Spring 6-21-2023

Assessing the Effect of FinTech Adoption on Country's Productivity

Mai Metwally
maimetwally@aucegypt.edu

THE AMERICAN UNIVERSITY IN CAIRO
الجامعة الأمريكية بالقاهرة
Graduate Studies

Assessing the Effect of Fintech Adoption on Country's Productivity.

A Thesis Submitted by
Mai Metwally Mohamed Metwally
Supervised By: Dr. Mina Sami Ayad

to the
Master of Science in Finance
Graduate Program

11th May 2023

In partial fulfillment of the requirements for the degree of

Master of Science in Finance

Table of Contents

Abstract:

The relationship between total factor productivity of countries, for both low-income and high-income countries, and Fintech adoption will be examined in this paper. Also, a background on Fintech history will be discussed and explored briefly along with Fintech future risks and opportunities. Starting off with the importance of TFP, it is also known to be "Solow residual" (named after American Economist "Robert Solow"). TFP shows and examines the performance along with efficiency of the entity or country. It shows how well and efficient the firm or country in transforming its inputs to the desired outputs. Moreover, it is the ratio between GDP (gross domestic product) of firms along with weighted sum of labor and capital. As per earlier studies, TFP is considered the engine of economic growth noting that Solow's study (over years 1900 to 1949) showed that it has a significant impact on U.S economy. Higher productivity has many benefits to both firms and countries. It means that the resources were effectively utilized, better quality, less overhead costs and less time-to-market. Consequently, this will lead to higher profits for stakeholders and per capita income generated. Finally, there will be overall prosperity and growth. In a nutshell, progression and growing of country's TFP is crucial, where policymakers, governments and businessmen should pay more attention to it. Previously, there were many papers addressing and identifying positive correlation between Fintech adoption and either economic growth of a country or one of the factors affecting countries' TFP (financial market developments, firms' efficiency, etc.). In this paper, it will add and highlight not only the relationship between TFP and Fintech proxies but also, it will show significant correlation especially between low-income countries and Fintech proxies. Results show that there is a significant correlation between said proxy and TFP. Moreover, results show that Fintech proxies affect low-income countries even more than high-income countries. Worth mentioning that, data were extracted from "Penn World Tables" for all variables except for Fintech Variables are exported from "Global Fintech Index".

Introduction:

The development of Fintech became very important for all continents and countries whether it is a developed or a developing country. As shown in many research and papers, Fintech adoption positively affected all industries and firms' efficiency and productivity. This will consequently positively affect country's total productivity. Some of researchers defined Fintech as an innovative technology, which facilitate financial service processing. Also, it develops and stimulates new financial services and products such as online banking, personal and corporate financing activities, and P2P lending (Leong and Sung, 2018). Fintech's development goes back for more than 155 years; however, recently it has gained more popularity and importance, especially after 2008 Global Financial Crisis. The world witnessed a total loss of confidence in traditional, existing financial system. Having said that, it was important to investigate and start taking affirmative actions to change and correct failures. Almost all countries started to set standards and pay great attention on "too big to fail" institutions, capital adequacy requirements, prudential rules, etc. These standards and guidelines were used to attack and diminish terrorism financing, money laundering along with to ensure global financial stability. Meanwhile, Fintech products and services started to flourish while imposing a new a challenge, regulations dilemma, on the world. However, on a national basis, Fintech has aided the financial inclusion, which will eventually alleviate and lessen poverty along with income inequality. One can view Fintech as a new tool that provides the world with new, improved services and products at lower costs (Najaf et al., 2021). Another main trigger for the development and growth of Fintech nowadays was the COVID-19 pandemic. It forced everyone to stay at home; in addition, it showed the need and urgency for digital connectivity. Also, it contributed to spread of many small FinTech providers, which facilitate all types of financial service activities (Feyen et al., 2021). In addition, FinTech played a crucial role from the downturn caused by pandemic through enhancing and improving the governments' performance in managing the recovery phase (Shareeda et al., 2021). Worth mentioning that, nowadays,

Fintech has progressed and evolved to include new technologies such as blockchain, artificial intelligence (AI), and machine learning (ML).

Moreover, there was a remarkable increase, globally, in the number of Fintech entities during previous years. Moreover, according to Anton (2022), the value of investment in Fintech entities has reportedly surpassed US$1 trillion. Noteworthy, year 2021, investments in Fintech entities globally recorded over US$210 billion noting that, in year 2015, investments recorded US$14 billion. Also, Africa witnessed a significant growth noting that, its investments in Fintech sector doubled from US$800 million in 2020 to $US1.6 billion in 2021. Nevertheless, still there is a vast room for Fintech sector, especially in financial sector, to expand in Africa noting that, financial exclusion prevails. It even prevails in Nigeria, which is considered one of the largest economies in there. Unquestionable, there were some forces that hinder accessing traditional financial services, sometimes even Fintech, such as absence of acceptable identification document along with credit history, poverty, illiteracy, cultural and religious beliefs, etc. According to World Bank reports, there are more than half a billion citizens in Africa don't have satisfactory identification document. Nevertheless, Fintech services and products actually enhanced and mitigated the problem. For instance, mobile wallet enabled unbanked individuals to carry out numerous financial transactions by only using their mobile phone. Moreover, there were 1.21 billion registered mobile money accounts by 2020 noting that, 45% of them were in Saharan Africa 548 million (Alade & Eroglu, 2022). Unlike Africa, most of the developed countries focus on adopting Fintech services and products to disrupt and interrupt traditional ones. Worth mentioning that, the deployment of innovative technologies will make better efficiencies, and consequently better country's TFP. Given absence of important financial services infrastructure, Africa has various new technology and inventions that can be utilized directly in the market (Yadav & Brummer, 2019).

Latest EY Global FinTech Adoption Index confirmed that Asia, especially China and India, still retains its global leadership in FinTech adoption. Worthy to note that, Hong Kong, Singapore, and South Korea have 67% FinTech adoption. Meanwhile, majority of markets

still lag far behind penetration of China 87%, except for India, which is now nearly the same.

Literature:

Historical Background

There were various research and literature reviews discussing the effect of Fintech adoption on firm's operating efficiency, and consequently impact of corporate efficiency on market performance and economic growth. Noteworthy that, digital innovation leads to industrial revolutions from a business model perspective. Moreover, some of research papers proved that impact of Fintech on country's economic growth such as China. Song (2022), showed that there is a positive correlation between economic growth and Fintech (i.e: credit, 3rd payment, insurance, etc.). He even quantified the effect by mentioning that "10% rise in fintech, third-party payment, credit, and insurance raises China's economic growth by 8%, 4%, 5%, and 16%, respectively". Also, there were some literature reviews highlighting the significant implication of Fintech in the EU countries. Specifically, the paper highlighted its great effect on emerging market economy along with a weak developed financial infrastructure. As this will aid and accelerate the growth & development of financial markets, but there must be rationalized regulations in order not to ruin it (part of the 4.0 industrial revolution) (Adube et al., 2022 & Lavrinenko et al., 2023). Some of research papers focused factors that affect the economic growth and productivity of firms, which will consequently affect total factor productivity of countries. For example, some focused-on measuring efficiency through indicators such as gross profit margin, accounts receivables, accounts payable, inventory, etc. There are various channels that showed FinTech playing a significant role in improving firm performance through enhancing efficiency. One of research papers studied FinTech versus non-FinTech manufacturing firms. It proved through simple regression that efficiency of FinTech entities is way greater than that of non-FinTech ones noting that, this efficiency contributed significantly to market performance (Dhiaf et al., 2022). Worthy to note that, computer vision used in warehouses improves operations' speed, reduces human intervention, and minimizes

errors. Moreover, the use of advanced operating along with manufacturing technology improves productivity and better manages working capital of Fintech firms (Atayah et al., 2021). Other papers focused on banking industry while highlighting that, there is a positive correlation between customers' satisfaction and FinTech services (Anjalika & Priyanath, 2018). Also, many studies have showed the competitive edge of Fintech firms in financial performance. For example, the effect of digital and agency banking along with process automation are significant in commercial banks found in Kenya. There are other factors that contributed to development and enhancement in financial performance such as internet (connectivity), mobile technology, data storage, information transformation and remote interaction between businesses and consumers. Consequently, these will lead to a sharp reduction in costs of data storage along with an exponential rise in computing efficiency (Bömer, 2020; Dwivedi et al., 2021).

Other researchers, such as Abbasi et al. (2021), tested the efficiency of Fintech by examining its impact on SMEs. He found a positive relationship between Fintech and the efficiency of SMEs. Also, Sangwan et al. (2020) believed that FinTech firms have improved operating efficiency by lessening their expenses, time (i.e: loans' processing time) and cost of foreign exchange transactions. Other literature reviews, stressed on the fact that, there is a positive, strong correlation between adoption of Fintech and financial inclusion. Having financial inclusion in countries, this will lead to fostering economic sustainability. Last but not least, it was highlighted the weighing effect of FinTech features including but not limited to convenience, security, traceability, efficiency, and scalability on operating efficiency. Also, it validated the effect on market performance by comparing FinTech vs non FinTech manufacturing entities. (Dhiaf et al., 2022). Other research papers showed that Fintech has a reducing effect on inflation and unemployment. Moreover, it stressed on the importance of actively making digital transactions. Unlike other research papers, this paper believed that current technology doesn't replace humans with machines. In fact, it will enhance human capabilities as new technology developments will require employees to develop new skills (Romdhane et al., 2023). Last but not least, other

researchers proved via ordinary least square regression that there is a negative relationship between Fintech usage and income inequality (Jensen, 2021).

Background:

"What is Fintech?"

The current terminology's birth goes back to a project in the early 1990s named "Financial Services Technology Consortium" by Citigroup (Arner et al., 2015; Kerényi & Molnár, 2017; Ratecka, 2020). Main aim of said project was to change reputation of the bank of resisting technological cooperation with outsiders (Hochstein, 2015). Nevertheless, even after almost 30 years, the "Fintech" terminology can be interrupted in different ways (Schindler, 2018; Elsinger et al., 2018; Rupeika-Apoga & Thalassinos, 2020; Allen et al., 2020). Given its versatility in prevailing applications along with perceptions, Fintech's definition is very challenging to agree upon. Moreover, it is considered in a very active stage of development (Rupeika-Apoga & Thalassinos, 2020). Meanwhile, it is crucial to have a clear one for policymakers and regulators to work accordingly and develop a particular, clear approach for many things such as: market development, potential regulation, data, and consumer protection, etc. Worthy to note that, as per Basel Committee on Banking Supervision (2018)'s survey, it showed that most of the authorities don't have a clear definition of Fintech. However, only fact that can't be altered is that it is composed of two words "financial" and "technology". Treu (2022) in his research paper mentioned and collected many definitions, around 25 definitions, from different sources regarding "Fintech" terminology. For examples, OECD (2018) interrupts fintech definitions as labels for entities that apply and adopt technologies. Nevertheless, they further extended definitions into 3 groups in order to be more precise in practice. First, "Technology-Oriented Focus" approach, which is associates with the etymological definition. Worthy to note that, such definition prevailed at the institutional level (IMF, BaFin, Deutsche Bundesbank, etc.). Second, "Function-Oriented Focus" approach, which focuses purely on functional and refers to possible financial market services or financial market functions.

Last but not least, third approach is a mix of the two, which includes heterogeneity too about financial market services or financial market functions.

Fintech's development goes back more than 155 years noting that, its evolution can be divided into 3 phases: from 1866-1967, 1967-2008, 2008-present. Starting off with the first phase (from 1866-1967), first innovative step during that period was the usage of telegraphy to facilitate financial transactions along with financial information. (Arner et al., 2015; Thakor, 2019). By end of WWII, world started to focus on developing field of both communication and information technology. Moreover, one of the most crucial milestones during this period includes the first "code-breaking tools", which were commercially developed on early computers by companies (for i.e: IBM). Another invention was first pocket calculator by Texas Instrument. Following second phase (1967 - 2008), it can be described and seen as the development from the analog to the digital age (Arner et al., 2015; Thakor, 2019). It witnessed various innovations developments such as the first use of the ATM, advancement of the electronic payment system "Fedwire" (in 1970) and online banking for customers (in 1980 in the US and 1983 in the UK). Also, use of Bloomberg terminals increased during 1984 along with "triumph" of the Internet are part of this period (Arner et al., 2015, Ratecka, 2020). Last but not least, third phase (2008 and extends to the present), it started right-off after 2008 financial crisis. During that period, there was a loss of confidence and uncertainty that prevailed. Nevertheless, such situation facilitated and eased the emergence of innovative companies that used financial and technological know-how for their activities. It showed that financial services are no longer offered only by regulated financial institutions as previously thought. This period is characterized by new technologies such as AI (Artificial Intelligence) and machine learning, Big Data, mobile Internet access, cryptography, etc. Consequently, this led to new providers and new applications for financial services (Arner et al., 2015, Ratecka, 2020). Not only growth of Fintech was due to loss of confidence after 2008 crises but also due to eagerness for economic development. Having said that, emerging markets (specifically Asia) occupied a distinctive position. Asian region's system is characterized and known to be controlled heavily by state, where there is no healthy competition in banking markets.

Given inefficiency along with corruption, public accepts any new financial alternatives offered by non-banking institutions (Arner et al.,2015).

Worthy to note that, on worldwide basis, total value of investments in FinTech firms upsurged reaching 168 billion U.S. dollars in 2019 up from 9 billion U.S. dollars in 2010. Moreover, FinTech companies more than doubled between 2018 and February 2021. Venture capital investments in Fintech companies can be used as an indicator of an emerging growth industry. Worth mentioning that, it increased during 2019 reaching 53.3 billion U.S dollars up from 1.89 billion U.S dollars in 2010. (Statista Research Department, 2021a; Statista Research Department, 2021b; Statista Research Department, 2020). Worthy to note that, Egypt is ranked the fourth African country in FinTech investment, and it has been ranked the second in MENA region for number of FinTech deals (23%) and FinTech funding (21%). As per CBE report "Egypt FinTech Landscape report 2021", even before pandemic situation, Egypt has been trying to minimize cash framework and encourage the citizens to pay digitally (i.e: paying governmental school fees via Egypt Post or Egyptian banks). Nevertheless, during the pandemic situation, there were multiple circulations on March 15, 2020 to restrain adverse events of COVID – 19 by maximizing the banking sector's contribution. It aimed for further encouraging and facilitating the usage of digital banking in daily financial transactions instead of the traditional way,

Causes of Fintech's Emergence:

There are numerous reasons and perspectives for Fintech's emergence noting that, below factors target aggregate macroeconomic variables. One of the factors is "disruptive innovation", as it replaces and alters success of existing technology, service, or products in the market (Kerényi & Molnár, 2017; Fáykiss et al. 2018). However, from a perspective of a classical, economic history (i.e: Smith, Schumpeter, Kondratieff, etc.), they believed that innovation was the reason behind the occurrence of market transformation along with economic growth. Worthy to note that, Fintech industry doesn't have its own R&D as it relies on existing technology and innovation. On the other hand, other researchers such as Philippon (2017, 2019) believed that the main driver for Fintech's emergence was

inefficiency of financial systems. Philippon took USA as an example while he highlighted the high expenses of financial intermediation. Worthy to note, this has been the case for decades. Having said that, finance industry may be interrupted as having inefficient regulation, barriers to entry along with increasing returns to firm size. As a result, Fintech emergence can be explained as Fintech firms have an incentive to "rent seeking and business stealing" Philippon (2017). Consequently, this will increase the competition and efficiency gains for financial intermediation entities.

Also, country's economic growth and financial development along with regulations are considered too main driver for Fintech's development. According to Claessens et al. (2018), there is a positive correlation between appearance of fintech and country's level of development. Worthy to note that, on the contrary, there is a negative correlation between fintech activities and the strictness of banks' regulations. Moreover, Claessens et al. (2018) stated that high, healthy competition in credit markets affected the emergence of fintech too. Also, the difficulty of accessing credit aids and supports Fintech firms to expand even more. Authors showed, by using regression analysis, that Fintech lending is higher in countries with a less competitive banking sector.

The real question is whether there are country-specific differences or not. Given that Fintech is still considered at the beginning of its life cycle with positive trend, there are no accurate results for consequences in case of any change in economic situation or macroeconomic shock (Treu, 2020). Worthy to note that, some of researchers tried to prove that there is a cross-country effect. They both examined monetary policy and low interest rates to support idea of Fintech emergence cross-country. They believed that, currently macroeconomic environment is forcing financial institutions entities to cut their costs with the intention of having higher profits. A fact that led companies to adopt and shift towards innovation and technology, Fintech, to reduce their costs (Treu, 2020). Nevertheless, Frost, (2020) undermines the previous example by stating that there is no evidence of link between both fintech lending volumes and low interest rates. Another perspective to look at is the supply and demand approach. Starting with the supply side, first, application programming interfaces (APIs), which are used for communication and exchanging data.

It enhances services specifically in the immediacy of payments as mentioned by Financial Stability Board (2019). In conjunction with APIs, nowadays smartphones include payment functions that are available to anyone. Another supply driver is the "Cloud Computing". Combining both Fintech along with cloud computing, it causes many benefits including but not limited to economies of scale, flexibility, cost, and operational efficiencies. Some entities use it for financial accounting or managing their customer relationships, etc. (Financial Stability Board, 2019; Vučinić, 2020). Last but not least, regulations both on national level and international level is considered one of the main supply side. After 2008 financial crisis, there were many reforms and improvements in financial regulations. This eased and facilitated entrance and rise of Fintech entities (Financial Stability Board, 2019; Vučinić, 2020). Moreover, data protection regulations of both national and international may impact level of competition, which will influence the possibility of new entrants to enter the Fintech market. In case there were differences in regulations, this may lead for young Fintech entities to operate and expand internationally into countries with weaker regulations (Treu, 2022).

As for the demand-oriented rationalizations for Fintech's emergence, first of all, clients' mind-sets and expectations have altered. As mentioned before, 2008 financial crises was a key factor as it led to a total loss of confidence in financial system. Having said that, people started looking for other alternatives beyond the existing system. Even nowadays, people's preferences and perspectives are altering. They are now searching for quick, easy, cheap, and secure payments remotely at any time. In addition, changes in demographic are driving demand too. For example, millennials generation is more willing to embrace Fintech services than traditional ones (Vucinic, 2020).

Fintech Opportunities

The existence of Fintech avoids information asymmetries and market frictions, which leads to, as mentioned above, cheaper transactions costs and suitability for users. (Claessens et al., 2018; Beck 2020). Berg et al. (2018), pointed out that digital footprint can be used to provide a better method to screen and select borrowers than traditional one. It gives a more

comprehensive view of consumers' financial lives. Moreover, it is anticipated to aid in minimizing the credit gap for citizens that are unable to obtain credit (Allen et al., 2020). Having said that, one of Fintech's opportunities is its ability to drive financials inclusion. This will positively affect the economy as this implies that each person and entities will have access to financial services & products that comply with their needs (World Bank, 2018). Worthy to note that, worldwide, an estimated of 1.7 billion people do not have access to a transaction account. Moreover, they are excluded from the formal financial system. As per Group of 20 "G20", financial inclusion is considered as one of the critical drivers of poverty reduction along with economic growth in emerging economies (World Bank 2020). Moreover, it was shown that economies that have diversity in financial intermediation will develop faster and decrease income inequality (Beck et al., 2007). As mentioned earlier, traditional financial intermediation entities are facing a problem given low profits and high costs. Consequently, there is an opportunity for Fintech companies to fill in this gap given that they have lower costs, more efficient, better risk management, etc. Another opportunity is improving global financial stability noting that, Fintech have the potential to develop degree of diversification along with decentralization as Fintech entities will provide wider variety of credit sources, better pricing and credit allocation. Worthy to note that, this will mitigate the effect of upcoming financial shocks (Financial Stability Board, 2017; Claessens et al., 2018; Fáykiss et al., 2018). In a nutshell, Fintech offers opportunity to have a general efficiency improvement. Again, this is due to being more convenient, efficient, profitable and transparent. In addition, it enhanced customer experience, increase competition and general welfare gains.

Fintech Risks

On the contrary, Fintech has its risks and drawbacks too. Like traditional financial intermediaries' entities, Fintech face and challenge same risks and forms of activity. Having said that, regulators and representatives need to be more caution and not to favor them over others. However, it is very crucial, especially in emerging economies, to make sure that imposed regulations will not hinder innovation nor market entry (Claessens et al.,

2018). There is a high regulatory risk when it comes to imposing regulations on Fintech as it has a high degree of heterogeneity, yet it requires regulations to constraint critical excess on time. Thus, there is a dilemma between attaining a balance of prudential regulations and supporting Fintech innovation whilst having financial stability. One of the researchers, Fáykiss et al. (2018), found a similar risk between laissez-faire vs extreme restrictions in Fintech. Worthy to note that, said dilemma can be solved by establishing "regulatory sandboxes." Said approach tests new technologies in a controlled environment as it tries to discover a balance between innovation and existing regulations (Claessens et al., 2018; Fáykiss et al., 2018).

There are other microeconomic and macroeconomic risks by other researcher. Like other traditional entities, Fintech may face maturity mismatch (financial), when a loan extends for a longer time than it is supposed to. Another one is liquidity mismatch (financial), where liabilities and assets have different liquidity features. Eventually, this will lead to “run risk”, which will disrupt markets. Also, another risk is having a high leverage (financial), where there is no enough equity to absorb unanticipated losses from maybe credit, market, etc. One of the most threatening risks is Cyber risks noting that cyber attacks have been growing. Another operational risk is the dependency on third party entities (i.e: cloud, telecommunication etc.). Worthy to note that, this could lead to a systemic risk when third party entities are having operational difficulties, and there is a stronger bond between Fintech entities and institutions. Last but not least, data protection and quality are really important as in case it wasn’t accurate, it could lead to incorrect results and risk of monetary losses (Financial Stability Board,2017; Faykiss et al., 2018; Vucinic, 2020).

As mentioned earlier, innovation and technology have the potential to cause macroeconomic risks over time. As a result, this may cause potential shocks to financial system along with increase probability of having a financial instability. Unquestionably, the magnitude of Fintech’s impact and risk will depend on nature of the said innovation. The following includes potential risks from Fintech as per Financial Stability Board (2017), Fáykiss et al. (2018) and Vučinić (2020). First, contagion risk, which means that if a problem (causing losses) appears at one entity or even sector, it will immediately spread to

other entities or sectors. As a result, this can destabilize completely the system. Another risk is the volatility noting that, financial system tends to overreact to any emerging information. Along with the increasing popularity of fintech, this may cause the financial system to react with even higher sensitivity to certain industry news and changes. Consequently, it will increase volatility at the systemic level.

Finally, there is a risk of forming a possible speculative bubble, which can be described by using Minsky's model or the Minsky paradox (Minsky, 1978, 1992). It shows that even if the economy was booming, still a financial crisis can occur. He believed that a capitalist economic stem will eventually originate financial crises in addition, said speculative bubbles will affect behavior of market participants. Moreover, there was another perspective by Haim (2013) He believed that the growth of said instability could be described by five phases. First is the abnormal incident or shock, which alters the expectations of market participants, and consequently, it will suit the investments to another sector or induery of the economy. Second phase is characterized by prosperous phase, as there is increase in investment, price, debe financing and liquidity. This will eventually attract additional investors Follows the third phase, during this phase, risks are almost totally ignored as everyone is excited and euphoria prevails. Given the high lending and credit financed investments interest rates rise. As for the fourth phase, "financial distress phase", it is the start of complete opposite with previous phase. It starts with negative events, for example, disclosure of accounting scandals or liquidity obstacles given the high interest rates, or struggle in repayment of loans, etc. Instantaneously, insiders start to sell straightaway assets and move them to safety. Finally, phase five is the loss of confidence phase as it is associated with the bursting of the bubble along with decrease in industry's prices. This may lead to credit deals at banks along with corporate bankruptcies, which will widen the crisis causing real economic distress.

These phases could be replicated on Fintech sector. First, the exogenous event or shock was the 2008 2009 financial crisis, where people stared to lose confidence in the banking sector. As a result, people started shifting towards new alternatives and new technologies outside the established, traditional banking and financial section Given that Fintech sector

became profitable, this led as increase in venture capital investments, start-ups and global total value of investments Moreover, overall economic status aided to development of growth such as availability of liquidity, credit and low interest aid. Worthy to note that, Fintech sector is still considered at the end of second phase of said model, where it shed light on only positive side while ignored initial risks. However, a question is raised whether Fintech sector will have same exact phases including "financial instability" hypothesis and magnitude. According to Claessens et al. (2018), there are some Fintech companies that have settled on even higher proportion of riskier borrowers. There is a high probability of a severe crises in case, there were speculative bubble accompanied by regulatory dilemma.

Future Direction:

First, it is very crucial to have a unified definition for Fintech while focusing specifically on a regulatory definition along with including general fintech functions. Moreover, another thing is to focus on and classify Fintech's activities. There were some researchers that have examined initial works (Treu, 2022). Worthy to note that, as time passes, there will always be changes in the market economy, which will eventually cause new activities to be added and old ones to disappear. Having said that, the real challenge is whether there will be a definite definition for Fintech that can be easily altered and amended with future developments. There is a belief that the existing technologies could be used and focused on in order to differentiate between mandatory technology vs complementary technology for Fintech sector. Also, it is important to study Fintech activities in different countries, emerging countries (i.e: Mexico, Indonesia, etc.) vs developed countries (i.e: Switzerland, Sweden, etc.). This may result in region specific definitions for each area; in addition, it may show which macroeconomic and microeconomic factors play a role.

As mentioned earlier, one of the most challenging things to focus on is the regulatory dilemma. Therefore, there must be several approaches and research to answer and solve this regulatory dilemma. Unquestionably, it is important to examine and investigate the needed regulations for each Fintech activity. To start with, the use of sandboxes can be used as it follows the same direction. However, there are some aspects that need to be

tackled in order to further pursue such as the goals out of sandbox, its design, functions that it should map, country specific differences, etc. Moreover, one of the main goals is the economic benefit, where it should be answered from the test. Meanwhile, such test has its drawbacks noting that, overuse of closed sandboxes may deprive Fintech entities from the free play of market forces besides artificially grow to a critical size. Having said that, regulatory sandboxes must be examined from the perspective of market efficiency. Worthy to note that, regulations and rules of both financial and banking sectors are carried out at the national level and the supranational level. Accordingly, a cross country comparison of different approaches may provide information and show best method under different conditions. Moreover, commonalities on national level can be utilized in developing a framework for supranational regulation.

Another topic to be tackled and further examined is reasons behind the existence of Fintech. One of the assertions is that Fintech entities contribute to the improvement (efficiency) along with financial system's stability. Worth mentioning that, improvement indicates better allocation or access to and from financial resources. Moreover, stability combined with improvement may result in a reduction of systemic risk Imerman & Fabozzi (2020). Another question can be raised regarding whether Fintech entities can be integrated or are integrated into traditions banking and financial. Given that Fintech is efficient and decrease market inequalities, this means that it can support financial inclusion. This raise a question about the link and relationship between Fintech and financial inclusion, factors aiding the pace, why Fintech specifically in emerging markets, etc. Worthy to note that, especially after pandemic situation (COVID – 19), Fintech's adoption accelerated as all sectors started to move towards digitalization and lessen any face-to-face interaction. All the countries including Egypt started taking firm and fast actions to facilitate everyday transactions for their citizens. Consequently, it was shown that COVID – 19 has increased financial inclusion as assumed (Fu & Mishra, 2020 and Özil, 2020). Unquestionably, this was due to many factors such as greater trust and confidence in Fintech. Also, it facilitates smoother and better payment processing and continuous circulation of money. Also, it ensured that there are enough money during the crisis at all times. Narrowing down to a microeconomic

level, another topic that can be further tackled is the factors that characterize fintech entities along with which future business sectors will be in this area. Moreover, role played by many Bigtechs (i.e: Apple, Facebook, Google, Microsoft, etc.) and their importance. Noteworthy, Bigtechs develop the technologies that are usually used by young Fintech entities. Of course, given that Bigtechs are dominating the market, they can easily control and gain a big market share. Some approaches of these companies is the already entrance of the area of mobile payments and the development of their cryptocurrency (Financial Stability Board, 2019).

Last but not least future research is to examine Fintech and probability of forming a speculative bubble formation with a subsequent crisis. Meanwhile, it should be examined whether this will apply to the entire Fintech industry or specific areas only. As this will help in eliminating a possible bubble noting that, this may be linked to regulatory dilemma of Fintech, where it will create a holistic framework.

Conclusions

In conclusion, Fintech has been defined and understood in different ways along with the literature. The etymological meaning of Fintech is integration between the words "financial" and "technology". It is integration of technology into financial services entities to enhance their usage and delivery to customers. As mentioned above, to further understand the meaning, there were different views and definitions by technological and/or functional focus elaborated. Moreover, Fintech's history can be divided into 3 phases noting that, it has been there for decades (goes back to the development of the telegraph). Justifications behind Fintech accelerated growth since the last decade are as many as the perspectives and definitions. It ranges from the development of innovations and technologies to efficiency aspects, to market-oriented arguments (supply and demand oriented). Also, opportunities (i.e.: financial inclusion) and drawbacks (i.e.: regulatory dilemma) associated with Fintech. Finally, there are still more topics that need to be tackled and investigated furthermore such as relationship between financial inclusion and Fintech, and success factors (management oriented) that separate good from bad Fintech entities.

Methodology & Data:

Research Question:

Many previous research papers were concerned with the factors affecting the richness (high – income) and poverty (low – income) of a country. According to Acemoglu and Robinson (2012), they have proved that country's wealth doesn't depend on culture, geographical conditions, etc. yet it is all about the productivity, quality, and efficiency of institutions (political, economic, legal, and social ones). Having said that, it is important to focus on and enhance factors affecting the TFP (capital, labor, and Fintech) in order to improve country's economic growth and development in the long-term. Worthy mentioning that, the following are the reasons for significant, positive effect on country's economy. When institutions' goals are settled, this will guide them to the correct framework and operations. Also, resources of the society will be controlled, where it will reduce any corruption and maintain a good environment. Lastly, they will contribute in creating the needed prerequisites that will limit market imperfections during the process of economic development (Minh Ngoc & Loc Duc, 2020).

As mentioned earlier, the research paper will mainly concentrate and shed lights on the effect of Fintech adoption on the total productivity of countries. The study includes 150 countries, yet data had FinTech proxy limitations as there were only four years available under study. Worthy to note, given high variability in data between countries, a study was done on a sample of low – countries vs high – countries. The following countries were chosen from low-income (Yemen, Niger, Burundi, Chad, Madagascar, Guinea, Sierra Leone, Cote d'Ivoire, D.R. of the Congo, Egypt, Pakistan) vs high-income (Malta, Belgium, Estonia, Switzerland, Singapore, Germany, Slovenia, New Zealand, Australia, Canada, Netherlands, Sweden, Denmark, Finland, Iceland, Norway) based on availability of data while trying to cover a large area. This may negatively affect the strength of the relationship under study vs if the study included a more focused continent or region. (Adube et al., 2022 & Lavrinenko et al., 2023). The question that always prevails is whether adoption of Fintech factors will positively affect TFP of countries or not. Worthy to note

that, a further extension was done by using more Fintech proxies to test the validity and significance of correlation.

Research Methodology:

As previously discussed, the goal is to examine the effect of Fintech adoption on TFP of countries. In this case, a simple regression will lead to biased parameters due to the endogeneity issue. Having said that, to enhance model, Fixed Effects Regression will be used in our paper. Briefly, it is a statistical regression model, which is often applied to panel data to control for any individual specific attributes that don't change across period.

Variables and Previous Studies:

There were many previous research papers tackling and examining the magnitude and correlation between below variables and TPF. One of the research papers proved the significant effect of Human Capital on TFP especially in the long run. Sohag (2021), proved that Human Capital accelerates adoption of advanced technologies, which will consequently affect factor productivity positively. This study emphasized the importance of Human Capital (having good technical skills) to enhance even more technology and innovation unlike other papers that believe technology adoption will replace humans with machines. Moreover, skilled human labor promotes more efficiency in production and in technology (Sohag, 2021). Moreover, there was a study done on the major economies of the Eurozone (UK, Spain, France, Germany and Italy). It was concluded and noted that TFP's patterns were affected in said companies due mainly to 3 shocks in either real interest rate or real exchange rates or capital and labor misallocation on TFP. It showed that there are positive correlations between the interest rate and the real exchange rate (on the long run) on TFP. As for misallocation of capital and labor, it showed that there is an adverse effect on TFP growth in the long run. Noting that, for robustness, a panel VECM was used to check for causalities among the variables (Bellocchi, 2021).

Another research paper explored the effects of technological factors such research and development (R&D) and technology spillovers (i.e: foreign direct investments) on China's

TFP. This was tested by using provincial panel data of China. It showed that R&D investments along with technology spillovers have leading roles in enhancing and promoting TFP through linear analysis (Huang et al., 2019).

Moreover, Sohag et.al, 2021, too supported the same conclusion noting that, their findings reveal that innovations promote TFP through many direct and indirect channels in the long run. Regarding the population density, Fakter et. al, 2020, demonstrated that it increases the likelihood of TFP growth (through regression results). Also, higher population density enhances human capital through increasing rates of return on investment in schooling and other human capital. Other studies examined R&D (private and especially public) R&D on higher internal rates of return, which will consequently speed up country's growth, Japan's growth in their case (Ziesemer 2020).

I. Methodology and Variables:

Fixed Effect Regression Model:

$$TFP_{i,t} = \alpha + \beta_1\, Labor_{it} + \beta_2\, Capital_{it} + \beta_3\, Population_{it} + \beta_4\, IRR_{it} + \beta_5\, Exchange\ Rate_{it} + \beta_6\, Human\ Capital_{it} + \beta_7\, Fintech_{it} + \phi_i + \gamma_t + \varepsilon_{it}$$

- $TFP_{i,t}$ is the total Factor productivity of country i at time t,
- $\phi_i\ and\ \gamma_t$ are the region and year fixed effects.
- ε_{it} is the error term assumed to be IID.
- The Variables are introduced in Previous Lag forms.

	Source	Definition
TFP	Penn World Tables	Total Factor Productivity at PPP (purchasing power parity)
$Labor$	Penn World Tables	Number of employees engaged in the job market.
$Capital$	Penn World Tables	Capital at Constant National Prices (2017)
$Real\ Internal\ Rate\ of\ Return\ (IRR)$	Penn World Tables	Index to measure the profitability of investment in the country

		after controlling for inflation
Exhange Rate	Penn World Tables	Exchange Rate of National Currency to USD
Human Capital	Penn World Tables	Human Capital Index

Fintech Variables are exported from Global Fintech Index

Many proxies were used in the study such as:

- Financial Institution Account for Young: (percentages from those Aged 15-25).
- Later on other Variables were introduced:
  - % of Young (Aged 15-25) who saved money through Mobile or Financial Institutions.
  - Received Government payments/transfers into their bank accounts.
- Low & High income Countries chosen are shown below according to its Financial Accounts (% aged 15- 24)

II. Descriptive Statistics

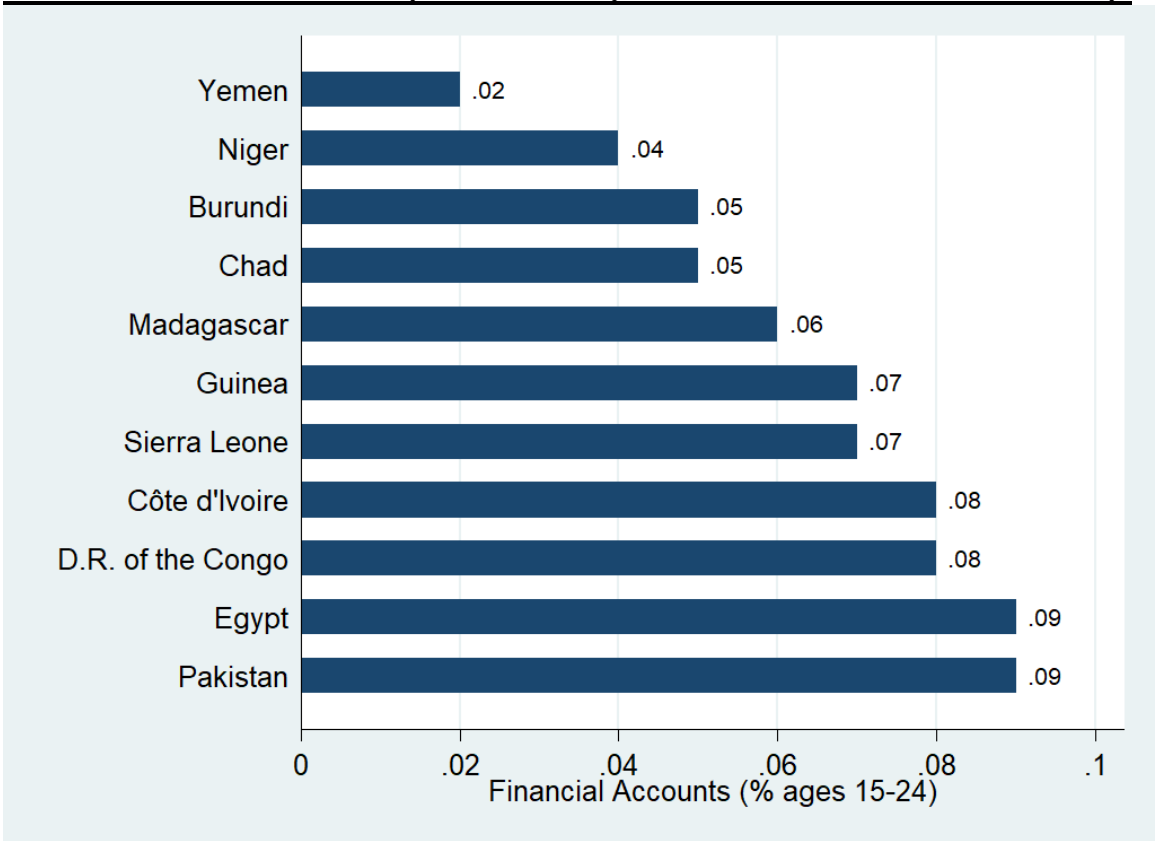
Stats	TFP	Employees	Capital	Population	IRR	Exchange Rate	Human Capital	Financial Institution Account for Young
Mean	0.66	18.11	0.96	40.09	0.12	3.30	2.64	0.47
SD	0.25	71.69	0.09	147.20	0.07	2.62	0.69	0.31
Min	0.05	0.00	0.61	0.00	0.01	0.25	1.19	0.02
Max	2.29	799.31	1.34	1433.78	0.48	18.15	4.35	1.00
Skewness	0.79	8.90	-0.54	8.16	1.40	0.85	-0.23	0.30
Kurtosis	6.26	89.35	4.60	73.42	6.42	3.17	2.05	1.73

Descriptive statistics are presented in Table II. It shows that the average TFP for all countries under analysis is 0.66, which can be considered low given that the max reached 2.29 yet min reached 0.05 (too small). Nevertheless, this shows that some countries (low – income ones) have very low efficiency in utilizing their resources. Having said that, adopting Fintech in these countries is a critical issue that needs more attention. Results

below show that there is a high correlation between the TFP and Fintech. Also, it shows that Fintech has a greater effect on low – income countries.

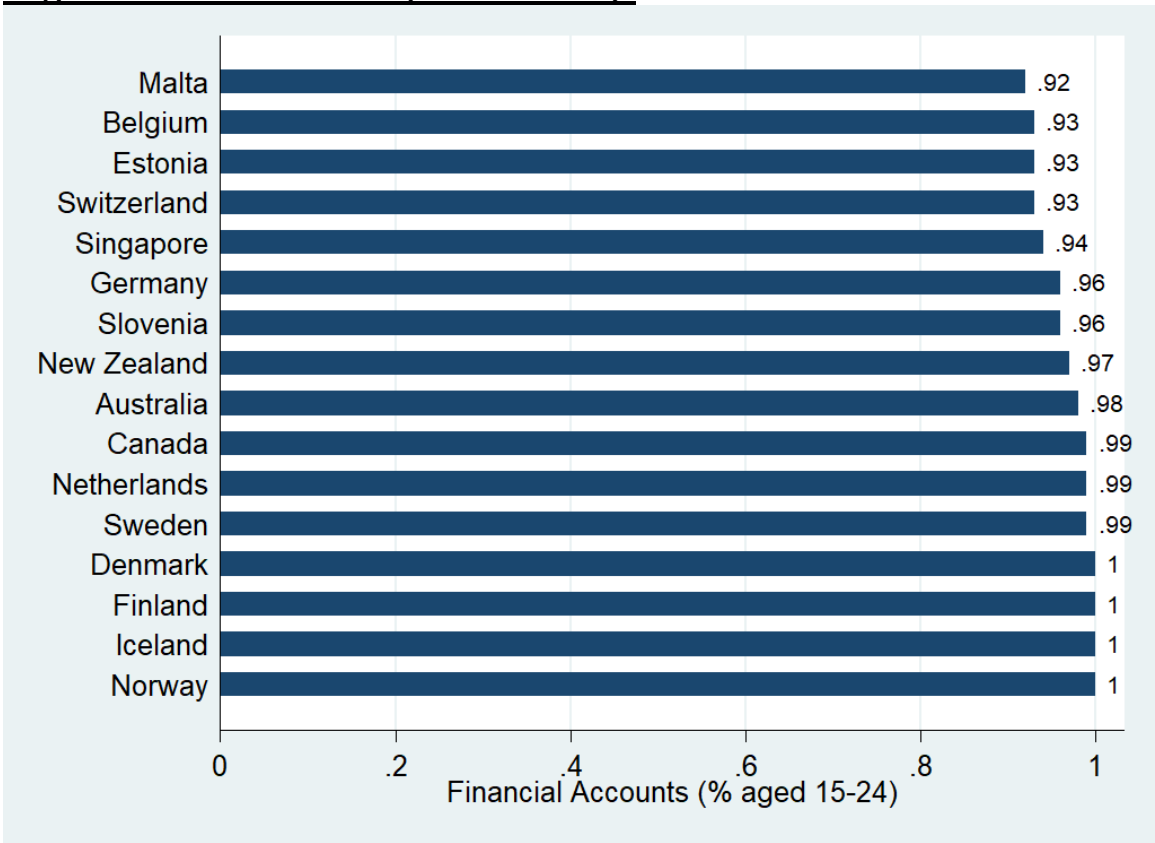
As shown below, almost all low – income countries are located in Africa. Worthy to note that, as the country level of income increase, there is increase in Financial Accounts too. Same applies to high – income countries, the higher the income (GNI per capita), the higher the percentage of financial accounts of youth (age 15 to 24 years).

Low – Income Countries (11 countries, 9 African countries & 2 Asian):



"Author's construction using Fintech Dataset"

High – Income countries (17 countries):



"Author's construction using Fintech Dataset"

Empirical Findings:

First table shows 3 different stages showing different results, where in each stage extra variables are added to test their magnitude. First stage, the dependent variable (TFP ratio) was regressed against only two variables "Labor" and Capital" (the common two factors affecting TFP). The R-squared recorded 0.4451, which shows that said variables contribute with almost 44% in TFP variance. However, when adding additional variables such as "Real Internal Rate of Return", "Exchange Rate" and "Human Capital", R-squared increased to 0.4993 (49%) showing additional contribution from said variables in determining TFP. However, these 3 extra variables didn't contribute much as they affected the results by only 5%. Meanwhile, in the last stage, Fintech proxy was added "Financial

Institutions accounts", where it increased further the variance of the dependent variable to reach 0.5375. However, this time the Fintech proxy's magnitude was significant as its R-squared reached 53.75%, an increase of 3.82%. Worthy to note that given limitation of data especially for Fintech proxies, observations decreased a little bit to 546 observations instead of 565 observations. Worthy to note that, F-Statistics (P-Value) recorded below 0.01 for all data under analysis, which shows that the model is significant for all data.

Testing the magnitude of factors affecting TFP on 3 stages:

VARIABLES	(1) 1	(2) 1	(3) 1
Labor	0.0189*	0.0386***	0.0398***
	(0.0103)	(0.0086)	(0.0088)
Capital	1.4538***	1.8882***	2.1299***
	(0.3832)	(0.3551)	(0.3774)
Population		-0.0001***	-0.0002***
		(0.0000)	(0.0000)
Real internal rate of return		1.5877**	1.8906***
		(0.6441)	(0.6843)
Exchange Rate		-0.0125***	-0.0152***
		(0.0032)	(0.0031)
Human Capital		0.0898***	0.0374**
		(0.0206)	(0.0183)
Financial Institutions accounts			0.2632***
			(0.0441)
Constant	0.3743***	0.2092***	0.2006***
	(0.0299)	(0.0666)	(0.0675)
Region FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	565	565	546
R-squared	0.4451	0.4993	0.5375

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As for the second table below, the main aim was to highlight the magnitude of Fintech proxy on each "Low-Income Countries" vs "High- Income Countries". Results showed that Fintech factors had a greater effect on low-income countries vs high-income countries recording 0.4203 vs 0.3220 respectively. This could be justified as adoption of Fintech in high – income countries are really high (above graph showed one of Fintech proxy almost saturated for all) vs very low adoption in low – income countries as shown in "Financial Accounts (% ages 15 – 24)" proxy. Worthy to note that, F-Statistics (P-Value) recorded below 0.01 for all data under analysis, which shows that the model is significant.

Testing the effect of Fintech proxies on Low – or High – Income countries:

VARIABLES	Low Income Countries	High Income Countries
Labor	-0.0847	0.0102
	(0.0545)	(0.0135)
Capital	2.6296***	2.6702***
	(0.4377)	(0.5856)
Population	0.0011***	-0.0002***
	(0.0004)	(0.0000)
Real internal rate of return	1.9911***	0.1123
	(0.4451)	(1.2051)
Exchange Rate	-0.0180***	-0.0046
	(0.0045)	(0.0044)
Human Capital	-0.0133	-0.0772**
	(0.0197)	(0.0324)
Financial Institutions accounts	0.2958***	0.2171**
	(0.0341)	(0.1055)
Constant	0.5618***	0.4845***
	(0.0699)	(0.1198)
Region FE	YES	YES
Year FE	YES	YES
Observations	218	148
R-squared	0.4203	0.3220
F-Statistics (P-Value)	0.000***	0.000***

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As for the last table, two Fintech proxies were introduced in order to reassure the effect of Fintech factors on TFP variance. As shown above in the results, both had a significant effect noting that, "Receive Government Transfers in Banks" proxy was higher than "Save Money Through Mobile" recording 0.5075 vs 0.4865 respectively. Worthy to note that, F-Statistics (P-Value) recorded below 0.01 for all data under analysis, which shows that the model is significant.

Other Fintech Proxies to validate magnitude on TFP:

	(1)	(2)
VARIABLES	1	1
Labor	0.0359***	0.0400***
	(0.0088)	(0.0092)
Capital	1.9190***	2.1107***
	(0.3840)	(0.3601)
Population	-0.0001***	-0.0002***
	(0.0000)	(0.0000)
Real internal rate of return	2.2596***	1.6842***
	(0.7553)	(0.6124)
Exchange Rate	-0.0066**	-0.0083***
	(0.0031)	(0.0031)
Human Capital	0.0363	0.0706***
	(0.0274)	(0.0189)
Save Money through Mobile (%)	0.3951***	
	(0.0463)	
Receive Gov Transfers in Banks (%)		0.2454***
		(0.0432)
Constant	0.1855**	0.0903
	(0.0762)	(0.0690)
Region FE	YES	YES
Year FE	YES	YES
Observations	490	520
R-squared	0.4865	0.5075
F-Statistics (P-Value)	0.000***	0.000***

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Instrumental Variable Model – Robustness Check:

In order to reassure the results, another model was proposed to test for the same FinTech proxies. Moreover, instrument variable used was "High Transaction". Meanwhile, drawback of this model is that it further decreased the observation due to data limitations and availability of the instrument itself. However, overall results show that FinTech proxies are significant as they passed the three tests applied yet this isn't the strongest model. Having said that, better instruments will be applied in the future (as extension) to have a more completed information and observation.

	(1)	(2)
VARIABLES	1	1
Save Money Through Mobile	0.516***	
	(0.189)	
Receive Gov Transfer		0.404***
		(0.141)
Labor	0.0213	0.0510
	(0.0373)	(0.0330)
Capital	1.661*	2.530***
	(0.934)	(0.770)
Population	-0.000185*	-0.000165*
	(0.000102)	(0.00001)
Real Internal Rate of Returns	-0.0916	1.271
	(2.437)	(2.124)
Exchange Rate	-0.0109	-0.0126
	(0.00936)	(0.00854)
Human Capital	0.0464	0.113***
	(0.0593)	(0.0384)
Constant	0.361**	0.0223
	(0.164)	(0.136)
Observations	98	101
R-squared	0.271	0.415
Cragg-Donald	49.663***	76.175***
Under identification test	34.633***	45.47***
Endogeneity test (P-Value)	0.11	0.971

Policy Recommendations:

- Policymakers and regulators to impose rationalized regulations (not strict nor extremely loose).
- Government must support and promote FinTech start-ups and entrepreneurships.
- Businessmen should consider adopting FinTech and advanced operations in their companies.
- Human/ employees should work on themselves and keep up to date with technology and innovation. Otherwise, they may be replaced by machines then.
- Traditional banking system, develop operations and transform into digital banking.

Conclusion:

The paper's results emphasize the importance of TFP and its effect especially on low – income countries. Having said that, achieving and focusing on TFP development should be an important topic and goal for not only policy makers but also entrepreneurs, entities, investors, and governments. There were many research papers concluding and highlighting the importance of environmental regulation on TFP; in addition to, stating when such regulations would enhance TFP. Yang et. al (2022) added that there are other factors that could hinder the effect of these regulations on firms' TFP such as bargaining power of firms, type of firms (whether it is non/state – owned) and non/ provincial city. In conclusion, results showed that Porter hypothesis (PH) is valid, where it stated that strict regulations will force firms and countries to expand more in the innovation field. Then, this will eventually enhance capital investment, technological innovation and resource reallocation in the production process of firms (ultimately entities and countries TFP) (Albrizio et al. 2017).

Another reason why it is important to study the TFP and its factors was triggered by other researchers. There were studies done on the importance and significance of total factor productivity growth in countries, focusing on middle – income ones. Kim, J. & Park, J. (2017) used cross – country panel data during the period of 1975 to 2014. It showed that the growth of TFP significantly impacted the country's upward transition from being a

middle – income to high – income country one. Worthy to note that, this paper also showed that the following resources: human capital, catch-up effect, smaller population, R&D, and weak currency have momentous effect on TFP's growth.

Other researchers focused on examining policy makers of post transition economies. They all had the same targets, which are to have a better standard of living for their citizens and to reach developed market economies. Moreover, it was marked that to catch up, this needs extensive investment in both capital and labor. To sum it up, it was argued by growth accounting literature that TFP is the main source of convergence.

Meanwhile, there is an obstacle regarding the international comparison of aggregate TFP growth. It does not consider the differences in the weights of sectors within the national economies. For instance, if the same industries in two different countries have similar TFP growth yet a different economic weight, the aggregate TFP growth will be different between the said two countries. This means that even though market competition forces may determine the results at the industry level, the results at the national level may differ.

Moreover, literature reviews highlighted that there are main determinants, on industry level, for TFP growth that are crucial for the survival, success and development of any firm. As mentioned earlier, these are R&D, human capital, healthy competition, and international trade, etc. (Botrić et al., 2017). Worthy to note that, a study on European countries showed that there are sectoral differences in TFP growth, where it highlighted that higher TFP estimates in service sector firms vs manufacturing firms.

Other studies done on developed economies (1970 to 2011), through using econometric regressions and growth accounting decomposition, showed that manufacturing TFP growth had a higher impact than non – manufacturing TFP growth on aggregate TFP growth (economic growth). This shows that even though there is a decline in the share of manufacturing "de-industrialization" in GDP, it is still considered crucial for economic growth. Worthy to note that, the increase in manufacturing part will help to narrow the income gap with other countries (F. Jia, et al., 2020).

In a nutshell, there is a significant correlation between Fintech's proxies (3 tested in our paper) and countries' TFP. Moreover, results show that Fintech proxies affect low-income countries even more than high-income countries. Also, one can conclude that the Fintech field still has a lot of work and research to be done on it. Worthy to note that, there were many limitations. First, there was low access to and availability of data, which limited the size of our data. The study includes 150 countries from low- and high-income countries. However, there was data limitation in the FinTech proxies used as they included only four years (2011,2014,2017,2021). Definitely, larger data would have been better to have more accurate results and avoid any outliers. Another thing is the definition of the dependent variable "TFP" since it is a non-observable variable, there are numerous methodological problems related to its estimation. Moreover, even inside either low – income countries or high – income countries, there will be a difference in sectors and subsectors' weights. This will eventually demand more investigation in order to assess the magnitude of such differences and their effect on our results (in case there were outliers).

In spite of these limitations, this paper still helps in explaining how and why Fintech development and TFP are important for economic growth. Results provide justification of why policy makers, governments, entrepreneurships, stakeholders, etc. in countries especially low – income, should focus more on enhancing such factors.

Lastly, it would be more fruitful to investigate and study at a firm level; however, access to data was very limited too. Nevertheless, an extension to this paper will be worked on to be able to thoroughly study and explore on a microlevel, firm level, the effect of Fintech adoption.

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