

ENVIRONMENT AND FINANCE: IMPACT OF FINANCIAL DEVELOPMENT ON CARBON EMISSIONS¹

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ABSTRACT

Carbon emissions and economic growth are related processes. Financial development is given increased attention in studies on their connection due to its impact on economic recovery. In economies having highly developed financial structures the growth of lending opportunities and active stock exchanges contribute to the reduction of financial difficulties for investments and developments both in the corporate and retail areas. Stock portfolios play a part in funding including popular green investments promoting the implementation of sustainable goals. State-of-the-art investments may be implemented to achieve energy saving and causing less carbon emissions. This study is to prove, however, the impact of a high level of financial development is not unambiguously positive. It cannot only drive spreading environment-friendly technologies but may also cause an increase in energy consumption and carbon emissions despite its improvement of efficiency.

JEL codes: G10, Q48, Q56

Keywords: financial development, economic growth, carbon emissions, green finance

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1 INTRODUCTION

The rise of air pollution is one of the biggest problems of our age, it is a challenge across many countries both for industrialised and emerging economies. Researchers all over the world study global warming and pay attention to find its reasons and mitigate its impact. The growing quantity of greenhouse gases, particularly carbon-dioxide in the atmosphere has been recognised as the main actor in the deterioration of the environment and the rise in average temperature. Air pollution in several European cities regularly exceeds the limit causing damage to human health.

The costs of climate change amount to millions of USD but the price of non-acting is higher than the most expensive scenario. Signatories to the Paris Agreement in 2015 made a commitment to try to reduce the rise in average temperature by under 2 degrees Celsius, since even a half-degree rise can cause irreparable damage to mankind and the environment. In a favourable case, researchers advise the costs of preventing and mitigating the risks of climate change may be close to USD 2 thousand billion to be spent, for instance, on rebuilding cities following natural disasters. On the other hand, the price of non-acting, i.e. maintaining the current situation with no stringency measures taken may cost three times as much (IPCC, 2014). Financing environmental damage is a challenge for the financial sector as well.

Given the above, there have been many studies on the factors impacting carbon emissions trying to identify answers to the question why carbon emissions occur, such as, increase of income, population growth, urbanisation, the magnitude of cross-border commerce or energy consumption. Some studies proposed that that the high level of financial development might be a factor influencing carbon emissions.

The improvement of the financial sector can indicate that economies can switch to low carbon intensity, which is set among the goals of the Paris Agreement by 2050. Applying simpler and more transparent lending procedures and lower interest rates, countries with high level financial structures can promote the spread of environment friendly technologies. Stock markets are usually more active in industrialised countries, which allows for financing environment friendly investment goals in portfolios. Listed companies can strengthen their commitment to the environment to improve their reputation. Therefore, the activity of stock markets may have a positive impact on the environment.

The objective of this study is to analyse the part the improvement of the financial sector plays in environmental protection, i.e. in the reduction of carbon emissions. It also tries to find an answer to opposite empirical findings in the literature. In chapter 2, I am going to describe financial systems and the part financial

development plays in economy also including the relevant indicators. In chapter 3, I intend to find a connection with the natural environment and present an explanation of the dual impact of the development of the financial sector through a few empirical examples. Chapter 4 is the summary.

2 FINANCIAL SYSTEMS IN ECONOMY

The development of the financial sector is present in the whole process of financial systems. Following a quick review of the components of financial systems, we are going to describe the factors identifying highly developed financial systems and to present the indicators used in the literature.

2.1 The economic role of the financial sector

Financial systems have basic functions to ensure economic resources are transferred across time, across borders and within different sectors of the industry also managing relevant risks. (*Merton–Bodie, 1995*). *Niemeyer (2001)* believes financial markets allow companies and individual players to manage economic uncertainty effectively and to share risks.

Financial systems have a complex task in serving the players of the economy. They have five functions (*World Bank, 2012*):

- a) provide preliminary information on potential investments;
- b) monitor investments after providing funding;
- c) facilitate commerce, diversification and risk management;
- d) mobilise savings; and
- e) facilitate the flow of goods and services.

To sum up, the main function of financial markets and institutions in an economy is to improve the effectiveness of capital allocation and to manage savings.

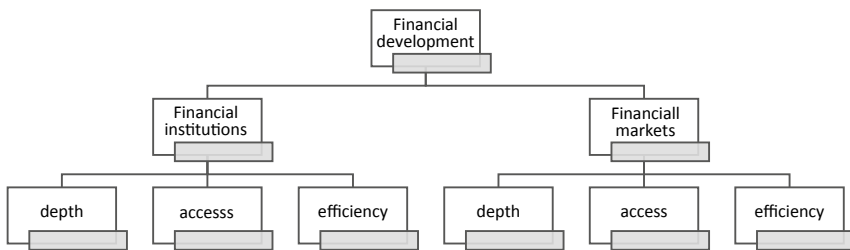
The development of the financial sector is played out in the above five-component system as the means to improve efficiency and reduce costs. „Financial mediation can contribute to the reduction of IT and transactional costs by mobilising savings, diversifying risks, channelling savings towards new investments and monitoring the funded projects” (*Mérő, 2003:591*).

The development of the financial sector means that markets and mediators mitigate the impact of IT, implementation and transactional costs and support the economy via the key functions of the financial sector (*World Bank, 2012*). A high-level financial sector is an advantage for the economy, since economic savings are

channelled into profitable investments on a developed financial market (*Stiglitz–Weiss, 1983; Diamond, 1984*). Countries having better financial systems today are expected to grow faster in the coming decades (*Levine, 2001; Méró, 2003*).

The level of financial development is defined using the characteristics of institutional structures and capital markets (*Figure 1*). Depth (size and liquidity), efficiency (ability to provide financial services at low cost) and access (ability to access to financial services) are all measurable parameters providing information on access to financial services, and the reliability and quality of contracts. IMF (2020) have supplemented the above with the dimension of stability.

Figure 1
Factors defining financial development



Source: own compilation based on IMF (2019)

Empirical studies have found a well operating financial system can support economic growth via mitigating IT and transactional costs and reducing poverty (*Levine, 1991; Bencivenga et al., 1995*). Strong positive connection has been found (*Beck–Levine, 2003*) between the level of financial mediation and per capita economic growth as well as the growth of productivity, which also indicate that financial development can boost the economy.

Several studies have proved a correlation of economic growth and national income with the level of financial development, whether it is an industrialised country with high income or an emerging country with low income (*Guiso et al., 2005; Christopoulos–Tsonas, 2004; Calderón–Liu, 2003*). The development of the banking sector and financial development contribute to economic growth (*Giovanni et al., 2013*), so I believe the indicator of the financial development has a key role in the economy.

Financial development is not simply a driver of economic growth, but also of the balanced distribution of income. *Stiglitz (2012)* has stated the high level of inequality can damage economic efficiency and productivity. According to *Baiardi–*

Morana (2016), the development of financial systems needs to be supported or at least monitored to promote more balanced distribution of income.

As we have seen above, the evolution of financial development in an economy provides important information and can contribute both to economic growth and the mitigation of inequality. Measuring financial development is difficult, since – as opposed to economic growth – it depends on several indicators. In the following chapter, we describe the indicators used to measure financial development in detail.

2.3 Potential indicators to measure financial development

Measuring financial development is essential to monitor the evolution of the financial sector and to understand its effects on the economy. In practice, however, measuring financial development is difficult. Financial development has several dimensions as illustrated on *Figure 1*.

In the literature there is no uniform definition of financial development or a specific indicator to measure it. Authors' ideas on a suitable indicator vary depending on whether to use one selected indicator or cover the level of financial development using several ones. Two distinct methods can be found: either you can see several indicators in a model or through the analysis of several indicators, e.g. principle component analysis (*Hayat et al., 2018; Coban-Topcu, 2013*). *Table 1* is a summary of solutions used to measure financial development.

Table 1
Indicators of financial development

Complex indicators	
Components	Authors
M2 bank loans (as percent of GDP), retail loans provided to the private sector (as percent of GDP)	<i>Katircioğlu</i> and <i>Taşpınar</i> (2017)
M3 broad money supply (as percent of GDP), the ratio of commercial bank assets to central bank assets plus commercial bank assets, liquid liabilities (as percent of GDP)	
adjusted net national income per capita, gross capital formation, gross fixed capital formation, private sector credit to GDP, direct foreign investment	<i>Hayat et al.</i> (2018)

Bank index

deposit money bank assets to GDP,
 financial system deposits to GDP,
 liquid liabilities as a share of GDP,
 private credit to GDP,
 bank overhead costs,
 net interest margin,
 concentration ratio,
 return on assets,
 return on equity,
 cost-income ratio

Çoban and Topcu (2013)
Beck és Demirgüç-Kunt (2009)

Stock index

stock market turnover ratio,
 stock market capitalization to GDP,
 stock market value traded to GDP,
 number of listed companies per 10,000 people

Depth, stability, efficiency, and access to the institutional system and the markets *World Bank (2012)*
Stolyarova (2013)

Several independent indicators

the ratio of stock market capitalization to GDP,
 the ratio of stock market value traded to GDP,
 stock market turnover,
 the ratio of deposit money bank assets to GDP *Sadorsky (2010)*

debt to GDP ratio,
 private sector credit to GDP,
 stock market capitalization to GDP,
 stock market turnover *Abbasi and Riaz (2016)*
Zhang (2011)

private sector credit to GDP,
 foreign direct investment per capita *Shahbaz et al. (2013)*

Sole indicator

private sector credit to GDP *Ozturk and Acaravci (2013)*
Pata (2018)
López-Menéndez et al. (2014)
Hove and Tursoy (2019)
Abid (2017)

Source: own data collection

Katircioğlu and Taşpınar (2017) created a five indicator-based index which had partly significant results only. Hayat et al. (2018) used principle component analysis, so his indicator was based on adjusted net national income, gross fixed capital formation, gross fixed asset capitalisation, domestic loans in the private sector and direct foreign investment. The resulting financial indicator significantly correlated with energy consumption. He used economic development rather than economic growth modelled by an index comprising several indicators. Coban–

Topcu (2013) also applied principle component analysis to avoid multi-collinearity (2013). They compiled two indicators out of two indexes. Bank index and stock index were based on Beck and Demirgüç-Kunt's study (2009) with some adjustment due to limited availability of data.

Stock markets are also mentioned as one of the driving force of carbon emissions albeit in fewer studies. Sadorsky (2010) pioneered using three separate indicators to measure the role of the stock market: stock market capitalisation to GDP, stock market value traded to GDP, and stock market turnover. The new indicators did not capture significant results in most cases. Others (Coban-Topcu, 2013; Abbasi-Riaz, 2016) refuted his results; they found stock markets had a major impact on economic activity, energy consumption and carbon emissions.

Empirical studies use private sector credit to GDP to measure financial development, which is also used to measure the population's spending willingness. (Ocutrk-Acaravci, 2013; Pata, 2018, Hove-Tursoy, 2019; Abid, 2017). However, the financial sector of a country covers different financial institutions, markets, and instruments, while the above indicators can only depict one or another segment. The easy availability of the indicators, in fact, supports their application, since they provide long time-series of data for the analysis of most economies globally. However, those indicators can only provide rough estimations of financial development, as they fail to include all its aspects.

The World Bank (2012) database of global financial development has developed a comprehensive but still relatively simple framework to measure financial development. It identified four groups of factors characterising smoothly operating financial systems. They are financial depth, access, efficiency, and stability, which are measured for the two principle components of the financial sector: financial institutions and financial markets (World Bank, 2012; IMF, 2020). Some empirical studies have used World Bank's (2012) financial development index to measure the impact of financial development to carbon emissions (Németh-Durkó, 2020; Stolyarova, 2013).

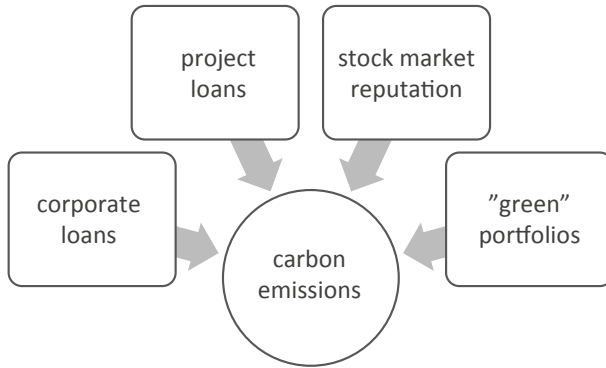
3 FINANCIAL DEVELOPMENT AND THE ENVIRONMENT

Financial development has a dual effect on carbon emissions. In this chapter, we present the reasons behind two opposite viewpoints and show empirical results.

3.1 Effects and counter-effects

Financial development is related to the capital flows of credit institutions, the capital markets and the rate of direct foreign investment and exercises its influence on the quality of the environment via the above three mechanisms (Zhang, 2011). Emerging economies are often forced to compromise between economic growth and environmental degradation, and a developed economy takes an advantage of the weak environmental policies of the least developed countries (Horvath et al., 2018). There are, at present, two views regarding the impact of financial development on energy consumption and carbon emissions. On the one hand, a well-developed financial system supports the growing borrowing by enterprises to boost further purchases (machines, equipment), and increases energy consumption in that way. The higher the energy consumption, the more carbon emissions are released into the air and the more polluted the environment (Chang, 2015). On the other hand, however, new products are necessarily environment-friendly and energy saving, and easy access to loans facilitates their purchase. New, modern household appliances and technical devices produce less carbon emissions; therefore, replacement of old ones may reduce energy consumption and carbon emissions (not necessarily linearly).

In line with the above two views, opposite results can be found in the literature on the impact of financial development on carbon emissions. Both views, however, agree that the impact is indirect and is connected to economic growth. *Figure 2* illustrates an interpretation of the environmental impact through corporate loans, project loans and presence on the stock market which, surprisingly, can both reduce and increase carbon emissions.

Figure 2**Channels of financial development to influence carbon emissions**

Source: own compilation based on presented literature

According to some research (Shahzab et al., 2013; Claessens–Feijen, 2007; Halicioglu, 2009; Tamazian–Rao, 2010), financial development promotes the reduction of carbon emissions, which can be explained by the spread of corporate lending, with the policy of environment protection as a positive outcome. Improvement in efficient production, cost reduction and improved competitiveness motivate corporate actors, while the modernisation of machinery is mostly funded from loans. According to Claessens–Feijen (2007), Halicioglu (2009) and Tamazian–Rao (2010), an economy with highly developed finance can support investments and developments by green environment-friendly projects both at micro and macro-level contributing in that way to the reduction of energy costs (also energy consumption) and – indirectly – to the mitigation of carbon emissions.

Loans cannot only help micro-players but governments too in mitigating the degradation of the environment. The role of banks is key in the implementation of green projects popularising clean energy or other environment friendly solutions. Applying proper policy agreements, financial institutions can provide the necessary sources for the operation of such projects and programmes that will contribute to the improvement of energy infrastructure, which can result in the reduction of carbon emissions (Jiang–Ma, 2019).

Improving efficiency is one but not the only means to reduce carbon emissions. Carbon emissions can also be reduced by switching to new alternative energy production methods. Credits issued to the sustainable energy industry can be an important element of an economy with high-level finance and can contribute to the spread of green energy projects through lending or capital financing

(Dasgupta et al., 2004). In addition, technological innovations reducing energy consumption further can also be supported (Beck et al., 2000, Alfaro et al., 2006) and the transition from fossil fuels to clean energy (Berlinger–Lovas, 2015).

As a complex indicator of financial development, measuring stock exchange presence also appears in the literature. The role of listed companies is important both for their trading and their reputation. Listed companies emphasise social and environmental values to improve their reputation (Lanoie et al., 1997; Paramati et al., 2016), which will appear in the implementation of environment-friendly technologies reducing carbon emissions in production and operation.

Environmental, social and governance factors, i.e. ESG aspects play a growing part in the financial world and financial decisions (Naffa–Dudás, 2020). „International green finance has been breaking records from quarter to quarter. It is not only small ethical companies that engage in it as it is gaining momentum on developed financial markets. There is no leading bank in the world that would not have a green loan portfolio, ESG-based asset management or would not issue green bonds” (Gyura, 2019).

Other analysts believe financial development has an adversary impact on the environment and they forecast disadvantageous trends considering economic growth. They think lending is an incentive to increase carbon emissions. A financial system operating effectively can eliminate IT asymmetry and expand financial channels. It means that businesses can have access to investment loans at much lower costs. Easy access to loans motivates the expansion of product range, purchase of more instruments, so it will significantly increase carbon emissions or, at least, energy consumption (Ozturk–Acaravci, 2013). The development of the financial sector provides a better and more efficient service to household consumer credit, making it easier for households to bring forward their time-shifted consumption and encouraging them to buy additional goods such as real estate, motor vehicles and other electrical appliances. The development of the financial sector projects the expansion of the household’s consumption in the long run. (Jiang–Ma, 2019).

According to the above approach, stock exchanges are drivers of economic growth, which can result in environmental pollution. Stock exchanges are important barometers of economies; the good performance of a stock exchange implies fast economic growth and the increase of the general welfare of society (Fain–Naffa, 2019; Jiang–Ma, 2019). Welfare boosts the consumption of businesses and consumers alike leading to increased energy consumption and carbon emissions as business activities proliferate (Sadorsky, 2010; Sadorsky, 2011; Mankiw–Scarth, 2008). The improvement of efficiency is not questioned; however, purchases expand so much that a rebound effect appears: the benefit of environment friendly

technologies (savings on carbon emissions) are exceeded by the total extra carbon emissions of the instruments.

To sum up, literature verifies that a dual effect is exercised. Financial development can promote substitutes to meet increased energy needs (reducing energy consumption leading to carbon emissions), on the other hand, it provides funds for lending to the energy industry (increasing energy consumption and carbon emissions). Stock exchanges can boost environment-conscious behaviour for businesses; partly by restructuring their operations and consumption and partly through the spread of ESG funds traded on stock exchanges and green portfolios to reduce carbon emissions.

3.2 Some empirical results

In the first studies – Claessens–Feijen (2007), Halicioğlu (2009) és Tamazian–Rao (2010) – the authors assumed that the development of the financial sector may provide environment friendly programmes with excellent financial services at low funding costs, so it will contribute to the reduction of carbon emissions. Later, as we can see in this chapter, the inclusion of the financial sector became a popular method of analyses.

Ten years ago, the impact of financial indicators on energy consumption and the environment was little known (Sadorsky, 2010). Few studies discussing the function of financial development on the quality of the environment were published in the leading journals (*Journal of Cleaner Production, Renewable and Sustainable Energy Reviews, Energy Policy*), which were responsible for a third of the studies on the topic. Finance journals started to show an interest in the field of energy, carbon emissions, or economic growth much later beginning from 2015.

Katircioğlu–Taşpınar (2017) used financial development in their model as a factor of economic growth mitigating energy consumption. They found a more developed financial system would promote successful energy management and the achievement of environmental goals via the reduction of carbon emissions short term. They, however, found positive correlation long term, so they advised long term planning and balancing environmental and economic objectives were particularly important, because their findings had shown a contradiction there. Sadorsky (2010) disagreed. His calculations allow the projection that financial development is not a process to be hailed in the struggle against climate change. The result of the panel database analysing 22 countries is that improving the financing capacity of the financial sector will increase energy consumption.

Studies by Ozturk and Acaravci (2013) are among the ones most often referred to. In their 2013 study they analysed an almost 60-year long period and found a

cause-and-effect relation between the variable of financial development and energy consumption and carbon emissions. The short-term cause-and-effect relation leads from financial development towards energy consumption per capita. The expansion of the financial sector results in higher incomes and growing energy consumption (Ozturk-Acaravci, 2013), confirming Sadorsky's results (2010).

Analysing the period from 1974 to 2014, Pata (2018) monitored the interaction of the variables supplemented with urbanisation. He reasoned urbanisation was important because most cities develop faster and contribute to national income more than the country average. So, if such areas start increasing, a more urbanised population will build up pressure on urban resources and the environment, which in the end results in increased pollution (Li-Yao, 2009). Applying three integrational vectors, Pata (2018) found economic growth, financial development and urbanisation were processes all increasing degradation. Surprisingly, the use of alternative energy sources has no effect. Economic growth is the most important factor impacting carbon emissions followed by urbanisation and financial development.

Finally, the analysis of the empirical literature results show that there are varied results, and an even more detailed literature review would support their diversity. The income level of a country has a significant role in carbon emissions (Mazur et al. 2015; Pablo-Romero and Sánchez-Braza, 2017), so an income shock can exert different effects in an industrialised than in an emerging economy. The same shock will increase carbon emissions in the former, while the shock will have the opposite effect in the latter.

4 SUMMARY

I analysed in this paper whether financial development plays an important role in the preservation of the natural environment. Environmental degradation is mainly measured by the quantity of emissions particularly carbon emissions, so I also used carbon emissions as an indicator trying to find a connection to the finance. Literature has proved there is a strong but indirect effect, since financial development has a key role in economic recovery, it can increase economic growth. Therefore, we should consider the impact of national income and environmental degradation when assessing financial impacts.

I have found that financial development is mostly measured using complex indicators comprising of several factors relating to the institutional background of finance and the operation of capital markets. The financial development index includes the characteristics of finance systems like access, depth, efficiency, and stability. Due to easy access, empirical studies often limit their investigation to

the private sector credit to GDP to measure financial development, however, that index can only partially capture the functioning of financial systems. To gain an insight into the full impact, it is worth measuring the strength of stock market presence, which can influence carbon emissions via the increase of green portfolios traded on stock exchanges or the achievement of the reputational goals of listed companies.

Studying the literature has revealed that a developed financial system improves access to credit and reduces transactional costs, which affects the consumption of both corporate players and households. and that will be linked to the state of the environment. This is the “energy effect”, which affects the environment through energy consumption. Further, the measuring tool should be supplemented with the impact made by the presence of an economy on the stock exchange.

Two opposite views have been found to describe the connection of finances and the environment. First, eliminating financial barriers allows the purchase of state-of-the-art energy saving machines and equipment that consume less energy than the old ones and generate less carbon emissions. Second, if an economy and lending grow too much, increased consumption and purchases brought forward will result in excess energy consumption increasing carbon emissions despite the improvement of unit energy efficiency.

The environment and finance are two areas that interact more and more in modern economies. The direction of the connection is subject to economy-specific factors. After studying the relevant literature, we suggest the connection of the two variables, i.e. financial development, and carbon emissions, should be evaluated related to one or another actual economy rather than drawing general conclusions.

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