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**Bachelor Thesis**

# IMPACT OF FINANCIAL INNOVATIONS ON GLOBAL ECONOMIC GROWTH: A SURVEY

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# INTRODUCTION

The global economy is highly influenced by all types of financial innovations in the financial system. For instance, the rise of money (one of the first financial innovations) has helped overcome the coincidence of wants and adverse selection problems caused by the barter system, this leading to an increase in global economic activity (Velde, 1998). The rise of commercial banking, the introduction of automatic teller machines (ATMs), even credit and debit cards all created a more transparent financial society and increased the global money supply in circulation (Dean et al., 2010). Nevertheless, in the late 20$^{th}$ century, financial innovations were highly idolized for their benefits. Thus, many innovations were first invented to increase the overblown promotion and only then to hopefully fulfill their functionality − increase economic greatness (Litan, 2010). Soon after the financial crisis started in 2007 and 2008, the promotion bubble burst, and global tension occurred. Many policymakers and even top economists blamed financial innovations (especially credit default swaps and the 21st century highly promoted collateralized debt obligation) for nearly bringing the global financial system and their economies to their knees (Litan, 2010). Afterward, the fundamental values of financial innovations were highly obscure and valued differently between specialists. Some state that financial innovations are popularly perceived as risk-inducing instruments with no positive impact on economic growth (Dwyer, 2011). Others state that these innovations drive force behind financial deepening and economic greatness (Blach, 2011).

To fully understand the relevance of this thesis, first, the meaning and the in-debt functionality of financial innovations must be observed. "Innovation" is defined in the Cambridge dictionary as "*(the use of)* a new idea or method" with the root of the word deriving from the Latin word Novus or new. Financial innovations do not always tend to be new ideas (or methods), but most likely, they are evolutionary adaptations of prior products that gain new specifications and possibilities once used. These inventions are often split into product and process innovations. Product innovations are newly formed financial market assets, physical cards, automatic teller machines, and process innovations are new methods of processing transactions, distributing securities, et cetera (Tufano, 2003). In my bachelor's thesis, I tend to combine both product and process innovations to one since both process and product innovation are often linked in this field of research. For an in-debt functionality overview, both Merton (1995) and Finnerty (1992) state that financial innovations help us in:

1. Transferring funds across time and space
2. Fund aggregation (or increasing liquidity)
3. Risk management
4. Extracting information to aid decision-making
5. Dealing with moral hazard and asymmetric information problems
6. Easing the process of sales by using optimized payment methods.

On the other hand, the Bank for International Settlements (1986) states that financial innovations are focused primarily on risk deduction, enhancement of liquidity, and increase of funding to support enterprises, leaving aside the first, fourth, and fifth functions written above. Each author describes the in-debt functionality differently, and this is because many innovations tend to have not one but few functions. For instance, mutual funds and exchange-traded funds tend to increase liquidity, manage risk, and ease sales. Online banking tends to help transfer funds across time and space, increase liquidity, extract information to aid decision-making, and ease sales. Thus, it is fair to say that there is no specific in-debt function for these particular inventions.

Coming back to the discussion on different approaches towards financial innovations, I fully accept that financial innovations should be viewed differently in present times, rather than praising the innovative authors and highlighting all financial innovations as it was common in the late 20$^{th}$ century. Innovations should be used with caution, understanding the risk of these new and sometimes unique products and processes. But with this thesis, I hope to disagree with comments made by some (not all) academics that interpret financial innovations as results of economic mayhem. For instance, the New York Times columnist and professor of economics Paul Krugman, as cited in Litan (2010), has asserted that it was "hard to think of any major recent financial innovations that aided society, as opposed to being new, improved ways to blow bubbles, evade regulations and implement de facto Ponzi schemes." In this bachelor's thesis, I will try to take up Paul Krugman's challenge and show that financial innovations are not for "blowing financial bubbles" but for increasing economic growth.

Furthermore, this thesis aims to evaluate the impact of financial innovations on global economic growth. For this evaluation to be conducted, first, individual financial innovations will be examined to determine the relationship between interest variables. Second, empirical articles in the field of financial innovation effectiveness will be analyzed to determine the quantitative impact of financial innovations on economic growth. Third, an empirical analysis will be conducted to support

previously gathered findings. All objectives are conducted to advocate the thesis hypothesis that financial innovations positively impact global economic growth.

The methodology of this bachelor's thesis consists of two qualitative approaches and one quantitative approach. The first qualitative method presents 11 financial innovations and the individual impact of these inventions on global economic growth. Additionally, these innovations are sorted by date of creation and sector relevance. The second qualitative method is a qualitative meta-analysis, where I inspect seven quantitative research articles and evaluate them by the discovered innovational impact. Eventually, the quantitative approach consists of an empirical analysis, where I examine the impact of financial innovations on global economic growth based on annual time series data. To compile this empirical analysis, I use the Autoregressive Distributed Lag technique and the pairwise Granger causality approach. All calculations are carried out using both R and EViews version 11.

Thus, this thesis is divided into three separate sections. The first section of this thesis is the qualitative approach of individual financial innovations. The second section is the qualitative meta-analysis. The third section is the empirical analysis. The bachelor's thesis ends with the main conclusions and recommendations in section four.

# 1. INDIVIDUAL FINANCIAL INNOVATIONS

This section contains the first part of the thesis, a qualitative approach to individual financial innovations, and this section consists of eleven subsections. The first three subsections document the first financial innovations: money, commercial banking, and financial markets. Subsections four to six represent financial innovations in the banking sector: automatic teller machines, credit and debit cards, and internet banking, while subsection seven shows the negative side of previously mentioned innovations. Subsections eight and nine document financial market innovations: mutual funds and exchange-traded funds (as examples of various pooled funds) and futures, options, and swaps (as examples of derivatives). Subsection ten shows the negative side of previously mentioned innovations. Eventually, subsection eleven represents the section conclusion. All financial innovations are chosen due to their excellent public accessibility and convenience, leading to the more significant usage of a particular invention and greater positive impacts on global economic growth (following Litan, 2010).

## 1.1. The rise of money

Long before money was invented, people used a barter system to exchange goods and services. This method of exchange was highly inefficient, but due to lack of research and development, it lasted for more than thousands of years. The main reason for the inefficiency was the "double coincidence of wants" problem (OpenStax et al., 2017). To be more precise, this problem occurs once a person wants a product or service and cannot provide the opposite party with goods of their choosing. For instance, if a local shoemaker wants to buy bread, the only thing the shoemaker could offer is shoes, and if the baker does not accept – this becomes a double coincidence of wants problem. Other flaws in the barter system were the lack of possibility of determining a long-term value of an exchanged product or service and lack of understanding of the true value of an exchanged good or service. These flaws often resulted in an adverse selection problem, where one trade party knew more about the product and its potential value, thus tricking the other party to gain higher profits. Both the double coincidence of wants problem and the adverse selection problem were causes of slow economic growth during the bartering days (Hogendorn and Johnson, 1986).

The rise of money and its functionality was the solution to resolve issues caused by the barter system (Velde, 1998). As defined in the Merriam-Webster dictionary, money is "something

generally accepted as a medium of exchange, a measure of value, or a means of payment." This definition represents three functionalities of money – a medium of exchange, a store of value, and a unit of account (OpenStax et al., 2017). To be more precise, the medium of exchange functionality represents money as an item widely accepted in exchange for all goods and services, thus resolving the double coincidence of wants problem. Both store of value and unit of account functionalities help determine a realistic and long-term fixed value of an item, thus overcoming the adverse selection problem caused by bartering (Banerjee and Maskin 1996). Due to the lack of quantitative research done in this field, it is tough to calculate the real impact of this financial innovation on global economic growth. Nevertheless, because of the resolving of issues caused by bartering, individuals can transact with each other freely and without fear of being frauded. This, as stated by Velde (1998), increased the volume of transactions done by individuals, thus increasing global economic activity and eventually increasing economic growth.

On the other hand, in an economy where money exists, tremendous economic growth faces different issues. For instance, before fiat money, commodity money faced devaluation, quality variation, and low supply issues that lead to similar adverse selection problems (Arvidsson, 2019). In some cases, one trade party knew more about the quality of the commodity than the other and thus gained additional profits after completing the trade. Fiat money tends to solve commodity money issues but faces a significant problem that is yet to be resolved – hyperinflation. Fiat money has unlimited supply and can be drastically controlled by the government. In some cases, this could be a good thing since the main goal for a government is to reach considerable economic growth in a country; thus, an increase in fiat money supply increases inflation, thus increasing spending and eventually increasing economic growth (OpenStax et al., 2017). However, due to the disorderly breakup of a currency zone, wars or revolutions, or even lack of monetary or fiscal authority control, this is not always the case (Åslund, 2012). We can see that countries like Venezuela and Zimbabwe tend to increase the money supply of a currency without additional analysis. As a result, we inspect a hyperinflation scenario, where the currency of a country loses its buying power, resulting in a decrease in economic activity, leading to significant economic downturns (Huertas, 2019). Nevertheless, hyperinflation is a rare phenomenon with only 58 occurrences in modern economic history, and it is not caused by a minor mistake; it is caused by a significant political disorder or serious economic madness in prerequisite.

### 1.2. The rise of commercial banking

According to Idiab et al. (2011), the first prototype banks were discovered in the fourth millennium BC, where wealthy families loaned grain to individuals given a fixed interest. The authors underline the Italian renaissance era as the critical point of improvement in this sector since wealthy families started to establish branches in many parts of Europe by offering loan services to a broad population and creating similar commercial banking branches as we have today. This profit-maximizing scheme pursued to work unrestricted till 1933, generating both significant profits for banks and extensive funding for individuals. However, due to increased demand for loans, lack of banking supervision – bankers conducted great speculative activity, resulting in the banking crisis of 1932. Roussakis (1997) stated that in 1933, the United States government published the Banking Act of 1933 to restore the banking sector and minimize economic consequences by increasing regulatory norms and promoting new policies. The academic furthermore mention that to improve banking sector supervision, this act determined the separation of the banking sector into two parts – commercial banking and investment banking. Till present day commercial banks serve small businesses and individuals with their everyday banking services – loans, checking, and saving account and investment banks serve medium to large companies and offer them debt and equity securities. Due to commercial bank individual accessibility, in this subsection, I inspect commercial banks as the primary financial innovations that had a drastic impact on global economic growth.

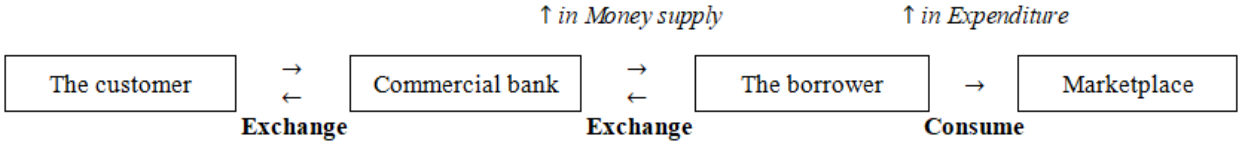
The commercial bank is described by Kagan (2021), an editor for Investopedia[1], as "a financial institution that accepts deposits, offers checking account services, makes various loans, and offers basic financial products like certificates of deposit (CDs) and savings accounts to individuals and small businesses." This description defines the main functionalities of commercial banking – receiving various deposits (source of liabilities) and loaning funds (source of assets). A client has multiple possibilities to make a deposit to the commercial bank – creating a checking account, where clients can deposit and withdraw funds without limits for a given cost, purchasing a certificate of deposit and leaving funds untouched for a fixed period, and gaining interest on this purchase, or creating a savings account, where the withdrawal of funds is regulated, and the interest rate is slightly lower than on the CDs option (Nawabzada, 2017). Clients tend to deposit funds because of the offered fund protection by the service provider and the central bank. Commercial banks tend to accept the responsibility of fund protection and accept deposits because these

[1] Investopedia is a popular financial content web site that provides investment dictionaries. This website can be located at www.investopedia.com.

deposited funds are eventually loaned to other clients for an interest rate higher than the interest rate given to depositors. This commercial banking profit-maximizing scheme increases profits generated by banks and the total money supply in circulation, thus increasing overall expenditure (Dean et al., 2010). To link expenditure and economic growth, an increase in economic growth is significantly caused by increased consumption and investment (Dean et al., 2010). To simplify the understanding of this particular phenomenon, Figure 1 presents a series of events linking the commercial bank profit-maximization scheme towards an increase in global expenditure that, as I already mentioned, increases economic growth. At first, the customer, indirectly (by creating a checking account) or directly (by purchasing CDs, creating a savings account, et cetera), exchanges deposited funds for a potential reward (an interest rate, the possibility to use bank services, et cetera). Next, the commercial bank conducts an exchange with the potential borrower. The bank offers a portion of customer deposits for an interest rate much higher than the cost of keeping the deposit. If accepted by the borrower, the commercial bank makes a sale and experiences increased bank revenue. This step also increases the money supply in circulation since deposits are now not only owned by the customer but also owned by the borrower. The final step is consumption - the borrower consumes the deposit in the global marketplace and thus increases global expenditure. In addition, to maximize profits, the commercial bank invests a portion of earnings in company-based development, leading to more similar sequences presented in this figure. Thus, it is clear that commercial banks and this profit-maximization scheme positively contribute to the global economy by increasing the money supply that increases global expenditure.

**Figure 1**

*Commercial bank profit maximization and economic expenditure.*




Note. This figure presents individual parties and describes a series of events that link the profit maximization scheme of the commercial bank towards increasing global expenditure. Arrows *right* and *left*, together with variables *exchange* and *consume*, present the relationship between parties, and arrows *up* present an increase in variables *money supply* and *expenditure* at a given series point. In addition, this figure is compiled by the author, based on the literature provided by Dean et al. (2010).

To contribute my findings with quantitative research, I also overview academic publications that inspect the relationship between economic growth and the development of the commercial banking sector. Paavo (2018) conducts a Granger causality test to inspect the relationship between

economic growth and banking sector development in Namibia and finds the relationship bi-directional, meaning that an increase in the banking sector results in an increase in economic growth and vice versa. Ragonmal (2015) conducts a Wald coefficient test to inspect the relationship of the banking sector development in Vanuatu and economic growth and finds a uni-directional causality, meaning that only the development of the banking sector increases economic growth. Given this information, I can assume that my theory is correct and increased commercial banking development tends to increase the customer base, increase deposits, increase the money supply in circulation, and increase global expenditure that leads to increased economic growth.

On the other hand, history shows that bank runs can potentially lead to harsh economic downturns. The Cambridge dictionary states a bank run as "a period when many people take their money out of a bank because they are afraid the bank will lose it or go out of business." There are many reasons for this particular type of fear – a recent financial crisis, speculative or even scandalous banking activity conducted, and even sometimes this is a result of a harmless (at first) bandwagon effect (Mofor, 2015). The result is a drastic increase in fund withdrawals by customers at a similar period. Due to the profit-maximizing scheme of commercial banking, only a small portion of deposits is kept to cover potential withdrawals. In contrast, a large part is invested in loans and bank development. Once liabilities of the bank (client withdrawal requests) are higher than assets (the portion of deposits kept), bank failure occurs. This results in a decrease in lending, reducing global expenditure and eventually leading to a halt in economic growth or even harsh economic downturns. Empirical evidence, gathered by Kupiec and Ramirez (2009), states that a 0.14 percent increase from the mean value of the liabilities of the failed institution results in a four percentage point decline in real GNP (Gross National Product) growth, thus approving my previous statement of harsh economic downturns. Nevertheless, as stated by Mofor (2015), bank runs rarely occur, and this is due to increased central bank supervision. Central banks have created widespread deposit insurances and organized bank-to-bank borrowing programs to help commercial banks pay off increased liabilities, thus reducing the likelihood of a bank run.

### 1.3. The rise of the financial market

It is tough to predetermine the exact date of the first financial market since, as stated by Hayes (2021) (an editor for Investopedia), the financial market is "<...> any marketplace where the trading of securities occurs <…>" and due to lack of specification of this marketplace different authors interpret this part of history differently. For instance, Malmandier (2009) finds traces of

securities (particularly company shares) traded by both individuals and companies back to ancient Rome. Greif (2006) states that these trades were poorly defined, and thus the first financial market can be pinned to medieval Italy, where traded "commenda" contracts represented the early forms of a limited partnership. Nevertheless, Stringham and Curott (2015) state that the rise of the traditional financial market sector and the first stock market was formed in the seventeenth century Amsterdam, where many investors could actively participate in an active secondary market by trading a few Dutch company shares. Due to the lack of trade options, previous authors state that the modern financial market emerged in the nineteenth to the twentieth century, with the rise of global security markets like the London Stock Exchange and the New York Stock Exchange, offering various trade possibilities and high levels of trade volume.

The major advantage of this financial innovation, as stated by Colombage (2009), and Shin (2013), is the possibility to mobilize personal savings and increase company capital at lower costs. The mobilization of saving advantages helps individuals secure funds and gain interest by buying regulated securities in the financial market. Therefore, financial markets can also reduce the risk of purchasing power decline due to inflation. The increased company capital advantage helps businesses raise cheap money for future investments in both long and short terms compared to taking loans from commercial banks at higher interest rates. These advantages can potentially lead to increased business expenditure that results in increased economic growth (Shin, 2013). Simplifying, most companies try to achieve profit maximization; thus, an increase in business capital will eventually lead to a rise in spending, aiming to increase production and ultimately increase revenue. To increase production, most companies will employ new personnel, thus increasing the spending majority that eventually leads to an increase in economic growth. Additional evidence is provided by Colombage (2009) and Guptha & Rao (2018). They find a uni-directional causality running from financial market development towards economic growth in Japan, Switzerland, the United Kingdom, and the United States of America from 1995 to 2006. Evidence shows that increased financial market development causes an increase in economic growth and vice versa.

On the other hand, history shows that not all sold securities in this particular market can be attributed to increasing economic growth, and thus the financial market does not necessarily cause a positive impact on economic growth, at least not in the short run. Some securities, usually due to their small market capitalizations, are not capable of generating any impact. And some securities,

because of their broad interest and lack of financial supervision, can cause price bubbles, most of the time resulting in a short-term economic downturn (Jorda et al., 2016). A price bubble is a situation where specific asset prices drift up rapidly from their fundamental value and, after a short period, decline abruptly (the bubble "bursts"). Jorda et al. (2016) find evidence that 41 out of 65 recessions are caused by price bubble "bursts" during the post-war period. Stated in a simplified way, because of the sharp price decline of a particular asset price, many investors generate negative returns and thus reduce their future spending, resulting in a general decline in economic activity – a recession. Nevertheless, as stated by Jorda et al. (2016), price bubble caused recessions tend to result only in short-term economic downturns. Thus, once the economy recovers from a recession, it grows, resulting in only marginally adverse long-run effects. Additionally, to prevent the short-run negative causality of these price bubbles to economic growth, monetary policy institutions also tend to inspect the impact of asset prices on employment and inflation and then adapt policies to maintain optimal long-term employment and price stability, by this increasing financial market supervision (Jorda et al., 2016).

### 1.4. Automatic teller machines

Until today, automatic teller machines (ATM) are one of the most used financial innovations that help banks to increase their productivity (see next paragraph), leading to an increase in economic growth (Ali and Kalu, 2016; Ahaiwe, 2011). The relatively short journey towards modern ATMs is described by Litan (2010). The first ATM prototype, a machine to mechanically dispense cash, was developed in 1939 by the City Bank of New York. Still, due to its low quality, this innovation lacked customer acceptance and was operational only for six months. Nevertheless, as Litan (2010) stated, the first modern electronic ATM was built in 1967 by the Barclays Bank in London, and soon after, the first network ATM was introduced in Dallas, Texas, in 1968. This modern ATM could be placed anywhere (due to networking), could be used anytime, and had an additional layer of protection (pin-code-based transactions), thus generating enormous public interest.

As stated in the previous paragraph, automatic teller machines help banks increase productivity, mainly because of optimized networking. Due to this innovation, individuals are free from time-taking queues in bank branches and can make minor banking transactions anytime and anywhere. As stated by Ali and Kalu (2016), the chance to make transactions at any given possibility lead to an increase in private sector demand deposits (that are used to make

aforementioned transactions), thus increasing the total amount of funds a bank can use for its services, eventually increasing bank productivity. Also, banks can service high quantities of transactions and thus gain additional revenue from fees. The increased bank income can be used to give out future loans, eventually, and again, increasing bank productivity and maximizing profits. Both factors stated above raise bank capital, and as stated in the previous subsection, "Rise of commercial banking" this leads to an increase in the money supply, thus leading to a rise in economic growth. Cookey et al.'s (2020) empirical findings perfectly contribute to this statement by providing evidence of a significant and positive long-run relationship between transaction values on ATMs towards economic growth in Nigeria. Also, these findings indicate that a 1% increase in the use of ATMs will increase the growth of the Nigerian economy by 0.1 billion nairas in the long run, thus approving the greatness of this particular financial innovation.

### 1.5. Debit and credit cards

As stated by Zandi et al. (2016), in the study conducted on behalf of Visa, debit and credit cards are essential financial innovations that reduce transaction costs and improve efficiency in flows of goods and service, by this highly contributing to economic activity. Credit cards were first introduced to the world by American Express and Bank of America in 1958, whereas debit cards were introduced in 1978 by the First National Bank of Seattle (Litan, 2010). The significant difference between these two types of cards is the intended functionality. Litan (2010) describes the function of debit cards as a means of payment, while credit cards serve as both a means of payment and a source of credit. Stated in a simplified way, debit card holders can buy products, pay for services and make money withdrawals using deposited funds only. At the same time, credit card holders can also use a small portion of bank funds at a given fee and a fixed return date. The option of what card to choose is based on both individual preferences and broad card acceptability.

Both debit cards and credit cards, as stated by Litan (2010), Wong et al. (2020), and Zandi et al. (2016), stimulate economic activities, increase bank profitability and subsequently enhance economic growth. For debit cards and debit card payments, Wong et al. (2020) state that increasing economic growth is caused by reduced transaction costs and improved efficiency in flows of goods, both leading to an increase in individual consumption and commercial bank investing. Stated in a simplified way, debit cards help card holders make payments for goods and services, without the need of banking branches, by this increasing the efficiency in flows of goods and services. This has the potential to increase card holder spending (individual consumption). Looking at this point from

the bank perspective, all transactions are initially done by banks, thus an increase in spending leads to a rise in bank revenue, and since banks are profit-maximizing firms, this revenue is invested. All of which leads to an increase in global expenditure and an increase in global economic growth. For credit cards and credit card payments, Litan (2010) states that increasing economic growth is caused by reduced transaction costs, improved efficiency in flows of goods, and additionally caused by increased funding for a given interest. Merely stating, credit cards help card holders make even more significant transactions by using personal funds and bank loaned credit (for a given interest). Similar to debit cards, these factors lead to an even more substantial increase in card holder spending, bank profitability, and eventually global expenditure. To provide quantitative proof of this particular effect, Zandi et al. (2016) conduct a study to inspect the impact of consumption (caused by card usage) towards GDP (as a measure of economic growth). The data is based on 70 countries (collectively accounting for approximately 95% of the world's GDP) from 2011 to 2015, and results are averagely weighted by country regions. Study summary results are presented in Table 1.

**Table 1**

*Summary Table: Average increase in GDP from increased card usage.*

| Region | Average Weighted by GDP | Average Weighted by Consumption |
|---|---|---|
| South America | 0.20 | 0.33 |
| Oceania | 0.12 | 0.22 |
| North America | 0.12 | 0.18 |
| Europe | 0.10 | 0.18 |
| Middle East | 0.09 | 0.23 |
| Asia | 0.06 | 0.12 |
| Africa | 0.05 | 0.08 |

Note. This table describes the relationship of increased consumption (caused by card usage) towards GDP for a particular region. The measure of given estimates is percentage points. In addition, this table is compiled by the author, based on Zandi et al. (2016), page 8.

Results presented in Table 1 suggest that consumption is positively correlated with economic growth, and both consumption (caused by increased card penetration) and economic growth tend to increase by 0.08% to 0.33% and by 0.05% to 0.20%, respectively. In addition, study results estimate 296 billion US dollars in increased global GDP at the given time frame, caused by this particular financial innovation. Thus, given results corroborate with findings gathered by Litan (2010) and Wong et al. (2020), and this provides insight - credit and debit cards (as financial innovations) positively and significantly contribute to global economic growth.

### 1.6. Internet banking

The innovation of internet banking (or e-banking) was one of the fastest-growing financial innovations at the start of the 21st century (Anesti, 2004). These authors define the rapid acceptance of internet services and the various advantages this innovation gives to both customers and banks as the main reasons for this phenomenon.

In the 1980s, internet banking was mainly used by individuals at homes and only by telephone calls due to the low demand for both computers and the internet (Sarel and Marmorstein, 2003). Nevertheless, the rise of modern e-commerce services in the mid-1990s led to a drastic increase in modern internet banking worldwide (Keivani et al., 2012). There are quite a few reasons, as described by the authors, for this particular rise: the increase in the supply of computers that lead to a decrease in prices of this specific good, the increase in competitiveness between internet providers that lead to a reduction in internet prices and eventually the drastic increase in the supply of goods and services offered online that could be paid only by making a banking transaction. It is clear that buying a good or service online and then going to the nearest banking branch to complete a transaction is highly inefficient, thus more and more individuals started to use internet banking services to save additional time while conducting minor transactions.

To inspect the advantages and the broad impact of this financial innovation on global economic growth, first two parties of this community must be separated – customers and banks. Anesti (2004) stated that customer-based advantages are convenience, transaction speed, cheaper service, and market transparency. Said in a simplified way, to make minor transactions from anywhere in the world without the need to go to a banking branch creates drastic customer convenience and saves additional time, thus increasing the transaction speed. Also, due to e-banking, customers can quickly inspect various bank offers before deciding which bank to use, thus creating price transparency and increasing the competitiveness between banks, resulting in cheaper services. Coming back to the banking-based advantage, the previous author underlines cost deduction. Stated in a simplified way, most transactions can be done online, and thus banks can reduce the number of operating branches and re-invest funds elsewhere. Briefly concluding, all customer-based advantages lead to an increase in transactions done by individuals, thus suggesting an increase in public consumption. The banking-based advantage leads to a reduction in company costs, and, as stated many times, because banks are profit-maximizing firms, funds saved are re-invested, thus suggesting an increase in investments. Both growth in public consumption and

growth in investment can be simply stated as an increase in global expenditure, this leading to a rise in global economic growth. To contribute these findings with additional quantitative literature, I inspect the empirical study conducted by Cookey et al. (2020). This study provides a significant and positive long-run relationship between transactions on internet banking and economic growth in Nigeria. In addition, these findings suggest that a 1% increase in the use of e-banking will increase the growth of the Nigerian economy by 0.04 billion nairas in the long run.

### 1.7. The negative side of financial innovations in banking

Increasing fraud-related criminal activity is stated to be the major consequence of automatic teller machines (Abdullahi et al., 2010), debit and credit cards (Carbo and Rguez, 2020), and internet banking (KPMG, 2019), all resulting in halted economic growth. As stated by all aforementioned academics, the reason for this particular increase is low risk and cheap equipment, compared to other criminal activity. The ATM Industry Association (2019) estimates a relatively small 4% increase in ATM-related fraud activity, comparing 2017 and 2018 data. Carbo and Rguez (2020) estimate a drastic 82% increase in card-related fraud per transaction worldwide, comparing data of 2014 and 2018. And KPMG (2019) states that an increase in internet banking-related fraud is recognized globally, but no additional estimations are shown.

The increase in fraud-related criminal activity in the banking sector tends to hurt both customers and banks. The KPMG (2019) research survey shows that only half of respondents (commercial bank clients that have been affected by fraud) recover more than 25% of fraud-related losses, this indicating that clients are not always authorized to get back lost funds and clients lose money. However, the lack of fund recovery does not necessarily halt economic growth, but it tends to reduce customer confidence in banking activities (Carbo and Rguez, 2020). The reduced confidence in banking reduces clients' deposits, which eventually leads to reduced bank capital. Reduced bank capital eventually leads to a reduction in loans made by banks to customers, which results in halted money supply growth and halts economic growth.

Nevertheless, as stated by Abdullahi et al. (2010), banks are highly familiar with fraud-related causal effects and are trying to reduce fraud attempts as much as possible to prevent profit deduction and halted economic growth. Banks are introducing new technologies, such as remote ATM management and foreign object detection (Abdullahi et al., 2010), multi-factor authentication,

device recognition, and Artificial Intelligence transaction inspection - all of which could provide an edge in the fight against fraud (ACI Worldwide, n.d.).

### 1.8. The rise of various pooled funds

As stated by the Pension Benefits Standards Regulations (1985), a pooled fund is "a fund established by a corporation that is duly authorized to operate a fund in which money from two or more depositors are accepted for investment and where shares allocated to each depositor serve to establish the proportionate interest at any time of each depositor in the assets of the fund." To be more precise, a pooled fund is a third party in the financial market that accepts funds from two or more investors (the first party) for a given fee and creates a portfolio by purchasing securities from security owners (the second party). By this, the first party gets a proportionate interest, the second party gains funds from sold securities, and the third party receives first-party paid fees. The main advantage of these pooled funds for investors, as stated by Lake (2019), is diversification, which is a possibility to be exposed to multiple assets at once, reducing the risk of an investment portfolio. Furthermore, as stated by Lake (2019), there are six types of pooled funds on the financial market (all of which are financial innovations): mutual funds, exchange-traded funds, hedge funds, closed-end funds, real estate investment trusts, and unit investment trusts that vary by their performance and management. The reason for this varicosity of pooled funds is quite apparent – an increase in investment choices results in an increase in investing, leading to a rise in individual pooled fund revenue. Due to the increased acceptance by the broad public, individual accessibility, and convenience of both mutual funds and exchange-traded funds, this subsection will only inspect these financial market innovations and their impact on global economic growth.

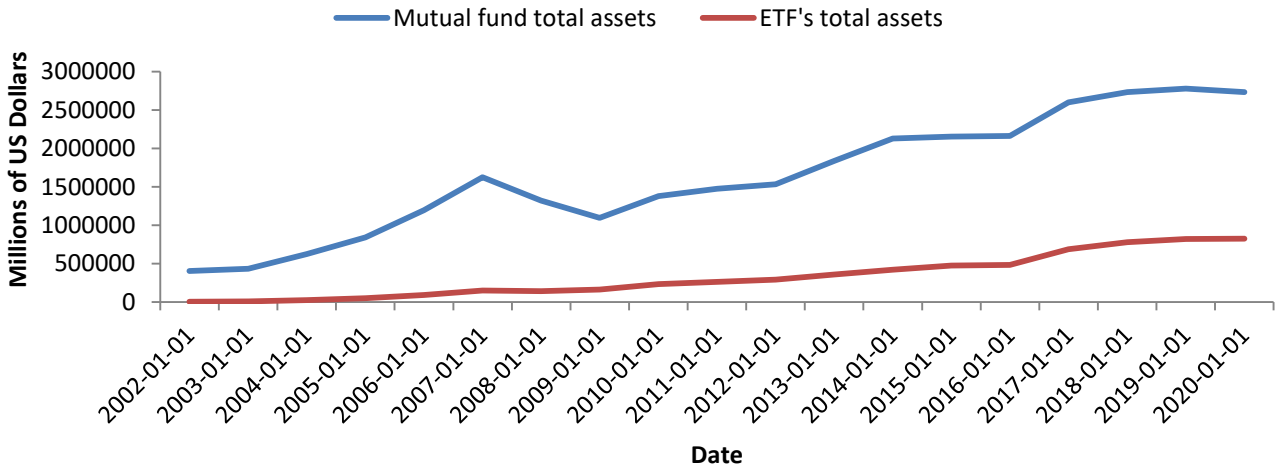
Mutual funds and exchange-traded funds (ETFs) are two types of pooled funds that contain a mix of many different assets and represent a common way for investors to diversify their investment portfolios. Mutual funds are relatively old financial innovations, traced back to the 18$^{th}$ century, while ETFs are relatively new financial innovations, where the first world's ETF was created in 1990 (Lake, 2019). As stated by the previous author, the main differences between these two financial innovations are management and flexibility. Mutual funds are actively managed by fund managers that can decide how to allocate assets in the fund. Simultaneously, ETFs are usually passively managed, and their assets are based simply on a particular market index. Additionally, mutual funds are purchased by investors at the end of each trading day, based on a calculated price. At the same time, ETFs are more flexible – they can be purchased anytime during active trading

hours. As stated in the previous paragraph, these differences help pooled fund investment companies attract different investors based on individual preferences.

The quantitative impact of these innovations on global economic growth is rarely measured in research, and this is due to a lack of measurement possibilities (Litan, 2010). Nevertheless, I inspect these financial innovations as types of investments funded by personal savings, which eventually increases global economic growth. As stated previously, pooled funds and, more precisely, mutual funds and ETFs contain a goal of profit-maximization. These funds try to increase their revenue by offering various investment possibilities to the broad public. This increases the number of investors, increasing the number of securities bought, eventually increasing the total financial assets of these funds (Zu, 2016). Figure 2 depicts a stable yearly increase in total assets held by mutual funds and ETFs from the early 2000s until the start of 2020, thus demonstrating the increasing interest in these financial innovations.

**Figure 2**

*Assets held by Mutual funds and exchange-traded funds.*




Note. This figure demonstrates the number of total assets held by mutual funds and exchange-traded funds for a given period. In addition, this figure is compiled by the author, based on data retrieved from the Federal Reserve Bank of St. Louis (FRED) database, series identifiers: BOGZ1LM654092603Q; BOGZ1FL564092603Q.

From the personal savings perspective, an increase in the varicosity of saving portfolios leads to an increase in individual savings, resulting in larger future capital investments, ultimately increasing economic growth (Zu, 2016). To simplify this idea, greater investment options attract more investors, leading to more funds invested and more funds saved. This leads to more funds in circulation and more significant expenditure, eventually leading to an increase in economic growth.

To further support this statement, I additionally inspect an empirical study conducted by Thornton (2009). He finds a positive long-run relationship between personal savings rate and real GDP in the United States of America, from 1948 until mid-2009. Additionally, calculating the simple percent correlation between these two variables, Thornton (2009) also finds a positive (but relatively weak) short-term relationship, suggesting that a higher savings rate is associated with faster economic growth. Of course, it would be incorrect to conclude that higher saving rates are responsible for increasing economic growth since many other variables determine this particular increase. However, findings gathered by Najarzadeh et al. (2014) suggest a bidirectional causality relationship between personal savings and economic growth, and thus, this greatly corroborates with findings collected by Thornton (2009). Eventually, this information suggests that increased savings (or investments) by individuals, caused by the increasing interest of mutual funds and ETFs (financial innovations), help increase global economic growth and positively contribute to the global economy.

### 1.9. The rise of various derivatives

As described by Black et al. (2012) in the Dictionary of Economics, a derivative is "a tradable security whose value is derived from the actual or expected price of some underlying asset, which may be a commodity, a security, or a currency." To be more precise, a derivative can be considered as an agreement between two or more parties that obtain a price predetermined by the particular asset. Litan (2011) and Vo et al. (2019) stated the advantages of this particular financial instrument are hedging risk exposure and underlying asset price determination. Said in a simplified way, by using derivatives, investors have an opportunity to reduce the risk of asset price reduction ("hedge" risk) since the derivative (or the underlying asset; agreement) has a predetermined price. Furthermore, as stated by Vo et al. (2019), there are many types of derivatives (all of which can be named as financial innovations), but the most used derivatives are: forwards, futures, options, swaps, exotic and credit derivatives, weather, energy and insurance derivatives, all varying by different underlined assets and their risk exposure. The reason for this broad varicosity of derivatives is obvious – additional derivatives help investors better manage risk and thus gain greater profits from their initial investments (Hull, 2002). Due to the increased acceptance, accessibility, and convenience of futures, options, and swaps, this subsection will only inspect these financial market innovations and their impact on the global economy.

Both futures and options are agreements between two or more parties to buy or sell a given security at a determined delivery time and price. These financial market innovations have been

available for some time, but only in the 1970s, due to the rise of authorized futures and options exchanges, these financial instruments unleashed a massive growth in the number and kinds of both futures and options, as well as the trading volume (Litan, 2010). The critical difference between these derivatives, as stated by Hull (2002), is the right of contract execution – futures oblige the investor to fulfill given determinants, while options do not. To be more precise, a future investment obliges both parties to buy or sell a product at a given price and time, while option contracts only create a possibility to do so, and this is not mandatory. Unlike futures and options, swaps are agreements only between two counterparties to exchange financial instruments, cash flows, or payments for a specific time. Developed in the 1960s, this financial market innovation was used overwhelmingly to reallocate financial risk (Litan, 2010). As mentioned in the previous paragraph, these derivatives and their differences help attract more investors to achieve a better risk management system that can lead to greater profits (Hull, 2002). To link greater profits with economic growth, it is wise to interpret profits as an increase in company, institution, or government capital that potentially leads to an increase in future investments (for the purpose of greater profits), thus evolving into an increase in economic growth.

Due to a lack of empirical evidence, it is hard to state the true impact of futures, options, and swaps on economic growth. Nevertheless, evidence stated by Şendeniz-Yüncü et al. (2018), Khan et al. (2017), Vo et al. (2019), and Haiss and Sammer (2010) represents great importance of derivatives markets in general. To be more precise, Haiss and Sammer (2010) show that the development of derivative markets influences economic growth by facilitating and increasing capital accumulation. Şendeniz-Yüncü et al. (2018) state that a well-functioning derivatives market makes it possible for companies to share risk efficiently and thus, conduct projects with higher risk and consequently boost economic growth. Both Khan et al. (2017) and Vo et al. (2019) document the existence of bidirectional Granger causality between derivative market development and economic growth. Furthermore, all studies state that futures, options, and swaps are the most widely used types of derivatives, thus it would be correct to presume that the gathered evidence suggests not only broad derivative impact but also individual innovation impact towards economic growth.

### 1.10. The negative side of financial market innovations

In my previous subsection, "Rise of financial markets" I mention the lack of financial market supervision as a partial reason for economic downturns. In this subsection, I inspect the negative side of pooled funds and derivatives, and I additionally try to approve this theory.

The major problem of pooled funds is high levels of fraud that can be prevented by market supervision (Rajapakse and Malaba, 2015; Zarrabi and Lundberg, n.d.). To briefly explain, investors are keen to give money to pooled funds for a chance to have diversified portfolios that reduces risk and expands profits. There is no certainty that the pooled fund's purpose will be fulfilled, sometimes funds can misappropriate investments for personal gain, establish Ponzi schemes and make unauthorized investments (Rajapakse and Malaba, 2015). This can eventually lead to a drastic decrease in investment capital, reduce individual spending, and generate economic downturns. Bernard L. Madoff Investment Securities LLC hedge fund can be viewed as a perfect example of pooled fund-related fraud. This hedge fund conducted one of the largest Ponzi schemes in US history, embezzling billions of US dollars from investors (Zarrabi and Lundberg, n.d.). The consequences of the Madoffs Ponzi scheme were rigorous: four suicides by significant investors and more than 50 billion invested US dollars lost (Cohler, 2017). Furthermore, as Zarrabi and Lundberg (n.d.) stated, it is hard to determine one unique method that prevents fraud, especially with pooled funds, since new technologies bring new ways of conducting criminal activity.

Extreme speculation could be interpreted as the major consequence of derivatives that, similarly to pooled funds, could be prevented by greater market supervision (Chu, 2010; Pollock, n.d.; Rajapakse and Malaba, 2015). Derivatives, as stated previously, are great instruments to hedge risk, but not all investors use this instrument only for its initial purpose. Many investors irrationally speculate in derivative markets by increasing initial leverage and short-selling, leading to an increase (and not a decrease, as the primary objective would suggest) in risk to increase profits (Pollock, n.d.). Stated in a simplified way, leveraged derivatives help investors to multiply the rate of return (or loss) significantly on the underlying asset, and short-selling lets investors borrow and sell derivatives at present and buy identical derivatives in the future, by this increasing the rate of return (or loss). The National Australia Bank disaster of 2004 (loss of 360 million US dollars) (Skeers, 2004) and the Metallgesellschaft AG disaster of 1993 (loss of 1.3 billion US dollars) (Laurent, 2010) are great examples of financial disasters caused by speculative derivative investing. Additionally, many great economists state that the global financial crisis of 2008 was partially caused by speculative derivative investing, to be more precise – speculative investing of Credit Default Swaps (CDS) and Collateralized Debt Obligations (CDO) (Daumal, 2018). Briefly explaining, CDS are swap-type derivatives based on credit defaults and work as insurance in case of payment default and CDOs are credit derivatives based on pooled individual loans and work as payment installments from mortgage owners to investors (Litan, 2010). Daumal (2018) stated that

the drastic rise of mortgage prices in the United States pre-crisis period led to a drastic increase in leveraged investments of CDOs and CDS, where CDOs acted as stable and consistent income and CDS acted as an insurance in case of CDO price default. Furthermore, Daumal (2018) that the turning point of this profit-maximizing scheme was the mortgage price bubble burst of 2008, where mortgage prices fell rapidly, and mortgage owners defaulted, leading to many worthless CDOs that had to be repaid by CDS providers. This burst led to a drastic decrease for both investor capital (investors that did not have CDS in their portfolio) and CDS provider capital (investment bank capital), and this eventually led to the global financial crisis of 2008 and a global economic recession.

Nevertheless, both fraud and speculation could be prevented by increased institutional regulation. In the case of pooled funds, both Zarrabi and Lundberg (n.d.) and Rajapakse and Malaba (2015) underline increasing regulatory competence as a factor that can potentially help reduce fraud. Previous academics state that the help of competitive supervision could prevent fraud attempts from evolving, thus reducing the consequence of a decrease in capital, eventually reducing economic downturns related to fraud. In the case of derivatives, Chu (2010) emphasizes the involvement of regulatory institutions that can help prevent great speculation leading to drastic decreases in investment capital. Chu (2010) states that revised capital adequacy would have prevented the number of CDOs sold to the broad public by investment banks, thus reducing the chance of a housing bubble collapse. In addition to the author, greater regulatory norms would have prevented excessive risk-taking by investors and would have helped to avoid the global financial crisis. Given the great importance of regulation activity, I approve my previous theory and presume that consequences of pooled funds and derivatives are broadly caused by lack of supervision, and lack of supervision leads to pooled fund-related fraud and derivative-related high-risk speculation that harm economic growth.

## 1.11. Conclusion

In this section, individual financial innovations were examined to determine an existing relationship between financial innovations and global economic growth. These innovations were chosen due to their excellent public accessibility and convenience (following Litan, 2010). To briefly present the summary of this section, Table 2 is reported. Results suggest that all previously described innovations positively contribute to global economic growth in the long run. First financial innovations tend to reduce economic problems and increase global expenditure (both for

individuals and businesses) by presenting new payment types, expanding the money supply in circulation, and funding companies. Financial innovations in the banking sector all tend to increase global spending by increasing public consumption and company-based investments. Lastly, financial market innovations tend to increase future expenditure by increasing the number of funds saved by multiple individuals. These outcomes, all in all, suggest a significant positive impact of financial innovations on global economic growth and thus present a positive relationship between these research variables.

**Table 2**

*Summary table of previously described innovations.*

<table>
<tr><th>Innovation</th><th>Positive outcome</th><th>Negative outcome</th></tr>
<tr><td>Money</td><td>↓ in problems caused by bartering</td><td>Possible hyperinflation</td></tr>
<tr><td>Commercial banking</td><td>↑ in money supply<br>leading to ↑ global expenditure</td><td>Possible bank runs</td></tr>
<tr><td>Financial markets</td><td>↑ business expenditure</td><td>Possible price bubbles</td></tr>
<tr><td>ATMs</td><td rowspan="3">↑ in public consumption, ↑ in investments<br>all leading to ↑ global expenditure</td><td rowspan="3">↑ number of fraud attempts</td></tr>
<tr><td>Credit and Debit cards</td></tr>
<tr><td>Online banking</td></tr>
<tr><td>Mutual funds</td><td rowspan="5">↑ in future investments</td><td rowspan="2">↑ number of fraud attempts</td></tr>
<tr><td>ETFs</td></tr>
<tr><td>Futures</td><td rowspan="3">Extreme speculation</td></tr>
<tr><td>Options</td></tr>
<tr><td>Swaps</td></tr>
</table>

Note. This table describes the positive and negative outcomes of previously inspected financial innovations. Arrows *up* and *down* present increase and decrease, respectively. In addition, this table is compiled by the author based on the results presented in this section.

However, innovations do have a dark side. Due to the lack of governmental supervision, innovations can halt global economic growth for a short period. Thus, institutions must take matters into their own hands to prevent negative financial innovation causalities. The only thing to keep in mind is that there is only a relatively small chance of a drastic negative outcome (like hyperinflation, bank runs, and price bubbles); thus, positive financial innovation outcomes outweigh adverse effects in almost all cases.

# 2. QUALITATIVE META-ANALYSIS

In this section, I survey seven different research papers that inspect financial innovation's impact on economic growth, both for individual countries and country groups. The empirical view on financial innovations and the relationship between innovations and growth is hardly inspected in present times, and this is due to no particular innovation measurement and no specific method of estimation (Bara et al., 2016; Nazir et al., 2020). Thus, the lack of empirical evidence is the main reason for this qualitative, not quantitative, meta-analysis. To conduct a quantitative meta-analysis, an appropriate systemic review must be done, and the heterogeneity of research articles must be inspected (Thompson, 1993). Due to the small quantities of empirical evidence based on this field of research, it is tough to conduct an efficient meta-analysis that avoids biases and represents significant results. Nevertheless, this qualitative approach will still inspect the impact of financial innovations on economic growth in order to investigate this research question in a broader context.

## 2.1. Literature review

Going on with the qualitative meta-analysis, in Table 3a, I visualize inspected articles by authors, dependent variables, financial innovation proxies, the estimated coefficients, the method of analysis, number of countries used, dates of observations, and the discovered impact. Furthermore, in the field of financial innovations, the dependent variable is always Gross Domestic Product, both in real and nominal terms, as a portion of GDP per capita, as GDP growth, or as normalized GDP. The reason for using GDP to measure economic growth is quite apparent – this measure indicates the size of the sample economy and perfectly visualizes economic performance. The proxy tends to differ between academic papers, but the most used proxies are broad-to-narrow money (M2M1) (used four times), growth in bank credit to private sector (GBCP) (used three times), and domestic credit to private sector (DCP) (used two times). Other proxies are used only once, and thus I will not inspect them further. The proxy M2M1 affects the demand for real cash balances, the income and interest elasticity for money demand (Bara and Mudzingiri, 2016; Bara et al., 2016; Qamruzzaman and Jianguo, 2017; Nazir et al., 2020), the proxy GBCP gauges improvements in financial services since it omits credit to the government or public enterprises (Idun and Aboagye, 2014; Bara and Mudzingiri, 2016; Bara et al., 2016), and the proxy DCP denotes to the ratio of the number of credit services to the private region for investment in the practice of loan, securities and other receivables (Qamruzzaman and Jianguo, 2017; Nazir et al., 2020). The coefficients estimated and the column

headed "Impact" strongly correlate since the impact is evaluated based only on significant coefficient values. From seven academic papers, only one article presents a significant negative coefficient. It thus suggests an adverse effect of financial innovations on economic growth in the long run. In comparison, six papers show positive and significant coefficients, thus offering a positive, and in some cases, even a strong positive, impact from financial innovations towards economic growth in the long run.

**Table 3a**

*Summary of published studies in the field of financial innovations and their impact on economic growth, part a.*

| Author | Dependent variable | Proxy | C | M | N | Date | Impact |
|---|---|---|---|---|---|---|---|
| Hao and Hunter (1997) | Nominal GDP per capita growth (%) | Years of organized trading in future instruments | 0.0019** | M1 | 63 | 1970-1988 | ++ |
| Idun and Aboagye (2014) | Real GDP per capita growth (%) | GBCP | -0.0472* | M2 | 1 | 1990-2009 | – |
| Bara and Mudzingiri (2016) | Nominal GDP per capita growth (%) | GBCP | 0.05 | M2 | 1 | 1980-2013 | + |
| | | M2M1 | 0.40** | | | | |
| Bara et al. (2016) | Real GDP per capita growth (%) | M2M1 | -0.269 | M2 | 15 | 1985-2014 | + |
| | | GBCP | 0.67 | | | | |
| | | Value of Mobile banking | 0.0186** | | | | |
| Qamruzzaman and Jianguo (2017) | Real GDP per capita growth (%) | DCP | 0.09*** | M2 | 1 | 1980-2016 | ++ |
| | | M2M1 | 0.65** | | | | |
| Cookey et al. (2020) | Real GDP (Nigerian Naira) | Value of transactions on ATMs | 0.1** | M2 | 1 | 2009-2018 | + |
| | | Value of transaction on web-banking | 0.04** | | | | |
| | | Value of transaction on Point of Sale terminals | 0.108** | | | | |
| | | Value of transaction on Mobile Payments | 0.101** | | | | |
| Nazir et al. (2020) | Real GDP per capita growth (%) | DCP | 1.19** | M2 | 3 | 1970-2016 | ++ |
| | | M2M1 | 0.34** | | | | |

Note. This table summarizes individual articles by eight factors. Column headings can be described as follows: "Author" presents the article that is summarized; "Dependent variable" and "Proxy" presents the main estimated regression variables; "C" presents the estimated long-run proxy coefficient; "M" presents the method number used in the study; "N" shows the number of countries inspected; "Date" presents the analyzed period; "Impact" presents the evaluated impact of estimated proxies on the dependent variable. Abbreviations are described as follows: GBCP is growth in bank credit to private sector, M3M1 is broad-to-narrow money, and DCP is domestic credit to private sector. In addition, this table is compiled by the author, based on published studies examined in this section.

[a] M1 (or method 1) is an OLS regression model estimation; M2 (or method 2) is an Autoregressive Distributed Lag (ARDL) model estimation.

[b] ++ denotes a significant positive impact of all proxies; + denotes a significant positive impact of some, but not all proxies; – denotes a significant negative impact of all proxies.

* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$.

Estimated results differ between academics due to many factors: used variables, number of observations at a given period, and, most importantly, the methodology used in the study. The

majority of authors (six out of seven, to be precise) use the ARDL technique to inspect the relationship between study variables (defined as method 2), and only one article, published by Hao and Hunter (1997), uses a standardized OLS regression model (defined as method 1). The ARDL technique is favorable in this particular situation since it's more robust and performs much better than a standardized OLS regression for a small sample size (what is usually the case while inspecting financial innovation effectiveness) (Ghatak and Siddiki, 2001). The reason why the study conducted by Hao and Hunter (1997) is an outlier in this section is relatively straightforward – to estimate a significant long-run coefficient using the ARDL technique, first, the ARDL bound testing approach must be conducted, and since this approach was first introduced by Persan et al. in 2001, authors could not run non-existing estimations. In addition, as described previously, only one article, conducted by Idun and Aboagye (2014), presents a significant negative relationship between financial innovations and economic growth, while other academics present significant positive relationships. The reason why this precise negative relationship occurred can be explained by inspecting the "unfit" proxy variable – GBCP. This proxy does not interact greatly with variable GDP and presents relatively small, or even none, significance while interacting with economic growth (Bara et al., 2016).

To provide additional information regarding the existence of a particular relationship, most authors conduct a Granger causality test to inspect the causal effects between the independent variable (financial innovation proxies) and the dependent variable (measurement of economic growth). The summary of multiple granger causality tests is visualized in Table 3b. Using this table, I can state that in the aforementioned literature, five bidirectional relationships exist, where both the dependent variable and the proxy affect each other, and one unidirectional relationship exists, where only proxy variables cause economic growth. In addition, Qamruzzaman and Jianguo (2017) indicate that no clear causal relationship exists between financial innovations and economic growth; and Hao and Hunter (1997) do not conduct a Granger causality test; thus, results are presented in terms "NA" (or "Not Available"). Eventually, the majority of academics suggest an existence of a causal relationship between financial innovations and economic growth, and it seems that financial innovations and economic growth reinforce each other.

**Table 3b**

*Summary of published studies in the field of financial innovations and their impact on economic growth, part b.*

| Author | Dependent variable | Proxy |
|---|---|---|
| Hao and Hunter (1997) | NA | NA |
| Idun and Aboagye (2014) | Yes | Yes |
| Bara and Mudzingiri (2016) | Yes | Yes |
| Bara et al. (2016) | No | No |
| Qamruzzaman and Jianguo (2017) | Yes | Yes |
| Cookey et al. (2020) | No | Yes |
| Nazir et al. (2020) | Yes | Yes |

Note. This table summarizes individual articles by an additional factor – results discovered from the Granger causality test. Column headings can be described as follows: "Author" presents the inspected article; "Dependent variable" presents the existence of a causal relationship from the dependent variable towards the proxy variable; "Proxy" presents the presence of a causal relationship from the proxy variable towards the dependent variable. In addition, this table is compiled by the author, based on published studies examined in this section.

[a] "Yes" describes a valid causal effect; "No" describes no significant causal effect.
[b] If academics do not conduct this precise test, results are denoted as "NA".

To analyze the real long-run effect of financial innovations on economic growth, based on the aforementioned academic literature, I construct an elasticity measurement and visualize it in Table 4. To calculate elasticities, proxy coefficients are extracted from Table 1a, and, taking into account model dependent variables, significant coefficients are averaged by their weights – the number of countries analyzed. Proxy coefficients that are insignificant or cannot be averaged (due to dependent variable differences) are omitted to inspect real outcomes.

**Table 4**

*Estimated elasticity based on published studies.*

| Dependent variable | Proxy | Estimated elasticity |
|---|---|---|
| Real GDP per capita growth (%) | DCP | 0.243 |
| | M2M1 | 0.382 |

Note. This table demonstrates the estimated elasticity for proxies DCP and M2M1, based on published studies presented in tables 3a and 3b. In addition, this table is compiled by the author, based on published studies examined in this section.

Thus, only two articles meet the given criteria – one is published by Qamruzzaman and Jianguo (2017), and the other is published by Nazir et al. (2020). Estimation results suggest that a 1% increase in proxies M2M1 and DCP lead to an increase in real GDP per capita by 0.382% and 0.243%, respectively. This estimation provides additional insight to the hypothesis of an existing long-run relationship for financial innovations on economic growth.

## 2.2. Conclusion

On the one hand, I can state that financial innovations contribute to economic growth, at least for most inspected articles. These articles suggest the existence of a positive and significant long-run relationship between at least one financial innovation proxy and economic growth. Six out of seven academic papers also provide evidence of a significant causality effect from financial innovations to economic growth, where the direction of causality is either unidirectional or bidirectional. In addition, the estimated elasticity approves a long-run relationship between financial innovations and economic growth and represents an increase in long-run economic growth once variables DCP and/or M2M1 increase. On the other hand, due to the lack of research articles in this particular field, results cannot establish a universal agreement in the literature.

# 3. EMPIRICAL ANALYSIS

In this section, I conduct an empirical analysis for two primary reasons: to inspect the impact of financial innovations on global economic growth and to increase the number of relevant quantitative literature in the field of financial innovation effectiveness. This empirical analysis is divided into four separate parts: Data description, Methodology, Representation and analysis, and Conclusion.

## 3.1. Data description

To reduce biases caused by large samples and missing data points, in this section, I inspect the impact of financial innovation on countries that are members of the Organization for Economic Co-operation and Development (henceforth, OECD). To be more precise, OECD is an organization consisting of 37 economically advanced countries (list of countries is presented in Annex 1) that try to stimulate economic progress and world trade. Since OECD countries contribute approximately 61%[2] of global GDP, it is reasonable to use this organization as a proxy for researching global economic development. Thus, this empirical analysis uses yearly time series financial data based on the aggregate measure of total OECD values from 1982 to 2019. Furthermore, three variables are used in this study:

1. Nominal GDP per capita growth, as a measure of economic performance, calculated in percentage points (hereafter, variable GDPg). Source: World Development Indicators (database) (World Bank, 2021)[3].
2. Domestic credit to private sector, as a proxy for financial innovations, calculated in levels (hereafter, variable DCP). Source: World Development Indicators (database) (World Bank, 2021)[4].
3. Adjusted broad-to-narrow money, as a proxy for financial innovations, calculated as a ratio[5] (hereafter, variable M3M1). Source: Main Economic Indicators (database) (OECD, 2021)[6].

The intention to use nominal instead of real GDP per capita growth is due to lack of real GDP value estimations by data providers. In addition, I use GDP per capita instead of standard GDP

[2] Value estimated using the World Bank development indicator for GDP, series identifier: NY.GDP.MKTP.CD.
[3] Indicator for GDP per capita growth, series identifier: NY.GDP.PCAP.KD.ZG.
[4] Indicator for domestic credit to private sector, series identifier: FS.AST.PRVT.GD.ZS.
[5] The ratio of broad-to-narrow money is calculated by dividing broad money by narrow money.
[6] Indicators for broad money and narrow money, subject: money aggregates.

since this method reduces biases caused by an increase in population or migration dynamics. The intention to use both domestic credit to private sector and adjusted broad-to-marrow money as proxies for financial innovations is relatively straightforward – these measures greatly emphasize the increase in money used by individuals and companies caused by the help of financial innovations (Bara and Mudzingiri, 2016; Bara et al., 2016; Qamruzzaman and Jianguo, 2017; Nazir et al., 2020). Due to the fact that increased funds have the potential to positively impact economic growth, as mentioned in the first part of this thesis, I expect to see a positive and significant value for these proxies.

To reach significant results, I make minor adjustments to both proxies. The proxy Domestic credit to private sector is distributed in growth terms, rather than levels, to reduce large numeric values (compared to other variables in this dataset). The proxy adjusted broad-to-narrow money consists of a different broad money supply measure, from M2 (as stated in the previous section "Qualitative meta-analysis") to M3, since the M2 measurement is not estimated for the studies aggregate measure - total OECD. These changes should not increase the volatility of our future model since proxy DCP generates identical specifications, and proxy M3M1 is estimated to have an approximate 5% difference in value[7] compared to the previous proxy M2M1.

### 3.2. Methodology

First, descriptive statistics are reported to overview the data. Second, a unit root test is conducted in levels and first difference to ascertain time-series properties. The order of variable integration is determined by using the Augmented Dickey-Fuller (ADF) test. Third, the Autoregressive Distributed Lag (ARDL) bound test approach is applied to inspect the existence of both data cointegration and a long-run relationship. Fourth, an Autoregressive Distributed Lag (ARDL) model is used to estimate both short-run and long-run (if existing) coefficients. The choice to use the ARDL technique is based on its suitability for a limited sample size of 30–80 observations and its reliable results for variables with mixed orders of integration (Ghatak and Siddiki, 2001). Fifth, a pairwise Granger causality test is conducted to inspect the causal relationship between study variables. Sixth, to verify the classical linear regression model

[7] This estimation is based on the M2 and M3 money supply calculations by Norrestad (2020) for the euro area. Given the fact that 17/19 countries of the Eurozone are also members of OECD and the M2 money supply accounts for 95.38% of M3, it implies that variable M3M1 differs in value by 5%, compared to variable M2M1.

assumption and examine model significance, the sample data is subjected to a Harvey heteroskedasticity test. Seventh, a country-specific analysis is conducted to examine homogeneity.

Based on the theoretical and empirical relationship of the study variables, this empirical analysis is conducted using two linear regressions for individual proxies (following Nazir et al., 2020). The reason to use two linear models (instead of one) is due to different proxy measurement points and different data providers, all of which can potentially reduce model fit, leading to less significant results. These linear models are specified in equations 1 and 2, where proxies for financial innovations are DCP and M3M1, respectively.

$$GDPg = \beta_0 + \beta_1 DCP_t + \varepsilon_t \quad (1)$$

$$GDPg = \beta_0 + \beta_1 M3M1_t + \varepsilon_t \quad (2)$$

Furthermore, variable $GDPg$ is nominal GDP per capita growth; variable $DCP$ is domestic credit to private sector; variable $M3M1$ is the adjusted broad-to-narrow money; $t$ is time; $\beta_0$ is the intercept parameter; $\beta_1$is the slope parameter; $\varepsilon$ is the error correction term.

### 3.3. Representation and analysis

Descriptive statistics are summarized in Table 5. At first glance, there are no extreme outliers visible in the data. Additionally, a positive mean of all variables can be seen, suggesting a positive trend over time. As a measure of dispersion, the standard deviations indicate that both GDPg and DCP variables are volatile and uncertain, while the variable M3M1 is suggested to be relatively stable. The level of Skewness is between -3 and 3, and the level of Kurtosis is between -10 and 10 for all variables inspected, thus suggesting a normal distribution (Brown, 2006). Furthermore, descriptive statistics are based on 38 annual observations for all variables in the data set, thus hinting that using the ARDL technique is adequate (Ghatak and Siddiki, 2001).

**Table 5**

*Descriptive statistics.*

| Variable | GDPg | DCP | M3M1 |
|---|---|---|---|
| **Mean** | 1.614576 | 1.406815 | 1.156974 |
| **Median** | 1.952167 | 1.815458 | 1.175921 |
| **Maximum** | 3.79289 | 12.71933 | 1.31381 |
| **Minimum** | -4.11964 | -10.6233 | 0.932685 |
| **Std. Dev.** | 1.389893 | 4.411547 | 0.099152 |
| **Skewness** | -1.84479 | -0.23976 | -0.86081 |
| **Kurtosis** | 8.871717 | 4.083541 | 3.019774 |
| **Observations** | 38 | 38 | 38 |

Note. Compiled by the author, this table summarizes the data set used in the empirical analysis.

Given that time series data exhibit trending behavior, which produces erroneous and misleading results, the Augmented Dickey-Fuller (ADF) unit root test is performed to determine time-series properties and the order of integration of used variables. The optimal lag length of this test is estimated using EViews automatic lag selection, based on the Akaike information criterion. Results are visualized in Table 6. To reject the null hypothesis of a unit root, I use the significance level of 5%. The results demonstrate that the null hypothesis for the dependent variable GDPg is rejected without additional modifications; thus, the variable is stationary, and the order of integration is order zero. In addition, the null hypothesis for both independent variables DCP and M3M1 is rejected at the 1st difference; thus, both variables are first-difference stationary. The order of integration of independent variables DCP and M3M1 is order one. These results suggest mixed orders of integration and thus fit the ARDL criteria.

**Table 6**

*Augmented Dickey-Fuller test results.*

| Variable | P-value | P-value (1st difference) | Order of integration |
|---|---|---|---|
| GDPg | 0.0010 * | - | I(0) |
| DCP | 0.674 | 0.0003 * | I(1) |
| M3M1 | 0.4718 | 0.0087 * | I(1) |

Note. This table presents a summary of ADF test results for research variables GDPg, DCP, and M3M1 and describes the order of integration of a particular variable. The column headed "P-value" presents test results for unmodified variables, and the column headed "P-value (1st difference)" shows test results for first-differenced variables. In addition, this table is compiled by the author.

* $p < 0.05$.

To conduct the ARDL bound test, two ARDL models are estimated using previously specified regressions (equations one and two). The optimal lag length is calculated using EViews automatic lag selection, based on the Akaike information criterion. Res are reported in Table 7.

**Table 7**

*Results of the ARDL bound testing approach.*

| Model 1 | | Model 2 | | Significance | I(0) | I(1) |
|---|---|---|---|---|---|---|
| **Test Statistic** | **Value** | **Test Statistic** | **Value** | 10% | 4.04 | 4.78 |
| F-statistic | 21.19309 | F-statistic | 11.82041 | 5% | 4.94 | 5.73 |
| K | 1 | K | 1 | 1% | 6.84 | 7.84 |

Note. Compiled by the author, this table describes multiple ARDL bound test results for models one and two. Based on the Akaike information criterion, the optimal ARDL model for both tests is ARDL (1, 1).

The computed F-statistic of both tests exceeds upper and lower bound statistics at the 10%, 5%, and 1% levels of significance; thus, the null hypothesis of no cointegration is rejected, and, therefore, cointegration exists for both models one & two. These findings support the hypothesis of

an existing long-run relationship between financial innovations and economic growth and also corroborate with the study findings of Idun and Aboagye (2014), Bara and Mudzingiri (2016), Bara et al. (2016), Qamruzzaman and Jianguo (2017), Cookey et al. (2020) and Nazir et al. (2020).

Given the status of cointegration, long-run and short-run coefficient estimations are conducted to find the exact impact of proxies DCP and M3M1 on economic growth. Estimation results are presented in Table 8.

**Table 8**

*Long-run and short-run estimation results.*

| **Long-run estimates (models 1 & 2)** | | | |
|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **P-value** |
| DCP | 0.22614 | 0.075194 | 0.0050 * |
| M3M1 | -1.130769 | 2.795455 | 0.6885 |
| **Short-run estimates (model 1)** | | | |
| C | 1.048873 | 0.229725 | 0.0001 * |
| D(DCP) | -0.010478 | 0.033453 | 0.7561 |
| ECT(-1) | -0.750375 | 0.113958 | 0.0000 * |
| **R-squared** | 0.600884 | **F-statistic** | 25.59417 |
| **Adjusted R-squared** | 0.577407 | **P-value** | 0.000000 * |
| **Short-run estimates (model 2)** | | | |
| C | 2.573347 | 0.558027 | 0.0001 * |
| D(M3M1) | 11.86823 | 6.654095 | 0.1837 |
| ECT(-1) | -0.8377772 | 0.169751 | 0.0000 * |
| **R-squared** | 0.421918 | **F-statistic** | 12.40761 |
| **Adjusted R-squared** | 0.387914 | **P-value** | 0.000090 * |

Note. Compiled by the author, this table presents long-run and short-run estimates for models one and two. Optimal ARDL models, based on the Akaike information criterion, are ARDL (1, 1).
* $p < 0.01$.

Evidence gathered by this estimation suggests that both proxies DCP and M3M1 are insignificant at the 5% significance level in the short-run and proxy M3M1 is insignificant at the 5% significance level in the long run. The reason for this insignificance could be due to increasing volatility, given the fact that all variables are calculated as averages for an aggregate, and thus insignificant variables are not inspected further. In addition, while observing the long-run proxy, DCP is significant at the 5% significance level, and therefore DCP can affect long-run GDPg in model one. Quantitatively, a 1% increase in the DCP measure increases GDPg by 0.22%. The validity of using DCP as a proxy for financial innovations corroborates with findings gathered by Qamruzzaman and Jianguo (2017) and Nazir et al. (2020). It seems that this proxy contributes to economic growth in the long run, even taking into account the insignificant short-run effect. Furthermore, both error correction terms (variable ECT) demonstrate that a deviation from long-run

equilibrium caused by a short-run shock is reversed in models one and two by around 0.75% and 0.83% in one year, respectively. Given that the ECT coefficients have a negative and significant value, it fulfills the conditions suggested by Pahlavi et al. (2005) and confirms the existence of a long-run relationship. Regarding model fit and significance, the estimated R-squared for both models suggests a moderate fit. The estimated p-value indicates that these models are significant at the 1% significance level.

To evaluate the direction of causality between the dependent and independent variables, I conduct a pairwise Granger causality test and report the results in Table 9. The optimal number of lags is automatically estimated based on the Akaike information criterion. At the 5% significance level, these test results suggest an existing unidirectional causality effect from DCP towards GDPg. Considering the 10% significance level, I also find an existing unidirectional relationship between financial innovation proxies, to be more precise: M3M1 has a causal effect on DCP. On the one hand, these results also approve our theory that only one proxy, domestic credit to the private sector, has a real impact on economic growth. On the other hand, since the proxy M3M1 tends to have a causality effect on DCP at the 10% significance level, we can interpret that some kind of causal effect should still exist between M3M1 and economic growth, just not direct.

**Table 9**

*Results of the pairwise Granger causality test.*

| Null hypothesis | P-value |
|---|---|
| D(M3M1) does not Granger Cause GDPg | 0.6253 |
| GDPg does not Granger Cause D(M3M1) | 0.1197 |
| D(DCP) does not Granger Cause GDPg | 0.0010 * |
| GDPg does not Granger Cause D(DCP) | 0.2768 |
| D(DCP) does not Granger Cause D(M3M1) | 0.6898 |
| D(M3M1) does not Granger Cause D(DCP) | 0.0948 ** |

Note. Compiled by the author, this table describes the pairwise Granger-causality test results for research variables GDPg, DCP, and M3M1.
* $p < 0.1$. ** $p < 0.01$.

In addition, to ensure that our estimated models are valid and free from heteroskedasticity, I conduct a Harvey heteroskedasticity test, where the null hypothesis supports homoscedasticity versus the alternative hypothesis of heteroskedasticity. Results suggest that the null hypothesis cannot be rejected at the 5% significance level, neither for model one nor model two (see Annex 2). Therefore, our models are free from heteroskedasticity, which means that all previously estimated results are valid and can be interpreted as significant.

Eventually, to provide additional validity in this empirical study, I conduct a country-specific analysis and inspect whether a homogeneous effect exists between individual countries. I use the first model (presented in equation 1) and omit the second (shown in equation 2) since only one proxy – DCP, has previously reported a significant long-run coefficient. The methodology of this country-specific analysis is as follows. At first, I inspect whether all OECD member countries fit the ARDL criteria. Secondly, I conduct multiple ARDL bound tests to see whether a long-run relationship exists between financial innovations and economic growth. Furthermore, numerous long-run estimations are conducted to present long-run proxy coefficients. Lastly, I average all coefficients and compare results to overview the existence of homogeneity.

Due to missing data for OECD member countries, Estonia, Latvia, Lithuania, New Zealand, and the Slovak Republic do not fit the ARDL criteria; thus, the sample size of this country-specific analysis is reduced to 32 countries. After conducting multiple ARDL bound tests, results suggest an existing long-run relationship between financial innovations and economic growth for all countries in this country-specific analysis at the 5% significance level (see Annex 3). Furthermore, long-run coefficient estimations suggest that the impact of financial innovations on economic growth is positive and significant at the 10% significance level for all 32 countries (see Annex 4). Eventually, the average estimate of all coefficients estimated is 0.21036. Comparing this estimate to the estimated long-run DCP coefficient of 0.22614 (previously reported in Table 8), I can state that results are highly similar, and the estimated error of comparison is approximately 7%[8]. The reason for this particular error can be due to the removal of five countries from the samples. Nevertheless, given the relatively minor difference, this analysis lends support for a homogeneous effect across countries, meaning that all previously estimated results for the aggregate value of total OECD are valid.

### 3.4.Conclusion

Due to the lack of quantitative literature in the field of financial innovation effectiveness, it is hard to predetermine the true relationship between financial innovations and economic performance. Thus, by the empirical analysis conducted in this section, I provide support for the hypothesis that financial innovations have a positive impact on the global economy, based on the

[8] The error is calculated by dividing the average estimate by the long-run DCP coefficient, subtracting by 1, and multiplying by 100.

Autoregressive Distributed Lag (ARDL) technique and the pairwise Granger causality test. This empirical study consists of annual time-series data for the aggregate measure of total OECD (as a proxy of global economic performance) from 1982 to 2019 and is based on two separate linear models. The dependent variable for both models is identical – nominal GDP per capita growth and independent variables differ based on different financial innovation proxies. Study results show that due to the existence of cointegration in the dataset, given the ARDL bound testing approach, a long-run relationship between financial innovations and economic growth exists in both models one and two. In addition, long-run and short-run estimations suggest that only one proxy, DCP, is significant in the long run to the extent that a 1% increase in the DCP measure increases GDPg by 0.21%. Regarding the insignificant variables M3M1 (for both short-run and long-run) and DCP (for short-run) – these variables may be affected by increased volatility, and, thus, additional research should be developed. Using the pairwise Granger causality test for the whole dataset, I find a significant direction of causality from proxy DCP towards GDPg at a 5% level of significance and proxy M3M1 towards proxy DCP at a 10% level of significance. These results suggest that both proxies can impact economic growth, only proxy DCP has a direct effect, and proxy M3M1 has an indirect effect. Eventually, using the descriptive statistics, estimated error correction terms, heteroskedasticity test results, and results from the country-specific analysis, I can conclude that estimated models are significant, efficient, and can be used for conducting further research on the topic of financial innovation effectiveness.

# CONCLUSIONS AND RECOMMENDATIONS

The topic of financial innovations and the real values attained by these inventions is extensively debated in this literature. Some state that these particular innovations are chaotic, poor inventions that do not influence the economy (Dwyer, 2011) or even influence the economy negatively (Idun and Aboagye (2014); Paul Krugman). Others interpret these innovations as great tools that drive the force behind financial deepening and economic greatness (Blach, 2011). At the start of this thesis, I took upon Paul Krugman's challenge to find some sort of positivity in these "chaotic" instruments and present a different view towards financial innovations.

Using individual financial innovation literature, I find various positive factors that emphasize the usage of these inventions. This literature suggests that financial innovations generate a positive impact on the global economy, or more precisely, on economic growth. For instance, the historically first financial innovations (e.g., money, commercial banking, and financial markets) reduce consequences caused by the bartering system, increase the supply of money in circulation, and increase business expenditure, respectively. Financial innovations in the banking sector (e.g., ATMs, credit and debit cards, and internet banking) tend to increase bank capital and bank financial performance. Finally, financial market innovations (e.g., various pooled funds, derivatives) increase individual savings and company funding. All previously mentioned factors tend to boost economic growth significantly.

By inspecting seven quantitative research articles in the field of financial innovation effectiveness, I additionally find proof of an existing positive and significant relationship between financial innovations and economic growth in the long run. In further support of these findings, researchers also prove a unidirectional or bidirectional causality directing financial innovations towards economic growth. However, due to the lack of research articles in this particular field, results cannot establish a universal agreement in the literature regarding the sign and magnitude of the effect of financial innovations on economic growth.

To strengthen my thesis and find support for the hypothesis that financial innovation leads to higher economic growth, I conduct an empirical analysis and inspect the impact of financial innovations on global economic growth, using the Autoregressive Distributed Lag technique and the pairwise Granger causality test. This empirical analysis consists of aggregate total OECD values (as a proxy for the global economy) from 1982 to 2019 and uses nominal GDP growth per capita as a

measure of economic growth, domestic credit to private sector, and broad-to-narrow money as proxies for financial innovations. My findings corroborate the results gathered by aforementioned studies – I find a significant and positive impact of financial innovations towards economic growth in the long run to the extent that a 1% increase in proxy DCP leads to a 0.21% in GDPg. In addition, the empirical analysis provides a significant causality relationship from financial innovations towards economic growth.

Eventually, findings from this thesis indicate a positive impact of financial innovations on the global economy (more precisely, on global economic growth) and oppose statements made by Paul Krugman. However, of course, Paul Krugman cannot be entirely incorrect – financial innovations do have a dark side. Nevertheless, financial innovation consequences are caused mainly by lack of institutional supervision, and thus institutions must take matters into their own hands in preventing the negative causal effects in the coming future. Also, due to the lack of quantitative literature in financial innovation effectiveness, it is hard to suggest some, if any, recommendations for institutions. Thus, I would strongly recommend academics to take action and inspect this broad field of study so that the true and positive relationship of financial innovations could be presented to the world and institutions could know how to take actions to prevent negative consequences caused by these instruments. This thesis could potentially be a great starting point for conducting further research.

# REFERENCES


Abdullahi, I., Mishra, A. & Ahmad, B. I. (2010). Fraud Detection and Control on ATM Machines, an Algorithm for Combating Cash and Fund Transfer. *International Journal of Physical Science, vol. 5.* https://www.researchgate.net/publication/235701234_Fraud_Detection_and_Control_on_ATM_Machines_an_Algorithm_for_Combating_Cash_and_Fund_Transfer.

ACI worldwide. (n.d.). *Fighting online fraud: an industry perspective, volume 3.* https://www.aciworldwide.com/-/media/files/collateral/trends/fighting-online-fraud-an-industry-perspective-volume-3-us-5227-1213.pdf.

Ahaiwe, J. (2011). The effect of automated teller machines on banks' services in Nigeria. *International Journal of Development and Management Review, vol. 6, no. 1,* pp. 96–107. https://www.ajol.info/index.php/ijdmr/issue/view/8181.

Ali, P. I., Kalu, E. (2016). Impact of automated teller machine on banking services delivery in Nigeria: a stakeholder analysis. *Brazilian Journal of education, technology, and society, vol. 9, no. 1,* pp. 65–72. https://www.brajets.com/index.php/brajets/article/view/251.

Anesti, D. (2004). *Internet banking history and strategies: a case study of U.S. and Greek banks* [Master thesis, California State University]. https://digitalcommons.csumb.edu/caps_thes/370.

Arvidsson, A. (2019). Capitalism and the Commons. *Theory, Culture & Society, vol. 37, no. 2,* pp. 3–30. https://doi.org/10.1177/0263276419868838.

Åslund, A. (2012). Hyperinflations are rare, but a breakup of the euro area could prompt one. *Peterson Institute for international economics, Policy Brief 12–22.* https://www.piie.com/sites/default/files/publications/pb/pb12-22.pdf.

Bank run (n.d.). *In Cambridge Dictionary.* [Accessed on 2020-03-01]. https://dictionary.cambridge.org/dictionary/english/bank-run.

Bara, A. & Mudzingiri, C. (2016). Financial innovation and economic growth: evidence from Zimbabwe. *Investment Management and Financial Innovations, vol. 13, no. 2,* pp. 65–75. http://dx.doi.org/10.21511/imfi.13(2).2016.07.

Bara, A., Mugano, G. & Roux, L. P. (2016) Financial Innovation and Economic Growth in the SADC. *African Journal of Science, Technology, Innovation and Development, vol. 8, no. 5–6,* pp. 483–495. https://doi.org/10.1080/20421338.2016.1226705.

Bank for International Settlements. (1986). *Recent innovations in international banking.* https://www.bis.org/publ/ecsc01a.pdf.

Blach, J. (2011). Financial innovations and their role in the modern financial system -identification and systematization of the problem. *e-Finanse, vol. 7, no. 3,* pp. 13–26. https://ideas.repec.org/a/rze/efinan/v7y2011i3p13-26.html.

Black, J. Hashimzade, N. & Myles, G. (2012). Derivative. *A Dictionary of Economics (4th ed.),* p. 106. Oxford: Oxford University Press. http://doi.org/10.1093/acref/9780199696321.001.0001.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research.* New York: Guilford Press. https://doi.org/10.5860/choice.44-2769.

Carbo, S. & Rodriguez, F. (2020) *Fraud in cash and electronic payments: taxonomy, estimation and projections.* International security league report. https://www.cast-acts.ca/gdc/wp-content/uploads/2020/07/FraudStudyApril_2020_lr.pdf.

Chu, C. Y. Cyrus. (2010). The Regulation of Structured Debts: Why? What? And How? *Southern California Interdisciplinary Law Journal, vol. 19, no. 3,* pp. 443–472. https://gould.usc.edu/why/students/orgs/ilj/assets/docs/19-3%20Chu.pdf.

Cohler, A. (2017). *The Evolution and Impacts of the Ponzi Scheme and Governmental Oversight.* https://www.ramapo.edu/honors/files/2019/08/Cohler-ASB-2017.pdf.

Colombage, S. R. N. (2009). Financial markets and economic performances: Empirical evidence from five industrialized economies. *Research in International Business and Finance, vol. 23, no. 3,* pp. 339–348. https://doi.org/10.1016/j.ribaf.2008.12.002.

Cookey, S. C. M., Ebiware, A. E., Gbarato, L. M., Kalu, L.C. (2020). Financial Innovation And Economic Growth Nexus In Nigeria: Evidence From Autoregressive Distributed Lag (ARDL) Bound Test And Granger Causality Approach. *International Journal of Innovative Research and Advanced Studies, vol. 7, no. 7,* pp. 70–79. http://www.ijiras.com/2020/Vol_7-Issue_7/paper_10.pdf.

Constantinides, G. M., Harris, M., Stulz, R. M. (2003). Handbook of the Economics of Finance, vol. 1, part A. In P. Tufano, *Chapter 6 – Financial Innovation* (pp. 307–335). Elsevier press. https://doi.org/10.1016/S1574-0102(03)01010-0.

Daumal, M. (2018). *The Economic and Political Causes of the 2008 U.S. Financial Crisis.* http://pseweb.eu/ydepot/seance/513077_PapierDaumalCrise.pdf.

Dean, E., Elardo, J., Green, M., Wilson, B. and Berger, S. (2010). *Principles of Microeconomics: Scarcity and Social Provisioning.* Open Oregon Educational Resources. https://openoregon.pressbooks.pub/socialprovisioning/.

Dwyer, G.P. (2011). *Financial Innovation and the Financial Crisis of 2007-2008.* http://jerrydwyer.com/pdf/innovation.pdf.

Finnerty, J.D. (1992). An overview of corporate securities innovation. *Journal of Applied Corporate Finance, vol. 4, no. 4,* pp. 23–39. https://doi.org/10.1111/j.1745-6622.1992.tb00215.x.

FRED. (2021). *Economic data.* [Accessed 2021-03-15]. https://fred.stlouisfed.org/.

Ghatak. S. & Siddiki, J. U. (2001). The use of the ARDL approach in estimating virtual exchange rates in India. *Journal of Applied Statistics, vol. 28, no. 5,* pp. 573–583. https://doi.org/10.1080/02664760120047906.

Greif, A. (2006). *Institutions and the path to economic modernity: Lessons from medieval trade.* Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511791307.

Guptha, S. K. & Rao, K. (2018). The causal relationship between financial development and economic growth: an experience with BRICS economies. *Journal of Social and Economic Development, vol. 20,* pp. 308–326. https://doi.org/10.1007/s40847-018-0071-5.

Haiss, P. & Sammer, B. (2010). *The Impact of Derivatives Markets on Financial Integration, Risk, and Economic Growth*. https://dx.doi.org/10.2139/ssrn.1720586.

Hao, J. & Hunter, W. C. (1997). A Test of the Impact of Financial Innovation on Economic Growth. *Managerial Finance, vol. 23, no. 11,* pp. 64–78. https://doi.org/10.1108/eb018656.

Hayes, A. (2021). *Financial Markets*. https://www.investopedia.com/terms/f/financial-market.asp.

Hogendorn, J. & Johnson, M. (1986). *The Shell Money of the Slave Trade (African Studies)*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511563041.

Huertas, G. (2012). Hyperinflation in Venezuela: A Stabilization Handbook. *Peterson Institute for international economics, Policy Brief 19–13.* https://www.piie.com/sites/default/files/documents/pb19-13.pdf.

Hull, J. (2002). *Options, futures, and other derivatives.* Boston: Prentice-Hall. https://www.researchgate.net/publication/265718180_Options_Futures_and_Other_Derivatives.

Idiab, A. I., Haron, M.S. & Ahmad, S. (2011). Commercial banks & historical development. *The Journal of Applied Sciences Research, vol. 7, no. 7,* pp. 1024–1079. http://www.aensiweb.com/old/jasr/jasr/2011/1024-1029.pdf

Idun, A. & Aboagye A. (2014) Bank competition, financial innovations and economic growth in Ghana. *African Journal of Economic and Management Studies, vol. 5, no. 1,* pp. 30–51. http://dx.doi.org/10.1108/AJEMS-09-2012-0057.

Innovation (n.d.). *In Cambridge Dictionary.* [Accessed on 2020-03-01]. https://dictionary.cambridge.org/dictionary/english/innovation.

Jorda, Ò., Schularick, M. & Taylor, M. (2016). The great mortgaging: housing finance, crises and business cycles. *Economic Policy, vol. 31, no. 85,* pp. 107–152. https://doi.org/10.1093/epolic/eiv017.

Kagan, J. (2021). *Commercial bank*. https://www.investopedia.com/terms/c/commercialbank.asp.

Keivani, F. S., Jouzbarkand, M., Khodadadi, M. & Sourkouhi, Z. K. (2012). A General View on the E-banking. *International Proceedings of Economics Development & Research, vol. 43,* pp. 62–65. http://www.ipedr.com/vol43/013-ICFME2012-M00033.pdf.

Khan, H. H., Kutan, A. M., Naz, I. & Quresh, F. (2017). Efficiency, growth and market power in the banking industry: New approach to efficient structure hypothesis. *North American Journal of Economics and Finance, vol. 42,* pp. 531–545. http://dx.doi.org/10.1016/j.najef.2017.08.004.

KPMG. (2019). The multi-faceted threat of fraud: Are banks up to the challenge? *Global Banking Fraud Survey.* https://assets.kpmg/content/dam/kpmg/xx/pdf/2019/05/global-banking-fraud-survey.pdf.

Kupiec, P. & Ramirez, C. D. (2009). Bank Failures and the Cost of Systemic Risk: Evidence from 1900–1930. *Federal Deposit Insurance Corporation (FDIC).* https://dx.doi.org/10.2139/ssrn.1421885.

Lake, R. (2019). *Pooled Investment Vehicles: Definition and Types.* https://finance.yahoo.com/news/pooled-investment-vehicles-definition-types-221343272.html.

Laurent, J. L. (2010). *Global Derivative Debacles: From Theory to Malpractice*. Singapore: World Scientific. https://www.worldscientific.com/worldscibooks/10.1142/9520.

Litan, R. (2010). *In Defence of Much, but Not All, Financial Innovation.* https://www.brookings.edu/wp-content/uploads/2016/06/0217_financial_innovation_litan.pdf.

Malmendier, U. (2009). Law and Finance "at the Origin". *Journal of Economic Literature, vol. 47, no. 4,* pp. 1076–1108. http://www.dx.doi.org/10.1257/jel.47.4.1076.

Merriam-Webster. (n.d.). Money. I*n Meriam-Webster.com dictionary*. [Accessed on 2021-02-15]. https://www.merriam-webster.com/dictionary/money.

Merton, R. C. (1995). Financial Innovation and the Management and Regulation of Financial Institutions. *Journal of Banking and Finance, vol. 19, no. 3–4,* pp. 461–481. https://doi.org/10.1016/0378-4266(94)00133-N.

Mofor, C. (2016). *The causes of bank-runs on banking institutions and its impacts on management operations.* https://www.theseus.fi/handle/10024/104830.

Najarzadeh, R., Reed, M. & Tasan, M. (2014). Relationship between Savings and Economic Growth: The Case For Iran. *Journal of international business and economics, vol. 2, no. 4,* pp. 107–124. http://dx.doi.org/10.15640/jibe.v2n4a7.

Nawabzada, M. S. (2017). The role and importance of commercial banking in domestic trade of Afghanistan. *Afghan Economic Society, vol. 19,* pp. 1–15. https://www.afghaneconomicsociety.org/images/pdf/019_Nawabzada.pdf.

Nazir, M. I., Yount, T. & Nazir, M. R. (2018). Financial Innovation and Economic Growth: Empirical Evidence from China, India, and Pakistan. *International Journal of Finance and Economics, forthcoming*. http://dx.doi.org/10.2139/ssrn.3166798.

Norrestad, F. (2020). *Value of money supply*. [Accessed on 2021-03-23]. https://www.statista.com/statistics/254248/development-of-the-money-supply-m2-in-the-euro-area/.

OECD. (2021). Finance. *Main Economic Indicators (database).* [Accessed on 2021-03-25]. https://doi.org/10.1787/data-00043-en.

Openstax, Greenlaw, S. A. & Shapiro, D. (2017) *Principles of Economics 2e*. Openstax. https://openstax.org/details/books/principles-economics-2e.

Paavo, E. (2018). *The Impact of Commercial Banks Development on Economic Growth in Namibia*. [Master thesis, University of Cape Town]. https://open.uct.ac.za/handle/11427/28116.

Pahlavani, M., Wilson, E., & Worthington, A. (2005). Trade-GDP nexus in Iran: An application of the autoregressive distributed lag (ARDL) model. *Faculty of Commerce-Papers, no. 144*. https://ro.uow.edu.au/commpapers/144.

Pension Benefits Standards Regulations. (1985). *Section 2, no. 1*. https://laws-lois.justice.gc.ca/eng/acts/P-7.01/.

Pesaran, M. H., Shin, Y. & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Economics, vol. 16,* pp. 289-326. https://doi.org/10.1002/jae.616

Pollock, D. S. G. (n.d.). *EC3070 Financial Derivatives.* https://www.le.ac.uk/users/dsgp1/COURSES/DERIVATE/SPECULATION.PDF.

Qamruzzaman, M., Jianguo, W. (2017). Financial innovations and economic growth in Bangladesh. *Financial Innovation's vol. 3, no. 19,* pp. 1–24. https://doi.org/10.1186/s40854-017-0070-0.

Ragonmal, L. (2015). *Impact of commercial banking sector development on economic growth in small Pacific countries: A case study of the Vanuatu economy.* [Master thesis, Lincoln University]. https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/7351/Ragonmal_MCM.pdf.

Rajapakse, P. & Malaba, N. (2015). Minimizing Exposure to Fund Management Fraud in Australia. *Banking & Financial Law Review, vol. 31, no. 1,* pp. 53–88. https://research-repository.griffith.edu.au/handle/10072/125276.

Roussakis, Emmanuel N. (1997). Global banking: origins and evolution. *Revista de Administração de Empresas, vol. 37, no. 4,* pp. 45–53. https://doi.org/10.1590/S0034-75901997000400006.

Sarel, D., Marmorstein, H. (2003). Marketing online banking services: The voice of the customer. *Journal of Financial Services Research, vol. 8,* pp. 106–118. https://doi.org/10.1057/palgrave.fsm.4770111.

Şendeniz-Yüncü, İ., Akdeniz, L. & Aydoğan, K. (2018). Do Stock Index Futures Affect Economic Growth? Evidence from 32 Countries. *Emerging Markets Finance and Trade, vol. 54, no. 2,* pp. 410–429. https://doi.org/10.1080/1540496X.2016.1247348.

Shin, Y. (2013). Financial Markets: An Engine for Economic Growth. *The Regional Economist, Federal Reserve Bank of St. Louis, issue July.* https://www.stlouisfed.org/publications/regional-economist/july-2013/financial-markets--an-engine-for-economic-growth.

Skeers, J. (2004). Australia's largest bank shaken by speculative trading losses. https://www.wsws.org/en/articles/2004/03/nab-m17.html.

Stringham, E. P., & Curott, N. A. (2015). *On the Origins of Stock Markets.* The Oxford Handbook of Austrian Economics, 324. https://doi.org/10.1111/ecaf.12178.

Thompson, S. (1993). Controversies in meta-analysis: the case of the trials of serum cholesterol reduction. *Statistical Methods in Medical Research, vol. 2, no. 2,* pp. 173–192. https://doi.org/10.1177/096228029300200205.

Thornton, D. L. (2009). What the Libor-OIS Spread Says. *Economic Synopses, no. 24,* pp. 1–2. https://doi.org/10.20955/es.2009.24.

Velde, F. (1998). Lessons from the history of money. *Economic Perspectives, Federal Reserve Bank of Chicago, vol. 22, no. Q1*, pp. 2–16. https://ideas.repec.org/a/fip/fedhep/y1998iqip2-16nv.22no.1.html.

Vo, D. H., Nguyen V. P., Nguyen, H. M., Vo, A. T. & Nguyen T. C. (2020). Derivatives market and economic growth nexus: Policy implications for emerging markets. *The North American Journal of Economics and Finance, vol. 54, no. 100866,* pp. 1–11. https://doi.org/10.1016/j.najef.2018.10.014.

Wong, T., Lau, W. & Yip, T. (2020). Cashless Payments and Economic Growth: Evidence from Selected OECD Countries. *Journal of Central Banking Theory and Practice, vol. 9, no. 1,* pp. 189–213. https://doi.org/10.2478/jcbtp-2020-0028.

World Bank. (2021). *World Development Indicators.* [Accessed on 2021-03-25]. https://databank.worldbank.org/source/world-development-indicators.

Zandi, M., Koropeckyj, S., Singh, V. & Matsiras, P. (2016). *The Impact of Electronic Payments on Economic Growth.* https://www.tralac.org/images/docs/9254/the-impact-of-electronic-payments-on-economic-growth-moodys-analytics-visa-february-2016.pdf.

Zarrabi, S. & Lundberg, L. (n.d.). *The Madoff Fraud.* https://docplayer.net/20877554-The-madoff-fraud-mve220-financial-risk-shahin-zarrabi-9111194354-lennart-lundberg-9106102115.html.

Zu, Y. (2016). *The Role of Mutual Funds in the Real Economy.* [Ph.D. dissertation, The University of Melbourne]. https://www.semanticscholar.org/paper/The-role-of-mutual-funds-in-the-real-economy-Zu/8008aa53ccc283d867c13f1af6270c6353a0542d.

# FINANSINIŲ INOVACIJŲ ĮTAKA PASAULIO EKONOMIKOS AUGIMUI

**DOVYDAS RIAZANOVAS**

**Bakalauro baigiamasis darbas**

***Kiekybinės ekonomikos programa***

Vilniaus Universiteto Ekonomikos ir Verslo Administravimo Fakultetas

Vadovas – Dr. Patrick Grüning

Vilnius, 2021

## SANTRAUKA

49 puslapiai, 2 paveikslai, 9 lentelės, 4 priedai, 79 šaltiniai.

Šio bakalauro darbo tikslas ištirti finansinių inovacijų įtaką pasaulio ekonomikos augimui. Tikslui įgyvendinti, darbas yra suskirstytas į tris pagrindines dalis: atskirų finansinių inovacijų analizė, kokybinė meta-analizė, ir empirinė analizė.

Pirmoje dalyje buvo tiriama atskirų finansinių inovacijų daroma įtaka pasaulio ekonomikos augimui. Gauti rezultatai rodo, jog beveik visai atvejais teigiama įtaka yra didesnė už neigiama.

Antroje dalyje, kokybinė meta-analizė atliekama siekiant plačiai išanalizuoti empirinių tyrimų rezultatus finansinių inovacijų efektyvumo srityse ir nustatyti šių inovacijų kiekybinį poveikį. Gauti rezultatai vaizduoja teigiamą finansinių inovacijų poveikį pasaulio ekonomikos augimui.

Trečioje dalyje, empirinė analizė atliekama siekiant patvirtinti ankščiau gautus rezultatus bei parodyti finansinių inovacijų daromą įtaką (matuojama dviem tarpiniais kintamaisiais) pasaulio ekonomikos augimui. Tyrimo rezultatai rodo, jog bent vienas kintamasis turi reikšmingą įtaką pasaulio ekonomikos augimui. Tai patvirtina pirmoje ir antroje dalyje nagrinėtą teorinę medžiagą.

Šio bakalauro darbo išvadose apibendrinami gauti darbo rezultatai ir užtikrina teiginį, jog finansinės inovacijos daro teigiamą įtaką pasaulio ekonomikos augimui. Taip pat galima būtų primygtinai rekomenduoti tiesiogiai susijusioms įstaigoms stebėti ir kontroliuoti naujas, nuolat atsirandančias inovacijas, kad išvengti neigiamų padarinių ir išnaudoti šių atradimų potencialą.

# IMPACT OF FINANCIAL INNOVATIONS ON GLOBAL ECONOMIC GROWTH: A SURVEY

**DOVYDAS RIAZANOVAS**

**Bachelor Thesis**

***Quantitative economics study program***

Faculty of Economics and Business Administration of Vilnius University

Supervisor – Dr. Patrick Grüning

Vilnius, 2021

## SUMMARY

49 pages, 2 figures, 9 tables, 4 annexes, 79 references.

This thesis aims to evaluate the impact of financial innovations on global economic growth. The academic paper consists of three main parts: the examination of individual financial innovations, the qualitative meta-analysis, and the empirical analysis.

Individual financial innovations are examined to determine both positive and negative outcomes of these inventions and present a clear relationship between particular financial innovations and global economic growth. Results suggest an outweigh of positive versus negative outcomes in almost all cases, thus hinting at a positive effect of these instruments on global economic growth.

The qualitative meta-analysis is conducted to broadly analyze multiple empirical articles in the field of financial innovation effectiveness and to determine a quantitative impact. Results suggest a significant positive effect of financial innovations on global economic growth.

The empirical analysis is conducted to support previously gathered findings by examining the impact of financial innovations (measured by two independent proxies) on global economic growth. This empirical study uses aggregate values of total OECD (as a proxy for the global economy) based on annual time-series data from 1982 to 2019, within the framework of the Autoregressive Distributed Lag (ARDL) technique and the pairwise Granger causality approach. Results suggest a positive and significant impact for one of two proxies and thus validate previous research findings.

This thesis ends with conclusions and recommendations, where study results are summarized, and the impact of financial innovations is positively evaluated. In addition, it is believed that financial institutions must take matters into their own hands to prevent any negative consequences caused by financial innovations and reach the maximum potential of these great inventions.

# ANNEXES

**Annex 1**

*List of OECD member countries.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Australia | Colombia | France | Ireland | Latvia | New Zealand | Slovenia | The United Kingdom |
| Austria | Check Republic | Germany | Israel | Lithuania | Norway | Spain | |
| Belgium | Denmark | Greece | Italy | Luxembourg | Poland | Sweden | |
| Canada | Estonia | Hungary | Japan | Mexico | Portugal | Switzerland | The United States |
| Chile | Finland | Iceland | Korea | The Netherlands | Slovak Republic | Turkey | |

Note. This list is compiled by the author based on information gathered from the OECD website.

**Annex 2**

*Harvey heteroskedasticity test results.*

| **Model 1** | | **Model 2** | |
|---|---|---|---|
| **F-statistic** | **P-value** | **F-statistic** | **P-value** |
| 0.909174 | 0.4471 | 0.352858 | 0.7837 |

Note. Compiled by the author, this table describes the Harvey heteroskedasticity test results for models one and two.

**Annex 3**

*Country-specific analysis: ARDL bound test results.*

| **Country** | **F-Statistic** | **Country** | **F-Statistic** |
|---|---|---|---|
| Australia | 23.16402 | Italy | 8.158299 |
| Austria | 6.433973 | Japan | 18.29112 |
| Belgium | 5.933961 | Korea | 8.174921 |
| Canada | 9.856173 | Luxembourg | 7.152982 |
| Chile | 7.235752 | Mexico | 5.958214 |
| Colombia | 11.58392 | The Netherlands | 7.182052 |
| Check Republic | 21.58230 | Norway | 12.59132 |
| Denmark | 6.832129 | Poland | 8.952855 |
| Finland | 5.850212 | Portugal | 15.91582 |
| France | 17.18520 | Slovenia | 9.581551 |
| Germany | 25.18531 | Spain | 21.58212 |
| Greece | 8.159211 | Sweden | 6.280213 |
| Hungary | 7.156412 | Turkey | 7.384195 |
| Iceland | 8.864217 | Switzerland | 9.150032 |
| Ireland | 16.86528 | The United Kingdom | 25.28103 |
| Israel | 19.73852 | The United States | 21.50321 |
| **Significance** | | **I(0)** | **I(1)** |
| 10% | | 4.04 | 4.78 |
| 5% | | 4.94 | 5.73 |
| 1% | | 6.84 | 7.84 |

Note. Compiled by the author, this table describes multiple ARDL bound test results for individual OECD member countries. To obtain significant results while inspecting homogeneity, the ARDL model is identified as ARDL (1, 1).

**Annex 4**

*Country-specific analysis: long-run estimation results.*

| Country | Coefficient | Country | Coefficient |
|---|---|---|---|
| Australia | 0.120305*** | Italy | 0.234531** |
| Austria | 0.184020** | Japan | 0.345361*** |
| Belgium | 0.212062*** | Korea | 0.198721** |
| Canada | 0.310523** | Luxembourg | 0.176052* |
| Chile | 0.110423** | Mexico | 0.140779* |
| Colombia | 0.098491* | The Netherlands | 0.131474** |
| Check Republic | 0.152317** | Norway | 0.167037*** |
| Denmark | 0.228912** | Poland | 0.082623** |
| Finland | 0.198068** | Portugal | 0.139471* |
| France | 0.292910* | Slovenia | 0.187532* |
| Germany | 0.352706** | Spain | 0.275123** |
| Greece | 0.159753* | Sweden | 0.193429** |
| Hungary | 0.138211*** | Turkey | 0.180032* |
| Iceland | 0.193589** | Switzerland | 0.253892** |
| Ireland | 0.245952** | The United Kingdom | 0.313017*** |
| Israel | 0.290234** | The United States | 0.424114** |

Note. Compiled by the author, this table describes multiple long-run estimation results for individual OECD member countries. To obtain significant results while inspecting homogeneity, the ARDL model is identified as ARDL (1, 1). $^{*}$ $p < 0.1$. $^{**}$ $p < 0.05$. $^{***}$ $p < 0.01$.