Conference Proceedings
of the International Scientific Conference
Technology, Innovation and Stability:
New Directions in Finance (TINFIN)

Zagreb, 5 – 6 May, 2022

Zbornik radova
međunarodne znanstvene konferencije
Tehnologija, inovacije i stabilnost:
novi pravci u financijama (TINFIN)

Zagreb, 5. – 6. svibnja 2022.

FACULTY OF ECONOMICS AND BUSINESS, UNIVERSITY OF ZAGREB /
EKONOMSKI FAKULTET SVEUČILIŠTA U ZAGREBU

COST ACTION
CA19130 FinAI - FINTECH AND ARTIFICIAL INTELLIGENCE IN
FINANCE - TOWARDS A TRANSPARENT FINANCIAL INDUSTRY

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u Zagrebu

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The International Scientific Conference Technology, Innovation and Stability: New Directions in Finance (TINFIN) was organized by the Faculty of Economics & Business, University of Zagreb (FEB Zagreb), Croatian Academy of Sciences and Arts (HAZU) and COST Action CA19130 FinAI - Fintech and Artificial Intelligence in Finance - Towards a Transparent Financial Industry.

Međunarodnu znanstvenu konferenciju Technology, Innovation and Stability: New Directions in Finance (TINFIN) organizirali su Ekonomski fakultet Sveučilišta u Zagrebu, Hrvatska akademija znanosti i umjetnosti (HAZU) i COST Action CA19130 FinAI - Fintech and Artificial Intelligence in Finance - Towards a Transparent Financial Industry.

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Foreword

COST Action CA19130 - *Fintech and Artificial Intelligence in Finance - Towards a transparent financial industry (FinAI)* had decided to organize, together with *Faculty of Economics and Business* of the *University of Zagreb* and *Croatian Academy of Sciences and Arts*, an international scientific conference on technology, innovation and stability in finance. By bringing around 60 researchers and practitioners from over 15 countries, the Conference aim was to extend our understanding of current challenges and roadmap for the financial industry driven by technology imperative, as well as to re-examine traditional issues in finance.

The result of this were 29 extended abstracts presented and discussed at the Conference. The Conference also included a keynote presentation by professor James Ming Chen, *Michigan State University*, *College of Law* (USA) and an invited talk by the Chair of the COST Action professor Jörg Osterrieder, *Bern Business School*, *Institute of Applied Data Science and Finance* (Switzerland). A COST Session on *Transparency in Finance*, and a meeting of the COST Action CA19130 *Working Group 2: Transparent versus Black Box Decision-Support Models in the Financial Industry* was held by distinguished members of the Action, professor Petre Lameski, *Ss. Cyril and Methodius University in Skopje*, *Faculty of Computer Science and Engineering* (Republic of North Macedonia) and professor Kristina Šutienė, *Kaunas University of Technology*, *Faculty of Mathematics and Natural Science*s (Lithuania). Finally, a panel discussion titled *FinTech in 2022 and Beyond: Possibilities and New Regulatory Challenges* with renowned experts and representatives from various stakeholders in the FinTech field was also organised within the Conference.

This book of proceedings is a collection of selected double-blind reviewed papers presented at the *Technology, Innovation and Stability: New Directions in Finance (TINFIN) International Scientific Conference*, held in May 5-6, 2022 in Zagreb, Croatia. In the papers the authors address FinTech and other perspectives in contemporary finance such as digital finance, financial innova-

tion, sustainable finance and ever-important issues of financial stability, risk management and over indebtedness. The published papers aim to ensure that the latest research findings are put into practice, which is beneficial not only for researchers and practitioners, but may also serve regulators and policy makers.

We would like to thank all who contributed in making the Conference and its proceedings a success. Enjoy the read.

Editors

THE ECONOMIC AND SOCIAL CONSEQUENCES OF PERSONAL OVER-INDEBTEDNESS IN THE EU

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Although there is no common definition of personal over-indebtedness in the EU, there is almost a unanimous consent that it can cause serious economic and social consequences. While over-indebtedness as an absolute category does not exist, because there is no level of indebtedness that would be unsustainable for an individual person of for a family if the investment structure of borrowed funds by maturity and profitability are adequate to the structure of available liabilities. Hence, over-indebtedness usually occurs in cases when the creditor misjudges the creditworthiness of the beneficiary, or if there are sudden changes in the living conditions of the debtor (illness, unemployment, etc.). The most frequently used indicator is debt ratio, defined as the percentage of debt in relation to disposable income. The higher the income, the easier it is to repay the overdue debt. However, the disadvantage of this approach is that the measurement of the amount of debt is compared with the income normally earned over a period of time, believing that income will not decrease in the future. Changes in income are usually unexpected, while relatively secure earnings and/ or income can be assumed only in a fairly small number of cases, such as public sector employees or retirees. Due to the economic crisis, the COVID-19 pandemic and significant price growth, the number of over-indebted persons in the EU has increased. Possible adverse consequences are primarily related to reduced opportunities for education, limited access to the labour market and, therefore, increased exposure to poverty and social exclusion. All mentioned factors endanger population health, increase healthcare expenditures and cause various other costs, like judiciary expenditures, a growth in outlays for social welfare policies and other. On the level of the whole society and economy, a justified economic and political concern is that over-indebted households will eventually not be able to repay their debts, which may cause a domino effect, a financial crisis and macroeconomic shock, like rising interest rates, declining employment and/or increasing poverty. The aim of this study is to analyse

the situation with over-indebtedness in the EU with particular attention to finding the causes and costs of personal over-indebtedness. The motivation of the study is to select the best possible ways of over-indebtedness prevention in various societies as well as to solve the existing literature gap dedicated to the observed topic. Furthermore, the paper also deals with the socio-demographic characteristics of the over-indebted individuals.

INTRODUCTION

The concept of social exclusion has been relatively recently adopted in the European Union. Social exclusion means non-participation or inadequate access to the education, the labour market, and social services as well as long-term captivity in poverty. Causes of social exclusion are often associated with insufficient employability, a low level of education and/or narrow or outdated knowledge and skills, and limited employment opportunities. The various components of social exclusion affect each other, creating a spiral of insecurity that finishes in constant and multiple deprivation. Personal over-indebtedness is undoubtedly a significant determinant of the emergence and/or worsening of social exclusion. There is a grounded hypothesis that the private over-indebtedness of the population is one of the most important factors of social exclusion. Personal over-indebtedness has been a serious problem in the EU even before the COVID-19 pandemic, energy crisis and present inflation, and it has worsened after the occurrence of these phenomena.

At the same time, over-indebtedness is an increasing cause of poverty and social exclusion, so it is a significant determinant of the overall wellbeing of the population. Borrowing money can help people to avoid or overcome existing poverty and destitution. It allows, for example, covering unexpected and urgent costs of repairing an apartment or house, which improves the quality of life, but of course does not solve the main cause of the problem: a lack of permanent, secure and sufficient income resources and/or living and spending beyond one's means. From the point of view of social exclusion, special attention should be paid to the individual level of risk of household over-indebtedness.

However, over-indebtedness research (Chmelar, 2013; European Commission, 2013b; Eurofound, 2020) has been more focused on considering the potential risk of financial stability and jeopardizing economic growth and development in the event of household over-indebtedness. In this paper, more attention is oriented to the individual level and ways to mitigate personal over-indebtedness. One aspect of economic and political concern is that over-indebted households will eventually be unable to repay their debts, which could lead to a domino effect and cause a financial crisis and macroeconomic shock, for example, an upsurge in interest rates, declining employment and/or increasing unemployment and poverty.

The goal of this study is to inform readers, professionals, and decision-makers of the causes and consequences, primarily individual and social costs, of personal over-indebtedness the EU. The motivation of the study is to analyse and propose the best possible ways of over-indebtedness prevention as well as to solve the existing literature gap dedicated to the observed topic. The paper also pays attention to the socio-demographic characteristics of over-indebted individuals. Following this short introduction, the second section is dedicated to the definition and the situation of over-indebtedness in the EU in the last 15 years. The third part deals with the causes and consequences of personal over-indebtedness. The text finishes with the conclusion and recommendation.

THE DEFINITION AND THE SITUATION OF OVER-INDEBTEDNESS

There are many methods for defining and measuring over-indebtedness. This diversity is a consequence of different socio-economic and legislative frameworks of over-indebtedness in various countries. Therefore, in the EU, there is no usual definition of over-indebtedness and no set of consistent statistics on it (European Commission, 2008). Most authors very often try to find out causes and consequences of over-indebtedness in the financial systems (Ntsalaze and Ikhide, 2016; Hyytinen and Putkuri 2018). In the UK, the attention is on arrears in paying regular bills. Thus, over-indebtedness is defined as a situation where individuals or households are in arrears on a structural basis, or at a substantial danger of getting into arrears on a structural basis (Oxera, 2004). In France, an individual is deemed over-indebted when he or she is unable, although willing, to fulfil his or her financial debt obligations gained for non-professional reasons (D'Alessio and Lezzi, 2013). According to the European Commission (2008), over-indebtedness implies an incapability to pay recurring expenses and, therefore, it is a permanent rather than a temporary,

or one-off, state of affairs. Such an unfavourable situation is not possible to be resolved only by borrowing more. For a household to meet its obligations, it is required to substantially decrease its expenditures or to increase its income. Consequently, an over-indebted household is defined "as one whose existing and foreseeable resources are insufficient to meet its financial commitments without lowering its living standards, which has both social and policy implications if this means reducing them below what is regarded as the minimum acceptable in the country concerned."

Due to the non-existence of an internationally accepted definition, all possible direct comparisons of personal over-indebtedness in different countries can be easily misleading (European Commission, 2010). However, it is particularly interesting that according to a study by the European Commission (2013b), there is no need for a better definition of this term, because the differences between individual countries are bigger than the similarities, so it is almost impossible to cover them with a single definition. There is a broad consensus among stakeholders – primarily analysts, experts, and policy decision makers – that the lack of a definition should not be a reason to avoid finding a quick and effective solution to the problem of over-indebtedness of people in very unfavourable and dire conditions.

Over-indebtedness as an absolute category does not exist, i.e., there is no level of indebtedness that would be unsustainable for the user if he or she takes care that the investment structure of borrowed funds by maturity and profitability is adequate to the structure of his or her liabilities. Therefore, over-indebtedness usually occurs in cases when the creditor misjudges the creditworthiness of the beneficiary, or if there are sudden changes in the living conditions of the debtor (illness, unemployment, etc.).

The most commonly used indicator is debt ratio, defined as the percentage of debt in relation to disposable income. The higher the income, the easier it is to repay the overdue debt. However, the disadvantage of this approach is that the measurement of the amount of debt is compared with the income normally earned over a period, assuming that income will not decrease in the future. Changes in income are usually unexpected, while relatively secure earnings and/or income can be assumed only in a fairly small number of cases, such as public sector employees or retirees.

The possibility of debt repayment depends on the amount and security of future income. The current high indebtedness rate may not be a problem if the expected increase in income actually occurs. If a young person now has a high level of indebtedness that creates problems for him or her, this later does not have to mean difficulty if he or she will earn an above-average income because

people tend to have a lower income while younger, higher income while middle-aged and again lower income when they get older and retire. Furthermore, the same level of debt for the persons (or the households) of different incomes *may not always be a serious burden* because there is a possibility that the person (or the household) is identified as over-indebted according to some indicator, but it still does not necessarily consider itself burdened with debt problems.

In most surveys on household debt, the amount to be set aside for overdue liabilities is compared to disposable income, but this is often burdened with data constraints. To get a more comprehensive picture, more indicators should be used. Thus, for Britain, more indicators were used to determine the characteristics when it is considered that a household is over-indebted. In short, the reason for alarm arises if the household is at least two months late with one payment of its housing loan, home utilities or other overdue liabilities, if it is in permanent deficit on current accounts and if it has more than four loan obligations.

The Money Advice Service (2016) combined data from three research analyses to classify a set of respondents on which to carry out this analysis (2,500 over-indebted people out of a total sample size of 16,000). Two questions were used across all three surveys to identify over-indebtedness. Respondents that answered yes to either, or both, of these questions were classified as "over-indebted". Using name, address and date of birth, the researchers matched survey respondents to an extensive database with a wide range of information. More than 500 data variables were coordinated to each respondent, ranging from demographic data, like age, gender, presence of children, to financial attributes, primarily income, assets, and a product holding. A statistical modelling technique called logistic regression was applied. It uses a collection of available information (such as age and type of housing) to assess the probability of an unexpected and unknown event (in this case over-indebtedness). Using this technique, the researchers found out patterns and traits amongst the combinations of variables that best described over-indebted persons. A number of different models were tested and adjusted. The final model contains sixteen various variables, which in combination can quite certainly predict a person's probability of being over-indebted.

Korczak (1998) states that due to the lack of a generally accepted definition of over-indebtedness and mentioned differences, it is difficult to reliably estimate the actual number of over-indebted people in the EU. In the mid-1990s, it was estimated that 25-30 million people were over-indebted, while there were 70 million people which were on the brink of personal over-indebtedness (Fagan, 1997). According to the assessment by Girouard, Kennedy and André

(2006), the number of over-indebted persons increased significantly in the period from mid-1990s to mid-2000s. The increase is particularly large in the context of the economic crisis.
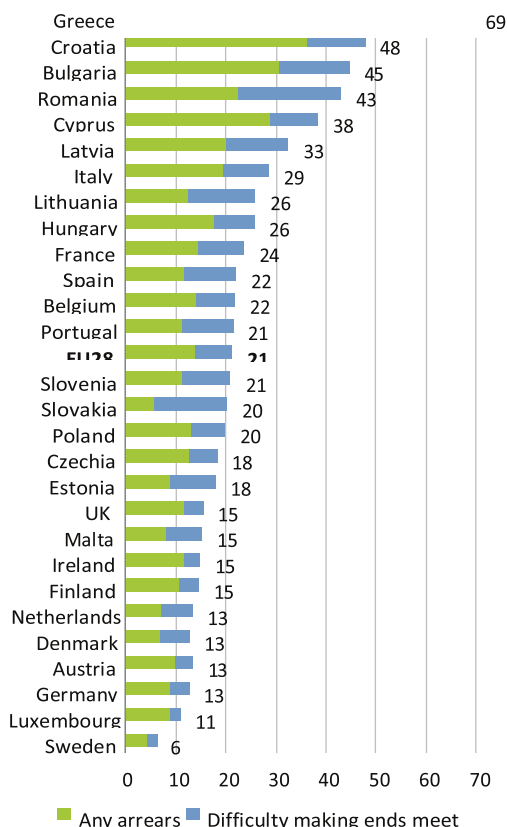
According to Eurostat (2015), the percentage of people in Europe who were unable to pay their utilities and repay loans increased between 2007 and 2011. Such problems are more common for tenants, but the number of homeowners who are unable to repay their long-term housing loans has also increased significantly. Delays in the payment of utilities as one of the forms of personal over-indebtedness are more common among tenants than among people repaying long-term housing loans. In the observed period, it seems that in both groups there was a deterioration, but the relative deterioration is greater in those who repay long-term housing loans. In the period from 2007 to 2011, the share of persons who were late with the payment of utilities rose among homeowners without long-term housing loans from 11% to 14%, while for those with long-term housing loans it increased from 10% to 13%. In the observed period, by those who rented apartments and houses in the private sector, there was no significant deterioration regarding personal over-indebtedness, and the share of those who were late with the payment of utilities was about 18%, while among people living in social housing it remained at 19%.

The European Commission (2013a) states that more than half of the eurozone population has no debts to financial institutions. Many of the remaining 44% of citizens who have debts do not have financial difficulties. Over-indebtedness usually occurs after an unexpected change in the level of income due to sudden unemployment or increased expenses due to illness, or excessive spending that is beyond the capabilities of the individual and his or her family. Of course, important life events such as a divorce or a break-up of a long-term extramarital relationship also have a significant impact, so those affected persons have to start organizing their lives almost anew. A particularly easy way to fall into over-indebtedness is in the condition of an economic crisis, when there are reduced employment possibilities, revenues are decreasing while the likelihood of additional earnings is limited.

A survey by Eurofound (2020) shows that in 2016, 14% of the population in EU28 faced problems related to on-time payments of rent or mortgages, consumer credit, debts on money borrowed from family or friends, or utility or telephone bills. Most at risk are persons aged 25-49. However, the biggest problem with over-indebtedness have persons aged 65+, what also seriously impacts their mental wellbeing. Regarding the proportion of people aged 18+ at risk of over-indebtedness, the worst situation is in Greece, followed by Croatia, Bulgaria and Romania, where two thirds and almost a half of the popula-

tion face this risk. On the other hand, such a problem is faced only by 6% of the population in Sweden and 11% in Luxembourg (Figure 1).

Figure 1: The proportion of people aged 18+ at risk of over-indebtedness: arre-ars or difficulties making ends meet, 2016, by Member State and EU28 (%)

Country	Value
Greece	69
Croatia	48
Bulgaria	45
Romania	43
Cyprus	38
Latvia	33
Italy	29
Lithuania	26
Hungary	26
France	24
Spain	22
Belgium	22
Portugal	21
EU28	21
Slovenia	21
Slovakia	20
Poland	20
Czechia	18
Estonia	18
UK	15
Malta	15
Ireland	15
Finland	15
Netherlands	13
Denmark	13
Austria	13
Germany	13
Luxembourg	11
Sweden	6

Any arrears ■ Difficulty making ends meet

Source: Eurofound (2020)

The health crisis caused by the COVID-19 pandemic has highlighted the need for effective household budget management. Fear of infection, social distancing, and stay-at-home orders prompted business closures and a serious decline in demand for travel, accommodations, restaurants, and entertainment as well as many other economic sectors. The temporary closure of business activities by many companies and increased unemployment as well as lost or reduced income by many individuals have shown the seriousness of personal

over-indebtedness and how important it is to properly manage personal finances (Kurowski, 2021). There are still no comparative studies with international overview and analyses of the impact of the pandemic on personal finance, but according to various national studies (for example, Congressional Research Service, 2021, for USA; for Spooner, 2021, for the United Kingdom), it looks like that this impact was very negative and long-lasting. As the pandemic has forced many individuals and households further over the edge of financial precarity, the debt burden has fallen disproportionately on groups such as key workers, carers, and racial minorities, primarily black people. Much of the household debt in both countries (and most probably in the majority of other countries) is now effectively unpayable, and many over-indebted citizens would need more than seven years just to pay back a single debt owed. This is particularly adverse having in mind high levels of personal financial indebtedness present prior to the occurrence of the pandemic and probably the end of the period of *cheap* loans which characterised the finance system in the last decade. Although the total outstanding debt to individuals in many countries is quite reasonable and not characterised by a dramatic increase (Francis-Devine, 2021), the situation for over-indebted persons significantly deteriorated. Thus, the further text deals with the characteristics of these persons and related consequences for vulnerable individuals and society as a whole.

OVER-INDEBTEDNESS AND RELATED INDIVIDUAL AND SOCIAL COSTS

Over-indebtedness poses a solemn menace, not only to the households directly concerned, but to society as a whole (Griffiths, 2000). It can be almost impossible for a person with serious payment problems to obtain an adequate employment, a home loan, new credit, take out an internet subscription, take out life insurance or pension policies. The European Commission (2013b) underlines a strong connection between impaired physical and/or mental health and problems with over-indebtedness. Cuesta and Budria (2015) show that in Spain, non-mortgage debt payments and debt arrears negatively impact people's health. Furthermore, the authors found mild social norm effects, according to which being less indebted than the reference group results in better health if all other conditions are the same.

Most researchers warn of the adverse impact of over-indebtedness on health, and thus the deteriorating position in the labour market, disruption of family harmony and marital tensions, difficult ability to maintain friendly, family and

neighbourly ties, all leading to social exclusion (Kempson and Whyley, 1999; Gloukoviezoff, 2006). Many persons with pecuniary problems seriously suffer from depression, stress-related symptoms, and feelings of helplessness, shame and/or social isolation and exclusion (Russell, Maître, & Donnelly, 2011).

According to the European Commission (2013b), a significant number of respondents in the selected countries highlighted the feeling of stigmatization due to over-indebtedness, which encourages isolation and withdrawal from participation in social life. One German respondent in debt said he felt like he was living in a cage. Another factor is a lack of money, as a consequence of the priority of debt repayment and outstanding liabilities of utilities. In many cases, social activities were the first victim of spending cuts leading to various forms of social exclusion. Most often, it is the inability to finance participation in various programmes so children from over-indebted families do not attend extracurricular activities or cannot go on school trips. Over-indebted parents mostly do not have money to give their teenage children to go out or to the seaside. Due to not going out or not visiting relatives and friends because they cannot return the hospitality, the world of over-indebted people is shrinking, and they give up social gatherings, informal friendly meetings, going to sports activities and trips. This can have a negligible adverse impact on a person who is not sociable, but as more research has shown, many over-indebted people suffer greatly from social exclusion (Russell, Maître, & Donnelly, 2011).

Furthermore, the analysis of the European Commission (2013b) examined the attitudes of over-indebted people who stated that they feel socially excluded due to debt stigma, and also because they simply do not have the money to get involved in everyday life. One respondent said: "I can't go to concerts and other cultural activities, that is, I cannot afford ordinary things like daily newspapers." Long-term unemployment and over-indebtedness, usually in addition to the above forms of social exclusion, also mean difficult access to adequate healthcare, as the trend of privatization of health insurance and rising health care costs is evident across Europe. This exacerbates existing family tensions and threatens the already poor health of over-indebted people. People with serious financial problems are often forced to a fall in household consumption (Dynan 2012; Albuquerque and Krustev 2015), primarily of food, which endangers their health and employability, and therefore, keeps them in poverty and indebtedness. Many studies have confirmed that personal over-indebtedness has unwanted and very dangerous health consequences such as a sudden weight loss, recurrent headaches, nervous disorders, and overuse of medications, especially sedatives. For Finland, it was found that the use of sleeping pills and similar sedatives was about four times higher in over-indebt-

ed persons than in the general population (Hintakka et al., 1999). Alwin and Renenson (1986) found a strong significant association between the inability to repay debt and adverse effects on a person's mental stability. Kavanagh (2000) cites adverse effects on the psychological state of the affected person: feelings of crisis, anxiety, fear, frustration and tension, conflicts with spouses and children, increased domestic violence, stress and depression, suicidal tendencies. Such allegations are confirmed by a study by Nykanen et al. (1995), which showed that over 70% of the target group of over-indebted people suffer from mental health problems, which is three times more than the total Finnish population. Here, too, every third person thought about suicide, while in the total population, this was recorded only in 3% of the respondents.

Ahlström (1998) investigated the health and quality of life of over-indebted persons in Sweden who had very poor quality of mental health, vitality, social and physical functioning, and suffered much more than the general population from physical pain. For Germany, Keese and Schmitz (2011) concluded that over-indebtedness strongly correlated with serious physical and mental health problems and overweightness. Fitch et al. (2007) believe that even psychiatric treatments are not very effective in resolving psychological problems caused by over-indebtedness. Deteriorating health conditions lead to an increase in health-related expenditures, which is likely to increase over-indebtedness and social exclusion.

There are generated costs for individual persons as well as for society. These are *direct costs* of treatment in hospital stay and medication, and *indirect costs*: reduced productivity, increased expenditures for covering sick leave benefits, the costs of long-term treatment and rehabilitation of affected persons and early retirement of a significant part of the working population. Over-indebtedness increases likelihood of criminal behaviour, and children dropping out of education. Thus, the risk of over-indebtedness and poor education attainment could easily mean that poverty and over-indebtedness are being passed on to new generations. One should not forget the costs of court proceedings for forced collection, loss of tax revenues, provision of advisory services and increased allocations for social welfare programmes because over-indebted people are often doomed to have a very poor quality of life and become long-term beneficiaries in the social welfare system.

As for the impact on the financial industry, when a negative income shock occurs – particularly in an environment characterised by high levels of household indebtedness – debtors may find it difficult to meet their commitments. This causes an increase in non-performing loans, and consequently weakens the balance sheets of financial intermediaries and could easily lead to the men-

tioned domino effect in ruining a relatively healthy and efficient financial industry and economy.

The European Commission (2013b) emphasizes the importance of recognizing the characteristics, determinants and pathways that lead to over-indebtedness. This involves considering resources, motivation, needs, the emergence (creation) of demand, market supply and related irrationalities. In terms of resources, low incomes and limited financial resources increase the risk of divorce in the early stages of starting a family, which further increases the risk of over-indebtedness. Motivation research has identified a variety of important primary emotions, such as greed, envy, and the like. Spending and investing are activities aimed at satisfying primary emotions. Individuals gain satisfaction in a variety of ways, including by diversifying consumption or purchasing goods and services to achieve (or affirm) status and prestige.

Different life events require different amounts of money to cover everyday needs. Financial needs are greater for young people leaving the family home, for young couples who are just starting to live together, for single-parent families, and/or for families with more children. Marketing activities certainly have a suggestive and manipulative power in creating demand, so advertising motivates people to buy products and services that they often do not need. Citizens are constantly confronted with the growing supply in the market created by private banks, savings banks, insurance companies, retail chains and other institutions that provide financial services. A frugal and attentive lifestyle focused on using one's own available funds without borrowing guarantees a debt-free life. But the growing use of consumer credit and the accelerating development of the financial market clearly show a further expansion in the number of users. Furthermore, irrationality is a significant determinant of misalignment of one's financial capabilities. Buying (especially on credit) is mostly impulsive behaviour, in which consumers are usually unaware of their own financial capabilities and the possibility of continuously waiving a part of their income to repay such loans.

CONCLUSION REMARKS

The aim of this paper is to consider the situation and activities for mitigating over-indebtedness as important determinants of social exclusion in EU member states. Over-indebted people and their families – who have difficulty repaying mortgages and other loans, unpaid utilities and/or telephone bills – may experience electricity cuts or foreclosures. In order to make ends meet,

these families must save on the most important necessities of life and food for themselves and their children. In the current context of economic hardship, an increase in income for these households is quite unrealistic. Members of these households often experience health problems, suffer from stress and feel great insecurity in terms of precarious housing.

Debt problems can be a contributing factor to household tensions and their possible disintegration. The consequences can be as complex and dangerous as divorce and/or homelessness, and almost always lead to the social isolation of the affected person and members of his or her household. Social exclusion is a very serious matter, people are ashamed of their over-indebtedness, they close themselves in the house, they draw the curtains so that it is not known if they are at home if a debt collector comes by chance. The social consequences of personal over-indebtedness are often underestimated, i.e., disruption of social cohesion and tearing of social tissue.

Personal over-indebtedness has grave private and social consequences and costs. Private costs are mostly related to health degradation of the persons in debt because it causes the feeling of stress, long-term exhaustion, anxiousness, deep psychological crisis, frustration, and fear. Such a situation imperils their stability and wellbeing, and therefore, they endure more physical pain in contrast to the total population. Over-indebtedness is not a uniform problem. Among people working in lower paid jobs and the long-term unemployed, over-indebtedness usually results from accumulated arrears and/or repayment of loans and credit card debts. However, most of the increase in over-indebtedness in Europe was caused by another group of people: persons who worked in decently paid jobs and had great difficulty repaying their mortgages and other loans due to job loss, but did not see any significant improvement in their income.

Between and within these groups, there are large differences in the causes and consequences of over-indebtedness, but there are also similarities because many users of financial services do not behave conscientiously and are exposed to excessive financial burdens and risks that they cannot bear. Long-term borrowing for the purchase of real estate on credit is often impulsive behaviour, in which buyers are not aware of their own financial capabilities and the possibility of the continuous waiver of a part of their income to repay such loans. When applying for a loan, applicants try to present themselves in the best possible light because they are not aware of how the bank sets limits for assessing creditworthiness and for their protection, all in order not to take on obligations that they are unable to meet. Because the bank also bears the risk of misjudging their ability to repay, it must include these costs in a higher interest rate.

Adequate preventive and educational programmes intended to teach citizens to conscientiously manage income and defend themselves against impulsive purchases beyond the personal abilities of monthly spending waivers are of crucial importance. Long-term financial health requires long-term financial planning and the development of financial analysis skills, and financially literate consumers. This also reduces many social costs associated with the social welfare system, such as social assistance, reduces health care expenditures and alleviates social exclusion. The most obvious limitation of our paper is the complexity of the analysed topic which requires further scientific research particularly in the conditions of the COVID-19 and increased inflation rates around the world primarily caused by the Russian aggression on Ukraine.

ACKNOWLEDGEMENT

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OPENNESS AND INFLATION NEXUS IN THE US: STATISTICAL LEARNING APPROACHES

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Recent empirical literature has recognized statistical learning as a potential approach to compete standard econometrics. However, most applications rely on data reach environment leading to improved forecasts but confusing its economic interpretability. Generally, critics of statistical learning often consider it as a black box that does not bring a lot to economic reasoning. Forecasting inflation rates was often emphasised as one of the most challenging and important topics due to its effects on wide areas of economics and finance. Various statistical learning approaches have already been applied to forecast inflation, but the link to economic reasoning is still a missing one. Therefore, full potential of statistical learning approach still waits to be illustrated. Wide ranges of variables from economic and finance have been included as inflation predictors in empirical literature that follows statistical learning approaches, but effects from abroad to forecast inflation rates have been neglected. External effects on inflation rates are generally neglected in case of large economies. However, it is reasonable to believe that effects from abroad matters in conditions of highly globalized world economies. Consequently, besides the missing link to economic reasoning, there seems to be one more weak point. This paper makes a step ahead to overcome existing weak points. While testing trade openness and inflation nexus in case of the US, this paper tries to link results from statistical learning approaches to economic theory. This paper employs statistical learning methods to examine openness and inflation nexus in the US economy. Based on the analytical

framework derived from the Philips curve and Romer's hypothesis, this research examines causality among considered variables and drivers of inflation in the US. The training data sample consists of quarterly data from 1948q2 to 2010q4 while out of sample evaluation was performed on the data sample that ranges from 2011q1 to 2020q3. Based on empirical results from this paper, Support Vector Regression outperformed Lasso Regression in forecasting US inflation rates. While the unemployment rate was found insignificant to improve forecast accuracy of US jmbninflation rates, openness of the US economy to international trade appeared as a significant predictor of inflation rates. Effects from inflation to trade openness were not empirically supported. The results of empirical analysis from this paper suggest that the inflation rate in the US was an externally driven phenomenon.

Keywords: *Inflation Rates, Trade Openness, Support Vector Regression, Lasso Regression.*

JEL classification: *F1; F2*

INTRODUCTION

Recent empirical literature has recognized statistical learning as a potential approach to compete standard econometrics. However, most applications rely on data reach environment leading to improved forecasts but confusing its economic interpretability. Generally, critics of statistical learning often consider it as a black box that does not bring a lot to economic reasoning. Forecasting inflation rates was often emphasised as one of the most challenging and important topics due to its effects on wide areas of economics and finance. Various statistical learning approaches have already been applied to forecast inflation, but the link to economic reasoning is still a missing one. Therefore, full potential of statistical learning approach still waits to be illustrated. Wide ranges of variables from economic and finance have been included as inflation predictors in empirical literature that follows statistical learning approaches, but effects from abroad to forecast inflation rates have been neglected. External effects on inflation rates are generally neglected in case of large economies. However, it is reasonable to believe that effects from abroad matter in conditions of highly globalized world economies. Consequently, besides the missing link to economic reasoning, there seems to be one more weak point. This paper makes a step ahead to overcome existing weak points. While test-

ing trade openness and inflation nexus in case of the US, this paper tries to link results from statistical learning approaches to economic theory. More precisely, the hypothesis stated by Romer (1993) assuming trade openness as an exogenous variable that governs inflation was tested for the case of the US using statistical learning approaches. Not to ignore internal effects in empirical analysis, the unemployment rate representing internal conditions of an economy was included as a potential predictor following the Philips curve. Romer's hypothesis was found valid for some small and open economies, but conclusions relevant for the case of the US cannot be derived based on the existing research.

The remainder of this paper is organized as follows: Section 2 briefly summarizes existing literature related to the topic under consideration. Section 3 presents methods. Section 4 presents research data and their pre-processing while Section 5 illustrates empirical analysis. The final section provides an overview of the main findings of the research.

BRIEF LITERATURE OVERVIEW

Ülke et al. (2018) examined performance of statistical learning approach against standard time series approach. Empirical results from the research data sample between 1984 and 2014 revealed better results from multivariate comparing to univariate specification while Support Vector Regression outperformed time series Autoregressive Distributed Lags (ARDL). The research considered unemployment rate, industrial production, personal consumption expenditure, employees on nonfarm payrolls, housing starts and differences in yields between 5-year and 3-month Treasury bond as predictors all representing internal sector dynamics. Sermpinis et al. (2014) used a wide range of macroeconomic variables and tested forecasting performance of SVR, random walk, autoregressive moving average, moving average convergence/divergence, multi-layer perceptron and recurrent neural network to predict US inflation and unemployment. Empirical results pointed out SVR as a preferred approach. However, except JPY/USD and GBP/USD exchange rates, all predictors present internal macroeconomic conditions and effects from the external sector were not taken into account. Plakandaras et al. (2017) used a data sample from January 1871 to March 2015 at a monthly frequency and considered ordinary least square (OLS), LASSO and SVR with autoregressive and structural forecasting specifications. The results pointed out that structural model specification did not outperform the autoregressive ones. Priliani

et al. (2018) used a monthly data sample from January 2010 to February 2018 and fitted the SVR-univariate specification to forecast the inflation rate. Marcelo et al. (2021) considered different statistical learning methods including Ridge Regression (RR) (Hoerl and Kennard, 1970), Least Absolute Shrinkage and Selection Operator (LASSO) (Tibshirani, 1996), Adaptive Least Absolute Shrinkage and Selection Operator (adaLASSO) (Zou, 2006), Elastic Net (El-Net) (Zou and Hastie, 2005), Random Forests (Breiman, 2001), factor models and Hybrid Linear-Random Forest Models. In line with the previous literature, the paper considered many variables and their combinations, but exchange rates were the only ones representing external effects. The results suggested random forest as a preferred among tested approaches to forecast US inflation, but SVR was not considered. Qin et al. (2018) based on SVR and ensemble empirical mode decomposition (EEMD) provided inflation estimates for China. Coulombe et al. (2020) examined favorable properties of statistical learning methods representing its advantages over standard econometric approaches in macroeconomic forecasting and pointed out the ability to capture important nonlinearities that arise as consequences of uncertainty and financial frictions. Oktanisa et al.(2020) found SVR as a successful method to predict inflation rates in Indonesia. All of the predictor variables except exchange rates were selected from variables representing internal economic conditions. Empirical literature presented in this section fairly suggests that inflation dynamics is a nonlinear phenomenon, and its nonlinear properties can be well captured with SVR specification. However, the exchange rate was the only variable representing effects from abroad on inflation within a country. Therefore, foreign effects on inflation might be under-examined. Romer (1993) hypothesized and confirmed the relationship between trade openness and inflation where an increase in trade openness was assumed to decrease inflation in a country. Several empirical papers using different econometric approaches provided sound empirical evidence in favor of Romer's hypothesis (Bowdler and Malik, 2017; Lin et al., 2017). Nonetheless, Yiheyis (2013) provided empirical evidence suggesting positive effects from trade openness to inflation in African countries. Empirical evidence from various parts of the globe suggests a different nature of the relationship. Baumann et al. (2020) examined drivers of inflation on the panel data of 124 countries from 1997 to 2015 and found globalization as a relevant driver. Conclusively, empirical literature is not consistent regarding the nature of the relationship between trade openness and inflation. Evidently, there is a space for empirical evaluation and theoretical consideration of the topic, and insights from statistical learning approaches might help understanding of the topic.

METHODS

Based on suggestions from recent literature and the nature of the empirical topic under consideration, this research employs statistical learning approaches and evaluates their performance. Firstly, autoregressive specification of inflation rate dynamics was identified. Afterwards, unemployment rate as a representative of internal sector and trade openness that accounts for foreign effect was tested to examine whether inflation forecasts can be improved.

Based on the concept from Granger (1969), if a variable improved the forecast of the autoregressive model, then the variable would be considered as a causal variable. Therefore, while extending autoregressive specification causality effects of unemployment rate and trade openness on inflation was examined. In the same way, potential reverse effects from inflation to trade openness were analysed as well.

SUPPORT VECTOR REGRESSION

An alternative to forecast time series is to follow statistical learning approach. In this paper, Support Vector Regression (SVR) introduced by Vapnik (2000) was considered. SVR is a statistical learning approach and can be applied either for a problem of classification or regression. SVR can be represented as in the equation (1):

$$f(\boldsymbol{x}, \boldsymbol{w}) = \sum_{i=1}^{D} w_i \phi_i(\boldsymbol{x}) + b \qquad (1)$$

Where $\{\phi_i(x)\}_{i=1}^{D}$ are the features of inputs while $\{w_i\}_{i=1}^{D}$ and b are coefficients estimated by minimizing Risk functional in equation (2):

$$R(\boldsymbol{w}) = \frac{1}{N}\sum_{i=1}^{N}\left|y_i - f(\boldsymbol{x}_{i,}, \boldsymbol{w})\right|_\varepsilon + \frac{1}{2}\|\boldsymbol{w}\|^2 \qquad (2)$$

Where $\left|y_i - f(\boldsymbol{x}_{i,}, \boldsymbol{w})\right|_\varepsilon = \begin{cases} 0, & \left|y_i - f(\boldsymbol{x}_{i,}, \boldsymbol{w})\right| < \varepsilon \\ \left|y_i - f(\boldsymbol{x}_{i,}, \boldsymbol{w})\right|, & \mathrm{x} \geq \varepsilon \end{cases} \qquad (3)$

The equation (1) can be considered as a hyper-plane in the -dimensional space, and that is defined by functions $\phi_i(x)$. Therefore, it is necessary to find a hyper-plane $f(\boldsymbol{x},\boldsymbol{w})$ that minimizes the risk functional R($\boldsymbol{w}$). The minimum is reached by functions in the equation (4):

$$f(\mathbf{x}, \boldsymbol{\alpha}, \boldsymbol{\alpha}^{\cdot}) = \sum_{i=1}^{N}(\alpha_i^{\cdot} - \alpha_i) \cdot K(x, x_i) + b \tag{4}$$

Where $K(x, x_i) = e^{(-\gamma \|x - x_i\|^2)}$ represents the radial basis kernel function, while α and α' represent Lagrange multipliers with constraints given in the equation (5):

$$\sum_{i=1}^{N}(\alpha_i^{\cdot} - \alpha_i) = 0, \ 0 \le \alpha_i^{\cdot} \le C, \ 0 \le \alpha_i \le C, \ i = 1, \dots N. \tag{5}$$

The parameters C and ε need to be chosen by the researcher. In this paper, SVR model specifications were tuned in a way that by varying $C \in [1, \dots, 100]$ and $\varepsilon \in [0, 0.1, \dots 0.9, 1]$ and the best SVR specification was found.

LASSO REGRESSION

Least Absolute Shrinkage and Selection Operator (LASSO) regression is a valuable tool since it performs variable selection and regularization (Tibshirani, 1996). The idea behind LASSO Regression is to augment the loss function such that sum of squared residuals are being minimized and the size of the parameter estimates penalized at the same time. LASSO includes a penalty for regression coefficients and trades off between an increase in bias and decrease in variance.

$$L_{lasso}(\hat{\beta}) = \sum_{i=1}^{n}(y_i - x_i'\hat{\beta})^2 + \lambda \sum_{i=1}^{m}|\hat{\beta}| \tag{6}$$

In Lasso regression, the sum of absolute coefficient is penalized (L1 penalty), and for high values of the regularization penalty (), some coefficients in LASSO regression may obtain a zero value. Therefore, LASSO regression reduces the problem of multi-collinearity, and preventing over-fitting can provide valuable insights into the variable selection. To select , ten-fold cross-validation was performed, and providing lowest bias and variance was selected.

FORECASTS EVALUATION

Frequently used Root Mean Square Error (RMSE) provided in the Equation (7) was employed to evaluate out of sample forecasting performance for each approach.

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2} \qquad (7)$$

Additionally, a frequentist statistics way of evaluation was enabled, and the Diebold-Mariano test from Harvey et al. (1997) was employed to test the null hypothesis of no difference in the accuracy between the considered specification and benchmark. Diebold and Mariano (2002) originally introduced the Diebold-Mariano test. The test specification in this paper under the null hypothesis assumes that the considered specification and benchmark specification have the same forecast accuracy, whereas under an alternative hypothesis, the considered specification provides a more accurate forecast than the benchmark.

The analysis was performed in the R software, open source and ready to use software with libraries "e1071", "glmnet" and "forecast" that support the selected algorithms (R Core Team, 2021).

RESEARCH DATA AND PRE-PROCESSING

The research data for inflation rates as a percentage change from the preceding period in prices for the gross domestic product, exports, imports, gross domestic product, and unemployment were obtained from the Bureau of Economic Analysis. Seasonally adjusted at annual rates and quarterly frequencies from the first quarter of 1948 up to the third quarter of 2020 were analysed. Trade openness was calculated as the sum total of imports and exports over GDP. The research data sample was split so that the training data sample consisted of quarterly data from 1948q2 to 2010q4 while out of sample evaluation was performed on the data sample that ranged from 2011q1 to 2020q3. Statistical learning approaches are often considered weak to detect trends in time series. Consequently, stationarity properties of time series under consideration were examined first. Stationarity properties were analysed using unit root tests including Augmented Dickey-Fuller (1979) (ADF test), Phillips–Perron (1988) (PP test), the Generalized Least Squares, and Dickey-Fuller test (DF-GLS) that was developed by Elliot et al. (1996), Kwiatkowski et al. (1992) (KPSS test). The results of the unit root test unambiguously indicate a constant mean and variance of inflation rates and unemployment rates within the considered time span while trade openness exhibited a stochastic trend. After differencing trade openness, its desired properties were obtained. Therefore, trade openness in its first differences exhibited stationarity properties, or mean and variance

were constant over the considered period. It's well known that the numerical value of a variable can influence estimation results, so the research data were further scaled and cantered to obtain mean zero and variance one.

EMPIRICAL RESULTS

To find a benchmark specification univariate, SVR specifications were estimated and evaluated first. To find the proper univariate specification, several approaches can be followed. One possibility is to rely on a correlogram and choose a number of lags that removes autocorrelation in residuals. The other possibility can be to follow the results from LASSO autoregression. The third possibility can be to evaluate the forecasting performance of the autoregressive specification with various lag selections. Findings from previous literature suggest SVR as the best suited approach to capture inflation dynamics. Consequently, univariate SVR specifications with different lags were evaluated. Since quarterly data were used, up to four lags were considered, and the preferred specification was selected following out of sample RMSE or RMSE based on the testing sample. Estimation results were provided in Table1.

Table 1: Univariate SVR specifications with different lags to forecast inflation

Prediction:			INF_t	INF_t	INF_t	INF_t
Predictors:	INF_{t-1}	ω	9.27	13.13	15.33	21.25
	INF_{t-2}		-	8.18	10.22	19.27
	INF_{t-3}		-	-	7.40	6.08
	INF_{t-4}		-	-	-	-9.15
b			-0.43	-0.13	-0.33	-0.31
ε			0.6	0.1	0.2	0.6
C			1	1	1	15
γ			1	0.5	0.33	0.25
RMSE			0.52	0.44	0.43	0.49

Source: Own estimates

The results in Table 1 indicated the autoregressive SVR specification with the lag three as the specification with the best forecasting accuracy. Therefore, the SVR specification with the lag 3 was considered as the benchmark specification in this research.

In what follows, the possible improvement of forecasting accuracy against the benchmark specification was considered. Firstly, the specification was extended to include potential effects from trade openness and unemployment rate. As illustrated earlier in the methodological section of this paper, Lasso regression might be useful for the variable and lags selection. Therefore, Lasso Regression was employed, and four lags were included. Estimates from the Lasso regression specification are provided in Table 2.

Table 2: LASSO regression estimates to forecast inflation

Prediction:			INF_t
Predictors:	INF_{t-1}	$\hat{\beta}$	0.57
	UNE_{t-1}		0.00
	TO_{t-1}		0.02
	INF_{t-2}		0.20
	UNE_{t-2}		0.00
	TO_{t-2}		0.04
	INF_{t-3}		0.05
	UNE_{t-3}		0.01
	TO_{t-3}		0.00
	INF_{t-4}		0.00
	UNE_{t-4}		0.00
	TO_{t-4}		0.00
λ			0.02
RMSE			0.49
Diebold-Mariano test statistics (p-value)			-1.2807 (0.896)

Source: Own estimates

As illustrated in Table 2, the estimates from Lasso regression suggest an autoregressive model with the lag 3 including effects from trade openness with the lag one and two as well as effects from unemployment with the lag three. The smallest effects appeared from unemployment rate. The forecasting accuracy of the Lasso regression specification was not any better than the benchmark in terms of RMSE or in terms of statistical significance. Afterwards, the specification obtained from Lasso regression was estimated using SVR approach to examine whether another estimator can improve the forecasting accuracy. The results were summarized in Table 3.

Table 3: SVR multivariate specification estimates to forecast inflation

Prediction:			INF_t	INF_t
Predictors:	INF_{t-1}	ω	34.09	31.56
	TO_{t-1}		20.06	19.96
	TO_{t-1}		29.23	27.35
	INF_{t-2}		21.41	20.78
	TO_{t-2}		21.69	20.89
	UNE_{t-3}		omitted	-0.49
b			-0.10	0.04
ε			0.2	0.1
C			2	2
γ			0.2	0.16
RMSE			0.37	0.39
Diebold-Mariano test statistics (p-value)			1.9549 (0.02899)	1.0449 (0.1513)

Source: Own estimates

The results in Table 3 suggest improved forecasting accuracy in terms of RMSE when SVR approach was employed while obtained forecasts were not statistically significant from the benchmark at 5% significance level. However, as one can see in Table 2, the smallest effect from unemployment with the lag three on inflation rate was found from the Lasso regression specification. Therefore, the specification was changed in a way that unemployment with the lag three was omitted, and the estimates were obtained using SVR approach. As illustrated in Table 3, when unemployment with the lag three was omitted, a more accurate forecast of inflation rates was obtained. While holding a significance level at 5% specification, the Diebold-Mariano test suggested a more accurate forecast compared to the benchmark, and RMSE is lower as well in comparison to the benchmark. Granger (1969), based on a prediction, introduced a statistical concept known as Granger causality. Following Granger (1969), if past values of time series X contain information that helps predict time series Y above and beyond the information contained in past values of Y alone, then there is Granger causality from X to Y. Bearing in mind the concept of Granger causality, the results suggest Granger causality from trade openness to inflation rates in the US. Furthermore, the effects were positive indicating an increase in trade openness of the US which corresponds to higher inflation rates. Romer (1993) stated a hypothesis assuming negative ef-

fects from trade openness to inflation. However, in case of the US, the results suggest positive effects. To consider effects from inflation to trade openness, the same procedure was followed with trade openness as a targeting variable to predict. Table 4 presents estimates for the autoregressive specification.

Table 4: Univariate SVR specifications with different lags to forecast trade openness

Prediction:			TO_t	TO_t	TO_t	TO_t
Predictors:	TO_{t-1}	ω	7.02427	12.3168	11.46453	13.30291
	TO_{t-2}		-	1.96147	-4.803353	-4.564271
	TO_{t-3}		-	-	-14.31415	-14.61938
	TO_{t-4}		-	-	-	-10.92692
b			0.3151084	-0.01343298	-0.1246008	-0.01073276
ε			0.4	0.0	1	0.9
C			1	1	1	1
γ			1	0.5	0.3333333	0.25
RMSE			1.315247522	1.244451795	1.236801155	1.260630573

Source: Own estimates

As illustrated in Table 4, the most suitable autoregressive SVR specification in terms of RMSE for forecasting trade openness was the one with the lag three. Afterwards, unemployment rate and inflation were included as predictors with up to four lags, and LASSO regression estimates were summarized in Table 5.

Table 5: LASSO regression estimates to forecast trade openness

Prediction:			TO_t
Predictors:	INF_{t-1}	$\hat{\beta}$	.
	UNE_{t-1}		.
	TO_{t-1}		0.26965546
	INF_{t-2}		.
	UNE_{t-2}		.
	TO_{t-2}		.
	INF_{t-3}		.
	UNE_{t-3}		.
	TO_{t-3}		-0.08436673
	INF_{t-4}		.
	UNE_{t-4}		0.02829510
	TO_{t-4}		-0.05808120
λ			0.04977024
RMSE			1.444174091
Diebold-Mariano test statistics (p-value)			-2.2583 (0.9851)

Source: Own estimates

The estimates in Table 5 do not provide a more accurate forecast in comparison to the benchmark specification for trade openness as a target variable to forecast. Furthermore, the estimates from LASSO regression suggest no effects from inflation to trade openness in the US. Afterwards, a comparison with the SVR estimates for the same specification was provided in Table 6.

Table 6: SVR multivariate specification estimates to forecast trade openness

Prediction:			TO_t
Predictors:	TO_{t-1}	ω	13.76405
	TO_{t-2}		-1.526216
	TO_{t-3}		-15.1979
	TO_{t-4}		-13.22091
	UNE_{t-4}		5.302816
b			-0.062129
ε			0.6
C			1
γ			0.2
RMSE			1.239504823
Diebold-Mariano test statistics (p-value)			-1.066 (0.8534)

Source: Own estimates

The forecast from the SVR multivariate specification outperforms the forecast from LASSO regression in terms of RMSE, but following the Diebold-Mariano test, the difference was not statistically significant at 5% significance level. When inflation rates with up to four lags were included in the SVR specification, the forecasting accuracy was not improved either in terms of RMSE[1] or in terms of statistical significance. Therefore, no effects from inflation to trade openness were identified in this research. Based on the empirical results from this paper, in the US, trade openness affects inflation while a reverse effect was not identified. An increase in trade openness seems to increase inflation in the US, and when modelling the inflation rate in the US, trade openness should be considered as an endogenous variable. The results of the empirical research presented in this paper are in line with recent findings from Comin and Johnson (2020) that pointed out inflationary pressure from trade integration in the US. When evaluating the results of Romer's hypothesis, explanations and discussion were often developed towards the issue of central bank independence (Lin et al., 2017). However, literature from international economics offered a factor-price equalization theorem (Samuelson, 1967) where

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[1]   The COVID-19 pandemic has severely affected trade openness in the US. When Bear 2020 is omitted from the sample, the forecasting accuracy from LASSO in Table 5 improves from 1.44 to 0.67 while the forecasting accuracy in Table 6 improves from 1.23 to 0.63.

international trade serves as a channel that equalizes prices of goods between trading partners. With lower prices in the US comparing to its trading partners, it is not surprizing that international trade increases price levels in the US. Further research might consider effects on prices in a specific industry sector and examine the role of the Federal Reserve System (FED) in US inflation dynamics.

CONCLUDING REMARKS

There are several conclusions that can be drawn out of the research presented in this paper. Firstly, the literature reviewed in this paper suggests a successful application of statistical learning approaches to forecast inflation rates while foreign effects on inflation dynamics were fairly neglected. Secondly, inflation dynamics exhibits nonlinearities, and an empirical approach that captures its nonlinear properties illustrates better prediction performance. Thirdly, forecasting approaches can be successfully applied to derive conclusions about the causality relation among considered analyses. The empirical results presented in this paper suggest SVR regression approach as a preferred approach compared to LASSO regression to forecast inflation rates in the US. The results further suggest a causal relationship from trade openness to inflation rates in the US in which an increase in trade openness increases inflation rates. The empirical results from this paper suggest no effects from inflation rates to trade openness in the US. The dynamics of unemployment was found to have negligible effects on inflation dynamics in the US pointing out that inflation dynamics in the US might be a foreign driven phenomenon. The empirical findings from this paper contradict Romer's hypothesis that assumes negative effects from trade openness to inflation rates. The results from this paper suggest price equalization between the US and its trading partners. However, the equalization should be verified within further research. Conclusively, there was an inflationary pressure from trade openness to inflation rates in the US. The effects on prices within industry sectors and the role of the FED remains to be examined in further research.

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ESG-RELATED CHALLENGES IN THE INSURANCE INDUSTRY: A MULTI-STAKEHOLDER PERSPECTIVE

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Challenges of implementation of the environmental, social and governance (ESG) factors in the business environment, such as ESG integration into existing product portfolio, the development of new sustainable products, adjustment of organisational internal policies and business processes as well as disclosure of non-financial information, are gaining momentum globally. These issues are especially challenging for financial institutions, in which management of risks is more complex than in non-financial organisations.

The insurance industry, as a professional risk underwriter, is expected to incorporate the concept of sustainability into both asset management as well as internal operations and underwriting processes. The implementation of today's complex related regulation may seem a great burden for insurers. Apart from being professional risk underwriters, insurance companies are among those financial institutions that have several mechanisms with a long-term horizon (e.g., manage long-term risks; the nature of their business stimulates interest for investing in sustainable organisations), which is favourable in terms of ESG integration. While much more research studies have been done on the ESG factors implementation in other institutional investors, such as pension funds and especially investments funds, insurers, however, still remain an under-researched field in ESG terms. Less is known about the ways in which insurance companies consider and adopt these non-financial factors in their business.

The purpose of this study is to analyse the current status of ESG factors implementation in various segments of insurance business – asset management, financial product development, adjustment of organisation and internal policies as well as non-financial reporting – and to examine its potential from an institutional, multi-stakeholder perspective. The study uses a qualitative survey through in-depth semi-structured interviews (N = 20) with different stakeholders (i.e., industry specialists, supervisory authorities, professional associations, consumers, and researchers). By introducing a multi-stakeholder perspective, we offer a comprehensive understanding of the phenomena. By focusing on the insurance sector of an EU country (Croatia), we find that the current aim of the insurers is to fulfil the minimum of expected compliance with regulatory requirements and that the implementation of ESG products as well as increase of their impact is planned in further business development. The latter is related not only to a development of isolated ESG products, but also, to a great extent, to the alignment of the overall existing portfolio with ESG requirements.

Keywords: *ESG, insurance, multi-stakeholder approach, neo-institutional theory*

JEL classification: *G22; G28; M14*

INTRODUCTION

Challenges of implementation of the Environmental, Social and Governance (ESG) factors in the business environment, such as ESG integration into existing product portfolio, the development of new sustainable products, adjustment of organisational internal policies and business processes as well as disclosure of non-financial information, are gaining momentum globally. These issues are especially challenging for financial institutions, in which management of risks is more complex than in non-financial organisations. ESG investing has been one of the most important topics in asset management in the past decade (e.g., Antoncic et al., 2020).

While the concept of sustainability, reflected in the ESG issues, is receiving growing attention from investors, firms, regulators, and researchers, little is known about its role in the insurance industry (Brogi et al., 2022; Chiaramonte et al., 2020). Much more research studies have been done on the ESG factors implementation in other institutional investors, such as pension funds and especially investments funds, whereas the insurers, however, still remain an

under-researched field in ESG terms. Less is known about the ways in which insurance companies consider and adopt these non-financial factors in their business. Specifically, although insurance belongs to the realm of finance, it has different characteristics from other financial sectors (Junsun, 2021). As institutional investors and risk-absorbers from businesses and individuals, insurers adopt an operating model that is more inclined to target long-term objectives, and they should be among the firms benefiting the most from engaging in sustainable practices (see, e.g., Chiaramonte et al., 2020). The stated distinguishing characteristic of insurance companies is described in Junsun (2021) as their *dual status*.

A lack of empirical research motivated us to analyse the current status of ESG factors implementation in various segments of insurance business and to examine its potential from an institutional, multi-stakeholder perspective, where we focus on the Croatian financial market. The study uses a qualitative survey through in-depth semi-structured interviews ($N = 20$) with different stakeholders within the Croatian insurance industry (i.e., industry specialists, supervisory authorities, professional associations, consumers and researchers) to examine the way and the extent to which ESG factors are implemented in the insurance industry; in segments of asset management, financial product development, adjustment of organisation and internal policies and non-financial reporting.

The paper contribution is three-fold. It offers systematic insights about the emerging ESG integration challenges in the insurance industry. Thus, we manage to map the insurance ESG ecosystem, adding to a still scarce literature in these terms. Furthermore, homogeneous and heterogeneous approaches and attitudes from different stakeholder groups are revealed. By introducing a multi-stakeholder perspective, we offer a comprehensive understanding of the phenomena. Moreover, we tested whether neo-institutional isomorphism exists across insurance companies. Finally, we provide useful practical insights into a complex issue of ESG factors implementation in one important segment of the financial industry.

THEORETICAL AND CONCEPTUAL FRAMEWORK

THE ROLE OF INSTITUTIONAL INVESTORS IN SUSTAINABLE FINANCE

Institutional investors include various institutions, such as investment funds, pension funds, and insurance companies. Sovereign wealth funds and public pension reserve funds are sometimes considered as institutional inves-

tors, too, although they could be seen as the ultimate owner of the assets they invest in (OECD, 2021, p.12). Institutional investors are significant participants in the world's economy and their share in international markets has been constantly increasing (OECD, 2021).

Besides their economic power, the way institutional investors manage assets fits well into the concept of sustainable finance, especially compared to other financial institutions. In terms of their asset allocation, these financial institutions tend to invest most of the managed assets into traditional instruments like bond and equities, which are also an established form of ESG investment. These traditional instruments account for between over half (for pension funds) and nearly 75% (for composite insurers) of direct investments of institutional investors in the OECD on average (OECD, 2021, p.15). This group of financial actors is specific because it has the incentives to address and mitigate long-term climate-related risks, particularly pension funds and other long-term-focused investors who cannot easily diversify out of global risks such as climate change and thus have an inherent incentive to address them (see, e.g., Financial Centres for Sustainability, 2021). This long-term investment horizon of institutional investors is what makes them one of the most important participants, if not the drivers of the ESG market, as seen in some countries (e.g., the example of the Norwegian Government Pension Fund – Global). Generally, these institutions are seen as ones having the highest potential in terms of sustainable investing and provide the largest contribution to the demand for sustainable financial products and services. On the other hand, there are some observations (Zadek, 2005, p.19) that although most institutional investors are considered long-term investors, in the context of modern financial practice, it would be more correct to understand even those financial institutions as investors that invest in a short-term, but forever. However, this question goes beyond the scope of our study, and it might be an interesting topic for future research.

THEORETICAL APPROACH

The embracement and implementation of ESG practices in business, and especially in the financial industry, is a complex and multi-layered issue, involving various stakeholders. Therefore, investigation of these issues requires a multi-stakeholder perspective which can provide a comprehensive understanding of the researched phenomena. With the aim of implementing the stated research idea, we base our research on a multi-stakeholder perspective and apply a triangulation approach to provide useful insights into different perspectives

of a complex issue (Strier & Werner, 2016). The concept of triangulation has a long history in the social sciences (Campbell et al., 2018), as a method used by qualitative researchers to check and establish validity and enhance credibility of findings in their studies (Guion, 2002), by using different sources of data/information (Guion, 2002). Apart from data triangulation, that is, using data from different times, spaces, and people, our study is also characterised by the investigator triangulation, as it involves several researchers in the collection and analysis of data. We use this theoretical approach in conducting semi-structured in-depth interviews to gain insights into the perception of different stakeholders (i.e., industry specialists, supervisory authorities, professional associations, consumers, and researchers) of ESG-related issues in the insurance industry.

Moreover, we apply the neo-institutional theory (also referred to as *new institutionalism* or *institutionalism*) as one of the main theoretical perspectives used to understand organizational behaviour as situated in and influenced by other organizations and wider social forces (Lounsbury & Zhao, 2013). This provided us with a basis for testing whether neo-institutional isomorphism exists across insurance companies, that is, a similarity of the processes or structure of one organization to those of another in terms of the embracement and adoption of ESG-related practices. As stated by DiMaggio and Powell (1983), isomorphism is a "constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions".

LITERATURE REVIEW

The role of institutional investors in fostering sustainable finance has been investigated by scholars from various perspectives, with an increase in a number of research studies seen in the late 2010s (e.g., Hu et al., 2020; Schoenmaker & Schramade, 2019; Sievanen et al., 2017; etc.). In general, a literature review of this field reveals that significantly more attention has been given to some institutional investors, such as pensions funds, and investment funds in particular (obviously reflecting the practical development of sustainable finance in various segments of the financial industry), while the insights into the insurance industry in terms of ESG still remain less explored. In business economics journals, where the research question of the vast majority of studies was focused on the financial performance of ESG investment compared to conventional investment (Revelli, 2017), the investment (ESG) funds make one of the three basic lines of research, together with the other two research targets – individual stocks and SRI indices (see, e.g., Brzeszczynski & McIntosh, 2014).

With regard to research on investment funds applying ESG practices, the vast majority of literature focused on the mentioned issued of financial performance in these financial institutions as well (Goldreyer et al., 1999; Humphrey & Lee, 2011; Ito et al., 2013; Leite et al., 2018; Lobato et al., 2021; Sun & Small, 2022; etc.). Chegut et al. (2011) provided a valuable contribution by reviewing the SRI mutual fund performance literature to provide best practices in SRI performance attribution analysis and pointed out to topics that require specific attention in this literature: data quality, social responsibility verification, survivorship bias, benchmarking, and sensitivity and robustness checks (see Ivanisevic Hernaus et al., 2022). A comparatively smaller portion of literature in (the dominating) business economics journals has been dedicated to other related topics such as, for example, investigating the relationship between moral orientation of investors and their financial market behaviour (e.g., Peifer, 2011), paying attention to *how* funds choose to account for ESG concern in the investment portfolio and whether these strategic choices surrounding the implementation of ESG affect retail investors' perception of sustainable quality, financial quality, and/or perceived overall quality of the ESG-fund (Hauff & Nilsson, 2022).

With regard to literature on pension funds potential in embracing and adopting ESG practices, conducted research studies are characterised by the application of different research approaches and analyse examples/samples from various countries worldwide. Some studies offered useful insights into how ESG investment from pension funds has been encouraged, for example, by analysing pension funds' path towards responsible investments (e.g., Vaanane, 2021), presenting a framework intended to provide pension funds with practical guidance for the successful implementation of a sustainable investing strategy (Woods & Urwin, 2010), examining how certain factors, e.g., investor associations encourage Responsible Investment behaviour (Yamahaki, 2019), and analysing the role of social responsible (SR) pension funds as influential institutional shareholders in the corporate sustainability of investee firms (e.g., Alda, 2019). Several research papers studied attitudes and preferences in terms of sustainable investment, in particular, they examined the attitudes beneficiaries and pension fund managers hold towards incorporating sustainability as a bigger factor into their investment portfolios (Strangmueller, 2018), and analysed preferences for sustainable investment among a representative cross-section of 2486 pension fund participants in the Netherlands (Delsen and Lehr, 2019). The latter authors interestingly found that sustainable investments were commonly favoured, even if they harmed financial interests, contributing to another line of research focusing on the financial performance implications

of considering ESG issues in financial decision making in these institutional investors (among others, Hoepner & Schopohl, 2018; Son & Kim, 2022).

Among institutional investors, the insurance companies in terms of ESG practices have up to now been least investigated, where most of the studies published examined the developed financial markets. Several studies focused on examining the influence factors for the ESG investment decision in insurance companies, e.g., evaluating the importance of policy, market, and civil society signals (Mielke, 2019) and identifying the determinants of ESG awareness where larger, more profitable, and more solvent insurance companies showed the highest level of ESG awareness (Brogi et al., 2022). Other studies, on the other hand, focused on the impact of such investment decisions on various business characteristics such as further management of ESG issues itself (Nogueira et al, 2018) or commercial stability of insurance companies (Chiaramonte et al., 2020), the latter paper finding that sustainability, proxied by Environmental, Social and Governance (ESG) scores, enhanced the stability of insurers, and that this relationship was driven by environmental and social dimensions. What is important for further and adequate application of ESG issues in financial decision making in insurance companies is provided by conclusions in a few studies that have pointed out that the continued resilience of the industry to ESG issues requires a systematic integration of various stakeholders' perspectives (Shea & Hutchin, 2013) and more recently, by Greenwood and Warren (2022), that the use of ESG investment strategies to mitigate climate risks is a "grey area" in which climate risk management practices are undefined within broad sustainability and responsible investment agendas. Taking into consideration the specific nature of the insurance business, Risi (2020) provided valuable insights into the mechanisms associated with different time horizons and investigated their effects on the adoption of SRI in Swiss insurance companies. A recent study by Schneider et al. (2021), with their survey evaluating investment strategies and thresholds for the exclusion of sectors and business practices, as well as insurance companies› strategies for sustainable business development, was somewhat closer to ours. And interesting study that could serve as a theoretical basis for further research was done by Gatzert and Reichel (2022), who, by analysing 1215 sustainability- and investment-related documents of the European and US insurance industry, developed a dictionary with principles, criteria and terminologies as well as strategies, also differentiating between the quality of reports.

EU STRATEGIC FRAMEWORK AND INSURANCE MARKET OVERVIEW

REGULATORY TRENDS AND EXPECTATIONS

The Paris Agreement was adopted with the intention of uniting all nations in the common goal of undertaking ambitious efforts to combat climate change and adapt to its effects, and to establish a global legislative framework aimed at stimulating sustainable long-term investments. It represents a turning point in multilateral dealing with the problems of climate change, and it was preceded by long-term efforts and the adoption of the Principles of Responsible Investment. Following the Paris Agreement, in 2016, the European Commission established the High-Level Expert Group (HLEG), a multi-stakeholder initiative focused on concrete measures that the EU can take to align one of the world's largest financial system with global objectives for sustainability. It was established in order to lay the foundations for the regulatory framework of sustainable finance. The Group ended up their mandate making key recommendations with the aim of integrating sustainable financing into the financial policy of the European Union and making institutional and small investors aware of the importance of long-term sustainable investments, with the ultimate goal of capital allocation for sustainable purposes.

EU Action Plan on Financing Sustainable Growth was published in 2018 as a fundamental document for turning the financial markets in the direction of the green transition. It is a part of the Capital Markets Union's (CMU) efforts to connect finance with the specific needs of the European economy to the benefit of the planet and our society. The need for further development of regulations in the field of sustainability led to the adoption of the European Green Deal, whose overarching objective is for the EU to become the first climate neutral continent by 2050, resulting in a cleaner environment, more affordable energy, smarter transport, new jobs, and an overall better quality of life. It was adopted in 2019 by the European Commission.

Furthermore, in January 2020, the European Commission presented the European Green Deal Investment Plan, aimed to mobilise at least €1 trillion of sustainable investments over the next decade, in three ways:
1. Financing: a greater share of the EU budget than ever will be dedicated to climate and environmental action.
2. Enabling: the EU will provide the necessary tools in order for investors to put sustainable finance at the heart of the financial system, including through green budgeting and procurement.

3. Practical support: the Commission will assist authorities and project promoters in planning, designing, and executing sustainable projects.

The EU's broader plan includes incentives to unlock and redirect public and private investment and ensure opportunities for investors – positioning sustainable finance at the heart of the financial system. Accordingly, the EU's long-term goal is a turnaround in the structure of supply and demand of investment products by institutional investors, who would then become a flywheel for further implementation of the concept of sustainability. The capacities of the public sector are insufficient to stimulate the sustainable growth, therefore, the new EU legislation seeks to encourage the financial sector to respond more strongly to mobilize the capital needed to realize the goals of the European Green Deal.

Political, social and investors' pressure has led to the introduction of a series of new European rules that are coming into force and will continue to be implemented in phases over the next two years. The package of legislative proposals issued by the European Commission in May 2018 was adopted and further work is underway in coordination with the European Green Deal.

The regulatory regime of the European Commission, as the leader in the formalization of the field of sustainability, is broadly designed to direct investments in financing of sustainable economic activities, in order to transform the economy and ensure financial stability by integrating ESG factors into risk management processes of market participants.

Financial sector plays a key role in achieving sustainability goals, so their investments should be more significantly redirected towards long-term development in a sustainable manner. In order to achieve the mentioned goals, during the period 2018-2020, a set of regulations was adopted in the EU:
1. The Sustainable Finance Disclosure Regulation (SFDR) – (EU) 2019/2088
2. Sustainable Finance Taxonomy – (EU) 2020/852
3. Low Carbon Benchmark Regulation – (EU) 2019/2089.

As specified, Regulation applies to financial market participants, among them an insurance undertaking which makes available an insurance-based investment product (IBIP).

As mentioned earlier, not only new acts but also the ones already adopted make an integral part of the legislative package implementing the provisions in the area of sustainable financing. So far, amendments to 6 sectoral delegated acts in the field of UCITS, AIFMD, MiFID, IDD and Solvency II have been implemented. Additionally, the Non-Financial Reporting Directive (NFRD), the EU legal framework for regulating the disclosure of non-financial informa-

tion by corporations, states that corporations have to report on ESG information. European listed and large public-interest companies with more than 500 employees that have either a balance sheet total of more than EUR 20 million or a net turnover of more than EUR 40 million are in scope, but it also applies to financials.

The three key EU regulations on sustainability disclosure, the EU Taxonomy, the Sustainable Finance Disclosure Regulation and the Non-Financial Reporting Directive are all relevant for sustainability disclosure. While the Taxonomy is a classification system – establishing a list of environmentally sustainable economic activities (disclosure regulation that applies to companies and asset managers in scope of the SFDR and NFRD), the SFDR and NFDR are focused on capturing and mitigating sustainability risks. The three European Supervisory Authorities (EBA, EIOPA and ESMA – ESAs) took a role in the supervision of the implementation of the robust regulatory framework, as well as developing regulatory technical standards (RTS) regarding the content and presentation of sustainability disclosures.

The EU SFDR aims to help investors by providing more transparency on the degree to which financial products consider environmental and/or social characteristics, invest in sustainable investments or have sustainable objectives. It requires specific firm-level disclosures from asset managers and investment advisers regarding how they address two key considerations: Sustainability Risks and Principal Adverse Impacts. With regards to asset managers, the SFDR also mandates transparency of remuneration policies in relation to the integration of sustainability risks. In addition, it aims to help investors to choose between products by mandating increasing levels of disclosures, depending on the degree to which sustainability is a consideration.

Data publication obligations arising from the SFDR, the EU Taxonomy, the RTS, as well as changes in the sectoral regulation, are divided into 3 parts:
- "high level" data, which will have the greatest significance and impact on financial market participants and financial advisors to whom the aforementioned regulations apply;
- a detailed representation of the data arising from the RTS proposed on the basis of the SFDR, divided into 3 categories:
  o rules that must be applied at the level of financial market participants,
  o rules that must be applied to all financial products, regardless of whether they apply the concept of sustainability in their business or not,
  o rules that must be applied only to those financial products that clearly express a focus on sustainability;
- an overview of the obligations resulting from the change in the sector regulation.

Obligations regarding the publication of "high-level" data, arising from the SFDR started on 10th March 2021. The Regulatory Technical Standards (RTS) define the new standard for sustainability-related disclosures in the financial services sector in the EU and supplement provisions of the SFDR and of the Taxonomy Regulation. They define details on the implementation of ESG-related disclosure requirements under the SFDR and the Taxonomy Regulation at entity and product level and include five annexes with templates for principal adverse impact statements, precontractual disclosure and periodic reports. They provide additional detail on the content, methodology and presentation of certain existing disclosure requirements under the SFDR and the Taxonomy Regulation. Entities subject to these requirements will need to ensure that their existing principles-based disclosures are updated to reflect the detailed requirements of the RTS.

The ESAs submitted draft RTS to the European Commission in April 2020 and February 2021, and additional draft RTS were submitted in October 2021. In a letter dated 8th July 2021, the ESAs stated their intention was to "bundle all 13 of the regulatory technical standards in a single delegated act". After the European Commission's proposals, the RTS must be reviewed by the European Parliament and the European Council. After numerous postponements, on 6th April 2022, the European Commission announced that it has adopted the regulatory technical standards to be used by financial market participants when disclosing sustainability-related information under the SFDR. The delegated act published by the EU Commission on 6th April 2022 comprises all the various RTS required under the SFDR. On 25th July 2022, the Delegated Regulation (EU) 2022/1288 of the European Commission was published in the Official Journal of the EU, which supplements the SFDR Regulation (EU) 2019/2088 with regard to regulatory technical standards. The RTS are coming into force on 1st January 2023.

MARKET OVERVIEW

The Croatian financial system is bank-based and characterized by dominance of banks with a 67.37% share in the total assets of all financial institutions. Insurance companies have a share of 6.47% and together with obligatory pension funds represent the most important institutional investors in the Croatian financial system (a share of 17.77%). The Croatian insurance market has a 0.10% share in the European Insurance Market. At the end of 2021, there were 7,913 employees in insurance undertakings, representing 21.5% of employees in the financial sector. Indicators of significance of insurance companies for 2020 in Croatia are as follows:

- Total premium in % of GDP: 2.9%
- Total premium per capita in USD: 398
- Life premium in % of the Total premium: 25.4%.

Developed countries and insurance markets are characterized by a share of insurance premiums in GDP which is above 6%, annual investments in insurance per inhabitant of more than 2,500 USD and a share of life insurance premium in total premiums exceeding 50%. All indicators show a significant growth area for insurance premiums in the Republic of Croatia. At the end of 2021, in the Croatian insurance market, there were a total of 15 insurance companies transacting business. Among these companies, 3 companies transacted life assurance, 4 companies exclusively non-life insurance, while the remaining 8 insurance companies transacted life and non-life insurance. Gross premium written amounted to €1,555 million, while claims paid amounted to €972 million. Non-life insurance premiums accounted for 75.2%, while life insurance premiums accounted for 24.8%. Assets of the insurance companies at the end of 2021 amounted to €6,432 million. Investments represent the key asset with a share of 79.0% and an amount of €5,023 million at the end of 2021 (CIB, 2022).

METHOD

The purpose of this study is to analyse the current status of ESG factors implementation in various segments of insurance business and to examine its potential from an institutional, multi-stakeholder perspective. The study uses a qualitative survey through in-depth semi-structured interviews (N = 20) with different stakeholders (i.e., industry specialists, supervisory authorities, professional associations, consumers, and researchers) to examine the way and the extent to which ESG factors are implemented in the insurance industry in segments of asset management, financial product development, adjustment of organisation and internal policies and non-financial reporting. By introducing a multi-stakeholder perspective, we offer a comprehensive understanding of the phenomena. Moreover, we tested whether neo-institutional isomorphism exists across insurance companies by focusing on the insurance sector of an EU country. Qualitative analysis in this study explores the opinions of three groups of experts to benefit from triangulation.

We conducted 20 interviews among insurers, the Croatian Financial Services Supervisory Agency, the Croatian Insurance Bureau, consultants, and academia. Respondents include board members, ESG experts, risk and asset managers, product development or compliance experts. Institutions were con-

tacted by e-mail with an attached invitation letter describing the research and interview questions. These institutions were asked to propose an expert in this field to answer the interview questions which was an inclusion criterion for conducting the interview. Interviews lasted between 45 and 60 min and were conducted in Croatian. Direct transcripts were made of the interviewees' answers. To increase the trustworthiness and credibility of the qualitative research results, triangulation was used (Bryman, 2012). Triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena (Patton, 1999). More specifically, data source triangulation, which involves the collection of data from different types of people, including individuals, groups, families, and communities, was used to gain multiple perspectives and validation of data (Carter, 2014). Stakeholder triangulation is one way that researchers can use to check different perspectives of a complex issue (Strier & Werner, 2016). Additionally, we tested preliminary research conclusions by presenting them on the expert conference *Croatian insurance days 2022* in May 2022.

Topics that are covered with qualitative research using a semi-structured interview protocol with six open-end questions with subtopics on the topics of: the Strategic focus and knowledge in the ESG field, Compliance with ESG regulation, Potentials of ESG-oriented products in life insurance, Potentials of ESG-oriented products in non-life insurance, and the Implementation of ESG criteria in investments.

The research process was based on the following steps. First, qualitative data from interview answers and transcripts were analysed using open coding that resulted in identifying 11 reasons (Strauss & Corbin, 1990). Interview answers were analysed question-by-question to define main opinions, determinants, and perspectives within the aim of the study. Second, data were constantly compared to determine categories and explore relationships within each which led to four perspective categories (Mason, 2002). Third, stakeholder triangulation contributed to the research in terms of the overall width of data because of the different interests and market positions of the three stakeholder groups.

RESEARCH RESULTS AND DISCUSSION

Below are the findings of the study. The results point to topics that relate to the *Strategic focus and knowledge in the ESG field*, *Compliance with ESG regulation*, *Potentials of ESG-oriented products in life and non-life insurance,* and the *Implementation of ESG criteria in investments.*

FINDINGS

1. Strategic focus and knowledge in the ESG field

The focus of the insurance industry in general and the supervisory authority on the ESG area is declarative, aimed at regulatory compliance but not at the level of previous regulations, e.g., Solvency II or IDD implementation. The current focus of the insurance industry is dedicated to the IFRS 17 and EURO implementation in Croatia. Some respondents consider the focus on ESG as a "marketing" approach of some insurers and not a true ESG complied business strategy. In addition, some partial scepticism and caution about actual effects on consumers and the industry is observed.

Information and knowledge in the ESG field is currently at the level of basic knowledge of the concept, the ESG knowledge is low at the level of the whole industry. It is a new area, as respondents emphasise, and there is a clear need for additional specialized education, exchange of experiences and "best practice". The level of knowledge about ESG is highly dependent on the ownership of the insurance company and support of the mother company. Foreign owned insurers are better positioned here.

Key challenges of the insurance industry in ESG implementation are emphasised in the establishment of metrics and indicators for monitoring, their regular updating, and availability of data. Regarding the product management and distribution of ESG complied products, respondents emphasise requirements of the Insurance Distribution Directive (IDD) and product offering, sales, and understanding of distribution channels about these products. There is a concern about sustainability and profitability ratio and consumers interest in these products. It is mainly considered that Croatian consumers are mainly focused on the profitability component of insurance products, especially in life insurance. It is also pointed out that insurers need to adjust their own business conduct and practice to the ESG mindset.

2. Compliance with ESG regulation

In relation to the regulatory framework adopted so far, the insurance industry is harmonized with SFDR regulatory requirements. Also, insurance companies are implementing ESG and climate scenarios in their Own Risk and Solvency Assessment (ORSA) process and report.

The strategic direction of insurance companies' business towards ESG is still without a strategic „twist" in business strategy and implementation of ESG in it. Some companies already have ESG elements incorporated into their

operations. Compliance with ESG regulation is in most cases dedicated to an ESG compliance team or working group, and some insurance companies are planning to hire ESG officers and establish an ESG organisational unit. Implementation costs of the ESG framework are currently low and expected to increase in the future.

The approach of the supervisory body in harmonization with ESG regulation was based on adjustment of the legal framework, informing supervised insurance companies and cooperation with EIOPA. The supervisory authority continuously monitors the development of the ESG area and the activities of the supervisory entities related to this regulatory framework. There has been no major supervision of ESG compliance so far.

3. *Potential of ESG-oriented products in life insurance*

In this part of the research, we analysed to which extent ESG factors are applied in the existing life insurance products. As a rule, existing products do not include ESG factors. Some foreign-owned companies offer ESG-based unit-linked life insurance products.

Regarding the plans to develop the new ESG-oriented life insurance products, most companies are considering and analysing the situation. There is less interest in the imminent in the development of new ESG investment life insurance although some companies are planning to introduce ESG-complied products of unit-linked life insurance. Some respondents point to scepticism about the profitability of these products and contribution for consumers.

The interest of consumers in ESG life insurance products, in opinion of the respondents, could be seen in the group of younger consumers. The profitability of the product remains the essential question and the demand also depends on the purchasing power of Croatian consumers. There is also a question of low ESG awareness and financial literacy in the Republic of Croatia. „Green's in", but there is also the problem of greenwashing stated by some respondents from the insurance companies.

4. *Potential of ESG-oriented products in non-life insurance*

In the part of implementation of ESG standards in non-life insurance products, limitations on risk-taking by some insurers is seen. There is also a question of the issue of reinsurance coverage for some insurance policies in „dirty industries". Market possibilities are emphasised in the importance of risk of sustainability and climate changes for non-financial corporations and new insurance coverages. The respondents point to types of non-life insurance that

can be developed through the ESG, e.g., agricultural insurance, property insurance, disaster risk coverage, and health insurance. Some insurance companies are introducing discounts for electric vehicles. The challenge remains in the lack of appropriate data and evaluations, the legal framework, e.g., scooter insurance.

In the part of new products that would tackle climate and cyber risks, the respondents point to cyber risk complexity and opportunity to advise the non-financial sector on climate risks and sustainability risks as well as insurance of renewable energy sources.

5. *Implementation of ESG criteria in investments*

Regarding the question of the extent to which the ESG factors are included in the investment strategy, some foreign-owned insurers are stating that they have been applying these principles even before the ESG regulation, based on the requirements of their mother companies. The mother companies' support is seen regarding the compliance of investments, limits, and portfolio evaluation through ESG criteria with some service and ESG rating providers. Based on the answers from the respondents, there is limited space for ESG investment in Croatia due to limited investment opportunities and a shallow financial market. In addition, they point to a lack of awareness and low development of ESG investment funds.

The problem of greenwashing could be solved by appropriate regulation and supervision, standardization and taxonomy, and by developing awareness which is a long-term process, then by higher transparency and awareness of a high reputational risk in greenwashing practices. The respondents also state that it is "difficult to avoid".

Regarding the profitability of ESG investment in relation to "traditional" investment, the respondents in general perceive it as a lower yield, but it should be emphasised that a long evaluation period is required to make solid conclusions. Also, the problem of insufficient information, a lack of ESG funds and ESG investments is raised again. Some respondents consider that there is a problem of ESG assets "bubble" on a financial market that is driving the asset prices of ESG investments. What should be raised here is the issue of the importance of consumer protection.

THEORETICAL AND PRACTICAL IMPLICATIONS

This study is an attempt to add to our knowledge and understanding of the embracement and adoption of ESG practices in financial institutions in general, and in insurance companies in particular. New theoretical insights come from demonstrating how different perspectives, gathered from various stakeholders, add to our understanding of the researched phenomenon. In particular, facts provided by in-depth interviews offered valuable insights into the current status of ESG factors implementation in various segments of insurance business (asset management, financial product development, adjustment of organisation and internal policies and non-financial reporting) and examine its potential from an institutional, multi-stakeholder perspective.

As far as theoretical contributions of this research are concerned, the study contributes to our understanding of the emerging ESG integration challenges insurance companies are facing, as these are still unexplored in previous literature, especially in this segment of the financial industry. Therefore, by offering systematic insights into these issues, we manage to map the insurance ESG ecosystem. Additionally, the study integrates two theoretical approaches (the multi-stakeholder perspective and neo-institutional theory), which provided a supportive basis for reaching a comprehensive perspective of a complex problem. By introducing a multi-stakeholder perspective, we offer a comprehensive understanding of the phenomena, much needed for a holistic overview of ESG-related issues in business. As Shea and Kutchin emphasize (2013), continued resilience of the industry to these issues requires a systematic integration of various stakeholders' perspectives. Research results indicated that the neo-institutional isomorphism holds only partially, as the similarity of the processes and approaches of one organization to those of another in terms of embracement and adoption of ESG-related practices was present only to a certain extent. With this regard, findings of this paper emphasize the need to develop and evaluate an adequate model and extent of implementation of ESG issues in various segments of insurance business. Finally, the theoretical contribution of our study also emerges from raising awareness of ESG issues implementation in financial practices in the developing Central and Eastern European financial market, where related literature is still scarce. This is partly due to the perceived conflict of ESG investing with an asset manager's fiduciary duty and partly due to low-quality ESG data despite the near ubiquity of sustainability reports (Antoncic et al. 2020).

In 2019, a survey about ESG strategies was sent to German private health insurance companies. The survey evaluated investment strategies and thresh-

olds for the exclusion of sectors and business practices, as well as company strategies for sustainable business development. The findings contrast with the expected intrinsic economic interest of the insurers to stop global warming and improve public health. Most assets are managed in a highly problematic manner, especially since the absence of capital allocated in fields contrary to medical ethics (e.g., firearms, armour) cannot be presumed. The lack of transparency is a major problem that limits clients in choosing the insurer who has the most advanced ESG criteria (Schneider et al., 2021). The conclusion of our research goes in line with the above mentioned.

From the practical viewpoint, in examining the way and the extent to which ESG factors are implemented in the insurance industry in various business segments, homogeneous and heterogeneous approaches and attitudes from different stakeholder groups are revealed. A large and diverse sample of interviewed stakeholders, covering the whole insurance industry at one financial market, is useful to demonstrate and determine what the most important ESG-related challenges in this industry are, what may help not only researchers but also practitioners to focus on their ESG efforts more successfully. We provide useful practical insights into a complex issue of ESG factors implementation in one important segment of the financial industry. The study will contribute with shedding light to ESG topics in the insurance industry, understanding it better as well as relating it to a practical, real context. To the best of our knowledge, this is the first research attempt of its kind not only at the Croatian financial market but also broader. This is especially important taking into consideration that the ESG-related regulatory requirements have emerged only recently, are expected to increase in the future and that their practical implementation raises issues.

Taking into account practical implications, to comply with the ESG regulatory requirements, insurers must ensure several key points:
- the risk management function considering sustainability factors when identifying and assessing risks,
- the actuarial function considering the effects of sustainability risks when expressing an opinion on the overall insurance risk-taking policy,
- risk management policy adequately taking sustainability risks into account and ensuring the measures undertaken to assess and manage the risk of loss or adverse changes in the value of liabilities (resulting from inappropriate assumptions regarding the formation of premiums and reserves) including sustainability risks,
- appropriate identification, assessment and management of sustainability risks, especially when it comes to investments,

- inclusion of the possible impact of sustainability risks in the Own Risk and Solvency Assessment (ORSA),
- avoidance of "greenwashing",
- paying attention to the client's preferences regarding sustainable products, by considering sustainability factors in the approval and monitoring process of each insurance product, and in that way engaging in protection of interests and transparency towards consumers.

One of the greatest burdens when it comes to complying with the aforementioned requirements is the fact that sustainability is becoming measurable. It is no longer enough for insurers to qualitatively explain their dedication towards these emerging risks (which is quite subjective and difficult to track), but from now on, the numbers in the form of KPIs, benchmarks and other trackable indices are required. All this happens within a fast-evolving regulatory framework, unequally covering various parts of the sustainable investment value chain, resulting in complexity and confusion among investors. Consequently, that could easily lead to launching falsely sustainable products and greenwashing the market.

Another debating point is the institutional investor's growing demand for ESG compliant investments, completely mismatched with the market supply. Standardization in ESG-labelling of issuers is highly needed for institutional investors to make relevant investment decisions. Furthermore, the upgrade and further development of ESMA's and NCAs' expertise is necessary in a way that the market participants can be better informed of how to apply various rules in the sustainable finance rulebook. When it comes to benchmarks, the lack of data availability impairs disclosures made by benchmark providers. Scarcity of publicly disclosed information and market concentration regarding ESG rating and data providers lead to unreliable metrics. Generally, the issue of the ESG evaluation criteria has been a subject of discussion for a long time. E.g., privately defined ESG indices and standards can increase the risk of compliance with the main objectives of the sustainable transformation of the economy. Therefore, the EU regulators have been taking into consideration the necessity of existence of public audit principles.

In summary, ESG markets evolve at a rapid pace. Over the next decades, climate change is expected to have a growing impact on global financial markets, so tools such as stress testing and scenario analysis are essential to enable the assessment of climate transition and physical risks. Those assessments are, however, jeopardized both with data availability and data quality issues, and this is particularly challenging for entities facing disclosure requirements. Implementing a strong regulatory framework is not an easy task, so gathering

and analysing the data when reporting, with still fluid and fractured metrics is problematic to both the market participants as well as the supervisors. By now, the European Supervisory Authorities conducted several surveys in order to test the understanding of draft pre-contractual and periodic templates developed for the Regulatory Technical Standards, and they all imply the same conclusions – the complexity of content and terminology, resulting in requirement for higher economic knowledge to be apprehensible. Sustainable finance requires going through a "learning curve" as all major game-changing trends did in history. This is a huge opportunity for insurers to use their sustainability credentials to fuel growth and attract clients, and redirect their business strategies towards customers, corporate social responsibility, climate change, education, data protection and security, demographic change, product management innovations, etc.

LIMITATIONS AND FUTURE RESEARCH

This research is based on the insurance industry in Croatia which is still in a developing phase. Although it is a good example of a small insurance market of an EU member state which is complied with the EU insurance regulatory agenda, the conclusions of this research could be applicable for similar markets of CEE countries but not for large and developed EU markets. It could be interesting to conduct research on a larger scope of EU countries in order to get relevant data and experience with ESG implementation in insurance companies business strategies, operations, products, and asset management.

Combining both quantitative and qualitative methodology could also point to wider conclusions and impact of other variables such as profitability, solvency, and the insurer's business model to the level of ESG implementation in a business conduct. These directions could encourage researchers to include above mentioned topics and methodologies in their research agenda.

CONCLUSION

Our research findings help in articulating the underlying processes and the business environment of insurance companies which influences their practice of ESG implementation. This paper contributes to research in the insurance industry and sustainable finance, by analysing the status of ESG factors implementation in various segments of insurance business and examining its

potential from an institutional, multi-stakeholder perspective. The research conclusions based on qualitative methodology on the Croatian insurance industry point to a complexity of adjustment of ESG criteria in a business strategy of insurers, products in life insurance, non-life insurance, and investments of insurance companies. For a small and developing insurance market such as Croatian, it is of highest importance to exchange experience and develop "best practice" of ESG implementation. The inadequate level of financial literacy and consumer education on ESG is an obstacle from the insurers' point of view to develop ESG-based products, especially life insurance products. The question of the profitability of ESG unit-linked life insurance remains, as well as consumers' (un)willingness to eventually trade profitability for an ESG component. Although, future research is necessary to determine if this is really the case. The EFAMA's analysis of the profitability of ESG funds indicates that the average return on ESG equity funds was 10.4% 2016-2020, and on "traditional" equity funds 9.2%. ESG bond funds have a lower yield than traditional ones, with an average yield of 2.5% 2016-2020, compared to 2.9% for non-ESG bond funds (EFAMA, 2021). The future focus of insurers should be on integrating sustainability into the business model instead of only complying with regulatory requirements.

Sustainability is becoming imperative in the world of institutional investors who should develop internal procedures and policies taking ESG criteria into account. Investors, clients, and regulators have high expectations, and those market participants that adapt quickly and show an affirmative attitude towards the concept of sustainability are likely to contribute significantly to the company's reputation and strengthen the base of loyal clients. Also, pioneering engagement in this, for many still an enigmatic area, is a possible opportunity to profit from trends that are already underway and inevitable.

Representing the second-largest group of asset owners (behind pension funds), insurance companies are crucial players in the transition to a sustainable economy. The insurance industry can change the drive in two ways: by its own responsible operations, investment decisions and asset allocation, where it has the ability to make a significant contribution to tackling climate change and wider ESG challenges via sustainable investing, while at the same time, it can also incentivize other businesses and individuals by considering ESG factors in underwriting.

While insurers are facing the challenges of covering risk in a rapidly changing world, sustainability is setting several subjects in focus. The most important of them are risk management, disclosure requirements, evolving regulation and stakeholder management – focused on the client's preferences.

In order to properly and timely deal with these questions, efforts across all the entity's value chain have to be made, including: strategy amendments, underwriting, investment strategies, risk and claims management, product management, marketing, and corporate culture. Sustainability governance is undoubtedly a task for each corporate department, and it will require independent unit dedicated just to this subject in abbreviated time. What distinguishes insurers from other participants in the financial industry are two completely separated business lines: life insurance and non-life insurance, which must be managed in their own ways, including ESG requirements as well.

ACKNOWLEDGEMENT

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BUILDING A CASHLESS SOCIETY: PERSPECTIVES FROM ECONOMIC GROWTH

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This study investigates the relationship between cashless economy and economic growth within the framework of future of money. While there are numerous studies available on cashless economy, the benefits of cashless economy and economic growth perspective are generally neglected in the literature. Panel data analysis is applied to assess impact of cashless economy on economic growth by selected countries in the years 2012-2019.

Our study proposes describing the green growth with main pillars and collecting the data of green growth indicators. These indicators are Production-based CO_2 productivity, GDP per unit of energy-related CO_2 emissions, and GDP per capita, the dependent variable. Banknotes and coins in circulation and the number of credit cards per inhabitant are used in panel data analysis as a proxy of cashless economy. According to empirical findings, it is found that the regression coefficient of CO_2 productivity and the number of cards per inhabitant is significantly positive, indicating that the cashless economy and carbon-neutral production have a significant promoting effect on economic growth. On the other hand, banknotes and coins in circulation have a negative effect on economic growth. These empirical findings correlate with the fact that producing coins and paper money leads to CO_2 emissions. Cashless economy is better for the environment, and people will not need to carry cash and coins in their wallets if they prefer digital payments.

Keywords: *Central Bank Digital Currency (CBDC), Green Growth***,** *Fintech, Panel Data Analysis*

JEL classification: *E4; O44; P34; C23*

INTRODUCTION

The principal aim of this study is to analyze economic growth and cashless economy in the frame of green growth indicators. In addition, this study provides insight into cashless economy and CBDC (central bank digital currency). Cashless economy and CBDC will be explained from the perspectives of economic growth. Cashless economy brings many benefits to economic growth, by producing improved human well-being and social equity. Governments are adopting fintech and cashless economy to fight poverty. In this paper, cashless society will be evaluated from the perspective of economic growth. Economic growth aims to improve human well-being and social equity. Fintech (financial technologies) and cashless economy can be developed to achieve this goal. Economic growth can contribute to eradicating poverty. Some sectors which have the potential to stimulate green economic growth can invest in eco-friendly production and payments for the ecosystem. The transition to a green economy and green finance will vary among countries. Also, it depends on each country's physical and human capital stock and level of development. Digital money, cashless economy, and green finance promote green economic growth. Fintech companies tend to develop products and services based on digital money. These digital forms of money create more efficient and green economies.

The United Nations (2018), the Sustainable Development Goals (SDGs), the and implementation of the Paris Agreement will require significant strategies to achieve green economic growth. Fintech offers the potential to enhance green finance technologies, such as blockchain, the Internet of things and big data, digital Money, and cryptocurrencies (Nassiry, 2018). Cashless economy and CBDC include achieving financial services at a low cost to all parts of society. It allows people to run their financial transactions efficiently, reduces poverty, and braces green economic growth (Arner et al., 2020).

The primary aim of this article is to explain the cashless society perspective of green growth. The paper is structured as follows: the first section describes cashless economy and CBDC; the second section discusses green growth nexus cashless economy ideas. There will be a literature review related with impact of cashless economy on green growth in the second section. The empirical section looks at panel data results of cashless economy on green economic growth relationship analysis. Empirical results, policy suggestions and our findings are listed in the conclusion part.

CASHLESS ECONOMY

Cashless economy includes electronic payment (debit or credit card) and digital currencies. Money is digital and invisible aside from numerical displays on computer monitors or smartphone screens. As a result, the progress of cashless economy depends on technology and financial innovation (Deyell and Mukherjee, 2019).

Money in coins or notes apart from cheques and credit is called cash. Mobile banking is the most innovative tool of cashless economy. Apps of digital banking have the advantage of improving financial inclusion by providing low costs for money transfers and the potential for increasing financial literacy. They are best placed to provide data bill clients for purchases made. In developing countries, the security concerns about carrying cash have become an additional motivation to convey the financial exclusion of the unbanked sector. Globally, it is estimated that 2.5 billion people have no bank account. In Africa, 25% of the population has a bank account, but the mobile phone penetration rate is 80%. The mobile phone penetration rate is very high in developing countries. High mobile phone usage enables developing countries to enhance fintech and cashless economies (Rouse and Verhoef, 2016).

Payments between public institutions to persons (G2P, amount of salary or social benefit) and business-to-business (B2B) are managed in a non-cash form because cashless transactions are safer, cheaper, and more comfortable. Person-to-person transactions are largely made in cash (Górka, 2016). Unregistered and illegal activities are almost run by money. People generally do not receive a proof of payment or receipt by cash. Cashless economy is more beneficial for governments in terms of transforming the economy to be registered and enabling them to collect more taxes.

ICT infrastructure in the banking sector is crucial in running a cashless economy. ATMs (automated teller machines), mobile banking services, and e-wallets reduce capital requirements and financial inclusion by reducing the duration per transaction for ordinary people (Singh and Sebastian, 2021).

CBDC

Central banks are responsible for issuing paper currency and minting coins in the fiat money system. Central bank digital currency projects were advanced after the Facebook announcement of its digital money, Libra, in June 2019. CBDC means programmable digital money of a central bank in which trans-

fers achieve a peer-to-peer platform without any bank. The main aim of CBDC is to provide state-guaranteed electronic payment (Turi, 2020).

Traditional payment systems were built dependent on cash, but new technology brings new opportunities. CBDC depends on blockchain technology. When CBDC starts using blockchain, the context of monetary and fiscal policy will change. Blockchain and cryptocurrencies will replace the existing monetary system when money becomes cashless. Central banks want to manage monetary policy, and CBDC will be an important tool to keep authority in monetary issues (Bheemaiah, 2017). With the progress of CBDC and stablecoins, there will be more need for blockchain systems as the internet of value (Xu and Zou, 2022).

The progress and application of digital currency will reduce poverty in rural areas. The government provides fiscal and agricultural subsidies in rural areas, and CBDC helps trace whether the support is going to the right place. Besides, government and financial institutions could also analyze how farmers use the funds and improve policy-making skills with big data (Xu, and Zou, 2022). Digital currency allows any transaction event to be traced; cryptography links each block to the previous block. Digital currency systems are accessible to anyone with a device and an internet connection (Steinmetz et al, 2020).

The central bank has an important role in disseminating CBDC around diversity groups in public. The waiver of charges to encourage the use of digital wallets and digital money will enable women and other diversity groups to learn new technologies in the digital economy (Singh and Sebastian, 2021).

GREEN GROWTH NEXUS CASHLESS ECONOMY AND LITERATURE REVIEW

Heatwaves worldwide have been made more common and hotter because of climate change and will continue to get hotter until humans stop burning fossil fuels. Green growth and sustainable energy resources can be useful for governments to limit climate change. The world is, on average, 1.1-1.3°C warmer than in pre-industrial times; if the world continues to warm, half of the global population will have been exposed to life-threatening heat and humidity.

The United Nations Sustainable Development Goals (SDGs) and the implementation of the Paris Agreement will require effective strategies to achieve green economic growth. Fintech offers the potential to enhance green finance technologies, such as blockchain, the Internet of things and big data, digital

Money, and cryptocurrencies (Nassiry, 2018). Cashless economy and CBDC include obtaining financial transactions at low cost to all parts of society. It allows people to manage their financial transactions efficiently, reduces poverty, and enhances green economic growth (Arner et al., 2020).

When we look at the literature on cashless economy, there are two sides of the opinion. Firstly, there are numerous studies explaining the benefits of cash. An increase in uncertainty and the fear of financial crises lead to an increase in the store of value in the form of cash (Arango et al., 2016: Alvarez and Lippi, 2009). Cash is safe central bank money without any risk of default and very liquid (Krueger and Seitz, 2017). However, holding cash was very costly during the inflation era.

Gu et al. (2020) used panel data from 30 regions between the years 2005 and 2016 in China; this paper examines sustainability from three perspectives: economic growth, environmental quality, and social development. According to their results: Economic growth and environmental pollution are related significantly to the business environment. They conclude that a 1% increase in the business environment will raise GDP per capita by 0.203% and decline CO_2 emissions by 0.252%.

Acaravcı and Öztürk (2010) analyze the causality between economic growth and the carbon dioxide ARDL model. According to the empirical findings of the bound test, a long-run relationship between carbon emissions per capita and GDP per capita has been found in this study.

Zhou et al. (2022) analyzed the impact of fintech and green finance on green growth. They used China's local data for the years 2011-2018. According to panel data analysis, empirical results show that fintech significantly and positively affects green growth.

According to the literature review, researchers have previously studied one or more of the following variables: economic growth rate, carbon dioxide, environmental pollution, and green finance indicators. This study examines the relationship between economic growth and the following variables: Banknotes and coins in circulation and the number of credit cards per inhabitant will be independent variables as a proxy of cashless economy. In addition, production-based CO_2 productivity, a green growth indicator, will also be the independent variable. The main aim of this study is to analyze economic growth and cashless economy in the frame of green growth indicators. Considering the lack of studies focusing on cashless economy and economic growth, this paper fills this research gap.

DATA AND METHODOLOGY

This paper outlines the relationship between economic growth and cashless economy. In the empirical section, panel data analysis, the impact of cashless economy on economic growth will be applied to the selected countries 2012-2019. Argentina, Australia, Brazil, Canada, China, Hong Kong, India, Indonesia, Japan, Korea, Mexico, Russia, Saudi Arabia, Singapore, South Africa, Sweden, Switzerland, Turkey, and United Kingdom. The random effect method will be used in panel data to analyze cashless economy impact on green growth. When u_i's are supposed to be random variables and uncorrelated with X_i variables, most methods use random effects (Baltagi, 1995).

$$Y_{it} = X_{it}\beta + \mu_i + u_{it} \tag{1}$$

If there is no correlation between X variables and μ, the random effects estimator is consistent (Wooldridge, 2002). The random effect method will be used in panel data to analyze cashless economy impact on green growth.

Table 1: Indicators in the model

Variables	Definitions (measurement units)	Data Source
GDP	Real GDP per capita (US Dollar, 2015)	OECD Statistics, Green Growth Indicators. https://stats.oecd.org/
C_O2	Production-based CO_2 productivity, GDP per unit of energy-related CO_2 emissions (US dollars per kilogram)	OECD Statistics, Green Growth Indicators https://stats.oecd.org/
CARD	Number of cards per inhabitant includes with a cash function, debit function and credit function (thousands)	Bank for International Settlements, Statistics http://stats.bis.org:8089/statx/srs/table/CT13?f=xlsx
CASH	Banknotes and coins in circulation Value as a percentage of narrow money (%, USD bn)	Bank for International Settlements, Statistics http://stats.bis.org:8089/statx/srs/table/CT2?f=xlsx

$$GDP_{it} = CARD_{it}\beta + CASH_{it}\beta + CO2_{it}\beta + \mu_i + u_{it} \tag{2}$$

Banknotes and coins in circulation and the number of credit cards per inhabitant will be independent variables in panel data analysis as a proxy of

cashless economy. Production-based CO_2 productivity, a green growth indicator, will also be the independent variable. GDP per capita will be used as a dependent variable in the panel data model.

In the study, random and fixed effects panel data models were estimated with dependent and independent variables definitions summarized in Table 1. When the two models are compared using the Hausman test, the random effects model is consistent if there is no unit effect correlation with the explanatory variables, according to the alternative hypothesis. The fixed effects panel data application considers natural, geographical, and population differences among the countries covered in the model. In contrast, the change in the time dimension of these differences is ignored. In addition, the estimators of the random effects model are biased and inconsistent when unobserved within-group effects are correlated with explanatory variables (Asteriou and Hall, 2021). The Hausman test, summarized below, was applied to choose between the random or fixed effects model in panel data analysis.

RESULTS

RANDOM AND FIXED EFFECTS MODEL AND HAUSMAN TEST

In panel data analysis, the data (country, company, etc.) observed in the T time dimension, N cross-sections and similar categories are formulated as follows.

$$y_{it} = \alpha_i + \beta X_{it} + u_{it} \tag{3}$$

Y dependent and X explanatory variables include i=1.2,………………..N sections and t=1.2,…………………T periods. It is called a balanced panel if there is data for t times for all sections.

In the fixed effects model, the assumption is made that the constant can change within the group. Therefore, different constants are allowed within each group. Furthermore, it is assumed that the unit (time) effects may be correlated with the independent variables (Asteriou and Hall, 2021).

$$y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + u_{it} \tag{4}$$

The matrix representation of the above-fixed effects model can be formulated as follows.

$$Y = D\alpha + X\beta' + u \tag{5}$$

Another alternative we can use in panel data analysis is the random effects model. Another difference between the fixed and random effects model is that the parameters for each section are not fixed but are treated as random parameters (Das, 2019).

$$a_i = a + v_i \tag{6}$$

v_i is the 0 mean of the standard random variable. The random effects model is formulated as follows.

$$Y_{it} = (a + v_i) + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + u_{it} \tag{7}$$

$$Y_{it} = a + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + (v_i + u_{it}) \tag{8}$$

The random effects model has the advantage of using a dummy variable. Another advantage over fixed effects is that it is a generalized least squares estimator (Asteriou and Hall, 2021).

The Hausman test is used in panel data analysis to choose between the fixed and random effects models. The null hypothesis of the Hausman (1978) test is established as there is no correlation between the explanatory variables and the unit effect. The appropriate choice between fixed and random effects methods for panel data is based on the existence of a correlation between independent variables and unit effects. In the case of correlation, it is advantageous to use the fixed effects model. In short, in the Hausman test, the null hypothesis H_0 tests that the random effects model is efficient and consistent, and the alternative hypothesis tests that the random effects model is inconsistent (the fixed effects model is always consistent). According to the test results obtained when we applied the Hausman test statistic to our model (Table 2), it would be appropriate to use the random effects estimator since it is more efficient.

Table 2: Fixed and Random Effects Models, Hausman Test Statistics

Cross-section random effects test comparisons:				
chi2(3) = 0.16 Prob>chi2 = 0.9844	Regression Model	Regression Model	Hausman Test	
Variables	**Fixed Effect Model (b)**	**Random Effect Model (B)**	(b-B) Difference	S.E. sqrt(diag(V_b-V_
CO_2	0.762	0.755	0.000	0.002
CARD	0.087	0.086	0.001	0.003
CASH	-0.017	-0.017	9.20e06	0.0004
Constant	9.994	10.001		

TESTING AUTOCORRELATION, HETEROSKEDASTICITY, AND INTER-UNIT CORRELATION IN A RANDOM EFFECTS MODEL

The Durbin Watson and Baltagi-Wu tests are used in the autocorrelation test in the random effects model. Although critical values are not given in the literature, if the test statistic is lower than 2, autocorrelation is interpreted as important (Baltagi & Wu, 1999). Since the values are less than 2 according to the test outputs (Table 3), we observe an autocorrelation problem in the random effects model. In addition, the null hypothesis of both tests, namely that there is no first-order serial correlation, is rejected. In this case, it can be interpreted that there is an autocorrelation in our model.

Table 3: Autocorrelation Test for Random Effect Model

Wald chi2(4)=396.29 Prob>chi2=0.0000	
Baltagi- Wu LBI	1.094
Durbin Watson	1.057

In the random effects model, the existence of heteroskedasticity according to the units in the error residues is tested with the Levene, Brown, and Forsythe test (Brown and Forsythe, 1974; Levene, 1960). According to the test results obtained, the H_0 hypothesis is rejected, and it is concluded that the variance varies according to the units; that is, there is heteroskedasticity (Table 4)**.**

Table 4: Testing Heteroskedasticity

W0 =	8.1226326	df(16,	119)	Pr >F	=0.00000000
W50 =	7.8783613	df(16,	119)	Pr >F	=0.00000000
W10 =	8.1226326	df(16,	119)	Pr >F	=0.00000000

Finally, the Pesaran CD test was applied in the measurement of the correlation between units in the random effects model when the time dimension (T) is small, and the cross-section dimension (N) is large (Pesaran, 2004). According to the test results, the null hypothesis of H_0 is rejected; therefore, it is understood that there is a correlation between the units. On the other hand, Frees' (1995, 2004) test was also used to strengthen the correlation between units. According to this, the fact that the statistical value of Frees' test is greater than the critical values corresponding to all probability values (1%, 5%, 10%) indicates a correlation problem between units (horizontal section dependence) in the model. The test results are shown in Table 5.

Table 5: Cross-sectional dependence, Pesaran CD and Frees' Test

Pesaran's test of cross sectional independence = 0.777, Pr = 0.4370
Frees' test of cross-sectional independence= 4.792
Frees' test critical values
alpha = 0.10 : 0.316
alpha = 0.05 : 0.432
alpha = 0.01 : 0.660

RANDOM EFFECTS ESTIMATOR (HETEROSKEDASTICITY-ROBUST STANDARD ERRORS)

As a result, the model has statistical problems, heteroskedasticity, autocorrelation and cross-sectional dependency. In this case, a robust standard error estimator should be used to calculate the parameters in the model (Tatoğlu, 2016). The panel data of the selected 17 countries was used for Random Effects Estimator (Heteroskedasticity-Robust Standard Errors) regression, and the regression results are shown in Table 6.

Table 6: Heteroskedasticity-Robust Standard Errors for Random Effect Model, Estimated Coefficients

Wald chi2= 30.44 prob>chi2 =0.000					R^2 =0.624	
Variables	Coef.	std error	z st	p >z	%95	
CO_2	0.027	0.0071	3.84	0.000	0.01349	0.04165
CARD	0 .058	0.0162	3.63	0.000	0.02710	0.09072
CASH	-0.008	0.0042	-1.91	0.056	-0.01655	0.00020
Constant	10.124	0.2171	46.63	0.000	9.699	10.550

According to z statistics calculated with robust standard errors, the effect of CO_2 productivity and the number of cards per inhabitant on economic growth is positive and significant. On the other hand, banknotes and coins in circulation affect economic growth negatively and are statistically significant. The Wald test is significant, and R^2 is around 62%. Firstly, it is found that the regression coefficient of CO_2 productivity and the number of cards per inhabitant is significantly positive, indicating that cashless economy and carbon-neutral production significantly promote economic growth. Secondly, It is found that the cash level of the population variable (banknotes and coins in circulation) passes the significance test of a 10% confidence level and has a negative effect of economic growth.

CONCLUSION

Cashless economy has many tools that provide additional practical opportunities for households, firms, and society. From the economic point of view, cashless economy has the advantage of improving financial inclusion by providing low cost for money transfers and its potential for increasing financial literacy. In addition, cashless economy is more beneficial for governments in terms of transforming the economy to be registered and enabling them to collect more taxes. Also, private firms can collect data about their customers thanks to cashless transactions.

In this study, panel data analysis is applied to assess the impact of cashless economy and CO2 productivity on green growth by selected countries 2012-2019. In summary, we might say that cashless economy and CO_2 productivity positively affect economic growth. These empirical findings correlate with the fact that producing coins and paper money leads to CO_2 emis-

sions. Cashless economy is better for the environment, and people will not need to carry cash and coins in their wallets if they prefer digital payments. Covid 19 changed people's payment behaviours. During the Covid 19 pandemic, people preferred contactless payment to avoid human contact. The amount of digital and cashless payments has increased during the pandemic in many countries.

Finally, we have noted that cashless economy supports economic growth. Moving to cashless economy would give the economic administration more flexibility during financial crises. As for society, the task of cashless economy and preservation of the environment is crucial. These research results could be used in promoting a cashless economy with NFC, contactless payment, and mobile payments in wide areas of society.

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THE RISKS OF FINTECH COMPANIES TO FINANCIAL STABILITY: REGULATORY AND SUPERVISION PRACTICES IN CENTRAL AND EASTERN EUROPE

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The study analyzes data from 17 Central and Eastern European countries (Albania, Bulgaria, Bosnia and Herzegovina, the Czech Republic, Croatia, Estonia, Hungary, Kosovo, Lithuania, Latvia, Montenegro, North Macedonia, Poland, Romania, Serbia, Slovenia, and Slovakia), using the comparative methodology. This study highlights that the main challenges fintech companies face in CEE countries are: a lack of government support for financial technology innovation; a lack of support from regulators for fintech companies; coordination between the government and the startup ecosystem; and a clear fintech strategy by regulators and policymakers.

Data protection and cybersecurity risks are the two most prominent risks among CEE countries. All countries have relevant laws on data protection and cybersecurity. Many of them have also developed relevant strategies. To protect financial stability from these risks, countries must incorporate the General Data Protection Regulation (GDPR) into their legislation. EU member states have already incorporated GDPR into their legislation. Albania, Bosnia and Herzegovina, Montenegro, the Republic of Kosovo, the Republic of North Macedonia, and Serbia are not members of the EU, so they have taken several initiatives on their own.

The study methodology is based on a comparative analysis. Using indicators such as the Global Cybersecurity Index and the National Cyber Security Index, the most progressive countries are Lithuania, Estonia, Poland, and Croatia, while the countries with the highest degree of this risk are Bosnia & Herzegovina and Montenegro.

Keywords: *Fintech companies, cybersecurity, regulation, CEE, financial stability*

JEL classification: *G2; G18; G23; G28; G3*

INTRODUCTION

Fintech has the potential to increase efficiency, reduce costs, improve access to and delivery of financial services, enhance customer experience, and create markets for new and innovative financial services and products. It also poses risks, including money laundering, cyber-security, and data privacy. With the entry of fintech companies into the financial sector, several new sources of risk for banks have emerged. These companies' entry decreases banks' profitability, so the latter may take excessive risks in order to balance the downward impact on their profits.

Regulators must deal with a complex environment in which traditional banks compete with fintech companies, as well as the possibility of new types of risk. Early detection of these risks is crucial to their prevention, and new technology should provide continuous monitoring tools that use big data to act as early risk indicators.

The challenge is to create a regulatory environment that is flexible enough to accept new market changes while also providing regulatory certainty and a level-playing field for all market participants. Recently, in Central and Eastern European (CEE) countries, we have seen the entry of many fintech companies. However, with all the innovations that come, these companies naturally affect the emergence of problems within data protection and cybersecurity. Nevertheless, the respective state must be prepared to manage these important issues through relevant laws, regulations, strategies, and institutions.

New technology, and its interaction with businesses, can bring new risks to financial stability. The primary goal of this paper is to examine the major challenges that fintech companies face, as well as the risks that fintech companies will bring to the financial sectors in CEE countries. Also, we analyze how these issues are addressed in these countries and, finally, which countries are the most progressive and lag behind in this regard.

Other contributions include an analysis of CEE countries' data protection and cybersecurity risk legislation. The findings of this paper are important for relevant institutions in these countries, particularly for those that have not made sufficient progress in this area, to see how they can improve cybersecurity risk and data protection by taking progressive countries as an example, in particular, for their fintech companies and banking sectors. This is the first time this topic has been addressed with the involvement of a large number of CEE countries.

LITERATURE REVIEW

According to the Financial Stability Board (FSB, 2019:1), fintech is defined as *"technology-enabled innovation in financial services that could result in*

new business models, apps, procedures, or products with an associated material effect on the provision of financial services." Also, we have another definition by Bömer and Maxin (2018:5): "*The word fintech is a contraction of financial technology and comprises emerging companies that build internet-based solutions that enable or deliver financial services,*" According to Schueffel (2016:5), fintech is defined as "*a new financial industry that uses technology to improve financial activities.*" As a conclusion, we can say that fintech is changing the financial environment by introducing new products, business models, and players.

Consumers of fintech products may have fewer protections than consumers of traditional financial products if there are gaps in the existing regulations of the financial sector. Factors such as the complexity of fintech projects, ambiguity, or lack of consumer familiarity can lead to new risks from fraud or misconduct by financial service providers. In all cases where a fintech platform is unreliable or exposed to various threats, it can expose consumers to these risks (World Bank, 2021). When completing regular risk assessments, the FSB (2017) listed some potential areas where international organizations and national authorities should pay attention to fintech. Three of them are designated as priority areas: managing operational risks from third-party service providers, mitigating cyber risks, and monitoring macro financial risks. The first concerns the provision by regulatory authorities of current oversight frameworks for third parties (such as, e.g., in cloud computing and data services) that are appropriate. The second one is that the authorities, through ex ante emergency plans, information sharing, monitoring, and extensive financial and technological knowledge, can help reduce the probability of cyber events that have negative effects on financial stability. The third one is that authorities should think about improving their own ability to access existing and new sources of information.

Fintech presents a wide range of risks that straddle several areas. Several of these risks appear in each of the following situations to varying degrees: strategic risk, high operational risk, increased difficulties in meeting compliance requirements, especially anti-money laundering/combating the financing of terrorism obligations, compliance risk with regard to data privacy, outsourcing risk, cyber risk, liquidity risk, and volatility of bank funding sources. Because of increased automation and distribution of the product or service among banks and fintech companies, there may be less transparency about how transactions are carried out and who is responsible for compliance. This can put banks at greater risk of being held liable for the acts of their fintech partners if a consumer loses money or compliance requirements are not satisfied (BIS, 2017). According to the World Bank (2020), policymakers need

to be aware of the key risks posed by fintech companies before identifying an approach to regulating them. The main risks presented by fintech include (but are not limited to): legal/regulatory risks; lack of coordination; consumer protection and capabilities; oversight; risk management and governance; cyber risks; data; competition; anti-money laundering/combating the financing of terrorism (AML/CFT) risks; third-party reliance; business risks of critical financial market infrastructures; procyclicality; excess volatility; disintermediation; maturity and liquidity mismatch; increased inequality, etc.

Financial innovations have the potential to generate macro- and micro-financial risks over time, putting the stability of the entire financial system at risk. The type of financial innovation and its potential to evolve over time determine the extent to which it can have an impact and become a cause of financial risk. Contagion, procyclicality, excess volatility, and systemic importance are all examples of macro financial risks (FSB, 2017). As micro financial risks, credit risk, leverage risk, liquidity risk, maturity mismatch, and operational risks, particularly cyber and legal risks, are all potential risks (FSB, 2017).

According to Lewis and Baker (2013), the number of cybercrimes has increased as a result of fintech companies' financial inclusion. They also state that estimating the financial institution's economic loss is challenging due to the fact that cyber-attacks affect financial institutions' operations in a variety of ways. It means that cybercrime is not just a money loss but also a reputational risk for financial institutions. Furthermore, according to Kopp, Kaffenberger, and Jenkinson (2017), cyber-breaches result in a loss of consumers, reputation, revenue, brand, equity value, and higher operational costs for fintech companies. Cybercrime is a sophisticated danger; it is one of the most important and difficult issues confronting many corporations. It is an online crime that involves gaining unauthorized access to a person's or company's sensitive information for personal advantage. This occurs anywhere there is a computer link to cyberspace (Walden, 2007). In recent years, the likelihood of a financial institution being targeted by criminals via data processing centers has increased dramatically (ASBA & IDB, 2019). Fintech firms' cybersecurity risk has far-reaching economic ramifications for traditional banks' long-term viability.

The increased susceptibility of cybersecurity is owing to the inherent data integrity risk, data leakage risk, and malware attacks that fintech companies face. As a result of the ongoing cyberattacks, banks will face theft of important and sensitive data, hacking, and insider threats. It poses a quandary and calls into doubt traditional banks' and fintech businesses' collaborations. As a result, knowing the impact of fintech companies' cybersecurity risks on financial insti-

tutions would help policymakers discover channels through which policy changes can improve economic welfare (Najaf, Schinckus, Mostafiz, & Najaf, 2020).

Efforts by authorities to maintain financial stability need to determine whether the current oversight frameworks for key third-party service providers for financial institutions are appropriate. It is likely that many products of fintech companies have not undergone sufficient testing, and the rapid time of market entry may cause the premature adoption of new technologies, which may bring cyber risks (FSB, 2017). Cybersecurity threats will be a threat to both existing financial institutions and fintech firms. Risks can increase, especially in those countries where consumer protection standards are weak and supervisors are not aware of these risks. Consumer data protection in the fintech era is a challenge in itself. Cyber-attacks are becoming more prevalent, and new technologies are not immune. The capacity of regulators may not be equipped to address this challenge (Berg, Guadamillas, Natarajan, & Sarkar, 2020).

Policymakers and regulators have three alternatives for a regulatory strategy: laissez-faire, functional, or customised. Under the first, companies are free to develop and make use of fintech breakthroughs under the ordinary regulatory framework. This, however, comes with a number of drawbacks. First, fintech companies would have an unfair competitive advantage over banks due to the tight regulatory requirements imposed on them, and the lack of detailed standards also raises hazards for stakeholders. A functional approach, on the other hand, necessitates regulators' understanding of fintech business models and actors, both collectively and individually within the industry, in order to assess how to improve financial stability. As a result, if the activities are led by an existing financial institution or a fintech, the same legislation should apply to both of them. According to a customized regulatory strategy, regulators are supposed to discover the unique characteristics of the market and construct regulatory elements based on these new technology-enabled aspects (Colangelo & Borgogno, 2020).

According to a report by the World Bank (2021), fintech's most popular products are digital microcredit, peer-to-peer lending (P2PL), investment-based crowdfunding, and electronic money (e-money). P2PL matching platforms may have larger and sharper swings in credit provision than traditional financial institutions. When loan decisions are automated and/or based on new data or algorithms, their performance in a downturn is unknown. Other operational and legal issues are possible, especially in permissionless systems with huge networks of anonymous users (FSB, 2019a).

Table 1 presents the products that fintech firms can offer, the risks they may carry, and the approaches that countries should take, based on the World Bank's (2021) and Financial Stability Board's (2019) reports.

Table 1: Risks and Regulatory Approaches Source: World Bank (2021) pp. 54-144; FSB (2019a), pp. 4

Fintech Product	Definition	Risks	Regulatory Approaches
Digital micro-credit	Credit products that are short-term, low-value, and accessible via mobile devices, with automated credit scoring and quick approval.	Disclosure and transparency. Timing and flow of information. User interfaces. Unfair lending. Regulatory perimeter, etc.	Require prominent disclosure of both total cost metrics and clear breakdown of costs. Encourage greater standardization in presentation of fees/pricing. Require user interface to be user-friendly and easy to navigate, including on low-end mobile devices, etc.
Peer-to-peer lending (P2PL)	Online peer-to-peer (P2P), or user-matching, platforms allow users (e.g., creditors and borrowers) to interact directly and decentralize their risk-taking and decision-making.	Gaps in regulatory perimeter. Fraud or other misconduct. Platform/technology unreliability or vulnerability. Inadequate credit assessments; Conflicts of interest. Borrower fraud, etc.	Impose licensing/registration and vetting and competence requirements on operators and related parties. Require operators to have in place business continuity and handover/resolution arrangements. Impose creditworthiness assessment requirements on platform operators regardless of whether they are the lender of record. Address gaps in existing borrower-disclosure regimes by developing requirements specific to P2PL, etc.
Investment-based crowd-funding	The process of connecting and matching small businesses seeking investment capital by providing securities (debt or equity) to potential, often retail, investors (the crowd) via internet platforms.	Risks relating to the nature of securities offered on crowdfunding platforms. Consumers are not provided with adequate information Platform operator misconduct or failure, etc.	Require risk warnings and disclosures about key aspects of crowdfunding. Introduce authorization and vetting requirements. Require business/service-continuity arrangements. Require platform operators to undertake due diligence, etc.
Electronic money (e-money)	It is a store of value with the following characteristics: it is a digital representation of fiat currency (legal tender); it can be redeemed at face value on demand; and it is accepted as a means of payment by people other than the provider.	Gaps in regulatory perimeter. E-money platform/technology vulnerability or unreliability. Mistaken transactions. E-money not covered by deposit-insurance schemes. E-money not permitted to be redeemed for face value. Consumers not provided with adequate information. Unsuitable e-money products, etc.	Allow e-money activities to be undertaken only by licensed entities (including non-banks). Impose licensing/registration and vetting and competence requirements on e-money issuers and related parties. Mandate technology risk and cybersecurity management requirements. Require a mechanism that enables the consumer to verify transaction details before transaction completion. Limit activities that e-money issuers can carry out to minimize insolvency risk, etc.

METHODOLOGY

The study methodology is based on a comparative analysis. This methodology was used by Landman (2008) and Lor (2010). This analysis is designed to compare a small number of cases, typically between 10 and 50 (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2009).

The first step was identifying theoretical aspects of risks, regulatory approaches, and various cybersecurity measures. The next step is a thorough examination of each country's legislation. Countries are divided into two categories, EU member states, and non-EU countries. The evaluation methodology is similar to Berg et al. (2020). We have considered four criteria for risk assessment in CEE countries: the Global Cybersecurity Index, the National Cyber Security Index, the Digital Development Level, and detailed analysis of cybersecurity legislation, in particular the application of the GDPR. A cumulative evaluation of all five criteria is given in Table 4. In this analysis, we used relevant literature and databases, such as the websites of the World Bank (WB), central banks, and relevant regulators in Europe.

The Global Cybersecurity Index (GCI) is a reliable resource that assesses countries' commitment to cybersecurity on a global level. Each country's level of development or engagement is evaluated using five pillars – (i) Legal Measures (measurement of cybercrime and cybersecurity laws and regulations), (ii) Technical Measures (measuring the implementation of technical capabilities through national and sector-specific authorities), (iii) Organizational Measures (measuring the national strategies and organizations implementing cybersecurity), (iv) Capacity Development (measuring awareness campaigns, training, education, and incentives for cybersecurity capacity development), and (v) Cooperation (measuring partnerships between agencies, firms, and countries) – and then summed up to produce an overall score (IGC, 2020).

The National Cyber Security Index (NCSI) is a real-time global index that assesses a country's readiness to prevent cyber threats and respond to cyber incidents. The NCSI focuses on measurable areas of central government-implemented cybersecurity: legislation in force (legal acts and regulations), established units (existing organizations), cooperation formats (committees and working groups), and outcomes (policies, exercises, technologies, websites, programs, etc.).

The ICT Development Index (IDI) and the Networked Readiness Index (NRI) are used to construct the Digital Development Level (DDL). The DDL is the country's average percentage of the maximum value of both indices. The Difference shows the link between the NCSI and DDL scores. A positive result

indicates that the country's cybersecurity progress is on par with, or perhaps ahead of, its digital progress. A negative result indicates that the country's digital society is more advanced than its cybersecurity.

FINTECH COMPANIES' RISK REGULATION IN CEE COUNTRIES

Fintech companies offer a variety of products, but some specific fintech models that are also encountered in the CEE region are: digital payments, P2PL, equity crowdfunding, and crypto-assets (World Bank, 2020). In some circumstances, fintech firms operate outside of the existing regulatory and supervisory framework, resulting in an unfair playing field between financial institutions and new fintech players. This creates difficulties for regulators, particularly those with limited capacity, who may be unequipped to deal with the situation. All these risks can translate into increased financial stability risks, especially as the importance of fintech grows (Berg et al., 2020). Among the Balkan countries, only North Macedonia's regulators officially allow P2PL. Peer-to-peer lending appears to be legal under capital market legislation in Serbia, but it is unclear whether it is also permitted by the Central Bank of Serbia.

Because the regulations in Macedonia and Serbia are diverse, their approaches to crowdfunding are as well. Equity crowdfunding is approved in North Macedonia by the Central Bank of North Macedonia, but the Securities Regulator believes it to be unclear. The Securities Commission of Serbia has no reservations about equity crowdfunding, but the National Bank of Serbia has reservations about its legality. P2P lending, on the other hand, is outlawed by the Central Bank of the Republic of Kosovo. Also, the Central Bank of the Republic of Kosovo considers equity crowdfunding a prohibited activity. The current regulatory framework in other countries is clear on this aspect (World Bank, 2020). According to a report by the World Bank, the countries that have taken steps to regulate or clarify the legal status of crypto-assets are: the Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia (Berg et al., 2020).

Table 2 presents some of the challenges that fintech companies face and some of the risks that they may bring to Central and Eastern European countries.

Table 2: The main risks and challenges for the development of fintech firms in the CEE region

Country	Most commonly cited challenges to Fintech development	Major risks arising from Fintech
Albania	Lack of a clear Fintech strategy by regulators and policymakers	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.
Bosnia and Herze-govina	Inadequate government support for Fintech; Lack of enabling policies, such as the absence of an electronic signature law. Difficulties in enforcing uniform laws and regulations across the country. Lack of investment in research and development of new and innovative products by local IT companies;	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.
Bulgaria	There is a scarcity of local technical talent and ICT professionals. Lower levels of financial inclusion in comparison to other EU countries. Lower levels of internet use. A smaller domestic market.	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.
Czech Republic	According to the European Commission, there is a weak linkage between research institutions and the private sector. Some gaps in the targeted allocation of funding are hindering investments in innovation activities.	Security concerns and data protection are still hamper-ing the wide uptake of cloud-based solutions.
Croatia	Lack of support from regulators. Scarcity of local technical talent. Fixed broadband access is still expensive by EU standards.	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.
Estonia	The challenges include finding customers, accessing finance, costs of production or labor, availability of skilled staff or experienced managers, regulation, and expansion to international markets.	Awareness of the need for cybersecurity is still some-what low. Shortage of cybersecurity experts and "force multipliers". Lack of a cybersecurity R & D plan; Lack of an active cybersecurity cluster.
Hungary	The penetration of mobile and internet banking currently remains low, despite global and regional trends. Hungarian banks' IT budgets are among the lowest in the CEE region, making it dif-ficult for them to carry out activities that truly support innovation.	Data protection, Cybersecurity, and a new third-party threat.
Kosovo	Lack of financing. Poor ICT infrastructure in comparison with peers; Lack of statistics/data on various business-related metrics. International donor funding is critical to the ecosystem's vital actors.	Risks to financial consumer protection posed by new products and business models; AML/CFT risks; Cybersecurity risks.

Country	Most commonly cited challenges to Fintech development	Major risks arising from Fintech
Lithuania	Struggling to develop and launch their product/service pipeline, find suitable team members, and remain compliant with regulations; product portfolio expansion; international expansion; partnership building with established players.	AML and cybersecurity.
Latvia	Competition, finding customers, access to finance, regulation, costs of production or labor, availability of skilled staff, expansion to international markets.	Legal uncertainty, Consumer protection, Cybersecurity risks.
Montenegro	Lack of government support for start-ups and innovative activities; .cosystem infrastructure with qualified facilitators, fundraisers, mentors; Lack of financing and investors.	Financial consumer protection risks arising from new products and business models. Cybersecurity risks.
Republic of North Macedonia	Lack of financing. Lack of a conducive FinTech ecosystem. Emigration of local talent or "brain drain".	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.
Poland	A low level of venture capital and equity funding activity. A lack of a centralized, all-encompassing startup support system.	Financial consumer protection risks arise from new products and business models. Market concentration by incumbents. Cybersecurity risks.
Romania	Poor ICT infrastructure and lower levels of internet access in comparison with EU peers. Scarcity of local technical talent.	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.
Slovenia	The small market size in terms of customer numbers could prevent the potential entry of foreign players offering non-banking credit products.	Legal uncertainty, Consumer protection, Cybersecurity risks.
Slovakia	Non-banking consumer lending faces regulatory challenges.	Legal uncertainty, Consumer protection, Cybersecurity risks.
Serbia	Lack of financing; Lack of coordination between the government and the startup ecosystem.	Financial consumer protection risks arise from new products and business models. Cybersecurity risks.

Source: A summary by the authors from Berg et al., (2020) pp. 41-45;

The challenges for the development of fintech firms in these countries include a lack of funding and investment, underdeveloped ICT (Information and Communication Technologies) infrastructure, a lack of government and institutional support, regulations that enable fintech innovations, small domestic markets, and a scarcity of skilled workers in the technology space (Berg et al., 2020). From the table above, we see that all countries are threatened by cybersecurity risks.

Another important issue for data protection is the GDPR (General Data Protection Regulation). The GDPR is a European Union and European Economic Area regulation on data protection and privacy. The law governs how businesses secure the personal information of people who live in designated zones. The GDPR's goal is to give people more control over their personal data while also simplifying the regulatory environment for international trade. The GDPR was adopted on April 14, 2016, and became enforceable on May 25, 2018. The countries that have incorporated GDPR into their legislation are mainly EU countries: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia. (For more information see the GDPR website: https://gdpr.eu/).

Other countries that have not yet joined the GDPR are: Albania, Bosnia and Herzegovina, Montenegro, Kosovo, North Macedonia, and Serbia. Since they are not part of the EU, they have taken several initiatives individually. In Albania, there is a law on cybersecurity that applies to communication networks and information systems whose breach or destruction would risk individuals' health, safety, and wealth. Complete harmonization with the GDPR has yet to be achieved. Due to the deficiencies and non-alignment of the DP Law with the GDPR, in 2018, the competent authorities initiated the procedure for the adoption of a new GDPR compliant data protection law in BiH, but the Draft Data Protection Law has not been adopted to date. The Montenegrin Parliament is expected to pass a new data protection law that will bring the country's data protection legislation in line with the EU's General Data Protection Regulation (GDPR). The Republic of Kosovo passed the law in 2019. Despite the fact that Kosovo is not an EU member state, the law is expressly aligned with the GDPR and, similarly to the GDPR (Law No. 06/L–082 on personal data protection). Although the Republic of North Macedonia is not an EU member state, the Parliament of the Republic of North Macedonia adopted the Law in early 2020, which is almost entirely aligned with the GDPR. Since its enactment, the provisions of this law have yet to be put to the test in practice. Serbia has adopted the Data Protection Law, the content of which is largely harmonized with the GDPR (Law on Personal Data Protection). Also, in terms of cybersecurity risk, apart from the fact that all countries have a practical law and an office or institution that deals with this issue, some of them have developed practical strategies. Therefore, we have included in Table 3 the ways all countries deal with these two issues.

Table 3: Local data protection and cybersecurity laws and their authorities in CEE countries

Country	Local data protection laws and scope	Authority	Cybersecurity	Authority
Albania	Law No. 9887, dated March 10, 2008. "On protection of personal data."	The Commissioner for the Right to Information and Protection of Personal Data.	Law No. 2/2017 "For Cyber Security", dated 9 February 2017 National Strategy.	The National Computer Security Agency (ALCIRT)
Bosnia and Herzegovina	Law on the Protection of Personal Data No. 49/06.	Personal Data Protection Agency (PDPA)	Law on the Protection of Personal Data (No. 49/06, 76/11, 89/11); Law on the Protection of Classified Data (No. 54/05, 12/09) Law on Electronic Document Bosnia and Herzegovina (No. 58/14).	Department of Informatics and Telecommunication Systems. Sector of crime police. High-tech Crime Prevention Unit. Ministry for Scientific and Technological Development, Higher Education, and Information Society.
Bulgaria	Electronic Communications Act; Bulgarian Constitutional Republic. GDPR (General Data Protection Regulation)	The Personal Data Protection Commission The Inspectorate with the Supreme Judicial Council	The Cybersecurity Act. The Cybersecurity Council. The Cybersecurity Council Regulations. The E-Government Agency's Regulations. National Strategy.	The Cybersecurity Council. The National Single Point of Contact. The State E-Government Agency. National CSIRT. The State Agency for National Security
Croatia	Act on Implementation of General Data Protection Regulation. Electronic Communications Acts. Electronic Commerce Acts. Consumers Protection Act. GDPR	The Croatian Personal Data Protection Agency (AZOP) The Croatian Regulatory Authority for Network Industries	Act on cybersecurity of operators of essential services and digital service providers. Regulation on cybersecurity for operators of essential services and digital service providers' Act on Information Security. Measures to ensure information security are governed by regulations. National Strategy.	The Information Systems Security Bureau. National CERT. The Office of the National Security Council.

Country	Local data protection laws and scope	Authority	Cybersecurity	Authority
Czech Republic	The Data Processing Act implements GDPR and the Directive (EU) 2016/680 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons and repeals Council Framework Decision 2008/977/JHA. GDPR	Czech Office for Personal Data Protection	The Cybersecurity Act implements the Directive (EU) 2016/1148 of the European Parliament and the Council of July 6, 2016 concerning measures for a high common level of security of network and information systems across the Union; Act No.181/2014. Decree No. 316/2014 Coll. ("Decree on Cybersecurity") National Strategy.	The national Cyber and Information Security Agency (NCISA).
Country	Local data protection laws and scope	Authority	Cybersecurity	Authority (continued)
Estonia	Personal Data Protection Act (PDPA) GDPR	The Estonian Data Protection Inspectorate	Cybersecurity Act. Cybersecurity Strategy Republic of Estonia 2019-2022.	Information System Authority- Ministry of Economic Affairs and Communications
Hungary	With regard to minors, the Info Act supplements the GDPR. GDPR	National Authority for Data Protection and Freedom of Information	Act L/2013 on the Electronic Information Security of National and Self-Governmental Organizations Government Decree 187/2015 (VII. 13.) National Strategy.	The Special Service for National Security; National Disaster Management Authority; Authorities designating entities as national critical infrastructure operators.
Montenegro	The Personal Data Protection Law Agency	The Personal Data Protection Law Agency	The Personal Data Protection Law Agency	The Personal Data Protection Law Agency
Poland	Personal Data Protection Act In Poland, the GDPR is implemented by the Personal Data Protection Act of May 10, 2018. GDPR	The Personal Data Protection Office	National Framework of Cybersecurity Policy of the Republic of Poland for 2017-2022; 2019-2024.	Nask- a state-owned research institute supervised by the Chancellery of the Prime Minister.

Country	Local data protection laws and scope	Authority	Cybersecurity	Authority
Kosovo	Law No.03/L – 172 On the Protection of persona data	National Agency for the Protection of Personal Data	National Cybersecurity Strategy and Action Plan (2016-2019).	Ministry of Internal Affairs
North Macedonia	The Law on Personal Data Protection GDPR	The Data Protection Agency	Republic of North Macedonia: National Cyber Security Strategy and Action Plan 2018-2022.	The Ministry of Information, Society and Administration
Romania	Law No. 190/2018 ("Law 190") was issued to provide measures necessary for the implementation of certain GDPR provisions at the national level. GDPR	Romanian National Supervisory Authority for Personal Data Processing	Law No. 362/2018 on ensuring a high common level of security of network and information systems. Also, the following secondary legislation was issued: Order No. 599/2019; 600/2019; 601/2019. Government Decision No. 963/2020; 976/2020; No. 1003/2020; No. 271/2013	CERT – RO (the Romanian National Cybersecurity Incident); ANCOM (The National Authority for Management and Regulation in Communications).
Lithuania	Personal Data Protection in the Law of the Republic of Lithuania GDPR	State Data Protection Inspectorate	The Cyber Security Law of the Republic of Lithuania	National Cybersecurity Center
Latvia	Personal Data Protection Law GDPR	Data State Inspectorate	The Latvian Cybersecurity Strategy 2014-2018	Economic Crimes Enforcement Department of the Central Criminal Police Department.
Country	Local data protection laws and scope	Authority	Cybersecurity	Authority (continued)
Serbia	The law on Personal Data Protection	The Commissioner for Information of Public Importance and Personal Data Protection (the "Commissioner")	("Official Gazette of RS", Nos. 6/2016, 94/2017 and 77/2019") ("Law")	Regulatory Agency for Electronic Communications and Postal Services (RATEL).

Country	Local data protection laws and scope	Authority	Cybersecurity	Authority
Slovakia	Act No. 18/2018 Coll. on personal data protection and amending and supplementing certain acts. Act No. 351/2011 Coll. on electronic communications. Act No. 300/2005 Coll. The Criminal Code; etc. GDPR	The Office for Personal Data Protection of the Slovak Republic (the "Office")	Cybersecurity Act No. 69/2018 Coll. on cybersecurity and on amendments to certain laws. Act No. 300/2005 Coll. Criminal Code. Decree of the National Security Authority No. 165/2018 Coll. Act No. 300/2005 Coll. Criminal Code; 164/2018. 362/2018; 436/2019. National Strategy.	National Security Authority (the "Authority"). Other cybersecurity initiatives: Cyber Defense Center of the Slovak Republic. Cybersecurity Competence and Certification Centre. Cyber Club.
Slovenia	The Personal Data Protection Act, etc. GDPR	Information Commissioner of the Republic of Slovenia.	The Information Security Act. Electronic Communications Act. Electronic Commerce Market Act, Personal Data Protection Act, Electronic Business and Electronic Signature Act, etc. National Strategy.	Information Security Administration. Information commissioner of the Republic of Slovenia. Market Inspectorate, Agency for Communication Networks and Services of the Republic of Slovenia.

Source: A summary by the authors from: https://cms.law/; https://gdprhub.eu/; https://uodo.gov.pl/en/594; https://vdai.lrv.lt/en/legislation; https://www.enisa.europa.eu; https://www.dlapiperdataprotection.com/; https://www.mioa.gov.mk; https://vdai.lrv.lt/lt;https://www.enisa.europa.eu; https://www.dlapiperdataprotection.com/; https://www.mioa.gov.mk; https://mkm.ee/en

Based on the Global Cybersecurity Index (GCI), the CEE countries with the highest progression over the years are Lithuania, Estonia, Poland, and Croatia (left side of Table 4). Meanwhile, Serbia, Slovakia, and North Macedonia, from year to year, mark an increase in this index. From the Balkan countries, North Macedonia shows the highest results.

Table 4: *The Global Cybersecurity Index, the National Cyber Security Index, the Digital Development Level, and the Difference*

Country	Global Cybersecurity Index			GDPR	National Cyber Security Index	Digital Development Level	Difference	Rank
	Global scores and ranking of countries							
	Rank-2017	Rank-2018	Rank-2020					
Lithuania	56	4	6	YES	93.51	68.61	24.9	**2**
Czech Republic	35	71	68	YES	92.21	69.86	22.35	**4**
Estonia	5	5	3	YES	90.91	76.51	14.4	**5**
Poland	33	29	30	YES	87.01	66.61	20.4	**9**
Croatia	41	24	33	YES	83.12	65.34	17.78	**15**
Slovakia	81	45	34	YES	83.12	66.53	16.59	**16**
Latvia	21	44	15	YES	75.32	67.38	7.94	**25**
Bulgaria	44	46	77	YES	74.03	62.39	11.64	**26**
Romania	42	72	62	YES	71.43	60.67	10.76	**27**
Hungary	51	31	35	YES	64.94	65.72	-0.78	**38**
Slovenia	83	48	67	YES	59.74	70.55	-10.81	**46**
The European countries that are not members of the EU								
Serbia	89	58	39	NO	77.92	59.85	18.07	**21**
North Macedonia	54	34	38	NO	55.84	55.36	0.48	**50**
Albania	88	62	80	NO	48.05	48.74	-0.69	**66**
Montenegro	70	61	87	NO	35.06	57.79	-22.73	**87**
Bosnia and Herzegovina	135	118	110	NO	28.57	49.31	-20.74	102

Source: https://ncsi.ega.ee/ncsi-index/; https://www.itu.int/en/ (Global Cybersecurity Index 2017, 2018 and 2020). Note: We have no data on Kosovo.

According to the National Cyber Security Index (NCSI), the most progressive countries when it comes to cybersecurity risks are Lithuania, the Czech Republic, Estonia, Poland, and Croatia (right side of Table 4). From all the countries included in the sample, both indexes show that Bosnia and Herzegovina had the lowest results (left and right side of Table 4). A negative result

of the Difference between the NCSI and DDL for countries like Albania, Montenegro, Bosnia and Herzegovina, and Slovenia indicates that the country's digital society is more advanced than the country's cybersecurity.

Of course, such an important index is also the European Cybersecurity Index. The index analyzed each country based on the following factors: exposure rank, commitment to cybersecurity, victims of malicious software, social network or email hacking, online banking fraud, identity theft, and cybersecurity legislation. However, it is not given for all the countries in our sample, only for 24 European countries. Lithuania, Slovakia, Estonia, Latvia, and Slovenia are among the top ten countries with a high level of cybersecurity.

Probably due to different methodologies, these indexes produce different results, but approximately similar ones. Based on the three indexes, the most progressive countries in cybersecurity are Lithuania, Estonia, Poland, and Croatia. Bosnia and Herzegovina, on the other hand, is experiencing pronounced stagnation, probably due to the fact that in this country more than one legislation is in force.

For all CEE countries, global cooperation is a necessity that has the ability to enhance cyber risk awareness. Information sharing, monitoring, an emphasis on incorporating cybersecurity into early system design, and financial and technology literacy could all help reduce the likelihood of cyber incidents that threaten financial stability. Before drafting new rules on the risks that may arise from fintech products, regulators should review whether their existing frameworks adequately address these basic risks, as well as analyze the efficacy and impact of existing policies. Also, the country's circumstances will have a significant impact on the regulatory approach.

CONCLUSIONS AND RECOMMENDATIONS

Fintech companies have different challenges in entering the market with their products, especially in CEE countries where there is no economic development. Of course, with their products come various risks. Some of the challenges that fintech companies face are: a lack of government support for fintech; support from regulators; coordination between the government and the startup ecosystem; and a clear fintech strategy by regulators and policymakers. Data protection and cybersecurity risks are the two most prominent risks among CEE countries. All countries have relevant laws on data protection and cyber risk. Many of them have also developed relevant strategies. EU member states have already incorporated the GDPR into their legislation.

Using various indicators that measure the degree of cybersecurity, such as the Global Cybersecurity Index, the National Cyber Security Index, and the Digital Development Level, we can conclude that the most progressive countries regarding cybersecurity risk are Lithuania, Estonia, Poland, and Croatia, while the country with the highest degree of this risk is Bosnia and Herzegovina.

The results of this paper are very important for the regulators of these respective countries. These countries need to analyze the respective risks posed by fintech companies and develop appropriate strategies for their elimination. A collaboration between them and international institutions would help them achieve this goal. Balkan countries that are not members of the EU should take successful countries as an example, prepare legislation in line with EU requirements, and support fintech companies by creating conditions for market entry.

There may be some possible limitations to this study. A lack of data to test empirically the impact of various factors on the challenges of fintech companies (especially in Balkan countries). In the future, it will be interesting to study the impact of different factors on the challenges of fintech companies at the company level.

ACKNOWLEDGEMENT

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PREDICTIVE ANALYTICAL MODELS AS SUPPORT FOR THE BUSINESS DECISION-MAKING PROCESS – CASE STUDY CROATIAN CHAMBER OF ECONOMY – SKOR MODEL FOR BUSINESS RISK ASSESSMENT

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In today's complex business environment, characterized by globalization and rapid market development, along with all the challenges brought by the Covid crisis, predictive analytical models are a significant support for management in making quality business decisions.

The Croatian Chamber of Economy created a quantitative model for assessing the business risk of all companies registered in the Republic of Croatia. The model enables the assessment of the risk of insolvency for a selected business entity, a comparison of the business entity with the branch of activity to which it belongs and the risk group to which it belongs, a comparison of the business entity with the branch of activity to which it belongs and the 10% of the best business entities in that branch of activity, an overview of the financial indicators of the business entity, and recommendations to reduce risk.

The key variables used in the development of the model are business activity, county/headquarters of the business entity, financial ratios, and blockages of business entities. In the development of the model, multivariate logistic regression with selection procedures and analysis of the influence of variables was used. The result of the model is the probability of being blocked. The modelling process included a total of 75 financial ratios from 9 groups, and each variable was analysed individually in relation to solvent/insolvent.

Of all the variables in the modelling process, those important for separating solvent business entities from insolvent ones were selected, followed by a combination of variables that together provide a good estimate, a statistically accurate and logical model that includes indicators from all important groups of financial indicators.

The aim of the work itself is to present and analyse the developed predictive analytical model for support in business risk assessment and to present the possibilities that the model provides in terms of determining the rating of each business entity in the Republic of Croatia and all industrial branches.

The research results are related to the assessment of the riskiness of the business, which is expressed through the rating and points. Key financial ratios that increase or decrease the risk of insolvency are identified for each individual entity. On the basis of the analysis of business and risk for each business entity, recommendations for improving business, i.e., reducing the risk of insolvency, were created. The scientific contribution of the work is reflected in the creation of a new model for assessing the riskiness of business operations of all companies registered in the Republic of Croatia. The model makes it possible to predict the behaviour of a business entity more reliably in terms of solvency, that is, it makes it possible to identify the key parameters that affect the probability of entry into the blockade in the next 12 months. The practical implication of the Model is related to direct support to the business decision-maker in the context of a better understanding of potential risks related to cooperation or partnership with a specific business entity. Also, the risk profile of an individual industrial branch enables better assessment of opportunities for potential investors. In a theoretical sense, the knowledge obtained can serve as a basis for more advanced models, which includes the assessment of symptoms of possible financial problems for a selected business entity and the creation of prediction reports for a period of 24 months. The model also provides high-quality assumptions for the further development of methods and program support in terms of using parameters related to the blocking of business entities, which can be downloaded "on the fly", that is, at the very moment when the profile is created and thus additionally and even more precisely defined rating.

Keywords: *business decision-making, predictive analytics, prediction models, business risk, future behaviour*

JEL classification: *M20; M21*

INTRODUCTION

Globalization, rapid market development, complex business conditions and challenges brought by the Covid pandemic require managers to react quickly and decisively to changes in the environment and fulfil a whole series of tasks so that the business decisions they make are timely and valid. The quality of the decision-making process itself depends primarily on the ability to assess the situation and risks, on the experience, knowledge and wisdom of the manager, on the speed of reaction and on the available information needed to solve a particular problem. "The top management makes strategic decisions based on its knowledge and values and the ability to valorise and evaluate future events, so the way the business entity functions becomes a reflection of its strategic management, i.e., the efficiency and effectiveness of the business entity's operations are in direct correlation with the individual abilities and training of the manager. "(Šimić, 2019:270). Making such business decisions is associated with high risk and must not be based on partial information and intuition, but on reliable information from credible sources. A significant place in the business decision-making process belongs to predictive analytics and predictive models, which are used both for risk assessment and for the assessment of business opportunities and the quality management of business decisions. Great progress in terms of data storage, connection of data from different sources and distribution channels, and the speed of information processing are a reliable basis for the creation of various predictive models, which, thanks to patterns in the past, predict future events. Today's business conditions, which enable the use of a wide set of tools for the implementation of digital transformation and quality financial decision-making, enable us to reposition ourselves from the zone of an intuitive-insufficiently reliable decision-making model to rational decision-making based on fast, efficient, and reliable indicators. Predictive analytics is becoming indispensable in the business decision-making process, and modern managers make complex business decisions based on processed data from the system generated by data analytics methods.

Precisely for this purpose, the Croatian Chamber of Economy, in cooperation with experts in the field of finance and predictive analytics, developed a model for assessing the business risk of every company registered in Croatia. This paper will present the method of model development, a brief description of variables, methodology, and validation tests.

The aim of the work itself is to present and analyse the developed predictive analytical model for support in the assessment of business risk and to present the possibilities that the model provides in terms of determining the rating

of each business entity in the Republic of Croatia and all industrial branches. We also want to point out the importance of using predictive

analytical models in assessing the riskiness of business and making business decisions and show the way in which basic information can be obtained quickly and easily through the developed models.

BUSINESS DECISION MAKING

The business decision-making process can be systematized in the following way:

(Sikavica, Bebek, Skoko, and Tipurić, 1999:62-66).

- Decision preparation phase:
  o problem identification
  o setting decision goals
  o gathering relevant information
  o generating alternative solutions
  o evaluation of generated alternative solutions
- The decision-making phase
- Decision implementation phase and
- Decision implementation control phase.

The decision-making process itself cannot be tied to an exact methodology that can ensure a high-quality and successful process.

"Decision-making is only as good as the process by which it is created. It follows that in order to make good decisions, we must manage the activities that lead to those decisions well." (Yates, 2011:3).

It should be emphasized that managers must take special care of knowing priorities, making timely business decisions and resolving crisis situations. An important factor in the process of making a business decision is the availability of information and ensuring timely procurement and analysis of data. Barković emphasizes that: "It is the level and type of decisions that are made that make the difference between managers and other employees in the system." (Barković, 2009:39).

Koontz and Weihrich emphasize that in the majority of cases simpler problems, that is, operational and routine decisions, are decided individually, while complex problems, tactical and strategic decisions are decided collectively. As a rule, individual decision-making is faster and simpler than collective decision-making, because the decision is made by one person (individual) (Koontz,and Weihrich, 1990:124). Circumstances in which the management

have to make a decision, i.e., assess possible results as a consequence of that decision, can be:

- certainty
- risk.

Insufficient and incomplete information increases the level of risk, and the efficiency of decision-making in such conditions depends on the knowledge and experience of the manager.

Unlike decision-making under conditions of risk, decision-making under conditions of uncertainty is based on the assumption that the decision-maker does not know all the circumstances that can affect the overall outcome, that is, he does not have sufficient or reliable information about the possibility of an event occurring, so he makes the decision subjectively or based on his own experience.

"Uncertainty is the case when a decision has several possible outcomes, but, unlike risk, the probability of achieving each individual outcome is not known and cannot be estimated. " (Kereta, 2020).

Uncertainty can be objective and subjective. Objective exists in conditions of extremely complex and dynamic changes accompanied by a lack of valid information. Subjective uncertainty appears if the decision-maker does not have reliable information or does not know how to interpret it. Decision-making depends on the state of information and knowledge available to the management of business entities. The manager's activities are implicitly or explicitly connected with some form of forecasting, which evaluates future events, that is, the probability of an event occurring and its impact on the company. Pfeifer (Buble, Cingula, Dujanić, Dulčić, Gonan, Galetić, Ljubić, Pfeifer, and Tipurić, 2005:73) emphasizes that modern managers are overwhelmed with information and challenges, so "it is difficult even for top managers to clearly and precisely define their information needs or to keep these information needs under control." He also emphasizes the importance of applying a quality analytical model, which will enable preventive and proactive impact.

"Proactive behaviour implies intervention in the causes of unfavourable forecasts, capitalizing on favourable opportunities, etc. Reactive behaviour of companies implies limiting negative consequences or risks."(Buble et al., 2005). It is important to emphasize that the integration of results into the process of strategy formulation and in the form of action plans is of key importance.

The modern theory of business decision-making, therefore, does not exclusively deal with the creation of methods, but rather suggests the choice of optimal models that serve as quick and efficient support during the actual process

of making business decisions. Knowledge from several different disciplines is used, from mathematics and statistics, through information and computer sciences to business and artificial intelligence. After determining the structure of the model, the search for parameters is started. By collecting data from the real system and converting them into parameters, a final model is created. The model must be verified and valid, which is determined by testing in the entire range of values. (Wahlström, 1994:75).

FINANCIAL ANALYSIS AND MEASUREMENT OF COMPANY PERFORMANCE

In the Croatian Encyclopaedia (2021), economic analysis is defined as: "... scientific research and explanation of economic phenomena, relationships and processes. With scientific procedures, methods and means, the complex economic reality is broken down into its constituent parts, and each part is studied for itself and in relation to others in order to determine the internal connections and dependencies of economic phenomena, their causes and consequences, their integration into an interdependent whole, and conditioning and the legality of the development of that whole and its structural features. The analysis is performed using different methods, quantitative and qualitative economic research and proofs are combined, and mathematics has become the main tool for analytically deriving conclusions and proving scientific positions".

Qualitative analysis represents a synthesis of both approaches with the purpose of measuring the success of a company's operations. Individual items from the Balance Sheet and Profit and Loss Account are put into ratios and classified by categories, which, depending on the authors, may differ from each other. According to Tintor (Tintor, 2000:336), financial indicators can be grouped into the following groups:

- Activity indicators
- Financing indicators
- Asset constitution indicators
- Coverage indicators
- Indicators of long-term coverage
- Indicators of short-term coverage
- Liquidity indicators.

According to Žager, (Žager, Mamić Sačer, Sever, Žager, 2008). financial indicators can be considered through six categories:

- Liquidity indicators

- ▪ Indebtedness indicators
- ▪ Activity indicators
- ▪ Economic indicators
- ▪ Profitability indicators
- ▪ Investment indicators.

The common feature of all the mentioned indicators is the dependence on the business activity and the size of the company, therefore, these parameters should also be taken into account when comparing each other. According to Žager et al. (Žager, Mamić Sačer, Sever Mališ, Ježovita, Žager, 2017)., accounting information is indispensable for quality business management, which, with meaningful explanations, represents a significant basis for making judgments and business decisions. As a common denominator of the main information, which is to be obtained through the reports, information on the safety and success of the company's operations can be recognized. (Žager et al., 2017).

Figure 1: The connection between the indicators of financial report analysis and the basic criteria of good business operations

Source: Žager, K., Mamić Sačer, I., Sever Mališ, S., Ježovita, A., Žager, L. (2017). Financial Statement Analysis: Principles, Procedures, Cases – Third Revised Edition. Zagreb: HZRIF, p. 45.

PREDICTIVE ANALYTICAL MODELS IN THE FUNCTION OF MAKING QUALITY BUSINESS DECISIONS

Data analytics can be defined as the science of analysing raw data with the purpose of drawing certain conclusions related to it.

Data analytics (Sušac Zekić, 2017:20), in addition to data analysis, also includes all phases of data management and is divided into:

- Descriptive
- Diagnostic
- Predictive
- Prescriptive.

While descriptive analysis mainly uses simple statistical models, and diagnostic analysis focuses on finding the cause of events, predictive analytics is performed on multidimensional data with the help of online analytical processing and investigates the strength, direction of connections, trends and causes and exceptions, and approximates functions to create predictive models. (Sušac Zekić, 2017:20).

Scientists typically build predictive models that include (McClintock, 2016):

- Collection and preparation of data (with resolution of data quality issues)
- Research and analysis of data, in order to detect anomalies and highlight significant trends and patterns
- Building models using machine learning algorithms and statistical techniques such as regression analysis
- Testing and validating the model to determine its accuracy.

Data mining technology combines different approaches (Pejić Bach, Šarlija, Zoroja, Jaković, and Ćosić, 2019:265-287), e.g., machine learning, statistics and database management, which are used to find valuable patterns in data for further prediction and decision-making. The main purpose of data mining is to find and analyse unorganized information with the aim of improving business knowledge and activities. The most used data mining methods are classification, regression, grouping, visualization, association rules, neural networks, etc. (Pejić Bach et al., 2019).

Predictive analytics enables companies to be more proactive and predict possible customer behaviour based on exact data. „There is a large number of scientific papers in the world dealing with the analysis and assessment of the predictive capabilities of indicators, i.e., the ability of financial indicators to forecast certain business events." (Streitenberger and Miloš Sprčić, 2011:383-403). Beaver (Beaver, 1966:71-111) and Atman (Altman, 1968:589-609) use the methods of univariate and multivariate analysis. Later, conditional probability methods (Ohlson, 1980:109-131), neural networks (Zapranis and Ginoglou, 2000:11-20), etc. are introduced.

Streitenberger and Miloš Sprčić (Streitenberger and Miloš Sprčić, 2011:383-403), in their work, investigate the predictive ability of financial indicators in differentiating companies that will regularly repay loans to the bank from those that will significantly delay repayment.

The aim of the research was to find financial indicators, or a model composed of several indicators, which will identify companies that will be late with their loan payments to the bank. The research has shown that certain financial indicators carry sufficient informational content that makes it possible to distinguish decent companies from those companies that will be late in repaying loans to the bank. It is important to emphasize that this model enables the identification of risks before the creation of a credit relationship and is a quality tool for assessing credit risk. What is important to emphasize about this model is the fact that it takes exclusively financial indicators in the parameterization and creation of the model and refers to small companies. Therefore, there is potential for the development of new models for business risk assessment, which will apply to all business entities, regardless of their size, and which, in addition to financial indicators, will include other quantitative and qualitative parameters that can contribute to the creation of a better model.

CROATIAN CHAMBER OF ECONOMY SKOR – A MODEL FOR ASSESSING BUSINESS RISK

The Croatian Chamber of Economy, in cooperation with external partners, created a model for assessing business risk of all companies registered in Croatia. The model predicts the level of risk of a business entity being blocked for more than 90 days in the next 12 months. (Author: Croatian Chamber of Economy Score Model, 2021).

The key variables used in the development of the model are: company activity, county/headquarters of the business entity, financial ratios and blockages. The model was developed for the need to assess the riskiness of each company's business, and in the development of the model, multivariate logical regression with selection procedures and the analysis of the influence of variables was used. The result of the model is the probability of being blocked.

Basic steps in model building: (Author: Croatian Chamber of Economy Score Model, 2021).

- Sample definition
- Data collection
- Analysis of characteristics
- Scoring card modelling
- Validation of the scoring card
- Strategy setting and implementation.

The definition of the sample included the collection of data on business entities that will be used for modelling. When collecting data, it is necessary to keep all available characteristics, the significance of which will be determined by subsequent statistical analysis. The data sample that was available for model development and testing contained a total of 6414 business subjects. In the whole available database, here were 3207 entities that were blocked at least once for 90 days or longer in 2019. Among the solvent entities, the same number of business entities was randomly selected subjects. From this sample, a model development sample and a model testing sample were made   as shown in Table 1. Financial indicators were calculated for selected business entities based on their financial statements from 2018.

Table 1: Samples for model development and validation

Samples	Solvent business subjects	Insolvent business subjects
Sample for model development	2500	2500
Sample for model validation	707	707
In total	3207	3207

Source: Author

By analysing the characteristics, solvent and insolvent companies were identified in order to include them in the final scoring model. During the actual construction of the model, historical data were analysed in order to determine the characteristics that are important in predicting individual risk. Statistical methods used in the scoring card development industry are logistic regression, discriminatory analysis, breakthrough analysis, mathematical programming, neural networks, Markov's chains, expert systems, genetic algorithms, and others. The modelling process included a total of 75 financial ratios from 9 groups, and each variable was analysed individually in relation to good/solvent and bad/insolvent.

Table 2: Financial ratios

FINANCIAL RATIOS
Economic indicators (4)
Profitability indicators (17)
Liquidity indicators (9)
Indebtedness indicators (18)
Activity indicators (19)
Research and development indicators (2)
Productivity indicators (1)
Export and import (4)
Indicators of investment activity (2)
Other (1)

Source: Author

Of all the variables in the modelling process, those that are significant for separation were selected – solvent business subjects from the insolvent, and then, a combination of variables that provide a good estimate together was selected, a statistically correct model and a logical model that will cover indicators from all important group financial indicators.

MODEL CREATION

To create the model, the following variables were selected:
- Activities
- Share of cash in assets ($\uparrow$)
- Ratio of cash and liabilities ($\uparrow$)
- Duration of supplier credit ($\downarrow$)
- Receivables turnover ratio ($\uparrow$)
- Coverage level 2 ($\uparrow$)
- Ratio of retained earnings to assets ($\uparrow$)
- Net profitability of own capital ($\uparrow$)
- Relationship between investments and assets ($\uparrow$)
- Business income per employee ($\uparrow$).

The arrow in parentheses denotes the direction which influences the score. $\uparrow$ means that with the increase of these variables the score grows, and $\downarrow$ means that with the increase of these variables the score decreases. Categories and number of points are determined for each group of key ratios. The total score

for each client is obtained by adding up the points. The assessment of the riskiness of a business entity's operations is expressed through rating, points, and the probability of being blocked.

Table 3: Risk levels defined in the model

Croatian Chamber of Economy SCORE	Level risks
>558	Low-level risks
>538 and <=558	Medium low-level risks
>505 and <=538	Medium level risks
>468 and <=505	Medium high-level risks
<=468	High-level risks

Source: Author

Given that the model was developed on a sample that contained an equal number of good/solvent and bad/insolvent clients, and in the portfolio of all companies there are 2.45% insolvent (according to the definition used for the development of the HGK SKOR model), the probability of going into bankruptcy (PD) calculated from the scoring model were converted to that actual percentage of insolvents.

The calculation is made according to the following formula:

$$\hat{p}_i = \frac{\hat{p}_{*_i} \cdot \rho_0 \cdot \pi_1}{\left[(1 - \hat{p}_{*_i}) \cdot \rho_1 \cdot \pi_0 + \hat{p}_{*_i} \cdot \rho_0 \cdot \pi_1\right]}$$

$\hat{p}_i$ = new recalculated probability (considering the percentage of insolvent companies in the portfolio)

$\hat{p}_{*_i}$ = the probability obtained from the model development sample

$r_{0,1}$ = the proportion of solvent and insolvent in the development sample

$\pi_{0,1}$ = the proportion of solvent and insolvent in the portfolio

The distribution of the probability of going to the blockade can be found in table 4.

Score values and PD values are distributed in 10 rating category using files on all business subjects that were available (Table 5).

Table 4: Probability of going to a blockade

Probability of being blocked	Level of probability of being blocked
<=0.314%	Very low probability
>0.314% and <=0.796%	Low probability
>0.796% and <=2.073 %	Medium probability
>2.073% and <=8.866%	High probability
>8.866%	Very high probability

Source: Author

Table 5: Qualitative description of rating categories

Rating	Classes for score	Description and meaning category
AAA	>560	The best quality. The lowest risk. Extremely reliable business subject.
AA	>547 and <=560	Very high quality. Very low risk. Very reliable business subject.
A	>535 and <=547	Good quality. Medium low risk. Sufficiently reliable business subject. subject.
BBB	>520 and <=535	Satisfactory quality. Medium low risk. Reliable business subject.
BB	>505 and <=520	Mediocre quality. Medium level risk. Borderline reliability.
B	>492 and <=505	Borderline quality. Medium level risks. Borderline reliability.
CCC	>468 and <=492	Low quality. Medium high risk. Weak reliability. Caution!
CC	>448 and <=468	Very low quality. Medium high risk. Low reliability. Caution!
C	>425 and <=448	Very low quality. High risk. Unreliable business subject. Caution!
D	<=425	The lowest quality. Largest risk. Unreliable business subject. Caution!

Source: Author

VALIDATION OF THE CROATIAN CHAMBER OF ECONOMY SKOR MODEL

The model was tested on a source of data that was not used to develop the model. The total data sample for testing was 1414 business entities, of which 707 were solvent and 707 were insolvent. Validation of the scoring card included testing by using various qualitative tests, i.e., comparing the actual state of good/bad, i.e., solvent/insolvent with the assessment obtained by the scoring model. Validation was performed out of sample and out of time. Out of sample means data that did not participate in the modelling, and out of time means data that is not from the period from which the data was used to develop the model.

Validation of the dependence on score values includes the following tests: (1) distribution of scores, (2) ROC curve, (3) C statistics, (4) Gini coefficient, (5) KS statistics.

Figure 2: Graphic representation of score distribution
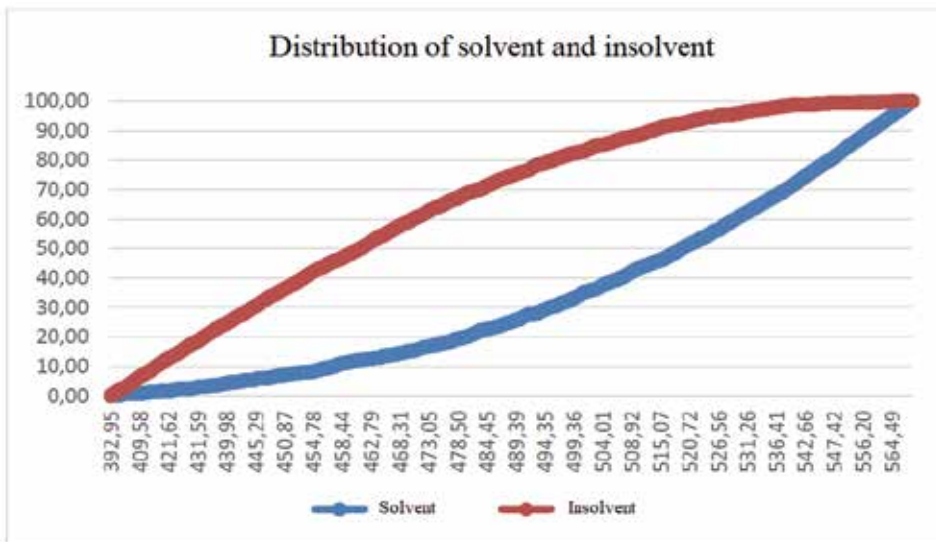
Source: Author

The figure shows that the model separates solvent from insolvent companies well.

Figure 3: Graphic representation of ROC curves
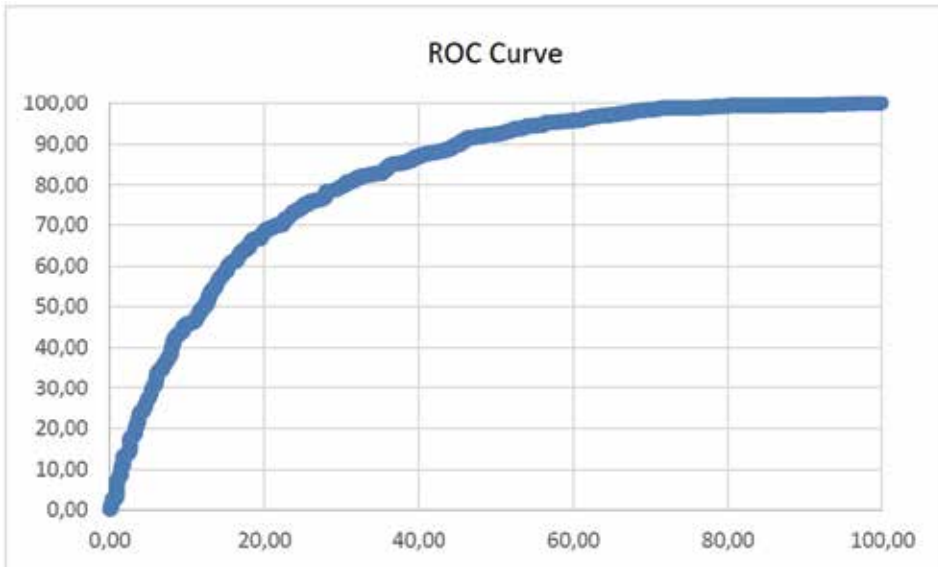
The ROC curve has a good and concave shape, and we can conclude that the model has maintained high quality.

As for the results of other tests, the area under the ROC curve (AUC) is 0.822, which shows the high quality of the model. The GINI coefficient is 0.643, which further confirms the high quality of the model. The KS statistic for the model is 50.49%, which shows a very good ability of the model in the classification between solvent and insolvent subjects.

Validation depending on the cut-off values includes the following tests: (1) hit rate of good/solvent (sensitivity), (2) hit rate of bad/insolvent (specificity), (3) total rate of hits (accuracy), (4) type 1 error, (5) type 2 error.

- Hit rate good/solvent
  The percentage of good/solvent clients correctly classified is 75.95%.
- Bad/insolvent hit rate
  The percentage of insolvent clients correctly classified is 73.27%.
- Total Hit Rate
  The total percentage of clients correctly classified is 74.61%.
- Type 1 error
  The percentage of insolvent companies classified as solvent is 26.73%.
- Type 2 error
  The percentage of solvent companies classified as insolvent is 23.71%.

The developed model is of high quality and precision and is used as a tool for creating the Croatian Chamber of Economy Credit Report, which individually shows the operations of all business entities in the Republic of Croatia. The very assessment of the riskiness of the business is expressed through the *rating and points* that predict the level of risk of entry into the blockade in the next 12 months in a period longer than 12 months. Key financial ratios that increase or decrease the risk of insolvency are identified for each individual entity. On the basis of the business and risk analysis for each business entity, recommendations were created for improving the business, i.e., reducing the risk of insolvency.

CONCLUSION

The digital age into which we have already deeply stepped requires quick adaptation and an even quicker reaction in terms of making quality business decisions and assessing future events.

In this context, the need for further development of prediction models for active support of businessmen in the process of making quality and timely business decisions was also recognized.

The Croatian Chamber of Economy Skor for business risk assessment is a high-quality and precise model that enables the creation of credit reports with the most important information about the rating of an individual business entity or a certain industry branch.

The scientific contribution of the work is reflected in the creation of a new model for assessing the riskiness of business operations of all companies registered in the Republic of Croatia. The model makes it possible to predict the behaviour of a business entity more reliably in terms of solvency, that is, it makes it possible to identify the key parameters that affect the probability of entering the blockade in the next 12 months. This is the basis for creating a risk profile of a business entity. The practical implementation of the Model is related to direct support to the business decision-maker in the context of a better understanding of potential risks related to cooperation or partnership with a specific business entity. Also, the risk profile of an individual industrial branch enables better assessment of opportunities for potential investors.

In the theoretical sense, the knowledge gained can serve as a basis for more advanced models. The model also provides quality assumptions for the further

development of methods and program support in terms of the use of parameters related to the blocking of business entities, which can be downloaded "on the fly", i.e., at the exact moment when the profile is created and thus define the rating even more precisely.

In accordance with the current needs of Croatian entrepreneurs, as well as forecasting future needs, the further development of the Model will be directed towards recommendations for growth and active support for companies in their own data analytics process.

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PRIVATE MONEY CREATION IN THE AGE OF FINANCIAL GLOBALIZATION

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In this paper, our aim is twofold. Firstly, we aim to explore the hierarchy and mechanisms of modern money (and near-money) creation, as there is admittedly a widespread misunderstanding of these issues. We showcase that banks are not just another intermediaries; they are at the heart of the clearing and settlement system in the two-tiered hierarchy of credit relations that characterize modern monetary economies. We adopt a balance sheet approach with double-entry bookkeeping analysis that most consistently captures the causality and elasticity of money creation, both at the national and international level. Secondly, on the basis of the aforementioned analysis, we discuss the financial innovation from the institutional perspective, including the latest iterations in the form of Fintech and cryptocurrencies. In doing so, we argue against the popular interpretation by which they represent a revolutionary private challenge to the existing, publicly-backed monetary infrastructure. In our view, Fintech and cryptocurrencies (similar to other innovative components of the shadow banking infrastructure) are better understood as the latest evolutionary forms of private financial innovation, which has been in turn the essential driver of the post-WWII financial globalization process. Financial globalization had its embryo in the architecture of the Bretton Woods system, its catalyst in the 'Nixon shock', and its sudden stop in the GFC. The process has been driven by private agents, kickstarted by the 'liability management' of the banking sector. However, any innovation's challenge until now has been heavily dependent on the willingness of public authorities to tolerate or reject them. This was true (for various political and/or economic reasons) in the groundbreaking developments of CD markets, eurodollar offshore creation, the rise of shadow banking and securitiza-

tion, and we consider it to be true in the contemporary case of Fintech and cryptocurrencies. More so, we conclude that the defining characteristic of the post-GFC financial system is that it is market-based and public-led, opposite to bank-based and private-led as it was during the majority of the financial globalization era.

Key words: *liability management, eurodollar, shadow banking, financial globalization, Fintech*

JEL classification: *E42; E50; E51; G21; G23*

INTRODUCTION

In the world of finance, 'revolutionary' is the new catchword for almost everything novel and technologically driven in the last decade or so. This mostly concerns the meteoric rise of Fintech – integration of advanced technological solutions and the financial sector – and cryptocurrencies, the new generation of speculative assets based on the highly innovative blockchain technology that bear promise of decentralization and democratization of finance. In a stylized popular view, the rise of Fintech is challenging the traditional banking and finance, while cryptocurrencies are apparently rivaling the conventional notion of money by being private-led and electronic (Harvey, 2015), decentralized (Hileman and Rauchs, 2017) debt-free (not a liability of anyone) and peer-to-peer exchangeable (Bech and Garrat, 2017). Together, they form something that is starting to be known as *decentralized finance* (Schär, 2021).

However, before even considering recent trends in the financial system, it is of paramount importance to properly understand already existing hierarchy and mechanisms of money and asset creation, as well as the architecture and development of the monetary and financial system itself. There is, admittedly, a widespread misunderstanding of these issues in the economy dominated by credit money, both in academia and in popular views.

The dominant narrative regarding the recent financial innovations is that of a private (almost rebellious or counter-cultural) challenge to the established fractional reserve banking system that rests upon the legitimacy and centrality of public money, backed by the governments' power. We deem this narrative misleading, not necessarily due to misunderstood innovations' characteristics, but because of a prevalent misunderstanding of the already existing monetary and financial system.

More precisely, without questioning the motivation of Fintech's or cryptocurrencies' emergence and associated agents, we do question the validity of its challenge to the existing institutional framework. Namely, a vast majority of money created and circulated in the modern global economy is, in fact, of a private and largely endogenous origin. More so, virtually all private money, private debt instruments, and near-money assets have been created through the help of endogenous liability management of banks and shadow banks, as well as circulated in the electronic or digital form for decades.

Hence, we develop a perspective that opposes these parts of the dominant narrative. We start by exploring a hierarchy and mechanisms associated with money creation in the modern (closed) economy, which are counter-intuitive to the standard textbook description. Most of the money in circulation is, in fact, demand-led, and its creation (as well as annulment), clearing and settlement is dependent on the two-tiered architecture of the monetary system which is hierarchically structured with the central bank at its apex.

At the same time, global economy has been witnessing a development of a parallel infrastructure of offshore markets and shadow banking that deviates from the established framework. This development has accelerated in the aftermath of the Bretton Woods collapse, and we regard it as a cornerstone of the financial globalization process. Parallel existence of two separate frameworks admittedly blurs the equivalence between monetary jurisdiction and monetary area. While bank money creation represents the *de iure* mechanism of money creation in the associated monetary jurisdiction, shadow banking and offshore markets represent the *de facto* mechanism of money and money-like debt creation in the associated monetary area.

Contrary to just stated, there are several erroneous views that still dominate academia (less so central banks). Put differently, economists are generally biased in several different ways when exploring monetary topics, probably due to the supremacy of the multiplier interpretation of money and money stock creation in the economy. On top of this, there is a general bias towards the government role in the international monetary system that neglects privately and endogenously created substitutes (Frasser and Guzman, 2020).

Because of this, little attention is given to the differentiation between monetary jurisdiction and monetary area in contemporary finance and financial flows (Awrey, 2017). Instead, what still makes a centerpiece of international economics is the logic of the Mundell-Fleming model, but the world of that model and its *impossible trinity* is a world of the *Westphalian* nation state (Murau et al., 2020) whose financial architecture, money creation and asset mobility mechanisms are old-fashioned and surpassed in the financially globalized environment of interdependence.

Consequently, our motivation is to delegitimize views that we deem imprecise and/or erroneous with the focus on private money creation and more broadly – private financial innovation. These could be generally stated as follows: *1) broad money creation is under strong causal and quantitative control of the central bank's monetary policy, heavily dependent on the concepts of a high-powered monetary base and the multiplication of excess reserves, 2) public money is the dominant type of money in circulation in the existing monetary system, 3) monetary area necessarily coincides with the monetary jurisdiction of the nation's (or monetary union's) central bank, 4) recent emergence of Fintech is a major private challenge to the established public-backed architecture of the current monetary and financial system, 5) emergence of cryptocurrencies represents a major threat to the existing government-controlled currencies that are susceptible to inflationary pressures due to the fiat nature of money in circulation, and 6) contemporary financial system can be best characterized by private innovation (such as Fintech and cryptocurrencies), with the diminishing role of public authority.*

We will argue against these stylized statements by exploring the following: i) inherent hierarchy and architecture of the existing monetary and financial system, ii) causal mechanisms and relationships present in the money/debt creation process, iii) historical evolutionary path of (private) financial innovation in the financial globalization process, and iv) change of dynamics between the bank and non-bank sector, as well as private and public agents in the contemporary world of finance.

The structure of the paper is as follows. After the introduction, in section 2, we disseminate architecture and money creation mechanisms of the contemporary monetary system in a closed economy, with the double-entry accounting approach that helps to pinpoint the underlying "hidden" hierarchy of money and money creation causality. Section 3 widens the analysis to an open economy with special emphasis on the post-WWII historical trends in the monetary and financial system that can best be described as the process of 'financial globalization'. In this section, we provide a basis for argumentation that novel financial innovations are evolutionary and not revolutionary steps in the aforementioned process. In section 4, we focus on the post-GFC macro-financial trends to showcase that unprecedented contemporary changes are not primarily private- but public-led. At the same time, we recognize that market-based funding largely replaced bank-based funding which was a staple in earlier decades (and centuries). Finally, section 5 concludes the paper.

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## ARCHITECTURE AND MONEY CREATION MECHANISMS OF THE CLOSED MONETARY SYSTEM

We start by exploring monetary architecture and money creation in the closed (national) economy. In this way, we delay differentiation between monetary jurisdiction and monetary area, as they are exactly the same for now. The architecture of the monetary system consists of many layers, but of two very distinct tiers: one on the outside and the other on the inside of monetary agents' transactions. The first one vastly dominates in scale and direct importance to economic activities of companies, households, and individuals. However, the second one is the institutional heartbeat of the system and hierarchically superior. Having said that, what constitutes "money" in one tier does not necessarily constitute "money" in the other tier.

Put differently, what constitutes money is in the eye of the beholder: in the lower tier, commercial banks' liabilities in the form of demand deposits is what general public, in addition to cash, regards as money (that is, the means of final payment); in the higher tier, central banks' liability in the form of reserves is "money" in the final clearing and settlement procedures between monetary agents. The bridge that connects these two otherwise separate payment systems is – cash.

Hence, *legal tender* of any monetary jurisdiction consists of cash and central bank reserves. Cash and reserves added together make *central bank money* which is the means of final payment at the top tier, i.e., in the interbank market. Having that in mind, the system needs central bank money (reserves) to settle interbank debts or net positive transactions, even when there are no reserve requirements, opposing the logic of money multiplier view (Rochon and Rossi, 2007).

At the same time, cash and reserves are perfectly convertible, as are cash and commercial bank deposits. However, crucially, there is no direct convertibility between reserves and commercial bank deposits. Before, this semi-permeability between the two tiers was very difficult to see, but due to the diminishing role of cash (and an ever larger role of electronic transactions), as well as massive monetary interventions of the past decade, it is now possible to better disentangle the peculiarities of these payment systems. Figure 1 depicts the stylized and hierarchical view of the payment systems' semi-permeability.

Figure 1: Semi-permeability between payment systems
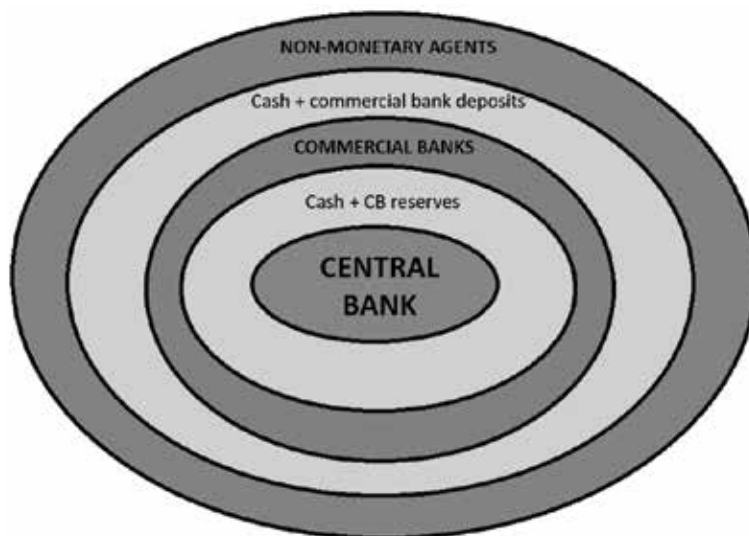
Source: Authors' work

The hierarchy of the monetary system is two-tiered with the central bank at its apex[2]. Underneath it are monetary institutions that have a direct access to central bank money. Further underneath them are various layers, starting with foreign banks and/or non-bank financial institutions (NBFIs) that do not have direct access to the country's central bank liquidity and ending with non-financial agents that carry out final payments in both cash and deposit money. Hence, to simplify, the first hierarchical tier is made up of all agents that have direct access to central banks' liquidity, while the second tier is populated by those who lack this direct access.

So, in essence, commercial bank money and central bank money (in the form of cash) are both used by non-monetary agents to conclude their transac-

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[2] Reasons for this are historical, but also inherent. Central banks in its origin were often just strong private banks whose liabilities could have a reasonable power to guarantee occurrence of net liabilities between smaller banks underneath it on their *nostro/vostro* accounts. Understood as such, central banks were primarily concerned with establishing proper payment systems and easing clearing and settlement among banks. In most of the countries today, central banks act as the primary clearing agent of the banking sector. And since virtually every company and individual in the advanced economies has a bank account, this conditions the inherent hierarchy in the system.

tions, representing finality at their hierarchical level. However, from the system-wide perspective, the final settlement[3] is done exclusively in *legal tender*, that is to say, in central bank money (reserves and/or cash) in the monetary jurisdiction's unit of account (Figure 2). As such, banks are at the core of a monetary economy of production and exchange (Rossi, 2007) as they provide payment instruments and services to retail customers (non-monetary agents) – passively expanding or contracting their balance sheets in the process – but they also demand clearing and settlement services from the central bank, or whoever is the infrastructure service provider (Committee on Payment and Settlement Systems, 2006).

Figure 2: Two-tiered architecture of the closed monetary system
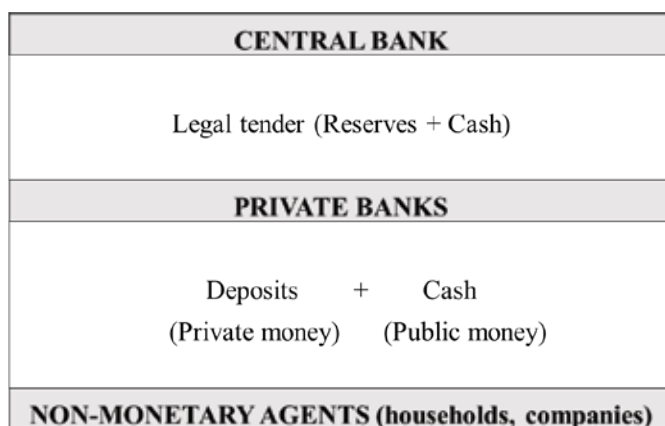
Source: Authors' work

Is this kind of a tiered system optimal in a way that it is structured? Arguably, yes. The most immediate purpose of the monetary system is the clearing and settlement of claims and obligations (and in the distant second, the intermediation role). For that, two main conditions are centrality and trust, and both are validated by the existence of hierarchy, that is in turn safeguarded by the central bank. In any hierarchical tier, the main characteristic of modern money is that it is a form of debt, an IOU (*I Owe You*) instrument and a direct liability of monetary institutions, but crucially, hierarchical nature conditions

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3   Final settlement represents 'the discharge of an obligation by a transfer of funds and a transfer of securities that have become irrevocable and unconditional' (Rossi, 2007; Committee on Payment and Settlement Systems, 2003).

that the higher quality debt clears lesser-quality debts. At the same time, the quality is primarily about the pattern of payments and less about default risk (Mehrling, 2000).

A central bank (or a central clearinghouse) is indispensable because a completely free-market economy lacks a natural agent whose liabilities would be considered money, as it is rare that one private agent has both risk-free liabilities and is a dominant payment agent or a 'middle-man' in various transactions. One obvious example are commercial banks and, indeed, their rise coincided with the rise of the clearing and settlement network among the banks themselves, through the *nostro/vostro* accounts. However, what they lacked was the institution whose hierarchical level was above them and that had the legitimacy and power to guarantee their liabilities with its own form of *ex nihilo* created liability. Without it, banks were highly susceptible to bank runs. That institution was born as a (private) clearinghouse and slowly became the central bank of today, in charge of price stability through monetary policy implementation[4].

Modern monetary policy is predominantly concerned with price stability, while its operational target is most commonly oriented around targeting the overnight short-term interest rate. But when economists think about price, they normally have only one in mind: the general price of goods and services in the chosen unit of account, or alternatively, its change, i.e., inflation rate. But in the hierarchy of money, three additional prices are also important to consider: the price of commercial bank deposits (or other possible money substitutes) in terms of *legal tender* (par), the price of domestic currency in terms of foreign currency (exchange rate) and the price of money (interest rate).

Arguably, the price of money is the most important price in the conduct of monetary policy, while the par between private bank deposits and *legal tender* is implicitly assumed as given but is, in fact, a necessary condition for the whole hierarchy to function. Having said so, the role of the monetary system and banking as such that is usually highlighted is the intermediation role. But arguably, even more important is the (passive) role of clearing and settlement of agents' transactions and, consequently, protecting the par. Because of this, central banks are necessarily defensive institutions that neutralize net inflows

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[4] Central banks first became cornerstone of the system as the clearing and settlement agent (seriously underappreciated trait in macroeconomics) and only later as the monetary policy agent. The bridge that connects these two agencies is the lender of last resort (LOLR) role, which represents the final liquidity backstop to the entire system, rendering its elasticity dependent on the quality of existing assets in the economy.

(outflows) of the clearing and settlement system. Otherwise, there would be a major volatility in the amount of outstanding reserves and in the overnight interest rate on the interbank market[5]. On the other hand, commercial banks must passively accept expansion or reduction of their balance sheets that is happening due to non-monetary agents' decisions, introducing inherent bias towards instability.

Since the conclusive end of the gold standard in 1973, the dominant kind of monetary analysis implicitly reduces contemporary (public) money to fiat money, which logically transpires from a classical notion of money as the gold bullion and private substitutes (as deposits and paper money in time of classical political economy) surrounding it. With no gold backing the currency, it is only backed in trust, i.e., *fiat*. And both fiat money and gold money are considered *outside* assets to the system, i.e., diverging from zero net claims and liabilities between economic agents. However, in the next paragraphs, we will explain that there is no true *fiat* public money in advanced economies of today, but *credit* public money that is necessarily backed by some kind of collateral (debt).[6]

Having just seen how contemporary monetary system is structured in two hierarchical tiers, the next step is to describe money creation (and annulment) mechanisms in it. In academic macroeconomics, money creation is normally understood to be exogenous and/or supply-led. More so, money as such is understood to be neutral, especially in the long run, endorsing a role of a 'veil' over the economic activity. This tradition harbors its origins all the way back to classics and the traditional separation of the real and monetary analysis (Schumpeter, 1954). Admittedly, this kind of separation did much damage to proper understanding of the monetary economy in which we live.

Generally, three theories of money creation and banking are in continuous rivalry with various degrees of influence through history: intermediation theory, money multiplier theory and endogenous (credit) money theory (Werner, 2016). Intermediation theory (or *the traditional model of financial intermedia-*

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5   Albeit, there is nothing especially novel about this, as it was explained already by Walter Bagehot (1873) in the 19th century.

6   In practice (though not in theory), "practical chartalism" (Mehrling, 2000) has been almost a universally accepted doctrine since decades ago. This renders the dominant analysis erroneous, because the nature of money in circulation – both private and public – is credit, hence, debt. Consequently, this has significant implications on the proper understanding of the monetary system's inner functioning. At the same time, the theoretical conflict between metallists and chartalists is still rampant, with the effect of the confusing diagnosis of the system's workings and the normative or policy suggestions.

tion) dominates the model-building part of academia, as it reduces banks to their role as intermediaries between savers and debtors, rendering all of the nuances and mechanics of modern monetary production economies redundant. It is also known as Tobin's (1963) *new view of banking,* while Jakab and Kumhof (2015) call it *the intermediation of loanable funds model*, as it is entirely based on the loanable funds approach. This theory is the most rigid and most unrealistic one, but then again, most user-friendly as a building block in the IS-LM model. But also, it is an important part of more sophisticated macro-models such as DSGEs through the closely related neo-Keynesian credit channel approach (Lavoie, 2019).

Money multiplier theory (or *the fractional reserve theory of banking*) dominates textbook descriptions of money supply describing a process of multiple deposit money creation through banks' lending of excess reserves towards non-monetary agents (see, for example, Mankiw, 2003; Mishkin, 2019). Tobin (1963) calls it *the old view of banking.* This was (and still is) the dominant textbook theory of money creation in the context of monetary policy since the invention of the multiplier concept in 1920 (Philips, 1920) and, especially, since it was legitimized by Poole's (1970) model. As such, it theoretically gave monetary authorities an even larger role than they inherently already had, but more importantly, it brought a lot of unnecessary noise both in academia and in central banking through the better part of 20th century due to its emphasis on the quantity of reserves (monetary base) as a preferred control variable in the conduct of monetary policy.

The third theory – that is factually a valid one – is the credit or the endogenous theory of money, by which banks are the originators of the *inside* money (Abel et al., 2016; Jakab and Kumhof, 2015; Lavoie, 2014) and the catalysts of the financial system's elasticity[7]. Endogenous theory traces its origins back to the 19th century's Banking School with their understanding of the 'reflux' mechanism and was, in fact, a dominant theory all the way until after WWI[8]. In essence, endogenous money theory describes monetary economy as a world of credit-driven and demand-led money, which is created and annulled in the opposite causal direction of that conventionally assumed. At the same time, banks are

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[7]   Elasticity here can be defined as the potential of monetary arrangement to generate endogenous swings in the money or credit stock (see Borio, 2019), meaning the creation of the new purchasing power, according to the effective demand schedule.

[8]   Why and how it fell out of favour is a story in itself, with most influential central banks (with the prominent role of the Federal Reserve) and academics such as J. M. Keynes and M. Friedman accepting the multiplication theory and the associated RPD (*Reserve Position Doctrine*). For a detailed account see Bindseil (2004).

not mechanically constrained by prior deposits taken or the amount of reserves since the causality goes from loans to deposits to reserves (and not the other way around). As such, there is no money multiplier at work, at best a *credit divisor* could be conceptualized (Lavoie, 2019). Understandably, excess reserves (excess liquidity) cannot be lent out and leave the central bank's balance sheet, with one special exception: transformation to cash (another form of *legal tender*).

As stated, the endogenous or credit theory of money has its origins in the Banking School, but also in the works of classics such as Macleod (1891), Wicksell (1898), and Schumpeter (1954). Keynes (1930; 1936) seemed to have adopted the endogenous money view in his 1930's *Treaties on Money* but curiously dropped it by the time of *General Theory* in 1936[9]. Afterwards, endogenous money theory was mostly saved by the works and efforts of the post-Keynesians, French circuits and the British Cambridge-based economists that opposed the neoclassical synthesis consensus of the post-WWII academia. This was especially evident in the writings of Le Bourva (1992), Kaldor (1982), Lavoie (1984), and Moore (1988), all of whom influenced the next generation of heterodox monetary economists.

The causality and validity of the endogenous theory has also been confirmed in recent years (finally) by central bankers and economists from leading international institutions, for example by the Bank of England (McLeay et al., 2014), the Bundesbank (2017), the IMF (Gross and Siebenbrunner, 2019) and economists working for the ECB (Bindseil, 2014; Bindseil and König, 2013) and the BIS (Disyatat, 2008; Borio and Disyatat, 2010). Because money multiplier as a concept is an artifact, reserve requirements usage has been rightly reduced in contemporary times. Instead of reserve requirements, the net worth of banks became the decisive factor in bank lending. In the words of Borio and Disyatat (2010: 77): "the main exogenous constraint on the expansion of credit is minimum capital requirements".

The precise details of this vast topic are outside of the scope of this paper, but what is crucial here is: 1) the origin of money in circulation, and 2) directional causality of money's entrance into the economy.

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[9] Throughout his career and writings, Keynes tried to escape the reasoning of the quantity theory of money. In the *Tract* he accepted the Cambridge cash-balance version of the quantity theory, criticized it in the *Treatise* and finally abandoned it in the *General Theory* to establish a new theory of effective demand (Moore, 1988). However, it could be argued that Keynes never truly succeeded in escaping the quantity theory's confusions (Kaldor, 1982; Kahn, 1984). And by adopting the RPD in opposition to the Bank of England's orthodoxy (Bindseil, 2004), he basically propagated the quantity theory's assumption that the stock of money is exogenous and controllable by the central bank.

Let us start with the origin. What constitutes money to the general public is the sum of cash (part of *legal tender*) and demand deposits (private bank liabilities). This is conventionally known as broad money or M1 monetary aggregate. However, what constitutes money to monetary agents is, as we have already explained, only *legal tender* (central bank money, i.e., cash and reserves). As it can be seen, both payment systems share cash as a constituent part, thus, cash is a way to transform private money to *legal tender*. The state (or more precisely, central bank) guarantees the par of this exchange.

It is important to acknowledge that all deposit money is in essence private money, with no consideration to the way it is created, because its payment system exists *alongside* (and not only as a convertible substitute) to the *legal tender*'s payment system. More so, demand deposits are nothing but a commercial banks' promise to pay or the IOU instrument of debt. Deposit money can be created in various ways. Most prominently, it will be created and annulled through banks' loans to non-monetary agents. In addition to this, it can be created through asset purchases from non-monetary agents, depositing cash by non-monetary agents and making payments for the public sector. But always, it is the creation and annulment of private money in question, as we are talking exclusively about commercial banks' liabilities.

However, to enable much of these transactions and circulation of private liabilities in the economy, as well as their parity with *legal tender* as the means of final settlement, the crucial role is that of the central bank and its own liability: *legal tender* itself. And *legal tender* is significantly differentiated from its private substitutes, regardless of the parity: every net monetary transaction of the economy, the final settlement must be done in the form of *legal tender* (generally, central bank reserves nowadays). In that way, the system as a whole is legitimized by the monetary authority of a public agent (central bank), but it is not dominated by public money. Instead, a vast majority of money in circulation is of a private origin, created and annulled by private agents.

What is still a source of misunderstanding is the nature of contemporary forms of public and private money. Generally, it is regarded that bank deposits are *inside money*, while cash and reserves constitute *outside money* (Lagos, 2006). This kind of analysis is built upon the famous Gurley and Shaw's (1960) *Money in Theory of Finance* from where the distinction originated. However, we argue that both public and private money in advanced economies are effectively *inside* money, meaning that net claims on these assets are equal to zero.

In the world of contemporary monetary economy, all money is necessarily debt by definition (as it is created through collateralized issuance of

liability by both central banks and commercial banks), and its net claim (liability) is equal to zero. Bank deposit is brought into existence as a liability versus loan on the assets' side of the bank's balance sheet. Similarly, *legal tender* is also brought into existence as a liability versus some kind of claim on the assets' side of the central bank's balance sheet (either a loan to or a purchase of a security from the banking sector or the government).[10] Therefore, both private and public money are credit money in nature, but with a different hierarchical weight.

This distinction could seem unimportant at first. However, it is not only a semantic notion, but a key to understanding the essence of the money creation process as a dynamic debt creation, as well as its role at the core of the contemporary monetary system. Money creation, understood fundamentally as liability creation, is not dissimilar to asset creation in the primary market. Both result in the expansion of the balance sheet of the respective institution. Having said that, proper understanding of money creation (and asset creation in general) is arguably a necessary step before understanding the validity of the potential financial innovations' challenges to the existing monetary and financial framework.

If money is created endogenously, how is it annulled or 'destroyed'? In other words, what guarantees the non-separation or equality of money demanded and money supplied? In short – *reflux* mechanism. Reflux mechanism was a staple argument of the Banking School, and it survived as an important tenet of the post-Keynesian school. In short, debt repayments equally 'destroy' deposits as loans create them. Another way is when non-monetary agents buy income-yielding financial assets from banks as they are drawing down their bank accounts, shrinking the bank's balance sheet in the process. The associated logic also works in the open economy through the compensation thesis (Lavoie, 2001).

On the other hand, academically dominant two theories of money creation – intermediation theory and multiplier theory – rest erroneously upon conceptualizing the exogenous stock of money. Intermediation theory assumes a completely exogenous stock of money (loanable funds) that circulates in the economy (that is then intermediated by banks between savers and debtors),

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[10]   Having that in mind, *legal tender* is not true *fiat* money when it is backed against collateral of any sort. If the opposite would be true (issuance of cash without any asset backing), it would be real *fiat,* and it would truly be *outside* money (and it would be potentially highly inflationary as such). As it is, the quality of public money depends on the quality of collateral, while accessibility depends on its price (interest rate driven by the central bank).

while multiplier theory allows for the creation of private money on top of the public money which serves as a monetary base, but the base is in turn a necessary causal precondition for the process to evolve, as well as a necessary *ex ante* constraint to further multiplication.

In the context of monetary policy implementation, there are two distinct positions: verticalist and horizontalist. The verticalist position is consistent with the multiplication theory, while the horizontalist position is consistent with the endogenous theory. The verticalist position dominates academic macroeconomics (especially textbook economics) with its view that the money supply function is exogenous, independent from money demand and – to a significant degree – controllable by the central bank. Today's best-selling monetary policy textbooks – such as Mankiw (2003) or Mishkin (2019) – still explain money supply through the multiplication process, assuming that the central bank "controls the supply of money by increasing or decreasing the number of dollars in circulation through open-market operations" (Mankiw, 2003: 482)[11].

However, the real monetary world of credit money is much more consistent with the horizontalist view. The horizontalist view can be graphically depicted as a horizontal money supply function in interest-money space (R^s in the 2nd quadrant) as shown in Figure 3. Credit is demand-led, and the equilibrium is established when C^s equals C^D (C^s is set as a mark-up above the price of reserves – R^s). Hence, as Moore (1996: 98) frames it: "[…] banks are price setters and quantity takers in their retail loan and deposit markets […] it is also necessarily the case that the demand and supply of money are interdependent.".

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[11]   But at least now there is some (albeit shy) degree of accepting that the central bank *cannot* really control the quantity of money supply: "…the central bank cannot unilaterally determine, and therefore cannot perfectly predict, the amount of borrowings from the Fed. The Federal Reserve sets the discount rate (interest rate on loans to banks), and then banks make decisions about whether to borrow. The amount of lending, though influenced by the Fed's setting of the discount rate, is not completely controlled by the Fed; banks' decisions play a role, too." (Mishkin, 2019: 394).

Figure 3: Graphical representation of the endogenous money model
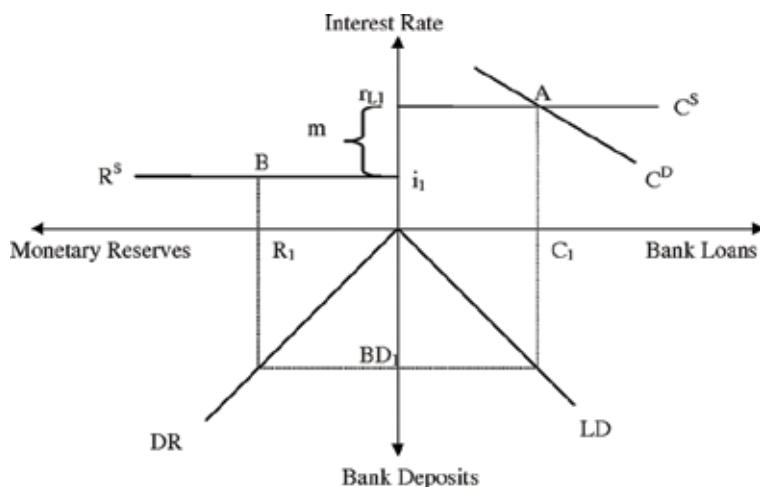
Source: Fontana and Setterfield (2009)

Seminal contribution in the development of the horizontalist position was Moore's (1988) *Horizontalists and Verticalists: The Macroeconomics of Credit Money*. The main message of the book was the rejection of the orthodox assumption that central banks – through the control of the monetary base – can exercise control over the money stock in the economy. Instead, the supply of credit money is endogenous, demand-led, and the central bank can only truly control its price, and not its quantity. Again, the main reason for this is the central bank's role as a clearing and settlement agent foremost.

This should have had a devastating effect on the neoclassical canon, but Moore's book was largely ignored by mainstream authors. As Moore wrote, the horizontalist position implies "…that the entire literature on monetary control and on monetary policy, IS-LM analysis, the Keynesian and the money multiplier, liquidity preference, interest rate determination, the influence of public sector deficits on the level of domestic interest rates, growth theory, and even the theory of inflation must be comprehensively reconsidered and rewritten." (Moore 1988: xiv).

While the book was ignored in the mainstream, it has been a major influence in the post-Keynesian monetary theory. Also, it has been validated by prominent central bankers of today as a book that correctly diagnosed the present (and not some imagined) monetary system and the role of monetary policy in it. Bindseil and König (2013: 384) write the following: "We find that the book has impressively stood the test of time and, despite part of textbook economics still insisting

on the money multiplier as an explanation for the money supply, it is not much of an exaggeration to say that we have all become 'Horizontalists' in the last 25 years." Hence, when it comes to monetary policy implementation, central bankers have largely buried 'verticalism' in their ways to achieve the operational target of monetary policy (Bindseil and König, 2013: 385).

Having this in mind, too often monetary theory resorted to the battle of normative stances or worldviews. It happened with the banking versus currency principle, it happened with the market versus state theory of money, and it happened again more recently with the neo-Keynesian and the neoclassical notions on money neutrality. This reduction from the diagnosis part to the prescription part arguably conditions a loss of great detail that is crucial to understand money creation mechanisms. The pivotal role in this reduction goes to Philips' (1920) introduction of the money multiplier, Keynes' acceptance of the *Reserve Position Doctrine* in his *General Theory* (Bindseil, 2004) and Milton Friedman's (1956) version of *reformed* quantity theory's influence on academia, popular opinion, and (admittedly less on) central banking simultaneously. Afterwards, the stage was set for the ideological conflict between Keynesians on one side and monetarists on the other for the better part of next several decades. But the truth is, even those who normatively opposed Friedman's policies and conclusions were inherently methodologically biased by his analysis due to the domination of the quantity theory's causal reasoning and emphasis on monetary aggregates (neo-Keynesians very much included)[12].

Now we will showcase valid causality of money creation in greater detail with the help of double-entry bookkeeping that is crucial in the proper analysis of banking and finance. As Godley and Lavoie (2007) show, every financial transaction necessarily involves both assets and liabilities as well as at least two agents, making a quadruple-entry principle a requirement. In the real world of banking, private bank deposits are created whenever there is a positive net bank lending to (or positive net asset purchases from) non-monetary agents (individuals, households, and companies). Similarly, deposits are annulled whenever there is a negative net bank lending to (or negative net asset purchases from) non-monetary agents. As such, deposits (which are essentially money to non-monetary agents) are at the center of the 'liability management'

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[12] Therefore, it is important to emphasize that the reduction of diagnosis towards the prescription makes the complex matter one dimensional. For example, without the elasticity of bank credit the rigidity of the gold bullion standard would be a major stumbling block to the economic growth of the Industrial Revolution era. On the other hand, commercial banks' elasticity would (and did) go unchecked with hazardous consequences until the advanced capitalism abandoned the classical idea of unfettered markets and institutionalized the central bank as the (public) lender of last resort and the final clearing and settlement agent.

of commercial banks. Net deposit creation enlarges the banking sector's balance sheet, while the loan repayment reduces it.

Let us consider now three scenarios of money creation through bank loan extension with the help of balance sheets in Figure 4. To make it easier to follow, we write down only the changes and not the final stock quantities. Additionally, we make an *in medias res* assumption in a sense that reserves are already existing in the system (i.e., we are not starting from a pure private credit economy). In scenario I, a client of bank A asks for a loan of 100 units of account (or, for example, goes overdraft on his debit account). Bank A extends the loan on the asset side and creates a new purchasing power – new deposit money – on the liabilities side as a new net addition to the client's account. Bank A did not look for an already existing quantity of deposits, nor did it mind the rate of the required reserves set by the central bank[13]. Hence, private money is created *ex nihilo* by the commercial bank on the basis of a loan provided on the assets' side.

Figure 4: Endogenous private money creation through bank loan extension

Bank A				
	Assets		Liabilities	
I	Loans	+100	Deposits	+100
	Reserves	-80	Deposits	-80
II	Loans	+100	Deposits	+100
			Loan from Bank B	+80
			Deposits	-80
III	Loans	+100	Deposits	+100
	Reserves	+80	Loan from Central bank	+80
	Reserves	-80	Deposits	-80

Bank B				
	Assets		Liabilities	
I	Reserves	+80	Deposits	+80
II	Loan to Bank A	+80	Deposits	+80
III	Reserves	+80	Deposits	+80

Central bank				
	Assets		Liabilities	
III	Loan to Bank A	+80	Reserves to Bank B	+80

Source: Authors' work

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[13] For simplicity, we proceed with a rate of required reserves equal to zero, as it is currently in the United States. However, if introduced, it does not change the causality direction of money creation in any case. More so, banks will extend loans and create new money in the current period, and only worry about portfolio choices regarding reserves in the next period, as most of renumeration is done with a time lag.

In the second step of Scenario I, we assume that the client of bank A wants to buy a good or a service with a price of 80 units of account from a non-financial firm that has an account in bank B. As the client makes the payment, bank B will passively enlarge its liabilities by crediting the account of the non-financial firm. To accommodate this enlargement of bank B's liabilities, the equal amount of *legal tender* – that is, the final means of payment between monetary agents – will be transferred from bank A to bank B, normally until the end of the working day (under the assumption that bank A has an excess sum of reserves and *ceteris paribus* regarding other transactions in the economy). Consequently, bank A's balance sheet shrinks (but still larger than before the original loan extension due to the quantity of transferred deposits), while bank B's balance sheet expands.

In Scenario II, we presume that bank A does not have excess quantity of reserves to necessitate the payment. In that case, the payment will still clear instantly between non-monetary agents, however, for the payment to be finalized between banks, the interbank settlement needs to be done by the end of the day. To enable this, bank A would normally head to the interbank market[14]. For simplicity, let's assume that bank B provides a loan to bank A. In that way, bank B again enlarges its balance sheet, but now through bank A's promise to pay bank B in *legal tender* (claim towards bank A), while bank A's balance sheet size remains the same as after the original loan extension (the liability towards bank B replaces the liability towards a non-monetary client).

Finally, in Scenario III, we showcase changes in the balance sheets with the assumption that there is either no liquidity available in the interbank market for bank A, or that it is more opportune to borrow directly from the central bank (as it has often been in the age of QE). And only in this scenario is the new (net) public money created. To accommodate the transaction between non-monetary agents, the central bank will now make a loan out of primary emission to bank A and transfer the required amount of reserves to bank B so that the transaction is settled. This expansion will be effectively automatic and represents the endogenous elastic nature of modern money creation. Of course, there are several more ways to sketch this process (for example, by bank A selling of securities in the portfolio to finance the deposit loss). In the following section, we expand the analysis by depicting open economy and securitization flows, which will capture historical and international dimensions of the process.

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14   We intentionally skip a step, again due to simplicity, where the central bank would automatically extend an intra-day loan to bank A and provide reserves to bank B if the payment system is organized as a real-time gross settlement system.

MONEY CREATION AND THE FINANCIAL GLOBALIZATION PROCESS

Having just seen the logic and mechanism of the money creation in the closed monetary system, the next step is to capture the international dimension of the process, as well as the historical changes that occurred in the last several decades. We have seen that the majority of money in circulation is basically private debt, an IOU instrument of endogenous origin. In this section, we will show that important financial innovations of recent past were also of private origin, rendering the 'revolutionary' threat of the latest innovations much less so.

Private financial innovation is not a new phenomenon. Quite the opposite: it can be best described as the defining characteristic of the financial globalization process since at least WWII. More so, the most important private financial innovation is arguably the historical occurrence of a commercial bank credit and the associated bill of exchange, that is nowadays taken for granted. In modern times, various iterations of private innovation represent key evolutionary steps in the process and include CD (*Certificate of Deposit)* markets, offshore money (and asset) creation, securitization and shadow banking, and the most recent one – the rise of Fintech, cryptocurrencies, and associated blockchain technology.

Naturally, throughout the years, lots of variables have changed. This is evident both from supply and demand sides. On the supply side, banks' behavior changed dramatically from passive to active, as will be explained. On the demand side, non-monetary agents turned more and more towards non-bank, market financing in the so-called shadow banking segment. But through the years, there were challenges to this framework both in regulatory and international nature, as agents sought to circumvent strict domestic regulations and connect on a global scale.

From the institutionalist standpoint, the world dominated by bank loans that we described in the previous section is the world of nationally regulated monetary systems in which monetary jurisdiction and monetary area are one and the same[15]. The process of financial globalization differentiated them. In

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[15]   In short, monetary jurisdiction is a decision-making area of a legal (and not necessarily geographical) classification. It is a legal space in which a state's banking regulation is applied, with the towering authority of the national central bank. On the other hand, a monetary area is a sphere of influence in which some unit of account dominates in denomination of credit money and debt creation. As described, it exceeds the territory of a state depending on the state's influence and the status of its currency (Murau et al., 2020). The most prominent monetary

this process, banks and non-banks together produced a series of innovations, creating a gray zone of vast, loosely regulated or even completely unregulated markets outside the monetary jurisdiction of domestic central banks. In what follows, we detail this process, starting with its origin and shapes throughout several decades with the end goal of understanding contemporary financial innovations as a part of these secular trends in finance.

After the end of WWII, most of today's advanced economies were just recovering from the great conflict, and as such they had characteristics of a war economy with a very strong government grip on the economic activity. The grip eased with time, but regulations and Keynesian economic policy remained a staple for decades to come. In that kind of environment, monetary systems had a strong national bias, such that monetary jurisdiction and monetary area coincided.

Similarly, financial markets were mostly fragmented across national borders. Only in the late 1950s did the serious attempt to 'escape' tight domestic regulation happen. The relationship that was cornerstone in the start of this chain of events – which will shape the long-term process of financial globalization – was the one between US commercial banks (especially Wall Street banks) and the City of London.

In what follows, we will sketch four main innovations that we regard as crucial in the financial globalization process: 1) development of the CD markets, 2) development of the eurocurrency offshore markets, 3) development of shadow banking and the closely related securitization process, and 4) development of Fintech and cryptocurrencies driven by information technology advancements. What connects all of these innovations could be summarized under the umbrella of 'liability management' innovation of the banking sector, making the role of banks – both commercial and central ones – a starting point to all of these innovations.

To start with, what was very important in the post-WWII period in the monetary policy sphere was the reserve management by central banks. By establishing the rate of required reserves imposed on the chosen liabilities of banks, the central bank could force banks to sell their portfolio securities to finance net loan additions. Without an adequate alternative, commercial banks were indeed restricted in their willingness to lend freely. Therefore, in their portfolio choices, dominating assets were government securities.

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area is that of offshore US dollar, legitimizing the US dollar's ambition to preserve its status as the world's reserve currency.

However, because the loan supply is mostly demand-driven, and banks do not have much control over the quantity of loans (and consequently, quantity of deposits) in the face of autonomous decisions of non-monetary agents, reserve management effectively pushed banks to innovate and find the necessary liquidity in other ways and markets. These ways and markets were at first in the form of a CD market at the domestic level. Later, banks created the eurocurrency market at the international level, which became and remained a misunderstood staple of the international finance until this day.

Because there was a regulation-induced discrepancy between the demand for loans and deposit growth, banks innovated their way around the Regulation Q which put a ceiling on deposit rates[16]. It started with the CD market which enabled banks to acquire additional funds at their own initiative (and not the initiative of their clients). This meant that they could increase loans without selling off securities, escaping the negative effects of securities' price drops and consequent capital losses. This was in essence the starting phase of the development that has since been termed 'liability management' (Moore, 1988) and what could be in general seen as the latest crucial phase of the banking sector's historical development (Chick, 1986).

Liability management is a set of policies (and abilities) of banks to increase their lending by acquiring additional funds through borrowing by, for example, issuance of CDs or similar obligations, without the need to sell marketable safe assets (such as Treasury bills) from their portfolios. In this way, banks have become much more proactive in seeking profitable opportunities, instead of passively waiting for deposits to arrive (Lavoie, 2001).

A negotiable certificate of deposit was introduced in the US in 1961. What it accomplished was a major shift in banks' behavior, as individual banks started to target asset growth rates and adjust their liabilities to suit their needs for funds instead of the opposite. In the past, the most prominent competition between banks was interest rate competition due to the struggle to acquire enough deposits and with them safe assets on the other side. Regulation Q restricted that practice, leaving banks' clients seeking alternatives, and consequently, banks themselves were seeking alternatives. One direct empirical effect was total deposits' growth at commercial banks of only 50% in the

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[16] Regulation Q was introduced in the time of the Great Depression with the goal to regulate the excessive risk-seeking behavior of banks by forcing limits on the interest rates charged by commercial banks. In 1933, the maximum permitted interest rate on checking accounts was zero, and the Fed was given authority to set limits on maximum rates payable by banks on both time and savings deposits (Moore, 1988).

whole decade of 1950s, compared to the increase in deposits of almost 400% at savings banks and savings and loan institutions (Moore, 1988).

Marketable commercial securities that rivaled the existing market for government securities basically conditioned the drop of funds received from demand deposits from 70% to 28%, and the liability management became the most important feature of the domestic US banking system in the 1960s and 1970s (Moore, 1988). Different little innovations to sidestep regulations were introduced, such as discounts tied to the deposit balances or creation of NOW accounts. Of course, the trend was acknowledged by the Fed as it used Regulation Q ceilings again to try and keep interest rates down and limit the CD market.

Now comes the international part of the banks' innovation. The response of the banking sector was a major innovation through the issuance of new instruments of liability management, namely, eurocurrencies. The creation of eurocurrency paved the way for the development of lightly regulated offshore markets and international financial centers, while the issuance of commercial securities by holding companies helped to open the avenue for the development of markets and institutions today collectively known as shadow banks. Consequently, cross-border (gross) banking flows took the central role in the financial globalization process.

Eurodollars are the very original versions of eurocurrency[17]. By definition, Eurodollars are dollar-denominated deposits or short-term debt liabilities in banks outside the United States, and even more important, outside the monetary jurisdiction of the Fed (the first condition had one major exception: the International Banking Facilities (IBF) that were located in the US territory).

Eurodollars were created "offshore", meaning outside of the Fed's jurisdiction, with a primary location in the City of London. They were easily transferred (however, with no direct link to the official domestic liquidity in CB reserves of the Fed) and had a great comparative advantage in being virtually unregulated (exempt from deposit rate ceilings and from reserve requirements)[18]. With the

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[17]   Just to clarify, eurocurrency does not have any sort of connection with the euro as a currency. It was created and established many years before the euro and the euro area were in serious conversations. The most popular synonyms or versions of eurocurrency are Eurodollars and petrodollars.

[18]   Eurodollars were mostly time deposits, with a fixed maturity that may vary from intra-day to years. Of course, very soon so-called eurobanks started to issue Eurodollar CDs which are negotiable debt instruments, enlarging the domestic CD market onto the global level. Accordingly, the Eurodollar market contains time deposits and bank loan granting, but again, arguably, the most important part of the Eurodollar market has been interbank market functi-

advent of Eurodollars (and the advances in the CD and federal funds market), banks no longer worried so much about costs of converting assets to required reserve ratio holdings of *legal tender*. Instead, they just borrowed the needed funds and expanded their balance sheets accordingly (Gable, 1974).

It is important to emphasize that eurobanks have also been able to create deposits endogenously, similarly to conventional commercial banks. What separates them is a lack of monetary jurisdiction over them (this had also, paradoxically, constrained them). A clear advantage is a lack of regulation in the form of reserve ratio requirements or the macroprudential discipline of the central bank. However, an important drawback is also at work: with no public overdraft backing of the central bank by reserves in the same unit of account as the eurobank's liabilities, it is much more challenging to cover possible clearing losses.

We can now move on to a simple example that acknowledges that the monetary area of the US (US dollar creation) is much wider than its monetary jurisdiction (under the authority of the Fed). Suppose that an Italian bank – Unicredit – is ready to finance a non-financial firm (Alfa Romeo) through loan extension in US dollars, and suppose that Alfa Romeo needs these USD-denominated funds to meet its obligations on the international securities market, i.e., to refinance previously issued USD-denominated bonds that are due. To note, the account of Alfa Romeo's bondholder is at Citibank in the US.

Because the US dollars created by Unicredit will be transferred to the account of Citibank, Unicredit must find ways to fund this newly created deposit (liability) transfer to Citibank. As it does not have direct access to US central bank money, it must find a way around it[19]. In general, Unicredit will resort (if it can) to take a loan from a correspondent commercial bank in the US by drawing (or running an overdraft) on its *nostro* account (Figure 5). Afterwards,

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oning in the background. In addition to banks, the main agents of the Eurodollar market have been MMMFs, foreign central banks, hedge funds, sovereign wealth funds, and non-financial MNCs.

[19] As explained in the previous section, payments in the given monetary jurisdiction are settled exclusively in the central bank money (reserves), meaning in *legal tender*. To be able to at least indirectly access this clearing and settlement system (in the 1st hierarchical tier), foreign banks need a correspondent bank in the given monetary jurisdiction. Hence, a foreign bank will open its account at a domestic bank (or a domestic branch/subsidiary of itself). The account that the foreign bank holds at the domestic bank is called a *nostro* account, while for the domestic (correspondent) bank, this is a *vostro* account. To finalize the payment, the correspondent needs to simply debit the *nostro* account of the foreign bank and settle the payment with the deposit receiver's bank in central bank money.

the correspondent bank (Unicredit NY) will transfer the deposits to Citibank, and the final settlement will be done in reserves. If Unicredit lacks a correspondent bank, it can bypass it by going the long-way around through shadow banking institutions that can issue their own short-term near-money liabilities, exchangeable for US dollar deposits in the Fed's monetary jurisdiction. Of course, the non-financial firm can also bypass a bank similarly and fund itself through a non-bank financial institution (NBFI). Either way, the final settlement will be done in *legal tender* (central bank money), as explained in section 2.

Figure 5: Eurodollars creation and transfer: overdraft funding

	Unicredit			
	Assets		Liabilities	
I	Loans	+	US dollar deposit	+
II			US dollar deposit	-
			Overdraft at Unicredit NY	+
	Unicredit New York			
	Assets		Liabilities	
II	Loan to Unicredit	+	Deposits	+
III	Reserves	-	Deposits	-
	Citibank			
	Assets		Liabilities	
		+	Deposits	+

Source: Authors' work

These two options necessitate normal functioning of international markets, i.e., trust and a large network of correspondent banks (and shadow banks) willing to back the Eurodollar creation and subsequent international clearing. The obvious constraint becomes the fact that Unicredit does not have a direct access to the Fed's liquidity and cannot fund the Eurodollar transfer to the US by merely taping into the Fed's balance sheet (however, as we explain in section 4, after 2008, the situation has dramatically changed, and the 3rd option for Unicredit suddenly became possible and very much welcomed by the offshore money markets).

Eurodollar markets developed first. Only later, by the end of 1970s and the start of 1980s – after the reign of petrodollars and in the face of the Volcker shock – did banks surpass their previous innovations with arguably the most impactful of them all. Basically, banks started to figure out how to make a structural, inherent flaw of the banking system (immediate liabilities versus long-term claims) into the competition of individual strength through aggressive profit seeking: they started to shift previously non-marketable assets (such

as long-term mortgage loans) off their balance sheets onto new, previously non-existing markets. *Originate to hold* transformed into *originate to distribute*. This helped to open a 'Pandora's box' of side effects, that we do not believe were originally envisioned or understood properly by monetary authorities, as banking liquidity risk slowly morphed into a structural systemic risk.

What was borne were wholesale money markets, shadow banks and the process of securitization. In short – financialization of economic activity. Individual risks were converging to a minimum while profit margins and the share in the economy's added value of the financial sector were rising. At that point in time, these innovations were heralded as important ingredients of the new era of *The Great Moderation,* accompanied by unprecedented optimism and market fundamentalism of the 1990s and early 2000s. At the same time, systemic risks were building, culminating in the bankruptcies of *Bear Stearns, Lehman Brothers,* and *AIG*, all in 2008. *Lehman'*s fall represented the zenith of the Great Financial Crisis (GFC) that can perhaps be best summarized as the global bank run on deeply intertwined money (repo) markets (Gorton and Metrick, 2009). Having said so, a privately led bonanza of the finance world had already been happening in full force long before cryptocurrencies' challenge was even in existence.

In the US, after 1981, consumer deposits were deregulated, and the restrictions on interest rate ceilings were removed, in turn making banks less dependent on purchased funds. But of course, history did not go backwards as the regulation introduced another constraint: capital requirements. And capital requirements were very much effective in making banks more hesitant to expand and structure their balance sheets solely to their own preference. Even more so, this pushed banks to sell off their loans, either to other banks or through the process of securitization.

As explained by Lavoie (2014), securitization can have two different meanings. The old meaning implies that banks would keep mortgages in their balance sheets, but they would issue securities based on these loans on the liability side (instead of looking for deposits). This is akin to Moore's description of 'liability management' (1988), except that banks would issue long-term bonds (and not only CDs)[20]. The new meaning is the dominant one today, and it is related to asset management. Broadly defined, securitization represents the transformation of a non-marketable into a marketable asset. An obvious ex-

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[20] Curiously, this is again not something completely new, as the first 'securitization' was in fact done in the 19th century Germany with securities knowns as *Pfandbrief* bonds (Lavoie, 2014: 202).

ample would be the sale of a number of loans granted by a commercial bank to an investment bank, which then transforms them into an asset-based security (ABS) or a collateralized debt obligation (CDO). These are long-term assets, but they are ultimately financed by short-term assets such as asset-based commercial papers (ABCPs). In turn, it was the ABCP market that represented the first offshore segment of the shadow banking phenomenon. Eventually, the process of securitization disconnected the link between credit extension and money growth, but it also disconnected the banks' balance sheets with the core of their operations and shifted inherent banking risk onto the whole economy, making banks freer to pursue higher risk opportunities themselves (which again fueled the securitization process and the rise of shadow banking). In other words, the issuance of short-term debt instruments by the banking sector significantly increased liquidity and financial stability risks, conditioning the necessity of the central bank's massive interventions decades later.

Even though conventional wisdom conflates both banks and non-bank financial institutions (NBFI) or shadow banks into mere intermediaries oriented around maturity transformation, we showcase in Section 2 that this is not the case with commercial banks. However, there has been recent development in understanding shadow banks as liquidity creators too, which can elastically change the level of economic activity (Nersisyan and Dantas, 2017). In that way, both banks and non-banks alike can be understood not only as agents of maturity transformation, but also as agents of liquidity transformation, i.e., ready to transform less liquid debts of hierarchically inferior agents into more liquid ones (Lavoie, 2019).

It is true that a commercial bank can buy an asset with its own *ex nihilo* created liability, while an investment bank, in principle, has to borrow the liability of a commercial bank to acquire a bond (Bouguelli, 2018), however, the distinction between banks and shadow banks has become more and more blurred in contemporary times. Lavoie (2019) sketches three cases in which NBFIs originate credit, and two of them include securitization. In Figure 6, we transpose one of the cases where the link between a bank and a shadow bank is more evident, as the shadow bank is represented through a Structured Investment Vehicle (SIV). In the first step, the bank grants mortgage loans to households buying new properties, creating new deposits in the process. These deposits are then proceeded to a bank account of the real-estate constructor. In the second step (row 2), 70% of the mortgages are securitized and sold to a NBFI – a Structured Investment Vehicle (SIV) sponsored by the bank. The SIV buys the newly created mortgage-backed security (MBS), but it needs liquidity to finish the transaction, so it gets a temporary loan from its sponsoring

bank. In step 3, the SIV performs its own liability management and sells 60 units of its own newly created liability (asset-backed commercial paper) to, for example, real-estate builders (from the row 1), whose bank deposits then fall down to 40 units (Lavoie, 2019).

Figure 6: Securitization process through a SIV conduit

	Banks		NBFI (SIV)		Non-financial agents	
	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
1	Mortgage 100	Deposit 100			Deposit 100	Mortgage 100
2	Mortgage 30 Loan to SIV 70	NFA Deposit 100	MBS 70	Loan 70	Deposit 100	Mortgage 100
3	Mortgage 30 Loan to SIV 10	NFA Deposit 40	MBS 70	ABCP 60 Loan 10	Deposit 40 ABCP 60	Mortgage 100

Source: Lavoie (2019)

In the phrasing of monetary circuit theorists, initial finance is performed by banks, however, final finance (funding) is in the realm of the market financial system. A similar conclusion stands in the case of investment banks when they finance through repos. Therefore, shadow banking is akin to "money market funding of capital market lending" (Mehrling, 2014). And within a few decades, it is possible to now convincingly claim that the monetary system of the 21st century is dominantly market-based and not bank-based anymore, as its main characteristic has become the integration of the money market with the capital market (Mehrling, 2012).

In any case, the monetary circuit necessarily starts with banks, as it is the case in the bank-based system. But the break happened in the midst of the process, as the originate and distribute model took over, through the transfer of credit claims onto the balance sheets of shadow banks. In the end, originally created deposit money will be annulled by eventual loan repayment (thus, closing the circuit), however, the whole process became more opaque, complex, and ultimately riskier as financial assets (liabilities) have moved away from its originators.

The international sphere of these innovations was more geopolitically driven, characterized by the in-fighting between some central banks over the regulation path to be taken[21], as well as the conscious effort of the United King-

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[21]   In the early 1970s, there were talks among central banks' representatives at the BIS whether the eurocurrency market should be regulated, and if yes, how. Altamura (2017) called it the 'Battle of Basel'. The most prominent divide was with the Bundesbank and Banca d'Italia on

dom to regain some of its lost influence through the soft power of finance. Of course, above all these relations was the great shadow of the US dollar, which reigned as the No. 1 world reserve currency, rendering the US dollar unit of account the dominant unit of eurocurrency creation, as well as any short-term debt creation in the global economy.

As such, offshore (dollar) markets – denominated in the US dollar and located most prominently in the City of London – had at least two natural public proponents in the US and the UK governments. Thus, the offshore markets had undergone an ambiguous development, but one which will characterize the post-WWII world of finance and the financial globalization itself: invented by private agents out of necessity (due to a regulatory squeeze), supported along the way by public agents (by their arbitrary decisions of accepting the innovation or turning the good eye closed) and developed through the decades into something more often misunderstood than acknowledged at the macro-level.

In this process, it can be argued that the most significant event was and still is somewhat underappreciated: the infamous 'Nixon shock', a unilateral break of the US dollar and gold parity. The Nixon shock happened in 1971 (and materialized by 1973), rendering the Bretton Woods system finished. Even more than that, it rendered the end of the classical notion of money as a unit of account representing something with intrinsic value. The power of dollar was based only on its global reach through the political, economic, and military power of the United States. Only after the Nixon shock did the monetary area of US dollar truly diverge from the notion of monetary jurisdiction. Later, a few other currencies as units of account will follow a similar path, albeit on a much smaller scale.

But what did exactly replace the Bretton Woods system? Some called it post-Bretton Woods (Altamura, 2017) as a system of flexible exchange rates and increasingly privatized capital flows, some even called it a 'non-system' (Ocampo, 2017). Either way, the shock itself did produce a sizeable academic debate at the time (e.g., Cohen, 1977; Cooper, 1975; Mundell, 1972), but the complete implications were withheld from those implicitly stuck with the intermediation or multiplication theories of money. When one considers the most important characteristic of the new system – the onshore and offshore endogenous creation of eurocurrencies and (near) money debt instruments – then the optimal naming is that of Murau, Rini and Haas (2020): the Offshore US

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the regulation side and the Bank of England on the deregulation side. According to Hawley (1984), the Fed was largely undecided whether the offshore dollar creation was positive or negative. Talks diminished after 1974 and the first oil crisis when the recycling of petrodollars became prominent (Murau et al., 2020).

Dollar System. Understood as such, the system that evolved and that is still in place (albeit with an uncertain future) has sourced its legitimacy in the unprecedented international demand for the US dollar as the global reserve currency.

Analogous to the national level, this new system – contrary to some sort of anarchy – has also developed a structured hierarchy to it[22]. At the apex has been the Federal Reserve as the ultimate US dollar liquidity provider, surrounded by other major central banks. However, what mattered most was not the domestic loan-based creation of deposit money that is then backed by the Fed, but the international liquidity that is endogenously created through the issuance of private debt instruments at the offshore Eurodollar markets. This included both money and near-money privately made assets to non-monetary agents easily convertible across units of accounts and borders.

Having that in mind, the story of private financial innovation and technological advancements was tied together from the beginning. Electronic payments on a grand scale (especially with the SWIFT network that was founded in 1973) multiplied the magnitude of transactions cleared worldwide. Banks started to move assets outside their balance sheets due to the regulatory squeeze, but they accelerated the process precisely due to new technological abilities. It was only a natural step that shadow banks became intertwined with Fintech. But only after the systemic collapse of 2008 did one private innovation gain a popular foothold as the potential ideologically fueled challenger to the monetary system itself: cryptocurrency *Bitcoin*, established on the basis of a completely new blockchain technology.

As we have seen, the main drivers of the financial globalization process were most often private agents, while public authorities merely reacted to the process along the way, generally with some time lag (Minsky, 1986; Murau et al., 2020). What is happening with the rise of Fintech and cryptocurrencies appears to be fundamentally the same, except we still do not know for certain what will be (arbitrarily) decided by public authorities. Because their decision to regulate more or less, to tolerate or reject new iterations, will prove to be crucial for the fate of this new round of private financial innovation.

Given the importance of money hierarchy in the present monetary system, what seems the most important part of public authorities' decision is the right to directly access the central bank's liquidity. In all previous decades and through all previous innovations, this right was exclusively reserved for traditional monetary institutions, namely banks and (sometimes) governments.

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[22]   Though, paraphrasing US Treasury Secretary John Connally's words in 1971, dollar remained the currency of the US, but became a problem for the rest of the world.

If a central bank decides to grant this privilege to a Fintech institution and/or a crypto non-monetary institution, it will be the public authority's choice and not the other way around.

Arguably, the wholesale money market – that is heavily dependent on the interbank market and the central bank's liquidity – is the heart and monetary plumbing of the contemporary financial system. In words of Mehrling (2010: 2): "It is in the daily operation of the money market that the coherence of the credit system, that vast web of promises to pay, is tested and resolved as cash flows meet cash commitments".

At the same time, in a non-bank, speculative and tech-driven sector, Bitcoin has been regarded as a promise of a new form of money, a new gold-like and market-based asset that is non-inflationary, unlike the existing public-backed currencies. But, as it was showcased, the dominant form of money is by far private money. It is not fiat in nature, but credit (debt). As such, it is not rigid as gold (or any other inelastically supplied commodity); on the contrary, it represents the inherent elasticity of the financial system: it is created and nullified through the acts of loan-making and loan-returning that are demand-driven. These are all characteristics that proponents of the crypto challenge have been missing, concentrating their focus only on the hierarchically lower tier of the monetary infrastructure: transactions between non-monetary agents.

Then, the prescription to the system's instability – decentralized, encrypted, non-credit, private, and non-inflationary currency – might be the opiniated solution, but this still does not make the underlying diagnosis correct. As such, if the prescription is valid, it can only be valid by a lucky guess[23]. And if one considers the cumulative process of financial globalization, driven by private financial innovation all through the post-WWII decades, then it becomes difficult to consider cryptocurrency as a revolutionary challenge to the existing framework. Quite the opposite: it seems like the next step taken in exactly the same process, by the same logic and similar motives of (albeit different group of) private agents.

The only tangible difference from within is that the innovation is driven

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[23]   In a normative sense, one could argue that the real instability is not coming from the public side of the money creation through the inflationary printing of a government currency, but through the soft regulation of both the offshore and off-balance sheet component. But these components were heralded from strict regulation prior to them, rendering the financial system itself inherently unstable. This is reminiscent of Minsky's arguments (1992), but it also points towards the policy conclusions of the Banking School of the 19th century.

further away from the traditional banking sector, sometimes directly opposing it. Nevertheless, the banking sector was not reluctant to endorse innovation in the past when it suited its interests. It does not seem as it will oppose another innovative step, again with a crucial condition that it suits its interests at a given moment. Through their own 'liability management' initiative, banks helped to create shadow banks and thus drive away funding from their balance sheets to money markets. But again, it is important to emphasize that banks are not just another intermediary or a financial firm; they are at the heart of the clearing and settlement system in the two-tiered hierarchy of credit relations that characterize modern monetary economies of production[24].

Having said that, there exists one tangible outside difference regarding novel innovations: the post-GFC monetary system is radically changed in comparison to the one before. The challenge of Fintech and especially cryptocurrency is considered as the opposition to the bank-based system in which public (fiat) money reigns. However, the money creation process in the advanced economies is neither dominantly fiat nor bank-based anymore, nor is any iteration of private innovation necessarily its main characteristic. Instead, the contemporary monetary system has been market-based for quite some time. What is really novel might be confusing at first for the insiders at the Fintech industry: for the first time since WWII, public authorities are dominant agents in the financial system. In the next section, we focus on the post-GFC macro-financial trends in a greater detail.

**POST-GFC MONETARY SYSTEM: MARKET-BASED AND PUBLIC-LED**

The secular change in the world of finance can be regarded as a change from a bank-based credit system to a market-based credit system (Mehrling, 2012). This transformation has been happening through several decades, start-

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[24] Thus, it is a kind of naïve thinking that any sort of financial innovation can displace the currently existing framework against the will of its stakeholders. With the monetary architecture in place, the majority of transactions in advanced economies is done through the banks directly, and virtually all of them are in the end recycled through the banking sector. The two-tiered architecture with two distinct hierarchical levels of payments necessitates that any outside stakeholder must do one of the following: a) be accepted into the first tier of payments as a monetary agent, or b) completely replace the architecture itself. The first scenario depends on the arbitrary will of the public authority, and the second one we deem as a highly unlikely precedent.

ing with banking innovation explained in the previous section, most notably the eurocurrency market innovation and the securitization process. In contrast to the national (closed) monetary system analyzed in section 2, we can now differentiate both onshore and offshore shadow banking components of the system. In Figure 7, we portray the onshore division on the left and introduce the offshore segment on the right. It is again evident how the traditional monetary jurisdiction (appliable to the central bank and commercial banks) can diverge from monetary area (appliable also to shadow banks in the offshore money creation segment).

Figure 7: National monetary system versus international monetary system
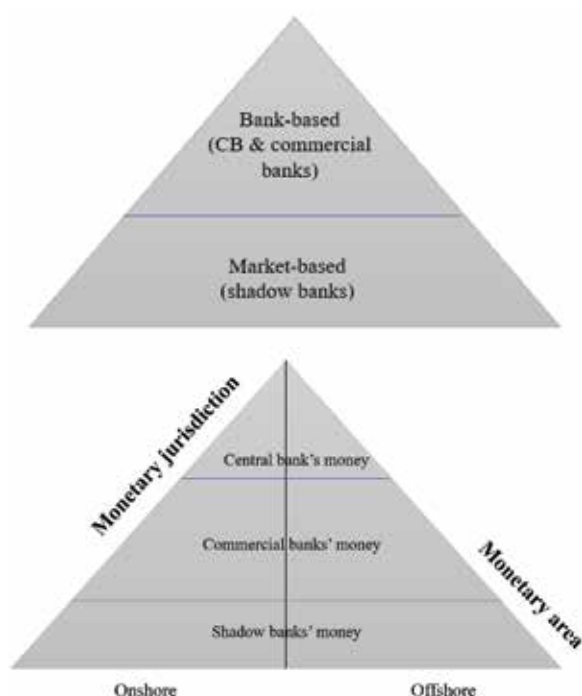
Source: Authors' work

In the GFC of 2007-09, it was primarily wholesale money markets in the shadow banking sphere that were under severe stress in contrast to the traditional bank-based system. What happened in the aftermath is widely considered to be an almost classical reaction of the Fed, followed by other major central banks: they acted in the spirit of Bahegot as the lenders of last resort (LOLR), providing billions in immediate central bank liquidity. In the fol-

lowing years, LOLR transformed into longer term *quantitative easing* (QE), nominally representing a neo-Keynesian intervention in the liquidity trap conditions. However, this is only a part of the vast magnitude of interventions, as it concerns mainly the traditional banking sector that we examined in section 2.

Already before the GFC happened, the majority of central banks abandoned the attempts to control the supply of money in favor of interest rate targeting. This practice was theoretically backed with the proposition of the so-called Taylor rule (Taylor, 1993), and it was widely recognized by the mainstream academia through the modelling of the monetary policy function as an interest rate determination and not as the money supply schedule[25] (see, for example, Woodford, 2003). Thus, monetary policy was firmly grounded in the so-called 'corridor' system where the targeted interest rate was, at least in theory, trying to navigate around the unobservable Wicksellian natural rate, positioning the overnight target in-between the deposit rate and the discount rate.

However, this neo-Wicksellian framework ignores the peculiarities of the money market and arguably introduces a bias towards monetary easing in the low-inflation environment. Consequently, when the GFC happened, central banks had to significantly change and innovate their policies. It started with ELAs (*Emergency Liquidity Assistance*) through primary emission loans to the banking sector, with various maturity times. Later, the new go-to policy was the balance sheet policy through massive and long-term outright asset purchasing programs called *quantitative easing* (QE) with the counter-cyclical aim to ease financing conditions, recover banks' balance sheets and hit inflation targets through transmission mechanism.

The side effects of these changes have been numerous. The most prominent one is the inflation of central banks' balance sheets on a historic level (Figure 8). As Lovrinović et al. (2021) show, the Fed's balance sheet in 2020 was more than 8 times higher compared to the levels in 2007, the Bank of England's more than 11 times higher, the Bank of Japan's more than 6 times higher, and the Eurosystem's more than 4 times higher (left part of Figure 8). Similarly, balance sheets have risen also in comparison to the country's GDP (right part of Figure 8). The most glaring example is the Bank of Japan's balance sheet that went from 21% of nominal GDP in 2007 to over 100% in 2019 already, with the Covid-19 crisis only driving it even higher.

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[25] And this shift has subtly and unconsciously proved right the long-established post-Keynesian position that central banks' power is confined to setting the exogenous supply price of central bank money (and not its quantity), which then guides and influences short-term market interest rates (Moore, 1996).

Figure 8: Central banks' footprint through balance sheet expansion
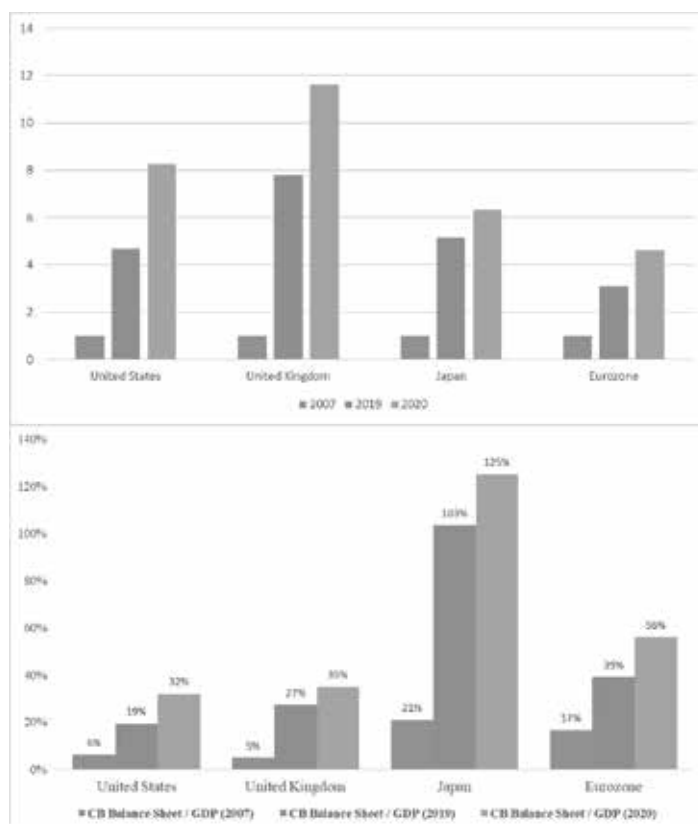
Another major change is the change in the daily conduct of monetary policy. Before, the 'corridor' system was in place. Now, it was the 'floor' system, as the abundance of excess reserves drove the overnight rate down to the deposit rate or the IORB rate (*Interest rate On Reserve Balances*). Finally, asset purchases on such a grand scale did succeed in lowering long-term interest rates, but the price of these assets rose considerably, inflating the financial markets in a way that conventional inflation rate measures (such as the CPI or the HICP) cannot capture.

Having said so, one major change did largely go unnoticed, especially its implications: the introduction of official swap lines between the Fed on one side and a selected number of major central banks on the other. Due to the Dodd-Frank Act forcing the Federal Reserve to lift confidentiality on its pro-

grams, in 2010, it was revealed that the Federal Reserve – through its emergency lending facilities – supported non-US commercial banks (especially in Europe) that were facing severe US dollar shortages. In addition to this, 14 central banks were granted the US dollar swap lines, representing almost a quarter of the Fed's total assets in winter of 2008-09 (Carre and Le Maux, 2020).

These swap lines had been serving as the unprecedented major public backstop to shadow banking, making in turn central banks not only lenders of last resort, but also *dealers of last resort* (Mehrling, 2010). As the private credit system imploded in the GFC, the public backstop in the spirit of Bagehot was paramount. But in reality, the interventions went way beyond. Swap lines were first thought of as *ad hoc* emergency, but they became a permanent feature of the monetary system in the next decade.

Foreign central banks can now tap into the Fed's US dollar *legal tender* liquidity by three different mechanisms, creating three peripheral layers to the offshore USD system. The first layer can receive emergency US dollar liquidity via the Fed's central bank swap lines by pledging adequate collateral denominated in different units of account. The second layer gets to use the Fed's new repo facility for the Foreign and International Monetary Authorities (FIMA) that was set in March 2020. To get the US dollars, foreign central banks must pledge US treasury bonds as collateral. Finally, the third layer can access emergency US dollar liquidity only via the IMF's Special Drawing Rights (SDR) system, set up back in 1969 (Murau et al., 2021).

Taken together with other unprecedented monetary (but also fiscal) interventions, it could be argued that the historic magnitude of public interventions turned central banks not only into lenders and dealers of last but *any* resort. In turn, this has marked a structural break in the long-term process of private financial innovation dominating the monetary system and the financial globalization process. The post-GFC monetary system has arguably become public-led for the first time since WWII, with an unprecedented footprint of central banks. In this kind of environment, novel private innovations – such as cryptocurrencies – have been relegated to being more akin to narrative-driven bubbles for the risk-hungry speculators than a realistic alternative to the existing framework.

Two of three necessary preconditions for this to happen were the existence of offshore markets and the process of securitization, but the third one proved to be crucial: the GFC itself. The GFC was indeed a systemic crisis of great proportions, after which the already existing trends of the market-based system's dominance (over bank-based) were amplified, backstopped and guaranteed by the legitimacy of central banks as *legal tender* providers.

This chain of events also had significant ramifications upon understanding the process of offshore private money creation. Namely, by introducing vast securities purchase programs and swap lines, the Federal Reserve effectively expanded its role of a banker's bank into the role of a shadow banker's bank. However, this was not constrained only in the Fed's monetary jurisdiction. The introduction of swap lines effectively meant offering a global public backstop to offshore US dollar markets. And this in turn erased much of the previously elaborated constraint on the Eurodollar creation – the lack of access to the US *legal tender.*

Consequently, financial institutions of today exist in a vastly different situation than those in the pre-2008 era. The contemporary financial world is a world of a public and not private footprint foremost, driven by historically unprecedented government interventions and innovations in a number of financial market segments. More so, there are expanding discussions and experiments regarding the retail CBDC (*Central Bank Digital Currency*) that would be held by the private sector agents as an electronic central bank liability (Gross and Siebenbrunner, 2019). In that way, the acceptance of CBDCs in major countries would represent a structural break in the long-term private money creation trends and, potentially, relegate commercial banks to a true intermediary between debtors and savers.

While the vast topic of public digital currency for non-monetary agents is outside the scope of this paper, it is an indicating sign that all private agents need to take more notion of what monetary (public) authorities are doing. And they are doing quite a lot. Dissimilar to the Bretton Woods era, when commercial banks were first to seek innovation and only then an approval by the regulation, the power of public authorities today seems even more prevalent.

In a way, one could argue that of all comparable financial innovations after WWII, Fintech (and its subset of crypto) is the least significant in the greater perspective. What signifies them is the artificial pro-cyclical bull market on one side and the alternative, technology-driven set of agents on the other side, joined by interest in the world of indefinite liquidity but minimal or even negative real returns on a vast number of pre-existing conventional assets. Consequently, the crypto world will thrive or fail in relation to the monetary authority's arbitrary decision. This is consistent with the emergence of CD, or offshore, or shadow banking markets indeed. But nowadays, monetary authority has relatively more power than previously imagined, as central banks transformed from the lenders of last resort (in special and/or crisis circumstances) to the lenders and dealers of any resort, making their footprint ever larger in the financial system.

Thus, it is difficult to think that private financial innovation of Fintech challenges the existing framework on the basis of its private innovative nature. At the same time, it is naïve to think that this challenge can succeed without and against the public authorities' approval. This especially concerns the authority of the central bank that stands at the center of the contemporary monetary system itself and as such dictates who has and who does not have a direct access to its *legal tender* liquidity through overdrafts or security dealings.

Having all this in mind, we argue that recent emergence of Fintech – seen as a subset of the larger shadow banking phenomenon – does little to fundamentally change the already existing hierarchy and mechanisms of private money and near-money creation, and does little to change the already existing patterns of financial innovation in the process of financial globalization. As such, Fintech (and in the narrower sense, cryptocurrencies) does not represent a major shift from previous trends; it is better understood as another novel strand of the existing process, not very different from other financial innovations of the past (such as Eurodollars and/or asset-backed securities of shadow banking) which were created and guided by private agents, and then tolerated and/or regulated by public authorities. Consequently, it is consistent to define cryptocurrency as a form of a money-like speculative asset backed by an innovative technological solution (blockchain technology), not very dissimilar to previous financial innovations such as asset-backed securities of shadow banking.

At the same time, all that was argued until now does not mean that Fintech lacks potential to significantly change the way modern banking and finance are done. It is doing so continuously and consistently. But it is doing so while simultaneously being undertaken inside the banking, shadow banking, monetary and financial framework that already exists, and not as an outsider breaking the wheel. Once it conforms itself enough – and the blockchain technology seems to have the most potential to be established – it stands to be (arbitrarily) accepted as the next logical step of the system, endorsed precisely by those institutions that have been critically heralded as the antagonists in the existing monetary system.

CONCLUSION

It could be said that the history of financial innovation is analogous to the history of banking itself. In spite of more popular recent examples, the greatest financial innovation of them all is probably the emergence of private credit

money. Loan and deposit business can seem almost trivial to an unfocused mind. However, for almost two centuries – with too few (though indispensable) dissident voices – the prevalent monetary theory got the causality of money stock creation backwards: it is not the money supply that generally influences the prices, but the opposite. In fact, there is no independent function of money supply separate of money demand. Having that in mind, both academia and proponents of decentralized finance in general overestimate the historical role of the central bank (or public authority) in the money supply and underestimate its stabilizing institutional role in what is an inherently unstable credit economy.

As textbooks erroneously described the money creation process, they also largely ignored payment systems and associated hierarchy of liquidity inside them. The dominant form of money that is created in contemporary economies is of private origin, created *ex nihilo* as the new purchasing power by commercial banks. Only in the second step is the clearing and settlement between banks done in the form of public money: the central bank's reserves. At the same time, the creation of money is conditioned by the specific institutional framework. The defining characteristic of this framework is the restricted semi-permeability between the *legal tender* and the private money in circulation. This semi-permeability is a consequence of the monetary system's design. However, the subset of institutions that have a direct access to legal tender (and thus have the privilege that their liabilities are regarded as 'money' by the broad public) is a consequence of arbitrary (albeit historically conditioned) choice by public authorities.

In the contemporary times, the story of financial innovation is again tied to the development of banks' 'liability management', with a primary motive to escape regulation in search of higher profit opportunities. Commercial banks started to actively seek funding while they passively granted loans, separating credit growth from demand deposit growth. At the same time, central banks were more or less strict in relation to the business cycle, but ultimately defensive (passive) and accommodative in their daily liquidity provisions through the setting of *legal tender*'s price. Unfortunately, textbook descriptions told the opposite story (of active loan supply and the setting of *legal tender*'s quantity).

The definite change in banks' behavior started by them evading the infamous Q regulations in the US and proceeded through the creation of the eurocurrency markets. After few decades, the core of the banking business was substantially detached from the banks' balance sheets through the process of asset-backed securitization. At last, economy was not bank-based anymore, but

market-based instead. And while elasticity of financing (backed by the endogenous deposit and offshore asset creation) did manage to escape the regulatory squeeze, shadow banking would prove to be too risky not to fail (but ironically, also too big to fail, as evidenced by the major monetary interventions in the post-GFC era).

Having this cumulation of events in mind, we argue that Fintech and cryptocurrencies represent the latest innovative step in the process of financial globalization since WWII. As such, we regard Fintech as a novel part of the already established and powerful shadow banking system. On the other hand, we argue against the implicit interpretation that the official banking system, with the leading public legitimacy and agency of the central bank (or more broadly, of the state), is now all of a sudden challenged in an unprecedented way by private innovation and/or a dual financing system in private agents' control. Instead, we see the rise of Fintech as a part of a private-led process that has been incorporating its novel characteristics alongside the traditional framework (and not against it) for decades – producing network externality and innovation – but also rising fragility in the ever more complex and interdependent financially globalized economy.

In this process, public authorities' role has been largely reactive. However, after the *Lehman Brothers* bankruptcy, central banks led the way to what will become a historically unprecedented public footprint in the monetary system. In addition to record central banks' balance sheet expansions, negative real interest rates, collateral easing policies and massive asset purchase programs that have been implemented, there was also one major innovation happening in the background: the public backstop to the global shadow banking system. This backstop has been happening through the large-scale concerted effort of major central banks – with the leadership of the US Federal Reserve – to provide emergency liquidity and US dollar swap lines on a continuous and fundamentally unrestricted basis, thus acting as the international LOLR (and underwriting what is essentially a public offshore US dollar creation).

Finally, this conditioned a change in dynamics of financial globalization in the post-GFC era. Instead of private agents' innovations being reluctantly accepted by public agents', the financial conditions have been driven foremost by a historically unprecedented public footprint. Thus, the contemporary challenge of Fintech and cryptocurrencies depends less on its inherent innovation or private origin and more on the arbitrary choices of authorities in the existing monetary and financial framework. Hence, it is an evolutionary step that is assessed upon and not a revolutionary threat that is forced upon.

ACKNOWLEDGEMENT

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