Financing the Green Transition and Banking Exposure to Climate Relevant Sectors in Europe and in Portugal

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Abstract

Climate change will undoubtedly pose risks to the financial system in general, and for the banking system in particular. Two main risks are being studied by organizations, regulators and central banks alike: transition risk and physical risk (Park and Kim, 2020).

Methodologies and frameworks are being developed to understand and control the risk that banks sustain in their balance sheets due to the climate transition. Institutions, such as the Network for Greening the Financial System (NGFS), the Financial Stability Board (FSB) and the European Banking Authority (EBA), are being active in the discussion on what these processes may look like and which information is important.

While data on banking exposure related to climate risk is still scarce, this dissertation uses the database from the EBA on exposure by NACE sectors to perform an analysis on which countries and banks are more exposed to the most emitting sectors (MES).

Based on data from EBA, it is estimated that 51% of the total EU banking exposure is related to the MES. Also, the emission intensity of each country's economy (emission of CO2 equivalent per value added) is a good indication of the country's banking system exposure to the MES. Sweden is the country less exposed to the MES (25%), as opposed to Romania (78%). Portugal's share is 56%.

Regarding the Portuguese banking system, the sector that contributes the most to the MES exposure is the manufacturing sector (16,9%), followed by wholesale and retail trade (14,9%) and construction (11,3%).

Keywords: climate transition risk, climate physical risk, sustainable finance, banking, credit risk

JEL Classifications: G21, E51, Q54

Resumo

A transição climática irá colocar desafios ao sistema financeiro em geral, e ao Sistema bancário em particular. Ambos os riscos de origem climática estão a ser alvo de estudo e análise por organizações, reguladores e bancos centrais: risco de transição e risco físico (Park and Kim, 2020).

Metodologias e estruturas de trabalho estão a ser desenvolvidas para melhor perceber e controlar o risco que os bancos detêm no seu balanço relacionado com a transição climática. Instituições como Network Greening Financial System (NGFS), Financial Stability Board (FSB) e Autoridade Bancária Europeia (EBA), estão ativos na discussão sobre como serão feitos estes processos e qual a informação imprescindível.

Enquanto a disponibilidade de dados da exposição da banca aos riscos climáticos ainda é escassa, a base de dados EBA contendo a exposição de cada banco por setor foi estudada para analisar que países e bancos estão mais expostos aos setores mais emitentes (MES).

Com base nos dados EBA, é estimado que cerca de 51% da exposição dos bancos da União Europeia sejam aos MES. Adicionalmente, a intensidade de emissões de cada economia (emissão CO2 equivalente por cada € valor acrescentado) é um bom indicador relativamente à exposição do setor bancário desse país relativamente aos MES. A Suécia é o país menos exposto aos MES (25%), contrastando com a Roménia (78%). Portugal tem uma exposição de cerca de 56%.

Relativamente ao setor bancário Português, o setor que mais contribui para a exposição aos MES é indústria (16,9%), seguido do comércio (14,9%) e construção (11,3%).

Palavras-chave: risco de transição climática, risco climático físico, finanças sustentáveis, banca, risco de crédito

Classificação JEL: G21, E51, Q54

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BCP – Banco Comercial Português
CCCAM – Caixa Central Crédito Agrícola Mútuo
CEFC - Clean Energy Finance Corporation
CGD – Caixa Geral Depósitos
CPRS – Climate Policy Relevant Sectors
DNSH – Do No Significant Harm
EBA – European Banking Authority
EBITDA – Earnings Before Interest, Taxes, Depreciation and Amortization
EC - European Commission
ECB – European Central Bank
ESG – Environmental, Social and Corporate Governance
EU – European Union
FSB - Financial Stability Board
GDP – Gross Domestic Product
GHG – Greenhouse Gas
GIB - Green Investment Bank
GSF – Green Supporting Factor
ILO – International Labor Organization
KfW - Kreditanstalt fuer Wiederaufbau
MES – Most emitting sectors (sectors 1 to 8)
MG – Montepio Geral
NB – Novo Banco
NFGS – Network for Greening the Financial System
PD – Probability of Default
SIB - State Investment Bank
SME – Small and Medium Enterprises
SRI – Social and Responsible Investment
TCFD - Task Force on Climate-related Financial Disclosures
UN – United Nations

1. Introduction and aim of study

The European Green New Deal increased the already ambitious targets for emission cuts in 2030 from a 40% target to a 50% target. It also added another ambitious and bold target – Europe being carbon neutral by 2050 (European Union, 2019).

The ten tools listed by the European Commission (EC) to achieve these targets start with a new Green Taxonomy, which will label activities based on their greenness, which was released by the EU in late 2020 (Union, 2020). The challenge of the classification of activities is key to address the climate change issue, as it will underpin the way that policy will (or not) change the economy, as per the EU's targets.

The EU predicts that an average of 260B€ of yearly investment will be needed to achieve these targets, at least until 2030. The amount of investment needed will have to be fostered by current and new policies and sourced via numerous financial instruments. One financial activity that will be at the forefront of the funding needed will be banking.

Banks will be a part of this conversation since i) the majority will soon face some of the risks arising with both the transition and the physical risks of climate change, as the amount of exposure to climate policy-relevant sectors (CPRS) that banks withstand in their balance sheet today is relevant; and ii) also because they are important tools and policy vehicles.

The literature on studies and reports of financial exposures to CPRS is taking off, but the data needs to be complemented with conclusions and policy recommendations. There is the need to assess the causality between green policies and performance in terms of individual banks and as peer group analysis. There is further research needed to shed a light on the impact that policy is having on decisions made by managers/ bankers and investors alike. The present study's main objective is to provide further insight into the risks that the European and the Portuguese banking system face today (and will face in the future) with respect to the climate transition.

The structure of the presented thesis is organized as follows: Section 1 gives a brief introduction to the risk and the prologue of the climate transition dilemma; Section 2 explains in further depth what are the predicted risks arising from climate change (in respect to the European banks) and presents the state of the art in terms of methodologies that banking authorities are working at the moment; in Section 3 the policy research studies are analyzed, in respect to some of the proposed actions to foster green investment and risk management efficiency and it will also refer to the frameworks put in place by global organizations; Section 4 will show the methodology used to make use of the data gathered for the present study and

the results from the data gathered from EBA's transparency exercise and economic data from Eurostat; finally, Section 5 will conclude the study with the general conclusions.

2. Financing the Green Transition

2.1. Climate Related Risks

In the context of climate change, and more specifically in its impact with the financial system, there are several risk assessments that market participants and regulators account for. Following a general review of the literature, the two main risks considered by authors comprise physical and transition risks.

Physical risks can be defined as the first-order risks which arise from climate and weather-related events, such as floods, storms, heatwaves, droughts and sea-level rise. The vulnerability of exposure of human and natural systems and transition risks are defined as the risks that can arise from the transition to a low-carbon and climate-resilient economy in a disorderly fashion (Park and Kim, 2020).

Transition risks result from mitigation challenges that occur as societies engage in the de-carbonization process. Governments will need to take action in order to do so, which will naturally impact the economics of many businesses and sectors. Some business models will be affected by the transitions we will be facing along the way. A tax on carbon consumption is, for example, a transition risk to most GHG emission businesses (Park and Kim, 2020).

2.2. Policy and Financing

When considering sectors related to climate-change, the sectors emitting more GHG will be the most targeted ones. Considered one of the most emitting (the most emitter in the EU, followed by the manufacturing sector using EUROSTAT data), the energy generation sector is probably the most technology advanced one in relation to the climate change dilemma. The shift towards sustainable practices within the sector has surpassed sector-barriers and influenced policy makers. As a consequence, a lot of research is made on how this green transition is and will be financed. It can be positive to understand what has been done in this sector that can have the same positive impact across other sectors.

2.2.1. The case of a transition success: the energy sector

Mazzucato and G. Semieniuk using data from new renewable energy projects concluded that the riskiest projects and new technologies were mostly funded by public entities, while

private investors only stepped in once the technologies grew and reached a certain level of maturity and the return on investment's visibility was less opaque (Mazzucato and Semieniuk, 2018). A summary of how renewable energy can be financed via different financial instruments can be found in a study published by Plowe *et al.* (Plowe et al., 2014). In the article, several alternative vehicles that could be used to finance energy projects are presented and explained, such as yieldco's, green bonds, and financing through green banks. The tax framework that these instruments are subjected to is also analyzed. Although the authors do not provide conclusions on the best suited instrument, it gives the readers a prospect of the alternatives that investors face when studying a possible investment in the new energy businesses.

As a financing policy instrument, some countries founded national green banks in order to foster the investment in risky but innovative green projects. A study by Geddes *et al.* (2018) on National Green Banks and their role in fostering the energy investment presents empirical evidence, based on 52 interviews, on the role of three state investment banks (SIB's) in addressing the barriers to financing low-carbon energy projects: the Clean Energy Finance Corporation (CEFC) in Australia, the Kreditanstalt fuer Wiederaufbau (KfW) in Germany and the Green Investment Bank (GIB) in the UK (Geddes et al., 2018). The study found that, for instance, in the case of the GIB, for every GBP 1 of public investment it has made since, an estimated GBP 3 of private capital was mobilized – or crowded in. Based on the authors views, SIB's provide capital and perform de-risking, but also perform an educational role in building and developing their own capabilities in order to better identify, assess and mitigate risk for the new investments to come.

2.2.2. Central Banks & Network for Greening the Financial System (NGFS)

As previously mentioned, the value of yearly investment required for the climate transition is a very demanding. As such, and in order to fulfill these necessities, the entire financial and political systems must compromise in targets, frameworks and requirements. Consequently, the role of central banks as the leaders of the transition in relation of the financial system has been put in discussion as to whether or not the central authorities should have a more direct influence in *greening* the financial system.

This is, at its extreme, an ideological discussion, and it is an ever-dynamic question. After the 2008 crises, the origins of central banking and its purpose also came into question (Park and Kim, 2020). The outcome was a confirmation of the role of central banks as a lender-

of-last-resort figure, adding that to the list of other mandates already in their portfolio, such as maintaining price and financial stability, stabilize exchange and employment rates, whilst regulating banking activities.

In relation to this, the UN Environment Inquiry (United Nations Environment Programme, 2017) states that the financial system will have to play a central role in allocating resources towards a sustainable and green economy, whilst tightening the lending on environment harmful activities. In order to do so, it suggests six policy changes, the majority of which are in the scope of central banks activities:

1. Introducing mandatory disclosure for all financial organizations of climate-related risks;
2. Assessing the possibility of a green macroprudential regulation, such as the introduction of a ceiling on credit to carbon intensive activities, countercyclical capital buffers or climate related stress tests;
3. Standardize the use of Green Credit Policy Instruments including subsidized loan rates for priority sectors, credit floors and ceilings or the proliferation of specialized financial institutions;
4. Concerning banks, provide green differentiated reserve and capital requirements;
5. Regulate the acceptance of carbon certificates as part of commercial bank's legal reserves;
6. The use of green quantitative easing.

However, despite all the emphasis the sustainable and responsible investment (SRI), a survey done by the NFGS showed that the nº1 motivation of central banks for engaging in SRI practices is reputational risk, and the motivation to set a good example coming in second. The motivation to protect investments on the Central bank's portfolio from climate related risk ranks only in third place (NGFS, 2020). The survey results show that there is a need for more engagement and education towards the risks, so that the green policies can also move forward.

2.2.3. Green Banking Frameworks

As mentioned earlier, the role of the central banks is being put in the center of the discussion, and that leads us to green banking. The concept of Green Banking, despite being increasingly common in the literature, is somewhat arbitrary. It can be superficially defined as a set of policies and actions carried out by central and commercial banks to improve the responsibility of the financial system concerning sustainable and non-sustainable activities, but it can take the shape of another framework design to achieve green banking practices. A

comprehensive list of methods in which this can be achieved is available in a paper by Park and Kim (Park and Kim, 2020) – also see figure 1. As it can be seen, the actors responsible for the frameworks vary from regulators, market participants and groups of institutions – as previously mentioned, the concepts vary widely.

Example	Actor	Concept
Equator Principles	Financial institutions	Risk management framework to assess and manage environmental and social risks in projects
Sustainable Banking Network (SBN)	Central banks, regulators and association of banks	Facilitate the collective learning of members and supports them in policy development and related initiatives to create drivers for sustainable finance
UNEP Finance Initiative (FI) Banking Programme and Principles for Responsible Banking	Banks	A partnership between United Nations Environment and the global banking sector with an aim to help banks understand environmental, social and governance challenges, define the banking industry's role and responsibilities in shaping a sustainable future and aligning banks' business with the objectives of the Sustainable Development Goals (SDGs) and the Paris Climate Agreement
Global Alliance for Banking on Values (GABV)	Banks	A network of banks using finance to deliver sustainable economic, social and environmental development

Figure 1: Green Banking Frameworks. Source: (Park and Kim, 2020)

In regard to the green banking theme, the European Banking Authority also has a framework of its own. Primarily, the European Commission's action plan on sustainable finance ultimately has 3 main goals: i) provide guidance and redirect capital flows towards sustainable investments, fostering sustainable and inclusive growth; ii) manage financial risks arising from climate change, environmental degradation and social disruptions; iii) to foster transparency and long-term perspectives in financial and economic activity (EC, 2018).

Following the EC's action plan, EBA's revised capital requirements directive (CRR 2/CRD 5) includes three mandates in the area of sustainable finance. The first calls on the EBA to assess the potential inclusion of ESG risks in the supervisory review and evaluation. EBA's second mandate requires large institutions with publicly listed issuances to disclose information on ESG risks, physical risks and transition risks. Lastly, the third mandate ("Article 501c," 2020) requires EBA to assess whether a dedicated prudential treatment of exposures to assets or activities in CPRS would be justified and in particular to develop a criteria for the assessment of **physical** and **transition** risks (EBA, 2019).

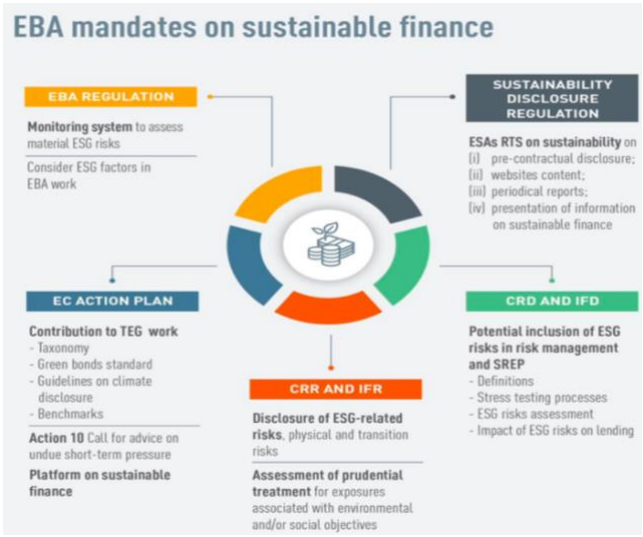


Figure 2: EBA's Mandates on Sustainable Finance. Source: (EBA, 2019)

With these mandates in place, EBA launched a pilot study, where a sensitivity exercise was performed on climate risk with a sample of 29 EU volunteer banks. The exercise focused on transition risk, and its main objectives were to explore data and methodological challenges, assess the banks' readiness to apply the EU green taxonomy and assess and compare, in a preliminary sense, the banks exposures in respect to climate risk (European Banking Authority, 2020). The data covered non-SME corporate exposure to non-financial obligors domiciled in EU countries and amounted to 2.4 trillion, which represents 42% of total corporate exposure and 78% of non-SME exposure. The data provides information on the sectors in which climate-relevant exposures are more concentrated.

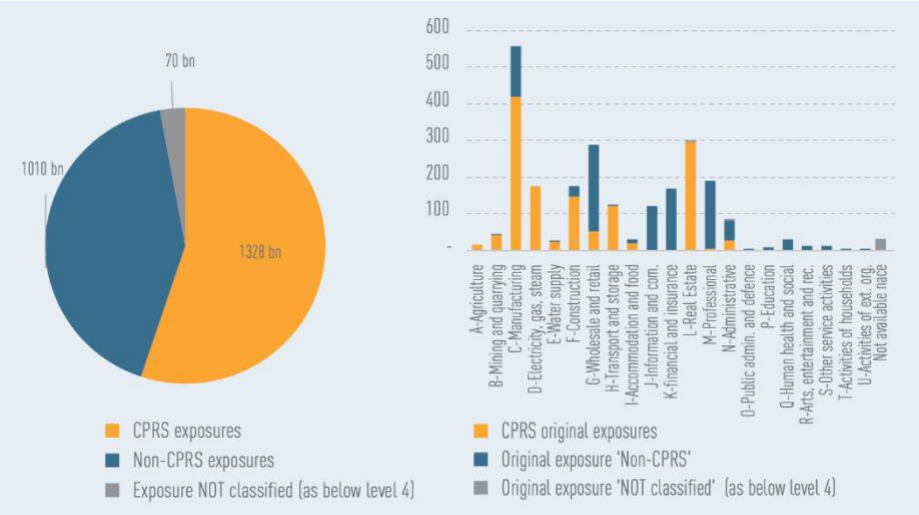


Figure 3: CPRS exposure at the EU Level. Source: (European Banking Authority, 2020)

Results show that a total exposure of EUR 1.3 trillion (55% of the total) is allocated to CPRS, mainly in the following sectors: manufacturing, electricity, gas, steam and air

conditioning supply, construction, transporting and storage and real estate activities. Exposures to sectors incorporate climate-relevant sub-sectors, such as mining and quarrying, information and communication, and wholesale and retail trade, are less significant. Exposures to sectors considered to be entirely not climate relevant represent only 2% of total exposure. As a complement to the CPRS analysis, the report also comprises a GHG emission analysis. However, as a consequence of the lack of data available, only 30% of the total exposures are matched directly with individual GHG data.

2.2.4. Green Policy - The Green Supporting Factor (GSF)

As previously shown, policy had a great deal of intervention in fostering the energy sector transition in order to perform the overall transition, policy has to be also put in place for financial institutions. Green banking policies will help turn banks into green banks. One commonly discussed policy is the Green Supporting Factor (GSF). The GSF would work as the introduced SME supporting factor, that lowered the capital requirements for banks to enhance lending to SME's. According to a study from the Bank of Spain (Mayordomo and Rodriguez-Moreno, 2017), the SME supporting factor increased lending to companies with revenues bellow 50 million EUR given that the banks adjusted their capital allocations and risk assessments using the supporting factor. However, the lack of visibility on the time frame availability of the measure poses inefficiencies on the policy.

As the SME supporting factor, the GSF would lower capital requirements for banks for their green exposures, therefore enhancing lending to greener projects. In a report on the GSF, Thomã and Hilke when analyzing the potential impact of the measure (Dankert et al., 2018) argue that a GSF should only be considered if there is evidence that the riskiness of green exposures is in fact smaller than normal exposures. As long as there is not enough evidence on this fact, the authors state that the financial stability of banks should be preserved. The authors also suggest that capital requirements tool should not be used as an instrument to serve more than one policy objective.

Based on data from the ECB's SDW ("ECB Statistical Data Warehouse," n.d.), a study from ECB (2021) estimated the share of green and brown assets held in the EU bank's balance sheets to estimate the impact that a potential Green Supporting Factor or Brown penalty would have in the EU banking sector. The study concludes that the brown penalty policy would have a higher impact on the capital requirements for banks vis-à-vis the GSF. This is the consequence of a much broader exposure that banks held at this point to carbon emitting activities than to

green ones. The impact of the GSF on the capital requirements is estimated in the range of up to 4 billion € in the EU banks. The study also estimates a small decrease of up to 26 basis points of the overall cost of capital for green projects. Also, the lending of brown assets would be decreased by 8%, according to the authors estimates (Thomä and Gibhardt, 2019).

2.3. EU Taxonomy on 'Green Activities'

In May 2018, the European Commission adopted a proposal for a regulation on disclosures relating to sustainable investments and sustainability risks aimed at integrating ESG considerations into financial markets. Since then, creating a harmonized classification of environmentally sustainable activities has been a priority for the European Commission. The introduction of the EU green taxonomy provides a universal and harmonized definition of green activities for companies based in Europe, doing business with companies from Europe or having a subsidiary in Europe. This first step is essential to adopt global language on sustainable finance and will help to vehicle green funding to the companies that are really sustainable oriented – avoiding the so-called 'greenwashing'.

The EU Taxonomy has embedded six main objectives in its classification that sustainable activities must meet (more than, but at least one):

- Climate change mitigation;
- Climate change adaptation;
- Sustainable use and protection of water and marine resources;
- Transition to a circular economy, waste prevention and recycling;
- Pollution prevention and control;
- Protection of healthy ecosystems.

Furthermore, the activities must:

- Contribute substantially to one or more of the environmental objectives and to the technical screening criteria.
- Do no significant harm to any other environmental objective (Do No Significant Harm ("DNSH") criteria).
- Comply with minimum social safeguards (under the draft regulation, these are defined as ILO core labor conventions).

The EU will allow market participants, investors, clients, suppliers and consumers to get a sense of each company's activities or products and which share of revenues, EBITDA and profits comes from sustainable activities. Furthermore, it will stablish European practices as the most climate-oriented policies. Multi-nationals that are based outside the EU are authorized to not comply to the EU Taxonomy, but just as long as their base-country demands climate and sustainable standards acceptable to EU.

As an example of the taxonomy application, the Spanish conglomerate group Acciona has released a case study on which it analyses its activities and businesses under the EU taxonomy and it provides an example on how reporting under the taxonomy will happen and how it can help the receiver understand the operations and their sustainability (Acciona, 2020).

Despite being only recently released, in June 2020, the new taxonomy has accounted for some reserves from critical actors. At the conference on Green Banking and Green Central Banking, Christine Lagarde stated that the Taxonomy is an important milestone, but lacks concrete technical criteria and it is still missing an individual instrument for carbon-intensive activities (European Central Bank, 2021a). Some authors also argue that, whilst welcoming the EU taxonomy, it will add extra complexity and open up an the chance for regulatory arbitrage (Dankert et al., 2018).

On the other hand, one important factor is the timeline under which it is to be implemented on a wider scale. If no opposition from the EU council on the taxonomy is to occur, Member states are required to implement its directive in 2022. The companies that are within its scope will start the disclosure of information related to year 2023. SME' will then need to comply with taxonomy rules from year 2026. Given the timeline presented, it will take quite some time before SME data disclosure is available. In the meantime, the climate risk will continue to grow and is necessary that it is dealt with using tools that can be deployed as soon as possible. It is with this prerogative that in the next chapter these tools are analyzed, with emphasis on risks arising for the banking industry.

3. Managing Risks arising from the climate transition

Solving the problem of financing access for greener activities and sectors is one big share of the challenge. However, the policy push can also have unintended consequences. As such, studies that show the risk level of green assets and projects are key to understand if the banks and financial institutions and their current capital requirements are in fact adequate to prevent systemic instability whilst financing the new green economy. On the other hand, some studies also shed light on what's to come for the institutions that carry exposure to the so called "brown" sectors.

3.1. The risk of going green & the brown risk level going forward

In 2010, Weber *et al.* (2010) suggested that there was significant correlation between sustainability practices and the debtor's performance, and that these tools could help financial institutions predict the counterparts' creditworthiness (Weber et al., 2010). The study was conducted based on a survey from 40 German banks, and used Cronbach's alpha test for consistency in a list of 91 items covering four fields: traditional, economic, environmental and social sustainability criteria. The results indicate that the sustainability criteria was able to predict traditional ratings, though its analysis was costlier.

Also, based on a five-year dataset of 24 Chinese banks, Cui *et al*. (2018) conclude that the allocation of loans to greener portfolios does reduce the ratio of non-performing loans (NPL) of the banks studied (Cui et al., 2018). The authors suggest that the green policy in place is having a positive effect on the quality of the bank's portfolios whilst fostering climate-friendly activities, based on the Chinese Green Credit Policy.

Although studies like the ones mentioned in the previous two paragraphs are quite helpful, their quantity is still small, mainly due to the lack of data and its poor quality. On the other hand, studies also focus on the institutions that have a big exposure to GHG emitting sectors and businesses.

On an European level, Weyzig *et al.* (2017) studied the potential losses of financial institutions that had significant exposure to companies with oil, gas and coal assets (Weyzig et al., 2014). In the banking sector, the authors choose the top-20 banks based in the EU in terms of asset value. The data was divided according to the types of assets held by the banks and the sector the counterparts operated in – based on data from Thomson One Banker. The study used

the data gathered to estimate that a total of 463 bn € from banks across the EU was held in exposure to high-carbon sectors – 1.3% of the total exposure.

In Austria, banking reporting practices require a granular disclosure on each bank's balance sheet item above certain individual values. Based on these datasets, Battinston *et al.* (2021) analyzed the Austrian banking's sector exposure to CPRS (Battiston et al., 2020). However, data quality is not pristine – bank data only accounts for unconsolidated level and does not present information on the use of proceeds. Authors had to resort to other databases to increase the robustness of their dataset. Results from their analysis show that a potential 26% of the total banking exposure are subject to climate transition risk, and high volatility resulting from a disorderly transition could affect the system via this exposure.

Vermeulen *et al.* (2018) analyzed the Dutch banking system exposure to sectors prone to disruption in a climate transition, modelled by four scenarios. Some 13% of the total exposure was held in carbon intensive activities such as mining & petrochemical (~3.3%), utilities (~2.2%), basic industry (~2,7%) and transport (~4,8%). Estimations on the losses for the banks in the scenarios studied show that up to 3% of the total exposure to these sectors could be lost (Vermeulen et al., 2018).

As observed, pioneer studies provide us with hopeful information in terms of asset quality and loan performance ratios. Nevertheless, risk management will continue to be on the regulator's and company's agenda, and with a bigger focus on sustainability issues. The path that has been set forth by these institutions focuses mainly in tools that will help harmonize information and data and produce global risk management procedures.

3.2. Tools to manage risk and its challenges

As a major hurdle, challenge and one constant note among the articles and studies that were consulted was the lack of and arbitrary nature of the data available. The majority of the studies mentioned the absence of a harmonized framework and metrics to allow, primarily, the study and state of the issue at stake and, as a second approach, to understand the scope and impact that possible policies could have on the institutions targeted.

In order to name some challenges related to data, authors mention: data about securities holdings of financial institutions, in particular relation to climate policy relevant sectors (CPRS)[1], is generally scarce, inconsistent or even undisclosed, as mentioned by Battinston *et al.* (Battiston et al., 2017); the information on the sustainability of financial products is

[1] CPRS is mentioned in further detail on the 2nd paragraph of section 3.3.

inconsistent, incomparable and at times unreliable, like mentioned by (European Central Bank, 2021a); the lack of availability of historical data account for diverging conclusions on studies following the same methodologies, as in (Dankert et al., 2018).

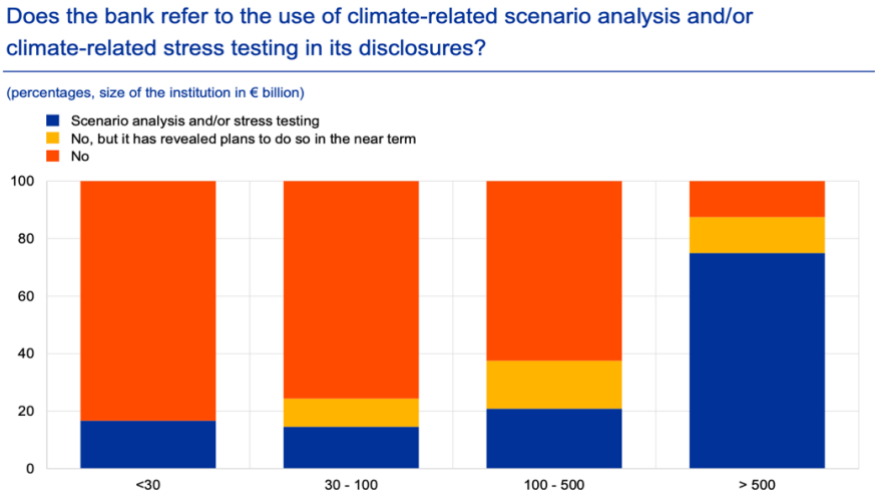


Figure 4: Share of financial institutions disclosing climate-related information and analysis. Source: Chart 1 present in (European Central Bank, 2020)

In terms of financial institution reporting, disclosure of climate related information is still a challenge. As pictured in the report from the ECB (2020) (European Central Bank, 2020), the larger the institutions, in asset values, the higher the probability of disclosing some information on climate-related analysis and/ or stress testing. In fig. 4 it is shown that only 20% of institutions of up to 500 bn € of asset value are reporting or have plans to report in the future climate related information. That number rises to about 75% when considering the bigger institutions, which have to manage a lot more assets and more risk.

An already fair amount of publications that aim at reaching a common ground for institutions and companies to assess, disclose and study their own activities were released. These frameworks allow also companies to compare themselves to others and mimic best in class practices or innovate through new approaches.

3.2.1. Data Disclosure frameworks

In 2017, the Financial Stability Board (FSB) created the Task Force on Climate-related Financial Disclosures (TCFD), as a way to improve and increase reporting of climate-related financial information (Task Force on Climate-related Financial Disclosures, 2017). With Michael R. Bloomberg as chair of the Task Force, the TCFD built a framework for institutions to disclose their climate-related data. This fairly comprehensive framework, as the TCFD points

out, will lead to three major benefits while ensuring a better disclosure on climate matters: better risk assessment, efficient capital allocation and enhanced strategic planning.

As per the Task Force, data availability and quality of that data remain its biggest challenge, mentioning several types of mismatches between measurements from different institutions in numerous metrics. For example: emissions measurement methodologies, product life-cycle emissions methodologies. Also, when considering the variability of climate-related impacts across sectors and markets, data will, as a consequence, amplify costs, deepen processes complexity and foster heterogeneity from those processes (Task Force on Climate-related Financial Disclosures, 2017).

In the 2020 annual report and the third status report, the TFCD states that a total of 1500 institutions globally expressed their support for the framework. Also, a total of 110 regulators support the TFCD – with a big part of the support arising from the Network for Greening the Financial System (NGFS) (NGFS, 2019)(TCFD, 2020).

3.3. Banking stress tests

There is a growing notion that financial regulators should assess the banking system's stability from climate risk exposure based on stress tests adapted to physical and transition risks. Some studies are being done on this topic, mainly to develop methodologies to model stress tests based on the characteristics of each segment of banks, from different geographies and dimensions. The EBA is currently active on achieving a methodology to impose climate stress tests to the EU banks (European Banking Authority, 2020).

So far, the initiatives to measure **transition** risk rely on sector-based approaches to classify climate-relevant exposures, for example employing the NACE 2 classification. In Battinston (2017), the authors remap all sub-sectors at NACE 2 level 4-digit into new climate policy-relevant sectors (CPRS), by combining criteria, including carbon emissions, the role of the sector in the supply chain and the existence of traditional climate-related policies for the sectors. Exposures to CPRS are defined as those exposures that may be potentially affected by transition risk. Overall, almost 98% of the EUR 2.4 trillion exposures submitted by banks are classified according to the CPRS method. (European Banking Authority, 2020)

Some challenges posed by the study of sector-based exposures also come from the fact that existing classifications of economic sectors such as NACE or NAICS were not designed specifically to estimate financial exposures to the so-called climate-policy-relevant sectors

(CPRS). Battinston *et al.* (2017) define a correspondence between sectors of economic activities at NACE Rev2 4-digit level and new defined climate-policy-relevant sectors based on their GHG emissions: fossil fuel, utilities, energy-intensive, transport and housing (Battiston et al., 2017). Although the EU released the new taxonomy on green activities (Union, 2020), in the last report from EBA on the risks to the banking sector, the above-mentioned methodology for CPRS exposures is used (European Banking Authority, 2020).

In terms of methodologies for stress tests, in Battinston *et al.* (2017) a network analysis of financial exposures shows that banks portfolios are both interdependent and largely exposed to what may come of the climate policy (Battiston et al., 2017). This methodology suggests that banks would not default due to their exposures to firms in the fossil-fuel and utilities sectors, but their capital positions could be affected by volatility in asset value induced by climate policies. Although granular data is not available, the authors propose that microeconomic data at the level of individual banks can be used to conduct a climate stress-test of the banking system by two exercises:

1. Compute the ratio of the exposures to CPRS for each bank over the banks' capital and determine an upper value on the magnitude of the losses considering that the equity value of the firms in the shocked sector would be lost;
2. Compute a VaR for each bank, using a distribution of shocks across CPRS.

On march 2021, the Vice president of the EBC Luis de Guindos made a relevant contribution to this discussion (European Central Bank, 2021b). The post made on the ECB blog shows the methodologies currently at work at the ECB to assess the exposure of financial institutions. To assess their risk, the ECB must assess also their counterparts' risk and the analysis comprises not only financial institutions but the whole economy – which is really the fundamental exercise at stake.

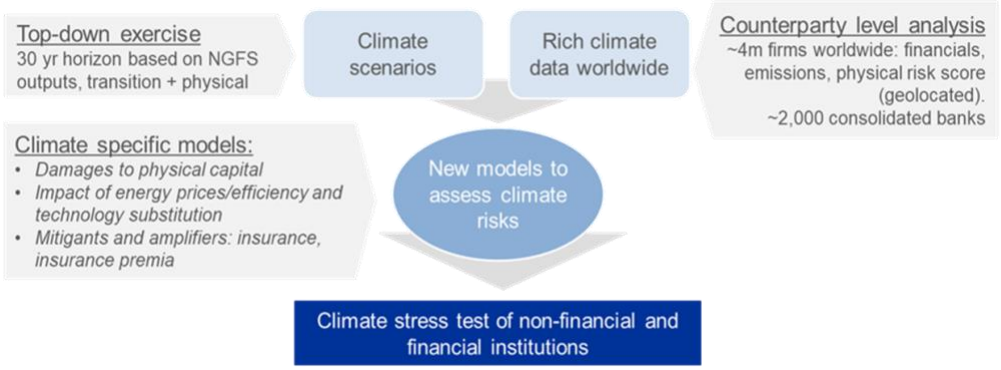


Figure 5: Innovative components of the ECB climate stress test. Source: Chart 1 present in (European Central Bank, 2021b)

Fig. 4 shows how the data on an array of areas is used to define the scenarios: inputs from the NGFS, financial data, geographical data to assess physical risk, emission data, time horizons, economic variables, etc. Based on a top-down exercise the ECB can enhance their current models to make climate models subjected to different scenarios. In the figure bellow there are three: 1. Orderly transition with limited physical risk, which works as a base scenario; 2. Disorderly transition with limited physical risk and 3. Hot house with extreme physical risk. The matrix presented is essential to understand the binomial of transition- physical risk and the tradeoffs between acting sooner rather than later.

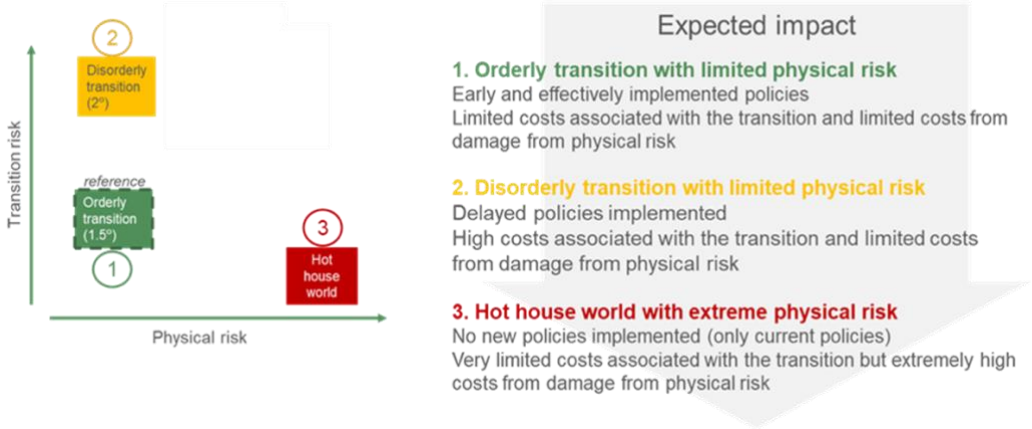


Figure 6: ECB climate scenarios. Sorce: Chart 3 present in (European Central Bank, 2021b)

In Fig. 7 and 8 preliminary results are shown from the ECB study (European Central Bank, 2021b). The increase in counterparts default probabilities (PDs) over the next 30 years under scenario 2 and 3 with respect to the orderly transition scenario shows a significant risk premium across sectors. Between scenarios 2 and 3, the latter shows greater harm to the overall economy as the increase in PDs is significantly higher than in scenario 2.

Across sectors, a less organized transition would lead to larger PDs than an orderly transition, more significantly so for the most polluting sectors, such as mining, electricity and transport. This is also perceptible from fig. 7, where it is shown both physical and transition risks across sectors and across countries within the Euro Area. Both mining and electricity sector remain the most prominent, but in this graph, it is also notable the risk that the manufacturing sector is carrying, especially in Denmark and in the Netherlands. Concerning Portugal, the risk is higher in standard sectors such as mining, but it is surprisingly high for unconventional sector such as education.

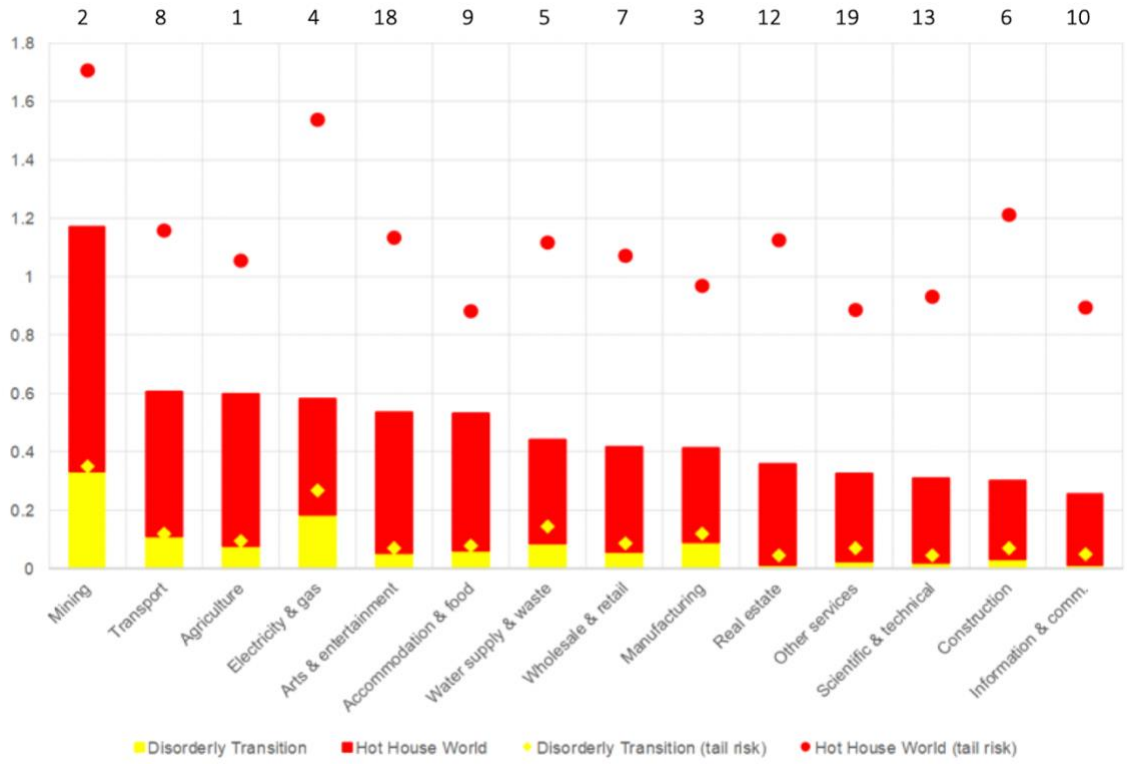


Figure 7: Default probabilities (%) in the two adverse scenarios vs orderly transition scenario. Source: Figure 4 present in (European Central Bank, 2021b)

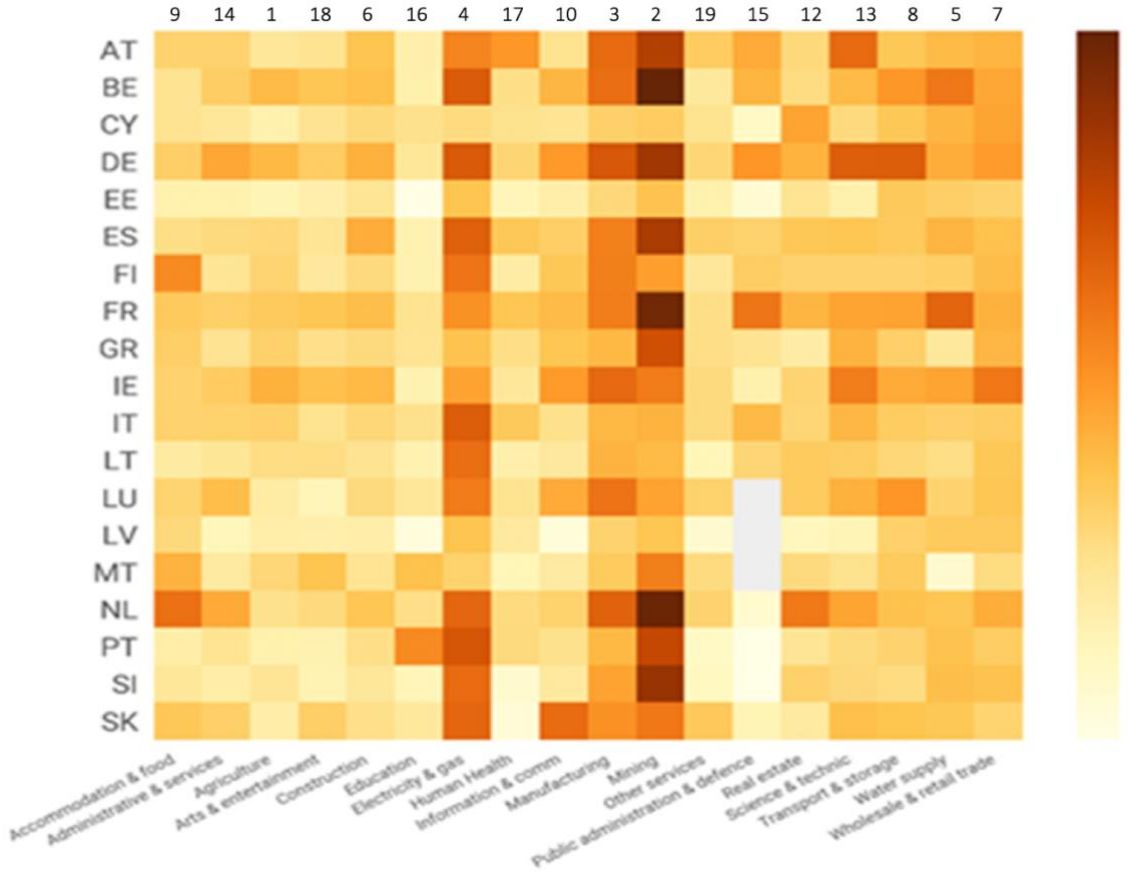


Figure 8: Mapping transition and physical risk for euro area firms by sector. Source: Chart 2B present in (European Central Bank, 2021b)

4. Estimating Banking Exposure to climate change risks in the EU

4.1. Methodology

Based on the Transparency Exercise in Autumn 2020, performed by the European Banking Association, the data on exposure of the banking sector to each NACE sector is available for 135 individual banks. The 27 countries where these banks are based on are as follows: Austria, Belgium, Bulgaria, Cyprus, Germany, Denmark, Estonia, Spain, Finland, France, Greece, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia and United Kingdom. The following countries are not present in the transparency exercise: Slovakia, Czechia and Croatia.

In relation to the data, the file Metadata (available in EBA's website[2]) is helpful do link the codes to their respective classifications. In terms of performance status, the data used was based not considering any breakdown from performance classification (performing, non performing, stage classification, etc). Relative to the loan's impairment, no accumulated impairment was taken into account since only the data corresponding to the Gross Carrying Amount was considered. Relative to the period, the reference data considered is June 2020.

Given that the banking exposure data available is only scattered by the 19 NACE codes, further data had to be retrieved in order to gain a deeper sense into which NACE sectors are contributing more to the emission of GHG in each country.

Based on data retrieved from the EUROSTAT, it is possible to gather emission data (in terms of CO2 equivalent) for each European country in terms of the 19 NACE sectors. Since the sectors more prone to transition risk are the ones that emit more of the GHG gases, given that the hurdles to continue to emit will become continuously more challenging, these are the ones we should to track more closely. Ultimately, the sectors that emit the most and that banks are more exposed to should be the ones at the center of environmental risk management by the banking sector.

4.2. Economic & Emissions Data

In order to understand how the exposure to different sectors will affect banks, we have to look at two vectors of data: economic relevance and emission intensity. The combination of the two will shed light on which sectors makes the most sense to analyze the banking exposure. In particular, we can have country-based analyses based on which countries are more emitting in

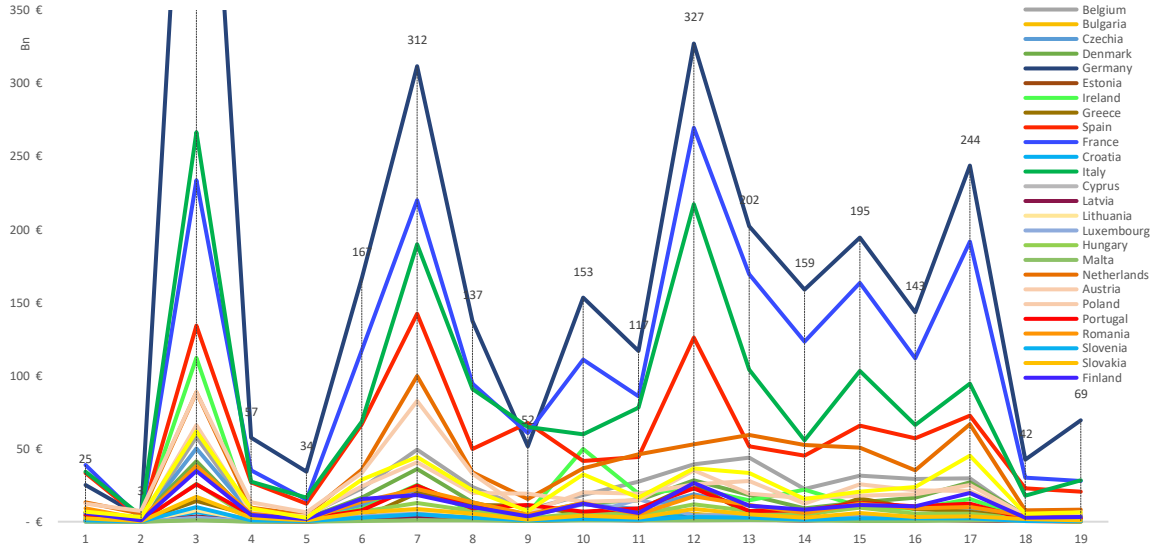
[2] https://www.eba.europa.eu/risk-analysis-and-data/eu-wide-transparency-exercise

which sector or have the highest dependence in economic terms. The transition risk will directly materialize the most in the sectors more prone to emissions and the contagion will spread to the sectors that rely on services and goods produced by these sectors.

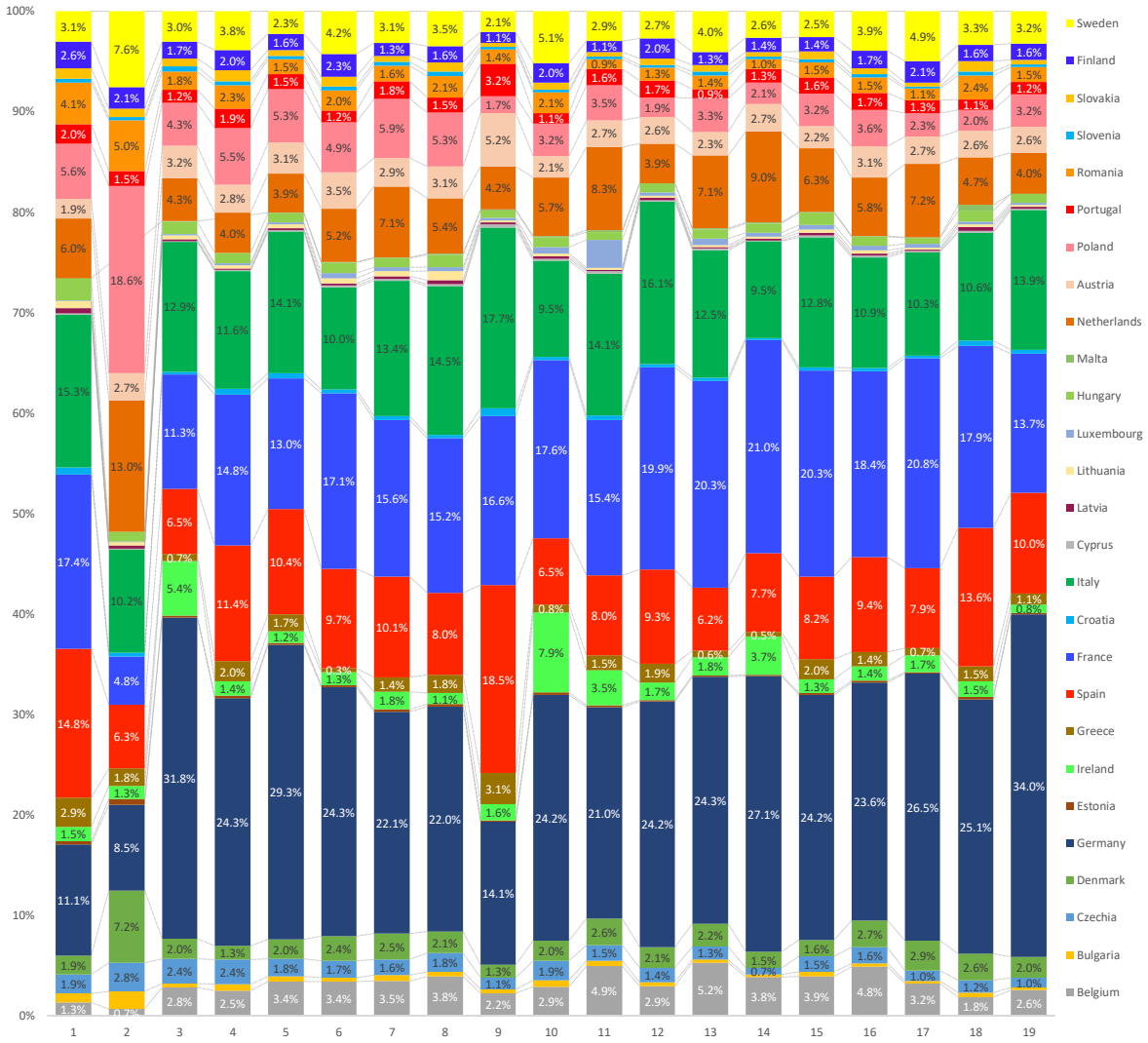
4.2.1. Economic data

Bn € (%)	Total	1	2	3	4	5	6	7	8	9
EU 27	12 482,3 (100%)	223,9 (1,8%)	40,4 (0,3%)	2 070,2 (16,6%)	235,9 (1,9%)	116,7 (0,9%)	686,1 (5,5%)	1 411,8 (11,3%)	623,6 (5,0%)	365,5 (2,9%)
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
	632,4 (5,1%)	555,8 (4,5%)	1 351,9 (10,8%)	833,9 (6,7%)	586,5 (4,7%)	804,3 (6,4%)	607,3 (4,9%)	920,6 (7,4%)	168,7 (1,4%)	203,9 (1,6%)

Table 1: Economic output in the EU (27 countries), by sector. Source: Data from EUROSTAT



Graph 1: Economic output of each country by sector. Source: Data from EUROSTAT



Graph 2: Relative economic output by county and sector. Source: Data from EUROSTAT

The economic environment is at the forefront of the transition. The strongest economic sector will be those which will be able to finance its transformation. In the elements presented in the previous page the aim is to clarify, in the EU reality, the absolute and relative weights of both sectors and countries.

Table 1 presents the economic output of each sector on the overall EU perspective. The manufacturing sector (3) represents almost 17% of total value added, with trade (7) coming in 2nd with ~11%. The third most prominent sector is real state (12) with a share total slightly below 11%. In relation to countries, graph 1 shows the absolute values of each EU country in every sector. Germany is the economic powerhouse in all but two sectors: agriculture (1) and food and hospitality services (9). The graph shows France, Italy and Spain following in an orderly fashion, respectively.

The relative weight of each country in terms of contribution to the overall EU output in each sector is presented in graph 2 – for relative contribution within each country, please see

Annex Graph 2. The same economic reality is shown, but in in smaller sectors (economically), one can see details such as the heterogeneity of the mining sector (2), or the relative weight Spain has in relation to the hospitality services (tourism) sector (9).

4.2.2. Emission data

From table 2 it is clear that sectors 1 to 8 are the most emitting sectors (MES) – all of each have a share greater than 1%. Sectors 9 to 19 show a % of less than 1% and in total represent around 5,3% of the total emissions. This might be the first indication that these sectors could be the ones aimed at analysis.

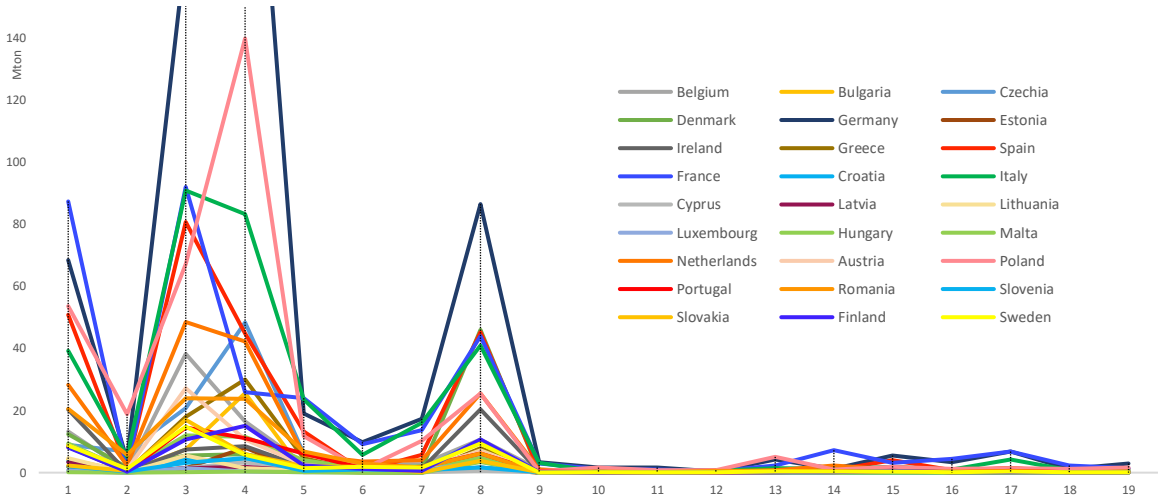
In terms of the relevance of each country, graph 3 shows the absolute emissions by each sector, on a country basis. Germany clearly stands out as the most emitting, especially in manufacturing (3), electricity (4) and transportation (8) – which account for 77,5% of the total. Germany is in fact the most emitter in all the EU across all sectors by a great margin (671Mton), seconded by Poland (345Mton), France (330Mton) and Italy (320Mton). The Polish emissions are largely due to their electricity sector (4), which accounts for 41% of the total emissions. In France, the agriculture (1) and manufacturing (3) sectors combined account for 54% of the total emissions and in Italy manufacturing (3) and electricity (4) account for the same share of 54%. A comprehensive graph of each relative share within a country of emissions by sector is presented in Annex Graph 2.

In graph 4 it is presented the relative weight of country emissions for each sector. The graph does not show absolute figures, but it is of relevance if we have to take into account specific countries to assess their relevance to the EU as a whole.

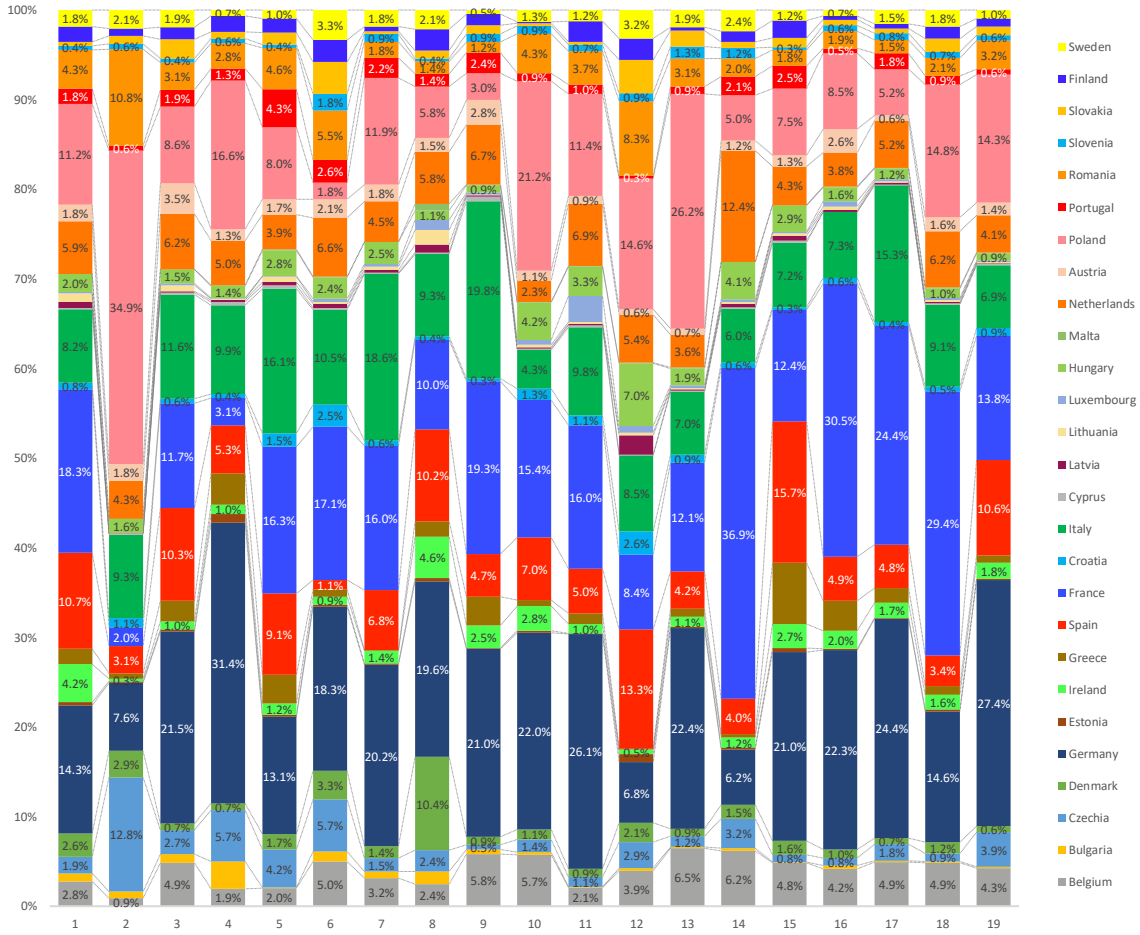
In respect to Portugal, we can state that it represents 1,7% of total EU emissions. The most emission intense sectors are agriculture (1), manufacturing (3) and electricity (4) with a combined share of 65%.

kTon, CO2 equiv (relative weight %)	Total	1	2	3	4	5	6	7	8	9
EU 27	3 049 773 (100%)	478 257 (15,7%)	54 048 (1,8%)	785 360 (25,8%)	842 907 (27,6%)	146 379 (4,8%)	53 593 (1,8%)	86 047 (2,8%)	441 933 (14,5%)	15 718 (0,5%)
	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
	7 797 (0,3%)	6 127 (0,2%)	5 812 (0,2%)	19 264 (0,6%)	19 408 (0,6%)	25 773 (0,8%)	14 674 (0,5%)	27 833 (0,9%)	7 690 (0,3%)	10 875 (0,4%)

Table 2: GHG emissions in the EU (27 countries), by sector. . Source: Data from EUROSTAT



Graph 3: GHG emissions of each country by sector. Source: Data from EUROSTAT

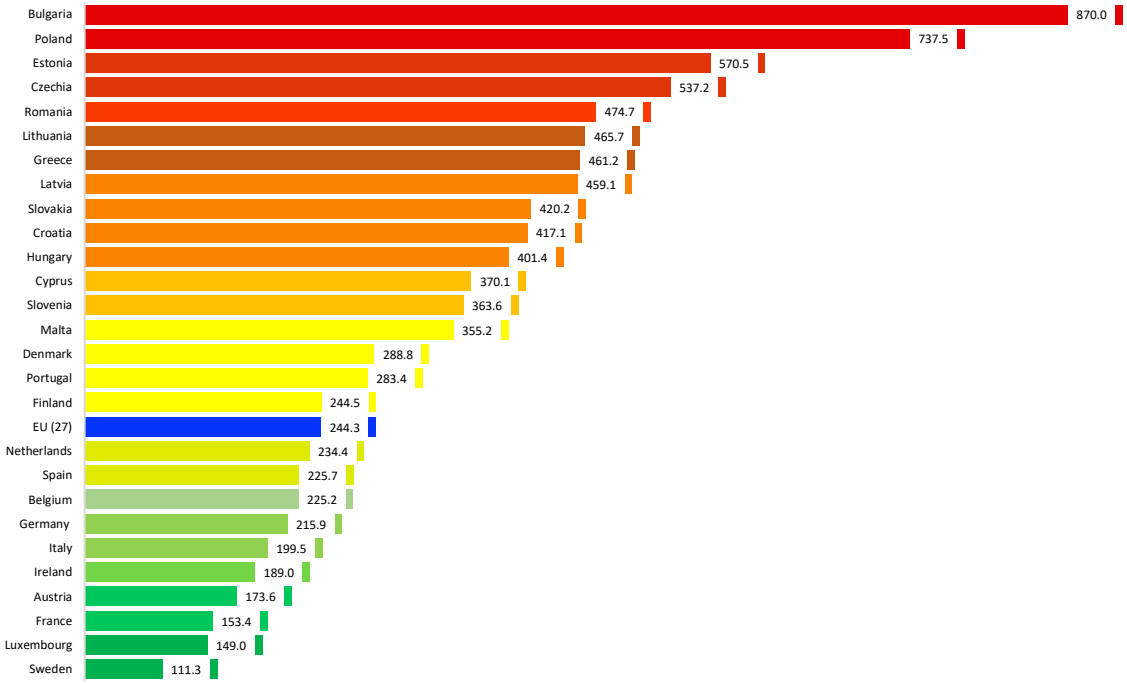


Graph 4: Relative EU GHG emissions by county and sector. Source: Data from EUROSTAT

4.2.3. Relation economic/ emission weight

It is now quite perceptible that the most emitting sectors (MES) are from 1st to 8th NACE codes - the most emitting sectors being 1 – Agriculture and the primary sector, 3 – Manufacturing, 4 – Electricity, Gas and AC supply and 8 – Transport and Storage.

Nevertheless, these values are absolute and hence the "intensity" of each sector is considered as an absolute number. It can be stated that a correction should be made in terms of weight in the overall economy. Hence, this section combines the notion of emissions and value added to understand each country's and sector's efficiency, i.e., the amount of emissions needed to produce value added.

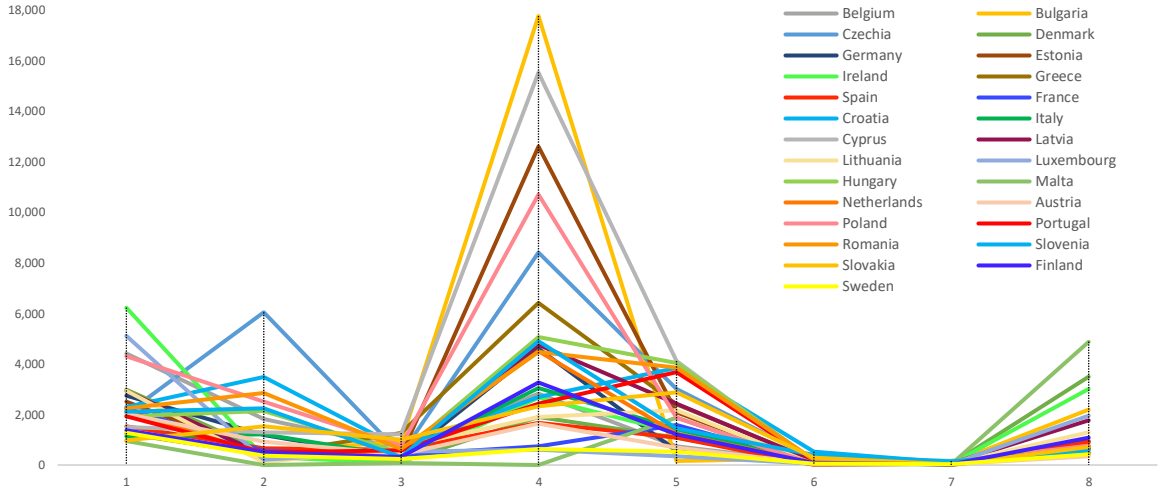


Graph 5: CO2 equiv., ton / value added, €. Source: Data from EUROSTAT

From graph 5 it is clear that Bulgaria and Poland are the most emitting economies in the EU in relation to their value added. This is mainly due to the emissions intensity of their power and electric sector (4) - see sector 4 on Graph 6 and Annex Graph 2. In the opposite side, Sweden is EU's most emissions efficient economy, as is quite notable their long-time green policies towards carbon neutrality. Luxemburg is also quite green efficient, although it benefits a great deal on an economy that is built upon low emission sectors, e.g. financial sector (11) accounts for 27% of GDP – see Annex Graph 1. Another interesting observation is in relation to Germany, that despite being by far the most emitting country in the EU (almost twice the emissions from Poland), ranks as the 7th most emission efficient economy.

As we show numbers about economic activity and emissions, it is pertinent to combine both metrics and get a clear view which countries and sectors have the most "green efficient" economies and sectors. To assess this relation across sectors and from this point on, only the MES are taken into consideration – sectors 1 to 8.

The heterogeneity across sectors (not only countries) is also quite high. From the analysis of Graph 6, it can be stated that sectors that weigh less on a country's economy have a tendency to be overlooked in terms of emissions due to their relative weakness when compared to others. This is true in Ireland's agriculture sector (1), the highest emitting in the EU, which accounts only 0,65% to the country's GDP (versus a 2,33% average for EU countries). As another example, in Czechia, the mining sector (2) is EU's least efficient one and this sector contributes a 0,77% share of the total GDP. Also, it is quite obvious Sweden's lead in almost every sector of activity in terms of the least necessity of emissions to produce valued added to their economy, mainly due to the policies already mentioned.



Graph 6: CO2 equiv., ton / value added, € by sector in the EU countries. . Source: Data from EUROSTAT

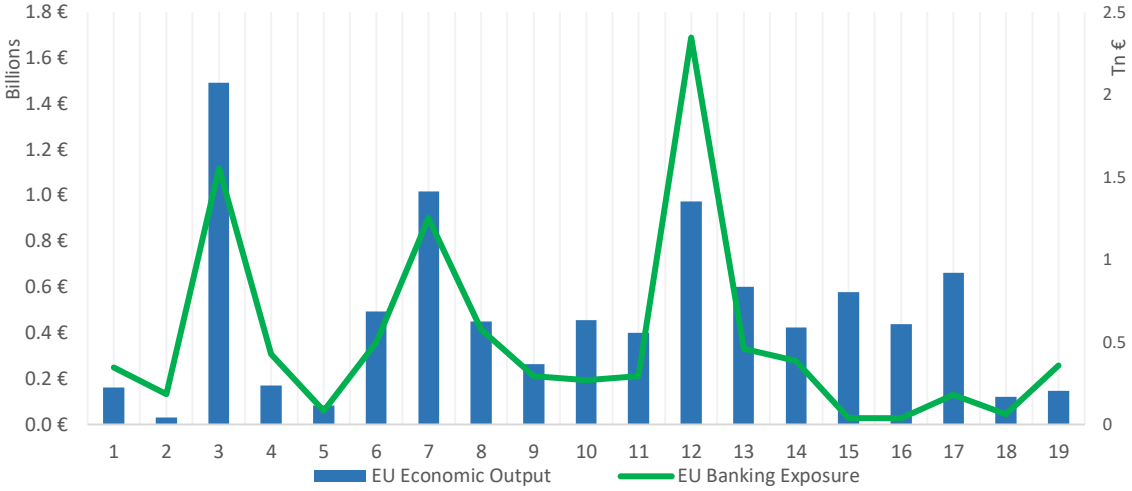
Another insight we can take from this graph is that the power sector (4) is by far the most emitting sector per added value. This also explains why it came to be the sector where the climate transition really took off, as mentioned in section II.

4.3. Exposure Data in the European Banking System

4.3.1. Overview

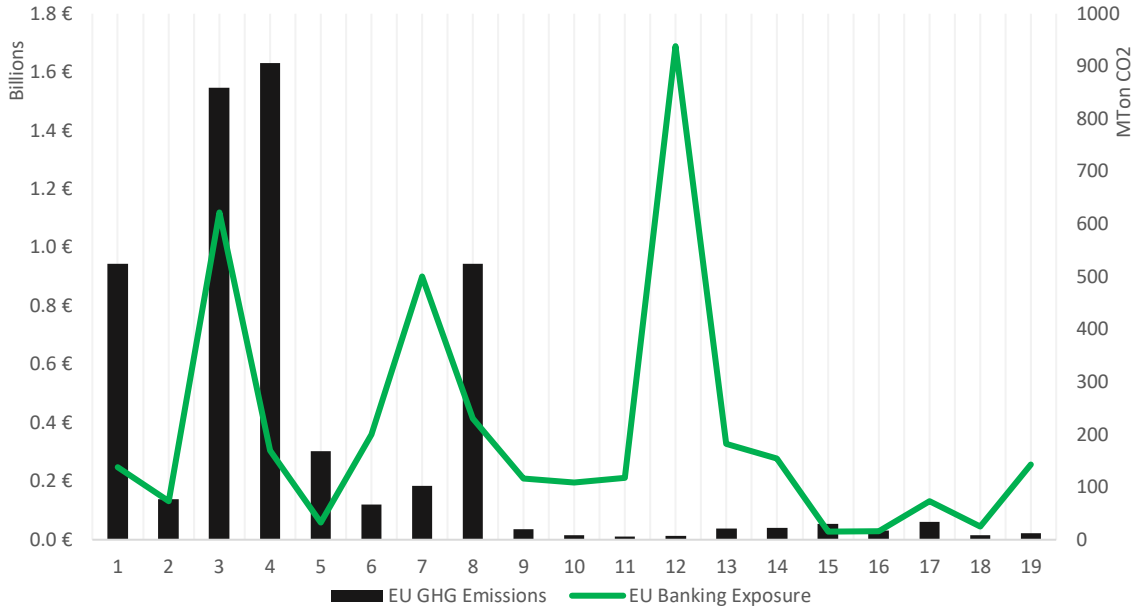
Having discussed and analyzed both economic output data and emission data from each sector and country, we are able now to discuss the exposure that the European Banking Sector faces – given the specificities of each country/ economy and its banking sector.

In graph 7 and 8 it is shown the bulk of data in terms of economic output and emissions in relation to the banking exposure – the figures shown are in absolute values for the whole European Union as of 2019.



Graph 7: Banking Exposure (Bn€) / Economic Output (Tn €) by NACE. Source: Data from EUROSTAT, EBA

In relation to Graph 7, the correlation between the economic output and the banking exposure is quite relevant. The economic output level is a good indicator of which sectors banks are more exposed to, despite some characteristics and specificities. The more relevant of these characteristics being: a) real estate (12) is by far the sector where the most exposure lies in absolute terms, which can be explained by the high level of real guarantees banks have at their disposal (the real estate itself), therefore being more available to lend money; b) the sectors more prone to have public ownership, such as water supply (5), public administration (15), education (16) and health services (17), have a significantly less bank debt in relation to their economic output than normal sectors where private ownership is the standard, which can be explained by the direct funding governments can provide to these sectors and c) the arts and entertainment sector (18) is also arguably running low levels of debt in relation to their economic output, given that the funding for these activities is perceived as risky (low certainty on future cash flows) and that the companies usually have little or no collateral to put up as guarantee – see the EC survey on financing cultural and creative activities (Directorate General for Education and Culture. et al., 2013).



Graph 8: Banking Exposure (Bn€) / GHG Emissions (Mton CO2 equi.) by NACE. . Source: Data from EUROSTAT, EBA

Considering Graph 8, and comparatively to Graph 7, no correlation appears to be perceptible. It is relevant, however, to compare the four most emitting sectors and their banking debt: a) Agriculture (1) is generally a sector with a high degree of subsidies, therefore being less dependent on bank debt to finance their activity; b) Manufacturing (3) appears to be the sector where a more direct correlation is present among all the sectors; c) Electricity supply (4) is sector that can have a high public ownership in some countries, whilst also having a very high degree of emissions in relation to its economic output (see Graph 6), therefore showing comparatively low levels of bank debt in relation to their emissions; d) transportation (8) seems to be half-way between the three previous situations given that it can have a high degree of subsidies / public ownership whilst have the capacity to issue bank debt using instruments of debt that use the transport assets as collateral, thus having access to high levels of debt.

4.3.1. European Banking Exposure in the MES

In table 3 it is shown the exposure of the banking system of each country relative to the MES - sectors 1-8. The sum of the exposure to the MES varies from 78% in Romania to 25% in Sweden. The comparison of the table below with Graph 5 shows a clear correlation between the emitting intensity of the economy and the country's banking system exposure to the MES.

Also, it is shown that the 2 most important economies in the EU (Germany and France) stand bellow EU average in their exposure to the MES: 41% and 47%, respectively.

Nevertheless, the 3 economies that complete the top 5 (Italy, Spain and Netherlands) stand above EU average: 66%, 60% and 60%, respectively.

Country	MES share	1	2	3	4	5	6	7	8	Total Exposure M€
RO	78%	9,58%	0,71%	19,58%	2,05%	0,81%	11,32%	26,19%	7,96%	3 777 €
SI	77%	1,58%	0,81%	29,55%	3,90%	0,95%	6,98%	20,60%	12,31%	5 428 €
GR	73%	1,76%	1,43%	19,27%	6,58%	0,16%	8,75%	21,54%	13,35%	89 116 €
HU	70%	6,54%	1,03%	18,89%	6,02%	0,94%	6,28%	22,99%	7,30%	15 000 €
IT	66%	2,13%	1,15%	27,94%	3,73%	1,04%	9,14%	15,67%	5,30%	747 738 €
PL	65%	1,52%	2,16%	25,40%	3,28%	1,19%	6,29%	17,33%	7,72%	28 993 €
BG	62%	2,92%	2,21%	19,22%	2,31%	0,42%	14,80%	16,57%	3,85%	2 320 €
LT	62%	4,50%	1,33%	18,32%	2,71%	1,86%	10,11%	14,58%	8,67%	1 075 €
LV	61%	9,37%	0,25%	13,66%	4,37%	1,08%	6,07%	13,53%	12,58%	805 €
NL	60%	13,93%	3,40%	14,66%	3,28%	0,77%	3,24%	14,09%	7,09%	578 549 €
ES	60%	2,48%	1,78%	18,30%	5,68%	0,72%	7,63%	17,28%	6,48%	795 890 €
IS	58%	13,28%	0,40%	17,02%	0,75%	0,60%	11,99%	8,83%	5,57%	10 391 €
PT	56%	3,65%	0,52%	16,86%	1,60%	1,31%	11,28%	14,80%	6,35%	59 705 €
OT	56%	7,89%	0,37%	12,17%	3,11%	0,72%	4,82%	17,96%	8,47%	4 092 €
CY	53%	1,29%	0,73%	8,91%	0,68%	0,62%	13,09%	21,14%	6,40%	8 434 €
GB	52%	2,55%	2,79%	17,87%	2,79%	0,94%	4,37%	15,56%	5,25%	953 555 €
BE	52%	2,12%	0,21%	14,35%	4,00%	1,80%	9,69%	14,39%	5,40%	112 998 €
AT	51%	2,13%	1,36%	18,15%	3,27%	0,88%	6,75%	13,69%	4,29%	167 949 €
FR	47%	3,74%	2,15%	13,43%	4,27%	0,56%	4,45%	12,59%	5,95%	1 721 772 €
MT	47%	0,12%	0,00%	10,36%	6,72%	1,22%	7,86%	15,86%	4,94%	3 149 €
IE	45%	5,06%	0,48%	20,10%	2,89%	0,55%	2,47%	9,26%	4,67%	67 176 €
DE	41%	0,62%	0,94%	13,96%	8,02%	1,56%	2,17%	8,22%	5,70%	835 360 €
FI	41%	5,43%	1,15%	10,90%	4,35%	0,91%	4,58%	6,96%	6,74%	171 326 €
EE	36%	6,21%	0,17%	13,08%	1,42%	0,07%	3,35%	10,01%	1,67%	958 €
LU	33%	0,94%	0,00%	6,74%	2,77%	0,02%	13,75%	6,21%	2,80%	6 547 €
DK	28%	2,58%	0,61%	8,49%	2,74%	0,30%	2,68%	6,51%	4,17%	193 538 €
SE	25%	1,22%	1,50%	5,72%	3,10%	0,72%	2,84%	4,69%	4,80%	273 934 €
Total	**51%**	**3,58%**	**1,89%**	**16,14%**	**4,40%**	**0,86%**	**5,17%**	**12,98%**	**5,98%**	**6 941 715 €**

Table 3: Exposure to the MES in EU countries' banking system. Source: Data from EBA

Table 4 presents the top 10 banks more and less exposed to the MES (including only exposures greater than 10 bn €). Concerning the least exposed banks, we find that one sector contributes for the great divide: real estate (12). Aareal Bank, for example, is present almost entirely in the real estate sector (89,6% of its total exposure). The average exposure of the 10 banks less exposed to the MES to the real estate sector is of 80,0%, which really explains the extremely low shares to these sectors. In fact, from the 38 banks with and exposure to the MES lower than the EU average, only 3 have a share of exposure to the real estate sector of less than 20%. The average % of exposure of the 38 institutions to the real estate sector is of 46,1%.

The most exposed banks to the MES also have, in most cases, a clear explanation to stand among others or just a preferred sector for the bank to operate in. The top 2 institutions are banks from car makers, which explains their huge exposure to the wholesale and retail trade (7). Manufacturing (3) and agriculture (1) are the other two sectors that help explain the very high exposure to the MES.

Bank Name	MES share	1	2	3	4	5	6	7	8	Total Exposure M€
Volkswagen Bank	89,9%	0,2%	0,0%	1,7%	0,0%	0,1%	2,6%	84,2%	1,1%	18 903 €
RCI Banque	81,4%	0,5%	0,0%	4,4%	0,5%	0,2%	6,3%	66,7%	2,8%	19 213 €
Credito Emiliano Holding S.p.A.	78,9%	2,1%	0,2%	44,8%	1,1%	1,3%	3,8%	22,9%	2,8%	14 409 €
National Bank of Greece, S.A.	75,9%	1,6%	5,0%	15,1%	12,6%	0,0%	5,7%	20,8%	15,3%	17 433 €
Alpha Bank, S.A.	74,4%	1,5%	0,5%	20,7%	4,4%	0,2%	10,3%	24,6%	12,2%	25 762 €
Piraeus Bank, S.A.	73,4%	2,3%	0,3%	21,3%	6,9%	0,2%	11,4%	17,3%	13,6%	25 415 €
Standard Chartered Plc	72,7%	0,5%	5,5%	32,7%	4,6%	0,3%	2,2%	20,1%	6,7%	116 579 €

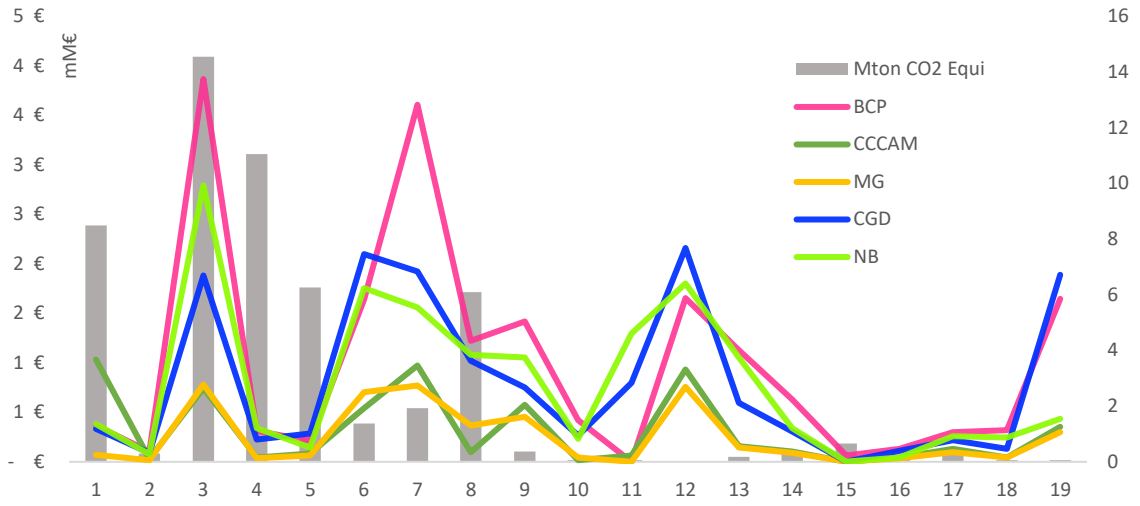
Banco de Crédito Social Cooperativo	72,6%	13,7%	0,3%	20,8%	0,9%	0,8%	11,2%	19,2%	5,2%	12 889 €
Coöperatieve Rabobank U.A.	71,7%	34,0%	0,7%	14,5%	1,8%	0,2%	2,7%	14,8%	3,1%	211 794 €
Banco BPM S.p.A.	70,6%	2,6%	0,6%	34,0%	1,7%	1,0%	12,0%	14,9%	3,7%	62 111 €
Aareal Bank AG	1,7%	0,0%	0,0%	0,0%	0,0%	0,0%	1,0%	0,7%	0,0%	23 825 €
Deutsche Pfandbriefbank AG	2,7%	0,0%	0,0%	0,2%	0,3%	0,6%	1,1%	0,0%	0,5%	28 100 €
Kuntarahoitus Oyj	8,0%	0,0%	0,0%	0,1%	2,7%	3,0%	1,2%	0,0%	1,1%	13 018 €
BNG Bank N.V.	9,4%	0,0%	0,0%	0,0%	1,6%	3,2%	2,2%	0,5%	1,9%	50 995 €
Landesbank Berlin Holding AG Group	10,0%	0,0%	0,0%	1,4%	3,0%	0,1%	0,9%	2,4%	2,0%	35 971 €
Svenska Handelsbanken	13,9%	1,0%	0,2%	2,7%	1,2%	0,3%	4,1%	2,7%	1,7%	99 369 €
Nykredit Realkredit A/S	16,4%	2,1%	0,0%	5,1%	1,5%	0,0%	1,9%	3,8%	1,8%	56 020 €
Kommuninvest - group	16,8%	0,0%	0,0%	0,0%	9,0%	5,8%	0,4%	0,0%	1,7%	19 501 €
Jyske Bank A/S	19,6%	1,8%	0,1%	4,3%	2,4%	0,2%	3,4%	4,7%	2,7%	28 170 €

Table 4: The 10 EU banks more and less exposed to the MES– includes only exposures >10 Bn€. Source: Data from EBA

4.3.2. Exposure in the Portuguese Banking System

At the European level, Portugal stands in the 13th place of the ranking of the countries more exposed to the MES – see table 3. With a 56% of exposure, Portugal has a greater share than the total weighted average of the exposure to these sectors by all institutions in the EU (51% of total exposure to the MES). In a sector by sector analysis with the average exposure, Portugal's banking system is clearly above average in respect to the construction sector (6), with a 11,3% of exposure in relation with a 5,2% of EU average. In fact, the construction sector is the 3rd most contributor to the overall exposure, only topped by manufacturing (3) with a share of 16,9% (in line with EU average of 16,1%) and by retail (7) with a share of 14,8% (slightly above EU average of 13,0%).

In relation to Portugal's exposure to the MES in comparison to the EU average, it is worth mentioning Portugal's exposure could potential be higher if not for the high share linked to the exposure of other services (19). In Portugal the exposure to the other services category is the 2nd highest of all the EU: 7,7% in relation to an average of 3,7%. The exposure classified in this "sector" is related more frequently to holdings companies, and it does not represent accurately the real sector of activity linked to that exposure – see graph 9.



Graph 9: Portuguese Banking Exposure (mM€) / GHG Emissions (Mton CO2 equi.) by NACE. Source: Data from EBA

As previously mentioned, the Portuguese banking exposure has a high exposure to the other services segment (19), with a share of 7,7%. Also, apart from the MES and sector 19, the real state sector accounts for 12,2% of the total exposure (bellow EU average of 24,3%).

Data from the Portuguese Banking Sector was also retrieved from the EBA Transparency Exercise and reporting is available from 5 institutions: Caixa Geral de Depósitos (CGD), Caixa Económica Montepio Geral (MG), LSF Nani Investments (NB) – vehicle which controls Novo Banco, Caixa Central - Caixa Central de Crédito Agrícola Mútuo (CCCAM) and Banco Comercial Português (BCP). The data from Santander Totta and Banco BPI are included in the data reported by these banking institutions at their consolidation level – Santander and Caixabank in Spain, respectively.

Bank Name	MES share	1	2	3	4	5	6	7	8	Total Exposure M€
BCP	59,5%	1,9%	0,5%	20,3%	1,6%	1,1%	8,6%	19,0%	6,4%	19 024 €
CCCAM	59,5%	17,3%	0,5%	12,5%	0,8%	1,4%	9,0%	16,3%	1,7%	5 962 €
MG	58,7%	1,5%	0,3%	16,3%	0,7%	1,3%	14,7%	16,2%	7,7%	4 773 €
NB	54,6%	2,5%	0,5%	18,8%	2,3%	1,0%	11,8%	10,5%	7,3%	14 879 €
CGD	52,2%	2,2%	0,6%	12,5%	1,5%	1,9%	13,9%	12,8%	6,8%	15 067 €
									Total	**59 705 €**

Table 5: Portuguese Banks Exposure to the MES. Source: Data from EBA

In relation to individual banks, graph 9 shows a clear picture of the 5 Portuguese banks with data available. As a complement element in our analysis Table 6 shows the total exposure to the MES and the total absolute exposure of each bank. The numbers and presence in each sector show up to some point the strategies of each bank in the pursuit of growth. As a clear example, CCCAM presence in the agriculture business (1) stands out in both absolute and relative terms. The presence of BCP in the manufacturing (3) and trade (7) sector is clear and represents the leadership of the institution in terms of this segment.

When comparing emissions and exposure, BCP also stands in the top spot, given that it has the highest exposure to manufacturing (3) and transport (8) sectors. In the broader picture, all banks have a greater exposure to the MES than the EU average, which will potentially mean more challenges to Portuguese banks in the future.

5. Conclusions and further research

This thesis is an attempt to understand and analyze how the banking system, in Europe in general and in Portugal in particular, are prepared to undertake the challenges arising from climate change risk, and in which sectors lies more of it. The number of institutions now working on methodologies and designing metrics is the highest it has ever been. Also, the political will to fuel funds and policies into the matter continues to grow. But this tendency still has its hurdles.

The data retrieved from the EUROSTAT and EBA is the most granular data available for the economy and banking sector within the EU in respect to the different sectors at the present date. Although one can analyze and discuss its relations, few conclusions are key for short- and medium-term future policies. Nevertheless, the author feels that the path to better understanding and managing climate related risk will have to be accompanied by more and better financial data reporting. The Taxonomy proposed by the EC will undoubtedly provide a good starting point from which analysis and policies can be designed from, especially when it is complied with by most companies across every dimension criteria up to the SME's.

From analysis on the information gathered, we can see that the countries where the banking system is less exposed to the climate transition risk are those that started "green" policies first, namely Sweden and their Nordic neighbors. The contrary is also true, meaning that counties with low emission efficiency economies have banking sectors more exposed to the risk of transition. The average exposure to sectors 1-8 (responsible by 95% of total emissions) in the EU is 51%. For this number also contributes the huge exposure that EU banks have to the real estate sector (12) alone (24,3%), which is left out of this category. Consequently, less than 25% of the total exposure is related to non-emitting and non-real state sectors.

Portugal has an exposure to most emitting sectors (MES) of 56%. Although the number is not worrisome, some precautions need to be taken into account, especially in respect to the manufacturing sector (3), which accounts for 27,7% of total PT emissions and represents 16,9% of exposure. The fact that the manufacturing sector contributes the most to the Portuguese GDP (13,9%) just adds up to the challenge.

Further work will continue to be needed in the years to come. Methodologies will for sure be improved and some of those will be left outdated in favor of innovative, more effective ones. The banking industry will have to go a long way to label their exposure, segment their clients (eventually in a more effective way than by NACE codes), and demand from them information

on their emission data and how their clients are dealing with both climate change risks, physical and transition. Meanwhile, risk management teams will start employing new models of environmental risk into the overall risk models so that bankers receive overall reports that mention what is the exposure of their institution to the climate change risks. These processes will come sooner or later, but sooner will provide less demanding risk management on both climate-change risks.

6. Annexes

6.1. List of NACE Codes

Nace Codes	Label
1	A Agriculture, forestry and fishing
2	B Mining and quarrying
3	C Manufacturing
4	D Electricity, gas, steam and air conditioning supply
5	E Water supply
6	F Construction
7	G Wholesale and retail trade
8	H Transport and storage
9	I Accommodation and food service activities
10	J Information and communication
11	K Financial and insurance activities
12	L Real estate activities
13	M Professional, scientific and technical activities
14	N Administrative and support service activities
15	O Public administration and defence, compulsory social security
16	P Education
17	Q Human health services and social work activities
18	R Arts, entertainment and recreation
19	S Other services

Annex Table 1: Nace Codes. Source: Data from EBA

6.2. List of Banks in the Transparency Exercise Autumn 2020 by EBA

Country	Name
Austria	Sberbank Europe AG
Austria	BAWAG Group AG
Austria	Raiffeisenbankengruppe OÖ Verbund eGen
Austria	Raiffeisen Bank International AG
Austria	Volksbanken Verbund
Austria	Erste Group Bank AG
Belgium	KBC Groep
Belgium	Investeringsmaatschappij Argenta
Belgium	Belfius Bank
Belgium	Dexia
Belgium	AXA Bank Belgium
Belgium	The Bank of New York Mellon
Bulgaria	First Investment Bank
Cyprus	RCB Bank Ltd
Cyprus	Bank of Cyprus Holdings Public Limited Company
Cyprus	Hellenic Bank Public Company Ltd
Germany	DekaBank Deutsche Girozentrale
Germany	Erwerbsgesellschaft der S-Finanzgruppe mbH & Co. KG
Germany	Deutsche Apotheker- und Ärztebank EG
Germany	Volkswagen Bank Gesellschaft mit beschränkter Haftung
Germany	Münchener Hypothekenbank EG
Germany	DZ BANK AG Deutsche Zentral-Genossenschaftsbank, Frankfurt
Germany	HASPA Finanzholding
Germany	State Street Europe Holdings Germany S.a.r.l. & Co. KG
Germany	Deutsche Bank AG
Germany	COMMERZBANK Aktiengesellschaft
Germany	Landesbank Baden-Württemberg
Germany	Landesbank Hessen-Thüringen Girozentrale
Germany	Norddeutsche Landesbank -Girozentrale-

Germany	Deutsche Pfandbriefbank AG
Germany	Aareal Bank AG
Germany	Hamburg Commercial Bank AG
Germany	Bayerische Landesbank
Germany	UBS Europe SE, Ffm
Germany	J.P. Morgan AG, Frankfurt am Main
Denmark	Jyske Bank A/S
Denmark	Sydbank A/S
Denmark	Nykredit Realkredit A/S
Denmark	Danske Bank A/S
Estonia	AS LHV Group
Spain	Banco de Crédito Social Cooperativo, S.A.
Spain	Banco Santander, S.A.
Spain	Unicaja Banco, S.A.
Spain	BFA Tenedora de Acciones, S.A.U.
Spain	Ibercaja Banco, S.A.
Spain	Kutxabank, S.A.
Spain	Liberbank, S.A.
Spain	CaixaBank, S.A.
Spain	Abanca Corporación Bancaria S.A.
Spain	Banco Bilbao Vizcaya Argentaria, S.A.
Spain	Banco de Sabadell, S.A.
Spain	Bankinter, S.A.
Finland	Kuntarahoitus Oyj
Finland	Nordea Bank Abp
Finland	OP Osuuskunta
Finland	Säästöpankkiliitto osk
France	SFIL
France	RCI Banque
France	Confédération Nationale du Crédit Mutuel
France	La Banque Postale
France	Bpifrance S.A. (Banque Publique d'Investissement)
France	C.R.H. - Caisse de refinancement de l'habitat
France	HSBC France
France	Groupe BPCE
France	Groupe Crédit Agricole
France	Société générale
France	BNP Paribas
France	Banque centrale de compensation
Greece	Alpha Bank, S.A.
Greece	National Bank of Greece, S.A.
Greece	Eurobank Ergasias Services and Holdings S.A.
Greece	Piraeus Bank, S.A.
Hungary	OTP Bank Nyrt.
Ireland	Barclays Bank Ireland Plc
Ireland	Citibank Holdings Ireland Limited
Ireland	AIB Group plc
Ireland	Bank of Ireland Group plc
Ireland	Ulster Bank Ireland Designated Activity Company
Ireland	Bank of America Europe Designated Activity Company
Iceland	Íslandsbanki hf.
Iceland	Landsbankinn hf.
Iceland	Arion banki hf
Italy	Intesa Sanpaolo S.p.A.
Italy	UniCredit S.p.A.
Italy	Unione di Banche Italiane S.p.A.
Italy	Credito Emiliano Holding S.p.A.
Italy	Banco BPM S.p.A.

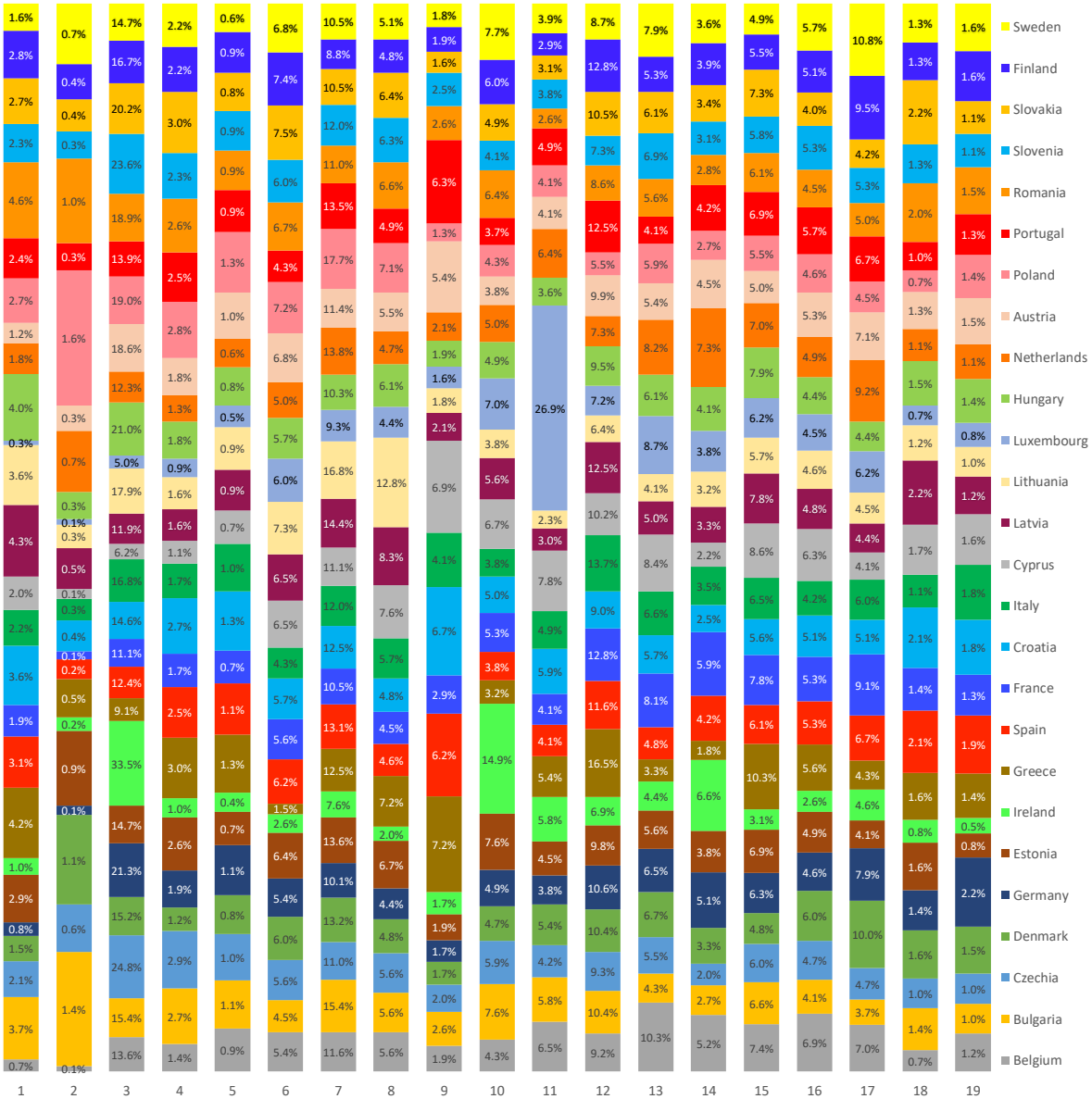
Italy	Banca Popolare di Sondrio, Società Cooperativa per Azioni
Italy	Banca Monte dei Paschi di Siena S.p.A.
Italy	Cassa Centrale Banca - Credito Cooperativo Italiano SpA
Italy	BPER Banca S.p.A.
Italy	ICCREA Banca S.p.A. – Istituto Centrale del Credito Cooperativo
Italy	Mediobanca – Banca di Credito Finanziario S.p.A.
Lithuania	Akcinė bendrovė Šiaulių bankas
Luxembourg	Precision Capital S.A.
Luxembourg	RBC Investor Services Bank S.A.
Luxembourg	J.P. Morgan Bank Luxembourg S.A.
Luxembourg	Banque Internationale à Luxembourg
Luxembourg	Banque et Caisse d'Epargne de l'Etat, Luxembourg
Latvia	Akciju sabiedrība "Citadele banka"
Malta	Commbank Europe Ltd
Malta	MDB Group Limited
Malta	Bank of Valletta Plc
Malta	HSBC Bank Malta p.l.c.
Netherlands	BNG Bank N.V.
Netherlands	ING Groep N.V.
Netherlands	de Volksbank N.V.
Netherlands	ABN AMRO Bank N.V.
Netherlands	Coöperatieve Rabobank U.A.
Netherlands	Nederlandse Waterschapsbank N.V.
Norway	DNB BANK ASA
Norway	SPAREBANK 1 SR-BANK ASA
Norway	SPAREBANK 1 SMN
Poland	Bank Polska Kasa Opieki SA
Poland	Powszechna Kasa Oszczędności Bank Polski SA
Portugal	Caixa Económica Montepio Geral, Caixa Económica Bancária, S.A.
Portugal	LSF Nani Investments S.à r.l.
Portugal	Caixa Central - Caixa Central de Crédito Agrícola Mútuo, CRL
Portugal	Banco Comercial Português, SA
Portugal	Caixa Geral de Depósitos, SA
Romania	Banca Transilvania
Sweden	Länsförsäkringar Bank AB - group
Sweden	Kommuninvest - group
Sweden	Skandinaviska Enskilda Banken - group
Sweden	SBAB Bank AB - group
Sweden	Swedbank - group
Sweden	Svenska Handelsbanken - group
Slovenia	Biser Topco S.à.r.l.
Slovenia	Nova Ljubljanska Banka d.d., Ljubljana
United Kingdom	Natwest Group plc
United Kingdom	Lloyds Banking Group Plc
United Kingdom	Nationwide Building Society
United Kingdom	Barclays Plc
United Kingdom	HSBC Holdings Plc
United Kingdom	Standard Chartered Plc

Annex Table 2: List of banks present in the data retrieved. Source: Data from EBA

6.3. Additional Graphs & Tables

Economic Output, M€	2019			
European Union	€	12 482 279,40	Latvia	€ 26 506,80
Belgium	€	425 002,20	Lithuania	€ 43 849,60
Bulgaria	€	52 859,90	Luxembourg	€ 57 610,50
Czechia	€	202 168,50	Hungary	€ 123 793,90
Denmark	€	272 921,30	Malta	€ 12 096,10
Germany	€	3 106 157,00	Netherlands	€ 722 150,00
Estonia	€	24 460,50	Austria	€ 355 359,00
Ireland	€	334 828,20	Poland	€ 467 843,20
Greece	€	155 780,40	Portugal	€ 185 162,80
Spain	€	1 089 802,00	Romania	€ 201 627,30
France	€	2 099 320,00	Slovenia	€ 42 343,20
Croatia	€	44 442,50	Slovakia	€ 83 985,50
Italy	€	1 605 631,50	Finland	€ 207 690,00
Cyprus	€	19 436,30	Sweden	€ 421 205,20

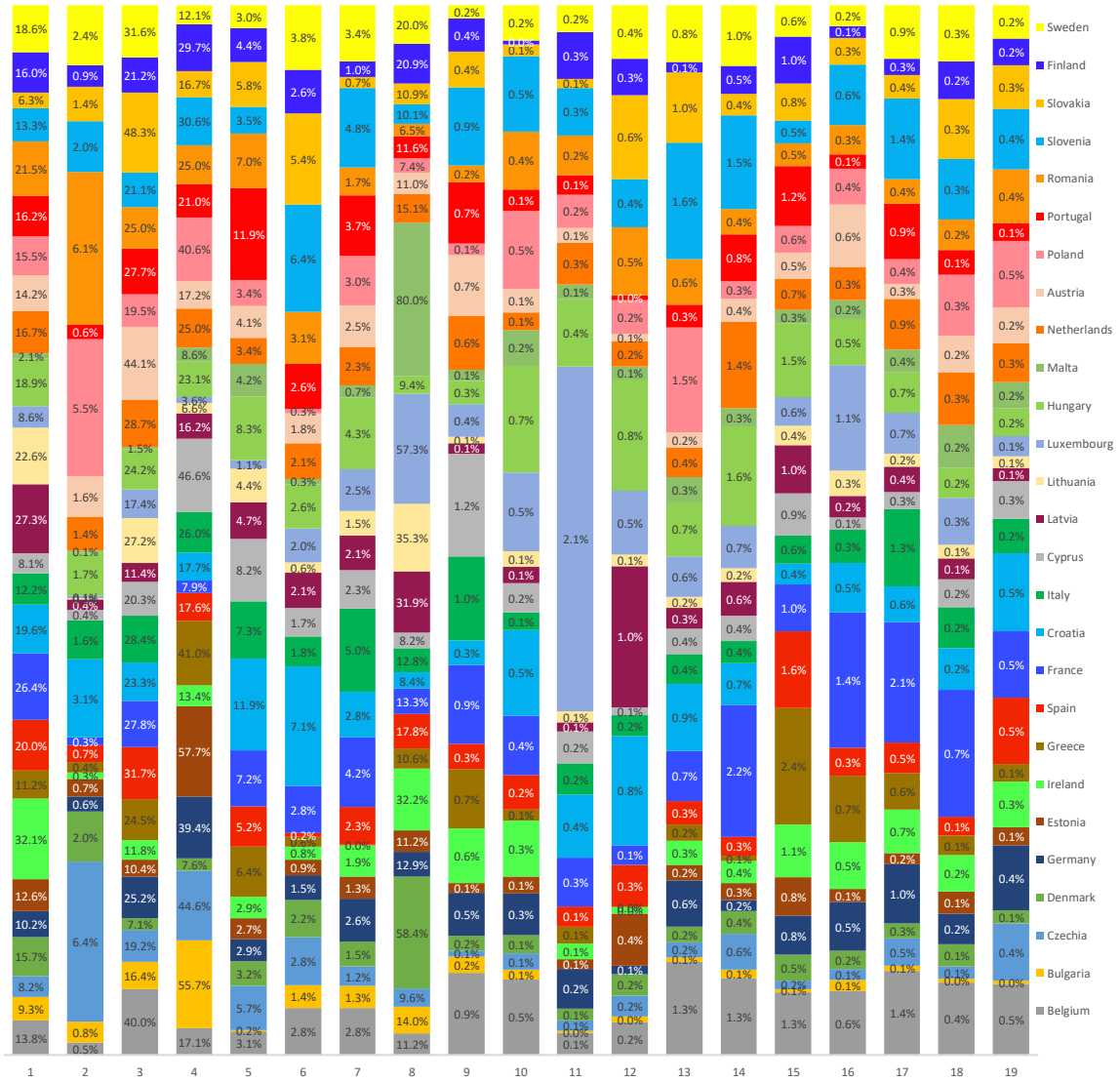
Annex Table 3: Economic Output per country, M€. Source: Data from EUROSTAT



Annex Graph 1: Relative economic output % within each country, by sector. Source: Data from EUROSTAT

GHG Emmissions (CO2 equiv.), Ton		2019	
European Union	3 049 773 292	Latvia	12 168 606
Belgium	95 698 376	Lithuania	20 419 019
Bulgaria	45 986 113	Luxembourg	8 584 529
Czechia	108 614 055	Hungary	49 690 202
Denmark	78 815 690	Malta	4 296 099
Germany	670 623 858	Netherlands	169 243 519
Estonia	13 955 166	Austria	61 697 642
Ireland	63 294 874	Poland	345 029 849
Greece	73 341 132	Portugal	52 482 808
Spain	254 787 800	Romania	95 705 807
France	330 936 868	Slovenia	15 394 292
Croatia	18 536 113	Slovakia	35 293 274
Italy	320 346 566	Finland	50 771 433
Cyprus	7 193 046	Sweden	46 866 555

Annex Table 4: GHG emmissions by country, ton CO2 equi.. Source: Data from EUROSTAT



Annex Graph 2: Relative GHG emissions within each country, by sector. Source: Data from EUROSTAT

Bank Name	% Exp. Sectors 1-8	1	2	3	4	5	6	7	8	Total Exposure M€
HSBC Holdings Plc	53,4%	1,2%	2,7%	20,0%	2,8%	0,6%	3,0%	17,9%	5,1%	492 225 €
BNP Paribas	55,3%	3,3%	1,3%	17,0%	6,3%	0,5%	4,7%	14,7%	7,5%	441 071 €
Groupe Crédit Agricole	58,0%	8,5%	3,1%	17,4%	4,4%	0,6%	3,8%	12,5%	7,5%	376 049 €
Banco Santander, S.A.	58,8%	2,5%	2,0%	16,7%	4,3%	0,5%	6,1%	20,7%	5,9%	326 735 €
Groupe BPCE	33,4%	1,5%	2,4%	7,2%	2,6%	0,5%	5,6%	11,0%	2,6%	287 432 €
UniCredit S.p.A.	61,1%	1,5%	1,1%	25,3%	4,3%	0,9%	6,8%	15,2%	6,0%	261 633 €
Confédération Nationale du Crédit Mutuel	33,1%	4,6%	0,3%	7,4%	1,1%	0,5%	5,4%	10,0%	3,9%	244 936 €
Société générale	47,6%	0,7%	4,7%	14,2%	4,8%	0,9%	3,3%	11,2%	7,7%	243 823 €
ING Groep N.V.	63,9%	1,4%	5,3%	20,3%	5,4%	0,9%	4,1%	16,4%	10,1%	234 114 €
Coöperatieve Rabobank U.A.	71,7%	34,0%	0,7%	14,5%	1,8%	0,2%	2,7%	14,8%	3,1%	211 794 €
Intesa Sanpaolo S.p.A.	69,8%	1,8%	2,4%	28,9%	4,7%	0,8%	8,9%	15,7%	6,5%	199 785 €
Deutsche Bank AG	37,8%	0,3%	1,8%	17,1%	2,4%	0,3%	2,3%	10,7%	2,9%	196 232 €
Banco Bilbao Vizcaya Argentaria, S.A.	62,6%	2,0%	3,0%	22,8%	7,1%	0,6%	6,3%	15,4%	5,4%	186 449 €
Natwest Group plc	46,6%	3,3%	1,4%	9,2%	3,1%	2,6%	6,7%	14,0%	6,3%	126 320 €
Nordea Bank Abp	43,3%	6,4%	1,5%	12,3%	3,2%	0,7%	4,2%	6,8%	8,3%	119 461 €
Standard Chartered Plc	72,6%	0,5%	5,5%	32,7%	4,6%	0,3%	2,2%	20,1%	6,7%	116 579 €
Barclays Plc	39,6%	4,3%	3,1%	12,2%	2,1%	1,0%	4,2%	8,4%	4,3%	114 390 €
COMMERZBANK Aktiengesellschaft	70,3%	0,4%	2,4%	35,5%	8,6%	1,6%	3,2%	13,0%	5,6%	105 641 €
Danske Bank A/S	34,6%	2,7%	1,1%	11,0%	3,5%	0,4%	2,7%	7,4%	5,8%	104 076 €
CaixaBank, S.A.	57,9%	2,0%	0,6%	14,7%	7,0%	0,9%	10,5%	13,3%	8,7%	100 261 €
Bayerische Landesbank	42,0%	2,2%	0,4%	8,1%	17,8%	4,9%	1,8%	1,9%	4,9%	99 668 €
Svenska Handelsbanken - group	13,9%	1,0%	0,2%	2,7%	1,2%	0,3%	4,1%	2,7%	1,7%	99 369 €
Lloyds Banking Group Plc	47,3%	9,0%	1,6%	9,0%	1,1%	1,3%	10,9%	9,8%	4,5%	94 825 €
Skandinaviska Enskilda Banken - group	38,6%	1,0%	3,2%	10,1%	4,9%	0,4%	1,5%	8,0%	9,5%	89 821 €
DZ BANK AG Deutsche Zentral	39,5%	0,8%	1,0%	10,8%	7,6%	0,5%	3,1%	5,8%	9,9%	81 835 €
ABN AMRO Bank N.V.	53,5%	6,7%	7,2%	8,2%	1,7%	0,5%	2,7%	14,4%	12,1%	80 444 €
Erste Group Bank AG	47,7%	2,0%	0,4%	17,4%	3,6%	0,7%	8,5%	11,3%	3,9%	75 049 €
DNB BANK ASA	52,6%	4,0%	5,5%	9,6%	4,7%	0,5%	9,4%	5,6%	13,3%	70 094 €
Landesbank Baden-Württemberg	44,6%	0,1%	0,2%	22,9%	6,5%	1,1%	1,6%	7,6%	4,5%	69 716 €
KBC Groep	58,8%	3,3%	0,3%	19,2%	3,6%	1,2%	8,1%	16,8%	6,2%	68 206 €
Landesbank Hessen-Thüringen Girozentrale	35,0%	0,0%	0,1%	9,7%	8,5%	4,9%	0,9%	1,9%	8,9%	67 334 €
Banco BPM S.p.A.	70,6%	2,6%	0,6%	34,0%	1,7%	1,0%	12,0%	14,9%	3,7%	62 111 €
Banco de Sabadell, S.A.	56,8%	1,6%	1,0%	16,3%	7,6%	1,2%	9,3%	13,4%	6,4%	57 698 €
Nykredit Realkredit A/S	16,4%	2,1%	0,0%	5,1%	1,5%	0,0%	1,9%	3,8%	1,8%	56 020 €
Swedbank - group	27,3%	2,3%	1,9%	7,0%	2,1%	0,2%	3,8%	5,3%	4,6%	53 957 €
BNG Bank N.V.	9,4%	0,0%	0,0%	0,0%	1,6%	3,2%	2,2%	0,5%	1,9%	50 995 €
Norddeutsche Landesbank -Girozentrale-	48,8%	1,9%	0,0%	6,2%	22,9%	1,2%	1,4%	4,2%	10,9%	50 648 €
Raiffeisen Bank International AG	64,3%	3,0%	3,5%	23,0%	3,4%	0,7%	4,4%	20,8%	5,5%	48 405 €
Unione di Banche Italiane S.p.A.	67,0%	1,7%	0,4%	30,2%	4,1%	1,6%	10,4%	14,5%	4,1%	44 423 €
ICCREA Banca S.p.A	68,5%	4,7%	0,3%	25,4%	1,4%	1,2%	14,8%	17,5%	3,3%	44 310 €
Bpifrance S.A.	38,3%	0,5%	0,3%	11,2%	10,0%	0,8%	3,0%	9,4%	3,3%	42 787 €
BFA Tenedora de Acciones, S.A.U.	68,1%	1,9%	1,0%	20,3%	8,0%	1,2%	7,7%	17,8%	10,2%	41 960 €
Banca Monte dei Paschi di Siena S.p.A.	69,5%	3,6%	0,2%	27,9%	3,4%	1,9%	11,6%	17,1%	3,8%	40 739 €
OP Osuuskunta	45,6%	4,4%	0,3%	10,6%	8,7%	0,8%	6,9%	10,0%	4,0%	37 050 €
Landesbank Berlin Holding AG Group	10,0%	0,0%	0,0%	1,4%	3,0%	0,1%	0,9%	2,4%	2,0%	35 971 €
HSBC France	49,8%	0,3%	0,3%	29,7%	2,9%	0,2%	1,3%	9,4%	5,7%	35 173 €
Belfius Bank	45,2%	0,3%	0,1%	8,1%	4,6%	2,8%	11,6%	13,7%	4,1%	33 537 €
Bankinter, S.A.	57,4%	2,1%	0,3%	19,0%	3,7%	0,7%	9,0%	16,5%	6,1%	28 477 €
Jyske Bank A/S	19,6%	1,8%	0,1%	4,3%	2,4%	0,2%	3,4%	4,7%	2,7%	28 170 €
Deutsche Pfandbriefbank AG	2,7%	0,0%	0,0%	0,2%	0,3%	0,6%	1,1%	0,0%	0,5%	28 100 €
Bank of Ireland Group plc	38,5%	6,0%	0,4%	16,5%	1,3%	0,5%	0,9%	8,9%	4,0%	28 049 €
La Banque Postale	23,3%	0,2%	0,1%	2,9%	5,4%	0,5%	4,1%	5,5%	4,6%	27 574 €
BPER Banca S.p.A.	69,1%	3,0%	0,2%	29,3%	3,1%	1,3%	10,8%	17,1%	4,4%	26 856 €
Alpha Bank, S.A.	74,3%	1,5%	0,5%	20,7%	4,4%	0,2%	10,3%	24,6%	12,2%	25 762 €
AIB Group plc	41,5%	6,6%	0,2%	11,6%	5,2%	0,7%	4,9%	7,6%	4,6%	25 513 €
Piraeus Bank, S.A.	73,4%	2,3%	0,3%	21,3%	6,9%	0,2%	11,4%	17,3%	13,6%	25 415 €
Aareal Bank AG	1,7%	0,0%	0,0%	0,0%	0,0%	0,0%	1,0%	0,7%	0,0%	23 825 €
Hamburg Commercial Bank AG	50,4%	0,1%	0,0%	2,7%	16,5%	0,2%	5,0%	3,0%	22,9%	23 610 €
Cassa Centrale Banca	67,7%	5,1%	0,4%	22,9%	1,7%	1,0%	15,7%	18,1%	2,9%	21 130 €
Eurobank Ergasias S.A.	67,7%	1,6%	1,0%	18,5%	3,7%	0,3%	6,1%	23,6%	12,9%	20 506 €
Raiffeisenbankengruppe	46,5%	1,0%	0,6%	20,3%	1,8%	0,6%	7,6%	9,5%	5,1%	20 021 €
Kommuninvest - group	16,8%	0,0%	0,0%	0,0%	9,0%	5,8%	0,4%	0,0%	1,7%	19 501 €
RCI Banque	81,4%	0,5%	0,0%	4,4%	0,5%	0,2%	6,3%	66,7%	2,8%	19 213 €
BCP	59,5%	1,9%	0,5%	20,3%	1,6%	1,1%	8,6%	19,0%	6,4%	19 024 €
Volkswagen Bank	89,9%	0,2%	0,0%	1,7%	0,0%	0,1%	2,6%	84,2%	1,1%	18 903 €
DekaBank Deutsche Girozentrale	28,5%	0,0%	1,0%	3,2%	11,0%	2,7%	1,5%	0,7%	8,7%	17 695 €
National Bank of Greece, S.A.	75,9%	1,6%	5,0%	15,1%	12,6%	0,0%	5,7%	20,8%	15,3%	17 433 €
Banca Popolare di Sondrio	63,5%	1,3%	0,6%	24,1%	4,1%	1,6%	12,2%	14,4%	5,2%	16 189 €
Mediobanca S.p.A.	51,1%	0,2%	0,1%	29,4%	2,4%	0,6%	4,0%	9,4%	4,9%	16 153 €
CGD	52,2%	2,2%	0,6%	12,5%	1,5%	1,9%	13,9%	12,8%	6,8%	15 067 €
Powszechna Bank Polski SA	67,4%	1,9%	2,2%	27,2%	4,6%	1,2%	5,3%	16,2%	8,7%	15 025 €
OTP Bank Nyrt.	70,0%	6,5%	1,0%	18,9%	6,0%	0,9%	6,3%	23,0%	7,3%	15 000 €
NB	54,6%	2,5%	0,5%	18,8%	2,3%	1,0%	11,8%	10,5%	7,3%	14 879 €
Abanca Corporación Bancaria S.A.	61,8%	2,9%	0,5%	22,6%	5,6%	0,9%	8,1%	12,6%	8,7%	14 833 €

Credito Emiliano Holding S.p.A.	79,0%	2,1%	0,2%	44,8%	1,1%	1,3%	3,8%	22,9%	2,8%	14 409 €
Bank Polska Kasa Opieki SA	62,2%	1,1%	2,1%	23,5%	1,9%	1,1%	7,4%	18,5%	6,6%	13 967 €
Citibank Holdings Ireland Limited	67,3%	0,1%	1,3%	43,4%	1,7%	0,2%	1,1%	13,3%	6,2%	13 614 €
HASPA Finanzholding	21,7%	0,2%	0,2%	3,3%	3,0%	1,0%	4,7%	6,4%	2,9%	13 070 €
Kuntarahoitus Oyj	8,0%	0,0%	0,0%	0,1%	2,7%	3,0%	1,2%	0,0%	1,1%	13 018 €
Banco de Crédito Social Cooperativo, S.A.	72,1%	13,7%	0,3%	20,8%	0,9%	0,8%	11,2%	19,2%	5,2%	12 889 €
BAWAG Group AG	27,4%	1,4%	0,3%	8,2%	2,3%	3,4%	2,4%	7,2%	2,3%	11 548 €
Dexia	28,9%	0,0%	0,0%	2,7%	5,3%	1,8%	13,9%	0,1%	5,0%	9 590 €
SBAB Bank AB - group	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	9 441 €
Nationwide Building Society	9,9%	0,0%	0,0%	0,0%	0,0%	0,0%	9,9%	0,0%	0,0%	9 215 €
Volksbanken Verbund	31,9%	1,0%	0,2%	5,6%	1,5%	0,8%	9,7%	10,4%	2,7%	8 625 €
Kutxabank, S.A.	59,9%	1,3%	0,0%	19,3%	1,7%	1,4%	15,6%	9,6%	11,0%	7 577 €
SPAREBANK 1 SR-BANK ASA	46,4%	3,4%	6,6%	3,8%	1,5%	0,1%	10,4%	3,6%	17,0%	7 523 €
Ibercaja Banco, S.A.	73,9%	5,2%	0,3%	17,8%	2,2%	0,7%	22,2%	20,6%	4,9%	7 081 €
Unicaja Banco, S.A.	61,2%	6,5%	2,0%	9,3%	7,2%	3,3%	18,1%	8,7%	6,0%	6 169 €
CCCAM	59,5%	17,3%	0,5%	12,5%	0,8%	1,4%	9,0%	16,3%	1,7%	5 962 €
Liberbank, S.A.	63,1%	4,0%	0,3%	17,6%	7,0%	0,8%	10,9%	16,1%	6,3%	5 762 €
Bank of Cyprus Holdings	48,7%	1,2%	1,0%	7,2%	0,2%	0,2%	12,1%	20,8%	6,0%	5 661 €
Banque Internationale à Luxembourg	38,6%	0,8%	0,0%	8,0%	3,3%	0,0%	16,0%	7,1%	3,4%	5 422 €
Sydbank A/S	68,6%	7,9%	0,3%	16,0%	3,1%	1,1%	7,0%	27,5%	5,7%	5 273 €
MG	58,7%	1,5%	0,3%	16,3%	0,7%	1,3%	14,7%	16,2%	7,7%	4 773 €
Landsbankinn hf.	58,3%	14,1%	0,1%	15,9%	0,4%	0,2%	13,9%	8,7%	5,1%	4 578 €
SPAREBANK 1 SMN	49,8%	13,8%	0,1%	4,8%	0,4%	0,3%	8,1%	3,9%	18,4%	4 523 €
Sberbank Europe AG	63,1%	4,1%	3,6%	19,7%	8,4%	0,9%	5,2%	18,4%	3,0%	4 302 €
All other banks	55,5%	7,9%	0,4%	12,2%	3,1%	0,7%	4,8%	18,0%	8,5%	4 092 €
Banca Transilvania	78,2%	9,6%	0,7%	19,6%	2,0%	0,8%	11,3%	26,2%	8,0%	3 777 €
SFIL	22,5%	0,0%	2,4%	8,9%	3,9%	0,0%	2,1%	0,0%	5,3%	3 715 €
Íslandsbanki hf.	57,6%	11,8%	1,0%	18,8%	1,5%	0,5%	7,7%	8,8%	7,4%	3 491 €
Nova Ljubljanska Banka d.d., Ljubljana	80,5%	1,8%	0,6%	26,5%	4,3%	0,8%	8,6%	22,0%	15,9%	3 466 €
Hellenic Bank Public Company Ltd	61,3%	1,5%	0,1%	12,5%	1,6%	1,6%	15,0%	21,8%	7,2%	2 773 €
Arion banki hf	59,9%	13,8%	0,1%	16,6%	0,1%	1,7%	14,7%	9,2%	3,7%	2 322 €
First Investment Bank	62,3%	2,9%	2,2%	19,2%	2,3%	0,4%	14,8%	16,6%	3,9%	2 320 €
Biser Topco S.à.r.l.	70,0%	1,2%	1,2%	35,0%	3,1%	1,2%	4,1%	18,1%	6,0%	1 963 €
Länsförsäkringar Bank AB - group	48,2%	6,9%	0,3%	8,4%	0,1%	0,7%	15,7%	9,0%	7,3%	1 845 €
Säästöpankkiliitto osk	31,7%	6,0%	0,4%	5,4%	0,4%	0,4%	9,0%	7,3%	2,8%	1 797 €
Bank of Valletta Plc	48,6%	0,1%	0,0%	6,7%	7,0%	0,1%	9,6%	17,7%	7,3%	1 796 €
State Street Europe	20,6%	0,0%	0,0%	17,1%	0,0%	0,0%	0,0%	2,0%	1,5%	1 633 €
UBS Europe SE, Ffm	19,8%	1,3%	2,8%	11,9%	1,1%	0,0%	1,7%	0,6%	0,3%	1 478 €
AXA Bank Belgium	35,6%	1,2%	0,1%	3,9%	0,1%	0,1%	14,9%	13,8%	1,5%	1 357 €
de Volksbank N.V.	38,3%	0,0%	0,0%	1,5%	32,6%	0,0%	1,8%	2,3%	0,2%	1 203 €
Precision Capital S.A.	7,1%	1,5%	0,0%	0,5%	0,1%	0,0%	3,1%	1,8%	0,0%	1 125 €
Akcinė bendrovė Šiaulių bankas	62,1%	4,5%	1,3%	18,3%	2,7%	1,9%	10,1%	14,6%	8,7%	1 075 €
AS LHV Group	36,0%	6,2%	0,2%	13,1%	1,4%	0,1%	3,4%	10,0%	1,7%	958 €
Akciju sabiedrība "Citadele banka"	60,9%	9,4%	0,3%	13,7%	4,4%	1,1%	6,1%	13,5%	12,6%	805 €
HSBC Bank Malta p.l.c.	48,1%	0,2%	0,0%	6,9%	11,4%	4,8%	2,9%	19,9%	2,1%	753 €
MDB Group Limited	41,4%	0,1%	0,0%	25,8%	0,0%	0,0%	8,9%	5,3%	1,3%	600 €
Investeringsmaatschappij Argenta	72,7%	0,0%	0,0%	41,1%	0,0%	22,0%	7,6%	1,8%	0,1%	309 €

Annex Table 5: Exposure in sectors 1-8 by EU banks. Source: Data from EBA

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