Factors Affecting the Implementation of University-Industry Technology Transfer Within the Pharmaceutical Industry in Cameroon

Uchechukwu Chielo Esther Evrad

PhD Research Scholar

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Abstract

This paper examines pharmaceutical research and innovations in the context of the Bay-Dohle Act of 1980 and the subsequent developments in the legal framework concerning Cameroon. It highlights the shortcomings in research and challenges faced by universities in Cameroon, along with resulting deficiencies that stem from these issues. University-Industry Technology Transfer (U-ITT) is fundamental in fostering invention and innovation of pharmaceuticals. The USA is considered as the pioneer country to introduce this approach through the adoption of the Bay-Dohle Act. Which permitted universities to possess patents and to market universities' outcomes developed under funded programs to other organizations, which facilitated university-industry technology transfer. This encouraged industrialized countries such as India, China, Brazil to have recourse to this type of technology transfer. Universities serve as hotbeds of scientific research nurturing a wealth of knowledge. In the transfer of technology between universities and pharmaceutical industry, research outcomes from universities are transferred to the pharmaceutical industry which combines them with its resources and expertise. A growing body of literature has demonstrated U-ITT to be effective in the combat of global threat with drug discoveries such as Allegra, Lyrica, MRNA vaccines. In the Cameroonian context, universities' researches are still undermined and results emanating from universities' laboratories are neglected and there are still no effective collaboration pattern between universities and industries. This is because of different challenges faced by universities, the pharmaceutical

industry and the State to promote technology transfer between the university-industry. Despite the efforts made by the Ministry of Higher Education (MINESUP) to establish policies such as the University-Industry Partnership Charter signed with GICAM in 2010, urging collaborative research. And the Framework Partnership Agreement signed in 2024 between MINESUP and the Standards and Quality Agency (ANOR) for the support and accompaniment of higher education institutions in the standardization and quality process as part of the implementation of university-enterprise. The aim of this article is to determine the factors inhibiting U-ITT in the pharmaceutical industry in Cameroon and the benefits to be enjoyed by stakeholders involved in such process. To achieve our objective, we use qualitative research methods. The study reveals that, universities, the pharmaceutical industry and the State collectively face challenges which hinder the successful implementation U-ITT in the pharmaceutical industry in Cameroon. To solve the problems discovered in our findings, the research provides the different attempts made by the state aimed at curbing and curtailing the lapses.

Keywords: *University, Pharmaceutical Industry, Technology transfer.*

1.0 Introduction

One aspect of academic-entrepreneurship is technology transfer, which is an essential component for invention and innovation. It creates a long-lasting connection between the research and business sectors. In the realm of U-ITT in the pharmaceutical sector, this process is crucial for the industry[i]. It enables universities to transform their knowledge, skills, and technologies into valuable products, thus fostering economic development. Countries like USA, Japan, Brazil, Israel, India, South Africa are existing plausible successes of U-ITT within the pharmaceutical industry. A developing country like Cameroon should be able follow the pathway in order to develop its local manufacturing of pharmaceuticals and reduce its dependence on the importation of pharmaceutical products. However, despite efforts by the Cameroonian government to encourage collaboration between universities and industry, various factors hinder successful technology transfer from academia to the pharmaceutical sector. These challenges which account for such failure are not only faced by the State, but by

both universities and pharmaceutical industry. Limited funding, lack of training and distribution channels, lack of willingness of the transferor and the transferee, weak intellectual property rights that prevent universities from converting their research into marketable products. On the pharmaceutical industry side, obstacles such as limited R&D, access to research finding, technical expertise and knowledge gap, regulatory compliance requirement, tax policies on industries, the reliance of the state on the importation of pharmaceuticals, limited academic-industry discourage collaboration with universities. Additionally, the Cameroonian government faces challenges related to inadequate regulations & policies, concerns over national insecurity and issues of embezzlement and corruption, all of which negatively affect university-industry technology transfer within the pharmaceutical industry.

1.1 Factors faced by universities

The following factors contribute to the slow engagement of universities in technology transfer process with pharmaceutical industry in Cameroon.

1.1.1 Limited Funding

In Cameroon, funding for education comes from grants, scholarships, sponsorships, and part-time employment opportunities. These financial resources are provided by both private and government entities serving both long-term and short-term needs[ii]. Known as ''Africa in Miniature'' Cameroon is rich in natural resources such as oil and gas, minerals, high-value species of timber, and agricultural products such as, coffee, cotton, cocoa which together account for 40% of its GDP through their export. Additionally, the commodity and service sectors contribute to more than 15% and 51% of GDP, respectively[iii]. The income generated from such resources. In recent years, the funding of education in Cameroon has been a high topic of concern as the government continues to fall short in meeting the needs. Despite a declared commitment to education, resource allocation has proven insufficient, resulting in various challenges and limitations. A recent United Nations Development Program (UNDP) report indicates that the education sector in Cameroon faces a funding deficit exceeding $300 million, which has critically affected the quality of education, affected the quality of education, leaving many schools without essential facilities[iv].

Government funding is intended to enhance the research capabilities of universities and lead to the generation of high-quality research outcomes. These results can serve as valuable resources for businesses. Additionally, the financial support that universities obtain from the government indicates the quality of their research, making them more appealing to companies that may decide to invest in these institutions. Consequently, it is anticipated that there exists a complementary relationship between funding from the government and that from the industry[v]. In 2024, the Cameroonian State granted subsidies ranging from 100,000,000FCFA (165,441,50USD) to 1,795,000,000FCFA (2,963,425,89USD) to 10 State's universities for the exercise academic year of 2024. These subsidies were intended for the construction of universities' buildings and equipment. However, our research shows that only two universities out of 10 universities, more precisely, the Universities of Bertoua and Maroua received subsidies of 30,000,000FCFA (49,632,45USD) and 100,000,000FCFA (165,441,50USD)[vi] respectively, allocated for the construction of laboratories. This weakens research because the remaining eight universities were not granted resources to establish laboratories. Thereby, leading to an absence or a reduction of R&D, not only at these universities, but also on the national plan. Hence, affecting U-ITT within the pharmaceutical industry in Cameroon, since a few or no technology will be created to the absence or low R&D initiatives.

1.1.2 The Lack of training and distribution channels

The successful transfer of technology to or within a company hinges on its ability to accurately, comprehend, assess, and assimilate new technologies. Effective technology transfer activities require skilled professionals with expertise in legal, business, scientific and licensing matters. Given the interdisciplinary nature of technology transfer, staff must possess the knowledge and skills to navigate its complexities[vii]. The experience of the TTO staff is vital, as some technologies can be highly implicit or their commercial applications can be challenging, or both[viii]. Bhatt emphasized the importance of involving individuals in the technology transfer and selection processes[ix]. This staff includes those at the TTO as well as those in the recipient industry. A significant barrier to implementing advanced technologies is the shortage of skilled personnel and the necessary expertise[x]. The workforce is often cited as a challenge in adopting many forms of smart manufacturing[xi], which are influenced by changes in manufacturing landscape and introduction of new technologies[xii].

For effective technology transfer to take place from universities to the industry, it is necessary to have trained personnel and well-established distribution channels[xiii]. By skilled personnel we mean, trained student-researchers, engineers, scientists, accountants on educational systems and programmes on innovation and transfer of technology. Distribution channels could include (technology transfer offices)TTOs and innovation incubators at universities, workshops, seminars and webinars launched by research laboratories, financial institutions, NGOs and governmental agencies advertising the concept of U-ITT to promote collaborative projects between universities and pharmaceutical industries to market new technologies.

1.1.3 The willingness of the transferor and the transferee

For the implementation of U-ITT in the pharmaceutical sector in Cameroon, both the technology provider (university) and the recipient (industry) must be willing participants. This willingness can be enhanced by the prospect of expanding their market and accessing new technologies that provide a competitive edge. Additionally, the quality of the relationship between university and industry partners is important for their readiness to engage in technology transfer. Trust, commitment, and mutual understanding foster a collaborative environment conducive to sharing knowledge and resources. Similarly, the physical closeness of the university and industry partners can influence their eagerness to work together[xiv]. Over and above all, the readiness to participate in technology transfer is influenced by how well the university and industry partner align organizationally. Elements such as organizational culture, decision-making approaches, and communication methods can either support or obstruct this transfer process. Cultivating a mutual understanding and setting up effective communication channels can improve the desire to work together. Ensuring that the supplier and the recipient of the technology know-how are willing to work together effectively, is a step forward for an effective technology transfer[xv].

1.1.4. Weak intellectual property Right's protection

In a knowledge driven economy, intellectual property is necessary. Cameroon understood the importance of IPRs in supporting innovation, creativity, and economic success. Its legal framework for IP protection includes patents, trademarks, copyrights, industrial designs, and trade secrets. These legal processes strive to protect 'individual and entities' creativity,

inventions and innovation against unauthorized use, duplication or dissemination. The IP law, the Bangui Agreement within the AIPO, is the fundamental legislation governing IP in Cameroon. It cover trade names, trademarks, patents, industrial designs, and geographical indicators. The Paris Convention for the Protection of Industrial property and the Madrid Agreement Concerning the International Registration of Marks and other international treaties were adopted by the AIPO.

One of the problems which weakens intellectual property rights protection in Cameroon is the absence of a unified legal framework. There is no cohesive IP system or consistent law through-out Africa. Although regional entities like ARIPO and AIPO have made efforts to standardize IP practices, there are ongoing concerns about how these systems are applied locally. The differing standards for cross-border enforcement contribute to a tangled array of legal frameworks, complicating IPP. On top of that, there is the implementation of unsuitable IP system. African countries like Cameroon has adopted Euro-Centric laws that may not cater to the unique cultural contexts or developmental needs of the ''African traits'' of its community. For example, apart from the Copyright Law of 2000 no other national law has been enacted and IPR protection remains uniformly weak which leads to frequent IPRs infringement in software and pharmaceutical sectors. In the same light, there exist no national law encouraging technology transfer in the research sector to align with the infrastructure of the country as well as its technological advancements. Besides, there is the problem of short period of time to enjoy IPRs protection of a pharmaceutical patent from the development stage to the final stage. The main power which a pharmaceutical patent grants to its holder is the exclusivity of manufacturing, using selling, offering for sale or importing an invention within a period of 20 years starting from the filing date of the patent application. The strict application of this principle is fair for the innovative pharmaceutical industry. Indeed, a large number of patents and various leads are required to arrive at a single molecule that can be used as a medicine. We sometimes speak of only one marketable molecule out of a hundred thousand tested. The commercial exploitation of the medicine, which follows the obtaining of a marketing authorization, occurs after a period of time averaging fifteen years. Furthermore, the risk of failure can arise at all stages of the development of the molecule and more particularly at the advanced stages due to a therapeutic deficiency during pre-clinical or even trials failed adverse effects noted during clinical trials. From these facts, we can observe that

in the pharmaceutical industry there is a lengthy regulatory approval process which causes IP protection to be short. The long-term regulatory process schedules cause the patent timeline to begin counting down long before the product is marketed. This shortens the time available for the industry to utilize patent protection and exclusivity to recover their research and development costs[xvi]. A strong IPRs system protection will encourage local pharmaceutical industries to find incentives to increase their investment in R&D activities and their collaboration with universities. On the other side, universities will benefit from the expertise of the industrial sector and the protection of their IPRs on their research output.

1.1.5 Low Absorptive and Desorptive capacities

Many companies and organizations tend to engage in innovative activities using their own internal resources, a practice known as closed innovation (absorptive capacity). In contrast, open innovation (desorptive capacity) refers to the active utilization of external ideas and technologies[xvii]. Research indicates that technology transfer is facilitated by the presence of skilled human capital within a country, which promotes the adoption of new technologies. Absorptive capacity (ACAP) is defined as an organization's capability to recognize, assimilate and utilize valuable new external information for commercial purposes. A critical aspect of innovation is the ability to leverage external knowledge, which is heavily influenced by prior knowledge, ranging from basic skills to awareness of recent advancements in a specific field. At the firm level, the unit responsible for innovation develops its absorptive capacity through various means, with studies demonstrating that firms engaged in their own research and development are better positioned to utilize external information[xviii].

In contrast to ACAP, which focuses on exploring external knowledge, desorptive capacity (DCAP) centers on exploiting that knowledge, involving activities related to knowledge transfer outside the organization. This concept introduced as a complement to ACAP, highlights two main aspects of DCAP in technological contexts: identifying opportunities for transferring know-how and implementing that transfer effectively. Furthermore, DCAP involves an organization's ability to monetize intangible assets, such as out-licensing or selling expertise. DCAP has significant potential to drive high innovation performance[xix].

Both ACAP and DCAP can apply to groups, divisions, or individuals, influenced by the motivation to transfer information and the capacity to learn and utilize technology. Recently,

the concept of DCAP has gained attention in academic discussions alongside ACAP, both viewed as cognitive facilitators or barriers for knowledge transfer[xx]. Together, ACAP and DCAP play essential roles in a company's ability to create new knowledge. For organizations to successfully comprehend and utilize other's ideas, they must also be capable of transferring knowledge externally. Without the right balance of these capabilities, the potential for innovation remains limited, making science-based collaborations quite rare[xxi].

The absorptive and desorptive capacities of Cameroon are very low. We lack adequate assets, in particular administrative and technological capabilities to transfer technologies from universities and to assimilate them into local pharmaceutical industries. This can pose an important trait to the R&D settings of Cameroonian universities and their entrepreneurial projection with the industrial sectors thereby lowering economic development of the country.

1.1.6 Unwillingness of some university's members

The lack of personal motivation of some universities' members encourages them not to engage into such collaboration. Faculty members for example, will prioritize their academic work at the detriment of U-ITT process which will for instance necessitate much time[xxii]. U-ITT's cooperation and innovation systems involve diverse network architectures, complicating technology transfer and posing a difficulty. Direct channel such as 'face-to-face interaction' is important for transferring tacit knowledge and which can be eased with geographical proximity. In our context, technology cannot be transferred when members are far from each other[xxiii]. Besides that, academic progression and recognition of universities' members often depend on scholarly achievements like research publications and grants. Whereas, engaging in technology transfer activities, university's members may not be given the same weight or recognition in academic evaluation processes. This discrepancy can result in lack of motivation or unwillingness among university members to engage in technology transfer initiatives.

1.1.7 Unawareness of students and researchers about technology transfer

For effective technology transfer, high-quality research findings alone are insufficient; it is also crucial to have a shared awareness and willingness among both organizations and individuals. The process of technology transfer is intricate and delicate; without proper

understanding, it can result in significant costs and losses. Insufficient awareness of the advantages of technology transfer can hinder advancement. Frequently, researchers and industry professionals work in isolation, lacking a clear understanding of one another's requirements and strengths[xxiv]. Besides that, there is little or no knowledge on the part of most university's members and researchers on the possibility that they can convey their research output in the scientific and technological domain into the marketplace. In Cameroon, « *Ignorance is a serious drawback to technology transfer. Therefore, there must be clear understanding on the part of research institutions, researchers and industry on what technology transfer is all about, the benefits it may bring to the parties involved and to the society as a whole* »[xxv]. Enhancing awareness, fostering an innovation culture, and highlighting success stories from comparable situations can help break down cultural barriers.

1.1.2 Factors affecting the Pharmaceutical Industry

There are a few factors that impinge on the willingness of the pharmaceutical industry in Cameroon to collaborate with universities to portray a real 'university-enterprise' technology transfer process in the pharmaceutical field. Some of these factors shall be discussed below.

1.1.2.1 Technical expertise and knowledge gap

The ongoing gap between academics and industry is one of the main obstacles to technology transfer in the pharmaceutical industry. This leads to a disconnect between pharmaceutical R&D and the evolving needs of the industry, often hampering invention and innovation. This gap is partly due to a lack of funding as well as various political, cultural, and organizational differences between stakeholders. Limited professional networks and a lack of capacity to actively build and/or sustain them also stifle strategic, long term collaboration[xxvi]. Both industry researchers and academic postdocs often lack incentives for innovative thinking and exploration, as success is more heavily tied to obtaining grants, publications, and conference services. In contrast, industry research primarily focuses on enhancing its own portfolio and generating returns for shareholders. Consequently, transitioning to this field is often seen as a setback for postdocs, leading many academics to be reluctant to pursue it[xxvii]. The factors responsible for such gap between universities and the industry shall be described as follows;

To begin with, the abilities of drug developers. These individuals often possess unconventional traits, willing to explore new areas and push their limits, which can make them feel out of place in academic settings[xxviii]. Unfortunately, throughout their educational paths, from undergraduate to postdoctoral studies, they are rarely equipped to transition from academia to the industrial side of drug development. Many relevant topics, such as commercial and regulatory aspects, legal issues, intellectual property knowledge, and basic project management, are not covered in their education. Additionally, they often lack training in important soft skills like networking. Given the significant gap in education for the new generation of startups, it is not surprising that fewer biotech workers are achieving success[xxix]. Moreover, the weaknesses within the industrial sector also contribute to the widening gap between academia and industry. Gaining experience in the industry is essential for acquiring practical and technical skills, yet students face limited chances to connect with industry professionals. There are generally few opportunities available for undergraduate, graduate, master's degree students, which often drives them to pursue doctoral programmes; approximately three-quarters of those completing their master's decide to continue on to a PhD. In the pharmaceutical industry, a PhD is almost always necessary for career advancement. Although, this educational path enhances one's scientific knowledge, it may also widen the gap between graduates and the practical roles required in emerging life science companies[xxx].

On top of that, we could also mention the insight of the academic setting which widens this gap. Academia frequently overlooks the fundamental goal of drug development, which is to effectively transform scientific ideas into clinical applications and subsequently into market-ready products in a timeliness and cost-effectiveness way. The process cannot be effectively achieved through isolated, small-scale projects with limited funding from individual university labs; it necessitates collaboration between academia and industry. Students and early-career professionals who lack exposure to industry may not fully understand the significant distinctions between various programmes and their disciplinary foundations, which can lead them to select paths that do not align with their career goals. This concern also impacts educators who have not crafted programmes that align with the broader objectives of emerging professionals, often resulting in financial consequences for those finish such courses[xxxi].

The core issue is that individuals earn their degrees in academia with a focus on pure science rather than practical field applications. This reveals a gap where drug developers fail to share their expertise with students, further exacerbating the gap. Although the trend of professionals not returning to academia is not restricted to the pharmaceutical and biotech fields, there are few academics who truly grasp the complexities of everyday drug development. Additionally, limited industry professionals opt to conclude their careers in educational roles. Consequently, educational experiences are often heavily based on scientific theory, lacking the real-world practical application needed for relevance. The expertise of educators is crucial to the student experience. Moreover, instructors with firsthand experience can provide guidance on the diverse career opportunities within this vast industry. We have observed that while some educators transition successfully into industry, few return to influence the curriculum. This shift is essential, as it is vital for seasoned drug developers to impart the lessons they have learned and their ability to navigate important decisions in both their professional and personal lives[xxxii].

1.1.2.2 The importation of drugs by the state

Africa is home to 70% of the global population living with HIV/AIDS and accounts for 90% malaria-related deaths, while the burden of non-communicable diseases is also on the rise[xxxiii]. As a result, there is a significant demand for safe, effective and affordable medications. However, the continent suffers from inadequate local pharmaceutical production, leading to a reliance on imported drugs, with an estimated 79% of pharmaceuticals in Africa being sourced from abroad. This dependence raises healthcare costs and exposes people to risks associated with supply disruptions. Although access to life-saving medications is a fundamental right, it remains elusive for many Africans. Challenges such as long wait times for international procurement, fragile logistics and storage systems, and high transportation and distribution expenses impede the widespread availability and affordability of essential medicines. Additionally, the high prices of patented treatments for diseases such as hepatities, cancer, and multidrug-resistant tuberculosis make them inaccessible for many patients[xxxiv]. Producing quality-assured medicines locally is essential for meeting increasing demands and ensuring reliable access to affordable medications over the long term. Africa has become the second fastest growing pharmaceutical market globally with projections indicating it will

reach $30 billion annually by 2016. There is optimism that, similar to other emerging markets, the anticipated industrial growth and modernization in Africa can promote social development and stimulate knowledge-driven economic growth, research, and innovation[xxxv].

From 2010 and 2023, Cameroon significantly increased its expenditure on pharmaceutical imports, rising from CFA 69.5 billion to CFA 166.6 billion, according to a report by the Competitiveness Committee, a branch of the Ministry of Economy. This marks a 139.7% rise, underscoring the nation's heavy dependence on imported pharmaceutical products. While the report did not detail the imported quantities or their countries of origin during this timeframe, data from Cameroon's National Institute (INS) reveals that in 2023, the country imported 4.2 tons of Medicines (including veterinary drugs) from the European Union (EU), costing CFA 62.9 billion. France was the top supplier, providing 2.017 tons of medications valued at CFA 28.5 billion, with India also playing a significant role, accounting for 7% of the trade volume and totaling CFA 39.5 billion in imports. The market remains pressured by smuggling and counterfeit drugs affecting local pharmaceutical businesses. Regardless of discussions around import substitution and boosting local production, official statistics indicate that Cameroon still relies on imports for over 90% of its pharmaceutical requirements. For instance, in 2021, the United Nations Economic Commission for Africa (ECA) collaborated with public and private sector representatives to develop a framework aimed at enhancing the local pharmaceutical industry's structure, resilience, productivity, competitiveness and viability in the short term. This initiative aims to help local stakeholders secure a significant share of the approximately CFA 200 billion (US$ 369 million) domestic pharmaceutical market and expand into the ECCAS sub-regional and Nigerian markets. During their discussions, ECA and Cameroonian experts identified three main challenges hindering the pharmaceutical sector's growth, with structural weaknesses making the country, like others, particularly susceptible to the dual impact of COVID-19 on public health and the economy. To address these issues, six key workstreams have been established for restructuring Cameroon's pharmaceutical industry and forming its inter-professional corps, which include: enhancing local production capacity, improving access to financing, providing economic incentives (such as tax and customs benefits), increasing market access, and strengthening the capacity of sector participants and support organizations.[xxxvi].

The reliance on imported pharmaceuticals have several on imported pharmaceuticals has several repercussion on the research environment like the diminishing of R&D incentives. A focus on importing drugs decreases the motivation for local companies to invest in research and development, leading to stagnation in innovation and reducing opportunities for universities to engage in new drug development. Besides, the scarcity of local research can contribute to brain drain where skilled professionals seek better prospects abroad, further deteriorating the local industry.

1.1.2.3 Limited Industry-Academia Partnerships

Developing new drugs is a complex process that involves not only understanding the intricate mechanisms of bio-molecular drugs but also navigating regulatory processes and commercialization challenges. To effectively navigate this landscape and expedite the rollout of new treatments, collaboration between the pharmaceutical sector and academic institutions is essential.

Besides, the financial elements and obstacles that come with high-level collaborations are also significant. The financial framework guiding these industry-academic partnerships is complex and diverse, often tailored to the specifics of the collaboration, the stage of drug development, and the negotiating power of each party. For instance, in the alliance between Pfizer and UCSD, Pfizer initially invested $5 million to help establish the Center of Microbiome Innovation at UCSD, with additional milestone payments possible based on the successful development of new antibiotics. These financial arrangements incentivize both parties to collaborate and share in the rewards of successful drug development, while also providing a framework for resolving financial disputes and ensuring equitable profit distribution. However, these partnerships, while promising, come with challenges related to intellectual property rights (IPRs) and aligning institutional goals. The negotiation process requires thoughtful planning and clearly defined agreements that specify the rights and responsibilities of each partner. IPRs can be a sensitive matter as both industry and academia aim to safeguard their inventions and findings. Data-sharing agreements need to be meticulously crafted to allow necessary access for research advancement while also protecting sensitive or proprietary information. Additionally, reconciling institutional priorities may

take time, as industry collaborators often focus on commercial success and quick market entry, whereas academic partners might prioritize scientific integrity and publication[xxxvii].

In various nations, including Cameroon, collaborations between academic institutions and the pharmaceutical industry can boost research and development, enable technology transfer and foster invention and innovation. These partnerships typically involve cooperation among universities, research organizations, and, pharmaceutical firms, focusing on areas like drug development, clinical trials, and regulatory compliance. In the context of Cameroon, such collaborations could help tackle local health issues, enhance access to medications, and aid in the growth of the pharmaceutical sector. However, the success of these partnerships is influenced by elements such as funding availability, regulatory conditions, and the capabilities of both academic and industrial collaborators.

1.1.2.4 The impact of tax policies on local pharmaceutical companies

The ability of pharmaceutical companies in Cameroon to produce locally is closely tied to the country's financial and tax policies. Additionally, the quality of infrastructure, the business environment, and overall economic conditions significantly impact the decisions of pharmaceutical players regarding local production versus importing drugs.

The significant level of taxation contributes to the dominance of the informal sector in Cameroon. The tax system consists of three regimes: the flat tax, simplified tax, and real tax regimes, each differing based on a company's revenue, size, and legal framework. The flat tax regime is applicable to sole proprietors with annual incomes under 10 million FCFA, exempting them from paying the patente, Personal Income Tax (IRPP), and Value Added Tax (VAT) if they are not subject to final taxation. Businesses earning between 10 and 50 million FCFA fall under the simplified tax regime, where they must pay corporate tax (IS) and IRPP monthly, in addition to annual payments that include net income tax, a patente based on revenue, and property tax of 0.1% for Additional Communal Cents (CAC), although new businesses are exempt from this property tax for their first two years. The real regime is for companies with annual revenues exceeding 50 million FCFA, which also requires monthly payments of IRPP and IS, along with a patente based on turnover and a VAT set at 19.25%, a consumption tax applied to the spending of economic agents. The primary taxes that apply

under the real regime include the annual net income tax, the patente, and Land Tax (TPF), similar to those in the simplified regime[xxxviii].

In Cameroon, based on the law of finance, there is the prioritization of custom duties and taxes exemption for imported medical equipment and appliances over a period of 24 months[xxxix] at the detriment of those manufactured locally which do not benefit from such exoneration[xl]. On top of that, resident corporations are taxed on their global income, whereas non-resident corporations are taxed only on income sourced from Cameroon[xli]. This do not encourage local pharmaceutical companies to engage in expansion and growth through collaborations or partnerships with the academia as substantial taxes can lessen profit margins. Moreover, by considering this kind of tax policy provision, it complicates the ability of local pharmaceutical companies to compete with imported medications, which may be produced at lower costs in countries with more favourable tax laws. Thereby, highlighting the local industry's struggle to effectively meet domestic demand.

Besides, companies that are based in Cameroon or have an effective management presence in the country; companies that maintain a permanent establishment (PE) in Cameroon or have an effective management office there; companies that have a dependent representative in Cameroon and companies engaged in activities that complete a full commercial cycle within the country are considered to be operating within Cameroon and are liable for corporate income Tax (CIT). CIT is assessed based on profits generated by entities operating in Cameroon for residents, or profits from transactions conducted in Cameroon for non-residents with a permanent establishments. Net taxable profits are calculated after subtracting all expenses directly linked to activities subject to taxation within Cameroon. The standard CIT rate in Cameroon is 33% for companies with revenues exceeding XAF 3 billion. For those with revenues under XAF 3 billion that fulfill additional legal criteria, the tax rate is lowered to 27.5%[xlii]. The tax rate in Cameroon is based on the turnover set either on 2.2% or 5.5% depending on the turnover and the taxpayer's regime. For taxpayers not registered with a taxation center and involved in import activities, this rate can rise to 15%. If the taxpayers sells in-bond goods, the rate may increase to 20%.

During the peak of the COVID-19 pandemic, elevated tariffs were placed on imported medicines and medical goods. These tariffs hindered affordable access to essential healthcare products by increasing wholesale and retail prices. On recent study showed that the ex-

factory sales prices for pharmaceuticals and active pharmaceutical ingredients (APIs) rose by as much as 80%, alongside an increase in costs for vaccine inputs and distribution materials. Furthermore, tariffs on various medical supplies, equipment, and personal protective gear raised domestic prices, making them less affordable tariffs on chemical inputs like APIs weakened the competitiveness of local pharmaceutical manufacturers. Consequently, the WHO has urged governments to ''*remove or reduce taxes and tariffs on essential medicines*''[xliii].

1.1.3 Factors affecting the state

The following factors do not permit the State to properly implement U-ITT in Cameroon.

1.1.3.1 Government regulations and policies

The government participates by offering political leadership and using coercive authority to affect firm's pricing, entry, production, investment and product choice decisions. Furthermore, the government has a role in establishing U-ITT legislation and regulations by offering incentives and subsidies to organizations (universities and local pharmaceutical companies) that participate in such processes. This will allow for the right construction of systems to ensure the efficient transfer of university research findings. The State must demonstrate political will to encourage U-ITT inside the pharmaceutical industry by developing and implementing policies, legislation, and other legal frameworks governing the U-ITT process. The Cameroonian state lack clear and appropriate laws and regulations on U-ITT within the pharmaceutical industry. Apart from the Charter signed by the MINESUP and the GICAM, and the framework Partnership Agreement between the MINESUP and ANOR, there exist no explicit national legal framework on university-industry collaboration in the pharmaceutical field. This ambiguity does not facilitate U-ITT process, as stakeholders (the university and the industry) will not be assured that their IPRs shall be protected during the collaborations and also the concern on resolutions of disputes which may arise. Without a formal law, universities may lack motivation to share their research outcomes with the pharmaceutical industry. The few gratifications awarded or the insufficient policies on U-ITT process will not galvanize universities' members to take part into such activity. Besides, the lack of a legal structure do not confer the necessary resources and distribution channels for acquiring skills in technology transfer practices. Thereby, limiting the ability of

commercializing research findings, resulting in loss of opportunities for collaborating with the industry.

1.1.3.2 National insecurity concerns

Security threats in Cameroon do not only undermine national stability and the rule of law but also have adverse effects on national development, in occurrence, research. Cameroon is currently dealing with three complex and prolonged crises affecting its Far North, East, North-West and South-West regions. Since 2014, the nation has been caught in a surge of Islam, religious violence, insurgency, and border conflicts stemming from Nigeria and neighbouring Central African states along the tenth parallel. The crisis in the Lake Chad basin has significantly impacted Cameroon's Far North area. The turmoil caused by clashes between non-state armed groups and security forces in northern Nigeria has extended into nearby countries, resulting in frequent incursions, cross-border raids, and assaults in Niger, Chad, and Cameroon. In late 2016, the Anglophone crisis led to instability in the North-West and South-West regions, inciting new armed groups and ongoing violent confrontations have displaced over half a million individuals. This Anglophone crisis has exacerbated the existing humanitarian situation in Cameroon. The violence from the Boko Haram insurgency in Northern Nigeria has driven many refugees to seek safety in Northern Cameroon. Additionally, more than 623,400 refugees escaping intermittent violence from armed groups in the Central African Republic since 2013 have settled in neighbouring countries, including Cameroon. This influx of refugees and internally displaced persons has increased population density in Northern Cameroon, threatening food security, social cohesions, and contributing to land degradation in the region[xliv].

In an attempt to solve these insecurities, the legislator passed a law to fight against terrorism in order to promote peace and security in Cameroon[xlv]. The government also went further by improving borders security. This has been done by taking measures to enhance security along borders with Nigeria and Chad in order to prevent Boko Haram infiltration and movement of weapons and supplies[xlvi]. These actions involve deploying more troops and utilizing surveillance technologies. Moreover, the government is also collaborating with international organizations in order to bring humanitarian assistance to the population. Some humanitarian aid such as food, shelter and medical aid has been given to assist those impacted by the crises

in order to meet their urgent needs and aid in their recovery. For example, the international Medical Corps which has begun working in Cameroon in 2008 till date in response to an influx of refugees from the CAR along Cameroon's eastern border is working in refugee camps in Adamawa, East, Far North, North and North-west regions to implement health programs that include disease surveillance, nutrition activities, mental health and just to name a few[xlvii]. The United Nations International Children's Emergency Fund (UNICEF) plays a crucial role in humanitarian aid, addressing the needs of crisis-affected children, women, and men in the North-West and South-West regions by assisting about 80,578 people, including 30% women, 27% girls and 23%boys through various water, sanitation, and hygiene initiatives[xlviii]. Furthermore, the government prioritizes improving intelligence gathering and cooperation with regional and international partners to better understand Boko Haram fighters and separatist activities and to coordinate counterterrorism efforts. Additionally, in November 2018, President Paul Biya established the National Committee for Disarmament, Demobilization, and Re-integration (NCDDR) to support former Anglophone separatist fighters and ex-Boko Haram militants in the Far North regions[xlix]. The aim of such centre is to promote security and stability by disarming combatants, removing them from military structures, and socially and economically integrating them into the society[l]. Besides, the government also deployed special units of the armed forces in schools of areas prone to military attacks in the different regions impacted by the crises with the aim of protecting students from combatants and enable teachers to dispense their lessons securely[li].

These ongoing political and social crises affect U-ITT in the pharmaceutical industry in Cameroon to the extent that universities' activities are being disrupted. This is due to frequent school closures, the destruction of educational infrastructures, the kidnapping and torture of teachers and students, the irregular dispensation of courses or lessons due insecurity concerns resulting to lack or no research activities conducted[lii]. By the same token, these crises have contributed to the brain drain and loss of talent in the academic domain of the impacted regions. In the hope of seeking better opportunities and security, skilled academics and researchers have migrated elsewhere, which has weakened the innovation and technology transfer activities of Cameroonian universities. To boot, government funding for higher education and R & D has decreased due to the economic impact of the crises, limiting resources for technology transfer initiatives and industry collaboration. Withal, these

disruptions have made it difficult for universities and industries to establish strong partnerships, hindering the transfer of technologies and knowledge.

1.1.3.3 The impact of embezzlement and corruption

Embezzlement and corruption are global threats that have detrimental effects on communities around the world. In the 2023 Corruption Perceptions Index published by Transparency International, Cameroon ranks as the 140th least corrupt country out of 180[liii]. These issues create considerable challenges in Cameroon, particularly in various sectors such as education and the pharmaceutical industry. Corruption in Cameroonian universities is evident through practices like bribery for grades, mismanagement of funds, and favoritism in hiring. Many students report needing to pay bribes to obtain passing grades or gain admission to certain programs[liv]. The widespread of corruption severely impacts the quality of education, as funds meant for educational improvements are frequently misused. This leads to substandard facilities and learning resources, which in turn maintain a cycle of poor educational results. On the side of the pharmaceutical industry, bribes are been paid to get around regulations and distribution of fake drugs. In addition to jeopardizing public health, this compromises the integrity of healthcare. Corrupt activities can thrive when there are insufficient regulations and enforcement systems in place. Pharmaceutical firms may influence prescription practices for financial gain rather than patient care by entering into unlawful financial connections with healthcare professionals[lv]. Although corruption[lvi] and embezzlement[lvii] are illegal in Cameroon under the penal code, these rules are not strictly enforced. The situation is exacerbated by the persistent impunity of public officials involved in corrupt practices within educational and pharmaceutical sectors.

To address corruption, Cameroon has established the National Anti-Corruption Commission (CONAC), which is responsible for investigating, collecting data, and analyzing reports of corrupt activities. However, CONAC lacks the power to freeze or seize assets and cannot forward cases to courts or other disciplinary bodies. Its oversight by the president and chairman raises concerns about the agency's independence and objectivity. Furthermore, it has faced criticism for slow response times to complaints and for not conducting independent investigations when needed.[lviii]. Additionally, the Supreme State Audit Office (CONSUPE)

and National Agency for Financial Investigation (ANIF) have formed a partnership to enhance efforts in combating corruption and preventing the misuse of state funds[lix].

In the pharmaceutical sector, embezzlement and corruption can seriously impede technology transfer between academia and business in a number of ways. Firstly it can lead to a loss of trust. Universities and industry partners may lose trust as a result of corruption, including theft. Companies may be hesitant to form collaborations when financial wrongdoing is suspected because they worry that their investments might be embezzled or that the results of the research could be skewed or altered for their own benefit. Moreover, embezzlement and corruption impair research integrity. The integrity of university research might be jeopardized when corrupt activities are involved. Research findings could be biased in favour of pharmaceutical company providing money if funding is linked to unethical activities like bribery and kickbacks. As a result, medical science may become less trustworthy[lx]. By the same token, they lead to delays and increased costs. Corruption frequently results ineffective procurement procedures, which raise expenses and postpone the release of innovative technologies. For example, the development and transfer of innovative pharmaceutical innovations may be slowed down by inefficiencies stemming from bribery or collusion in procurement processes[lxi]. Not only that, embezzlement and corruption may draw regulatory scrutiny. Corruption cases may draw regulatory attention, which could raise monitoring and compliance expenses for academic institutions and pharmaceutical firms alike. This can make technology transfer more difficult since both parties might have spent more money to make sure that rules meant to stop corruption are followed[lxii]. In addition to that, funding could be impacted. Potential funding sources and investors may be discouraged from sponsoring university-industry partnerships due to corruption. A university's capacity to innovate and successfully transfer technology may be constrained if it is thought to have a corrupt atmosphere, which could make it difficult for it to obtain funds for research and development. Not only that, corruption presents ethical issues that can hurt pharmaceutical businesses and universities reputations. They might further hinder technology transfer efforts by causing public reaction and a decline in stakeholders' desire to form collaborations[lxiii].

Conclusion

In summary, this paper demonstrates that U-ITT can be a mainstream through which universities' research outcomes can be transformed and marketed into final products by the pharmaceutical industry. The findings highlight the importance of the Cameroonian State to establish a U-ITT law. Which will provide robust legal mechanisms for the protection of stakeholders' IPRs, thereby, assuring pharmaceutical companies willing to invest in universities' research outcomes; provide legal structures for the management of potential conflict of interest that may arise among stakeholders; establish legal standards for regulatory compliance in technology transfer process and influence the development of strategies promoting U-ITT within the pharmaceutical industry. Besides, our findings also reveal that, the three main stakeholders (the State, universities and the pharmaceutical industry) have to establish a conducive environment with all necessary factors needed for technology transfer process between universities and the pharmaceutical industry. This research describes factors that may encourage the implications of the academia, the pharmaceutical industry and the State in technology transfer process in terms of challenges faced by the stakeholders in such process in Cameroon. Accompanied by different attempts made by the State to overcome such challenges. By tackling this issue, we can contribute to research in the pharmaceutical field and the well-being of the rising generation.

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