in China? The mediating role of regional innovation ecosystem

resilience. *Technological Forecasting and Social Change*, *188*, 122328.

Liu, S. X. (2016). Innovation design: made in China 2025. *Design Management Review*, *27*(1), 52-58.

Luo, Y., Sun, J., & Wang, S. L. (2011). Emerging economy copycats: Capability, environment, and strategy. *Academy of Management Perspectives*, *25*(2), 37-56.

Mahemba, C. M., & Bruijn, E. J. D. (2003). Innovation activities by small and medium-sized manufacturing enterprises in Tanzania. *Creativity and innovation management*, *12*(3), 162-173.

Malkin, A. (2022). The made in China challenge to US structural power: industrial policy, intellectual property and multinational corporations. *Review of International Political Economy*, *29*(2), 538-570.

Mariana, I. (2015). Consequences of the investment in education as regards human capital. *Procedia Economics and finance*, *23*, 362-370.

Markkula, M., & Kune, H. (2015). Making smart regions smarter: smart specialization and the role of universities in regional innovation ecosystems. *Technology Innovation Management Review*, *5*(10), 7-15.

Maskus, K. E. (2000). *Intellectual property rights in the global economy*. Peterson Institute.

Mathews, J. A., & Cho, D.-S. (2000). *Tiger technology: The creation of a semiconductor industry in East Asia* (Vol. 389). Cambridge University Press Cambridge.

Mazzoleni, R., & Nelson, R. R. (1998). The benefits and costs of strong patent protection: a contribution to the current debate. *Research policy*, *27*(3), 273-284.

Mazzucato, M., & Semieniuk, G. (2017). Public financing of innovation: new questions. *Oxford Review of Economic Policy*, *33*(1), 24-48.

McGrath, S. (2002). Skills for development: a new approach to international cooperation in skills development? *Journal of Vocational education and Training*, *54*(3), 413-430.

Melnik, J. (2019). China's "National Champions" Alibaba, Tencent, and Huawei. *Education About Asia*, *24*(2), 28-33.

Mendel, G. (1866). "Experiments in Plant Hybridization"(1866), by Johann. *Classic papers in genetics*, *4*, 3-47.

Mendeleev, D. I. (2013). *Mendeleev on the periodic law: Selected writings, 1869-1905*. Courier Corporation.

Minga, U., Mtambo, M., Katule, A., Mutayoba, S., Mwalusanya, N., Lawrence, P., Mdegela, R., & Olsen, J. (2001). Improving the health and productivity of the rural chicken in Africa: research and development efforts in Tanzania. Aciar proceedings, ACIAR, 134-139.

Miniaoui, H., & Schilirò, D. (2017). Innovation and entrepreneurship for the diversification and growth of the gulf cooperation council economies. *Business and Management Studies* 3(3):69-81.

Murray, R., Caulier-Grice, J., & Mulgan, G. (2010). *The open book of social innovation* (Vol. 24). Nesta London.

Muzaka, V. (2013). Intellectual property protection and European 'competitiveness'. *Review of International Political Economy*, *20*(4), 819-847.

Mwantimwa, K., Ndege, N., Atela, J., & Hall, A. (2021). Scaling innovation Hubs: impact on knowledge, innovation and entrepreneurial ecosystems in Tanzania. *Journal of Innovation Management*, *9*(2), 39-63.

Myers, R. (2013). Samsung and LG: from also-rans to dominance in consumer electronics.

Nabeshima, K. (2004). Technology Transfer in East Asia: A Survey. *Global production networking and technological change in East Asia*, *476*, 395.

Nartker, A. J., Stevens, L., Shumays, A., Kalowela, M., Kisimbo, D., & Potter, K. (2010). Increasing health worker capacity through distance learning: a comprehensive review of programmes in Tanzania. *Human resources for health*, *8*(1), 1-10.

Nelson, R. R., & Winter, S. G. (1982). The Schumpeterian tradeoff revisited. *The American Economic Review*, *72*(1), 114-132.

Nkwabi, J., & Mboya, L. (2019). A review of factors affecting the growth of small and medium enterprises (SMEs) in Tanzania.

European Journal of Business and Management, *11*(33), 1-8.

Oreku, G. S., Mtenzi, F. J., & Ali, A.-D. (2013). A viewpoint of Tanzania e-commerce and implementation barriers. *Computer Science and Information Systems*, *10*(1), 263-281.

Orr, G., & Roth, E. (2013). China's innovation engine picks up speed. *McKinsey Quarterly*, *7*(3), 109-117.

Osburg, T., & Schmidpeter, R. (2013). Social innovation. *Solutions for a sustainable future*, 18.

Ostraszewska, Z., & Tylec, A. (2015). Reverse innovation–how it works. *International Journal of Business and Management*, *3*(1), 57-74.

Parida, V., Sjödin, D. R., Lenka, S., & Wincent, J. (2015). Developing global service innovation capabilities: How global manufacturers address the challenges of market heterogeneity. *Research-Technology Management*, *58*(5), 35-44.

Paul, J., Menzies, J., Zutshi, A., & Cai, H. (2020). New and novel business paradigms in and from China and India. *European Business Review*, *32*(5), 758-800.

Pelinescu, E. (2015). The impact of human capital on economic growth. *Procedia Economics and finance*, *22*, 184-190.

Pietrobelli, C., & Staritz, C. (2018). Upgrading, interactive learning, and innovation systems in value chain interventions. *The European Journal of Development Research*, *30*, 557-574.

Pisano, G., & Teece, D. (1994). The dynamic capabilities of firms: an introduction. *Industrial and Corporate Change*, *3*(3), 537-556.

Planck, M. (1900). Ueber das Gesetz der Energieverteilung im Normalspectrum, von Max Planck. *Ann. d. Phys*, *4*, 553-563.

Planes-Satorra, S., & Paunov, C. (2017). *Inclusive innovation policies: Lessons from international case studies* (OECD Science, Technology and Industry Working Papers, 2017/02. Available at https://doi.org/10.1787/18151965.

Pollari, I., & Ruddenklau, A. (2018). The Pulse of fintech 2018. *Biannual global analysis of investment in Fintech.* KPMG International.Retrieved *27*(2018), 2018.

Querleu, D., Planchamp, F., Chiva, L., Fotopoulou, C., Barton, D., Cibula, D., Aletti, G., Carinelli, S., Creutzberg, C., & Davidson, B. (2017). European Society of Gynaecological Oncology (ESGO) guidelines for ovarian cancer surgery. *International Journal of Gynecologic Cancer*, *27*(7), 1534-1542.

Ramaswamy, K. (2007). *LG Electronics: global strategy in emerging markets*. Thunderbird School of Global Management, 1-12.

Reiljan, J., & Paltser, I. (2015). The role of innovation policy in the national innovation system: The case of Estonia. *Trames: A Journal of the Humanities and Social Sciences*, *19*(3), 249.

Rein, S. (2014). *The end of copycat China: The rise of creativity, innovation, and individualism in Asia*. John Wiley & Sons.

Rodrik, D. (2005). Growth strategies. *Handbook of economic growth*, *1*, 967-1014.

Saunders, K., & Radicic, D. (2022). Managing the knowledge for innovation in Eastern European firms: open or closed innovation? *Journal of Science and Technology Policy Management*, *Vol. ahead-of-print No. ahead-of-print*. https://doi.org/https://doi.org/10.1108/JSTPM-07-2021-0096

Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle. *Journal of Comparative Research in Anthropology and Sociology*, *2*, 137-148.

Semali, L. M., & Mehta, K. (2012). Science education in Tanzania: Challenges and policy responses. *International Journal of Educational Research*, *53*, 225-239.

Smith, K. R. (2006). Building an innovation ecosystem: Process, culture and competencies. *Industry and higher education*, *20*(4), 219-224.

Snihur, Y., & Wiklund, J. (2019). Searching for innovation: Product, process, and business model innovations and search behavior in established firms. *Long Range Planning*, *52*(3), 305-325.

Sonobe, T., Higuchi, Y., & Otsuka, K. (2012). Productivity growth and job creation in the development process of industrial

clusters. *World Bank Policy Research Working Paper* (6280).

Suseno, B. D., & Dwiatmadja, C. (2016). Technology transfer motive of managers in Eastern Asia: empirical results from manufacture industry in Banten province, Indonesia. *Problems and perspectives in management* (14, Iss. 2), 36-45.

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research policy*, *15*(6), 285-305.

Thorbecke, W. (2022). The East Asian Electronics Sector: The Roles of Exchange Rates, Technology Transfer, and Global Value Chains. *Cambridge Elements in International Economics*. Available at https://doi.org/10.1017/9781009216838.

UNCTAD. (2002). Investment Policy Review The United Republic of Tanzania. In: United Nations Geneva.

UNDP. (2015). *Tanzania Human Development Report 2014: Economic Transformation for Human Development*. Economic and Social Research Foundation.

Uzagalieva, A., Kočenda, E., & Menezes Albuquerque, P. A. d. (2010). Technological imitation and innovation in new European Union markets, *CESIFO Working paper* No. 3039, 1-33.

Walter, S. G., Heinrichs, S., & Walter, A. (2016). Innovator or copycat? Pre-entry innovation strategy and early performance of spin-outs. *Academy of Management Proceedings*, 2016 (1), Briarcliff Manor, NY 10510: Academy of Management.

Watson, J. D., & Crick, F. H. (1953). Molecular structure of nucleic acids: a structure for deoxyribose nucleic acid. *Nature*, *171*(4356), 737-738.

Weyrauch, T., & Herstatt, C. (2017). What is frugal innovation? Three defining criteria. *Journal of frugal innovation*, *2*(1), 1-17.

Witt, M. A. (2010). China: what variety of capitalism? (October 22, 2010). INSEAD Working
Paper No. 2010/88/EPS, Available at SS RN: https://ssrn.com/abstract=1695940 or http://dx.doi.org/10.2139/ssrn.1695940

World Economic Forum, V. (2020). The future of jobs report 2020. *Retrieved from Geneva*. Available at http://hdl.voced.edu.au/10707/555914.

Wübbeke, J., Meissner, M., Zenglein, M. J., Ives, J., & Conrad, B. (2016). Made in china 2025. *Mercator Institute for China Studies. Papers on China*, *2*(74), 4.

Yip, G. S., & McKern, B. (2016). *China's next strategic advantage: From imitation to innovation*. MIT Press.

Zeschky, M. B., Winterhalter, S., & Gassmann, O. (2014). From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness. *Research-Technology Management*, *57*(4), 20-27.

Zhao, M. (2006). Conducting R&D in countries with weak intellectual property rights protection. *Management science*, *52*(8), 1185-1199.