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ESG reputational risk and market valuation: Evidence from the European banking industry

Marco Mandas *, Oumaima Lahmar, Luca Piras, Riccardo De Lisa

Department of Economics and Business, University of Cagliari, Viale S. Ignazio 17, Cagliari 09124, Italy

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ABSTRACT

This study examines the potential bidirectional linkage between reputational risk exposure associated with Environmental, Social and Governance (ESG) factors and market valuation in the banking sector. We build a monthly panel dataset for 19 European listed banks from 2012 to 2020. We employ a Bayesian Panel Vector Autoregressive model to examine the dynamics between the two variables of interest. The findings show an inverse bidirectional causality between ESG reputational risk exposure and banks' market valuation and suggests that the impact of ESG reputational risk shocks on market valuation is more significant for high-exposed banks. Our results are consistent with the stakeholder and slack resources theories and highlight the importance of ESG factors in influencing the banks' market valuation. Moreover, the study demonstrates how prior financial performances impact the ESG reputational exposure. These insights provide guidance on how banks can manage their ESG risks to enhance brand identity and market value.

1. Introduction

The association between ESG performance (ESGP) and corporate financial performance (CFP) has been investigated in depth both theoretically and empirically by using different indicators for each variable of interest and various models to analyze their dynamics (Friede et al., 2015).

There are two theoretical pillars around which the debate is taking place. The first is the stakeholder theory (Freeman, 2010) proposing that ESG compliance has a positive impact on CFP as it could be, in the long term, a competitive advantage characterized by fundamental strategies that incorporate stakeholders' benefits and interests. One could understand this proposition as the transition of corporate policies from comprising exclusively "shareholderism" to embracing "stakeholderism" (Khlif et al., 2015). On the other hand, slack resources theory proposes that financial performance impacts corporate ESG compliance. Financially constrained firms are less inclined to allocate resources to ESG initiatives. Furthermore, when these firms experience a relaxation of financial constraints, spending on ESG activities tends to increase (Waddock and Graves, 1997).

Even though there is a considerable number of studies supporting both directions (Waddock and Graves, 1997; Chen and Wang, 2011; La Torre et al., 2021; Aydoğmuş et al., 2022), the findings do not seem to be conclusive given that they are diverse and sometimes contradictive. In fact, some papers claim that ESG compliance has a negative effect on financial performance which is in line with the shareholder primacy theory proposed by Friedman (2007), suggesting that ESG compliance could increase costs and, as a

* Corresponding author.
E-mail address: marco.mandas@unica.it (M. Mandas).

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consequence, negatively impact CFP (Brammer et al., 2006).

The theoretical framework provided by stakeholder and slack resources theories, suggests that both causality directions may hold simultaneously. However, in the existing literature, the association between ESGP and CFP is examined mainly using regressive models that suffer from endogeneity problems. In other terms, if there is a bidirectional causality, it is crucial to address the endogeneity of the subject variables as overlooking this matter may result in biased estimations. In an attempt to study in which direction the causation runs, another stream of research looks at the association between ESGP and CFP separately, neglecting potential simultaneous occurrences (Waddock and Graves, 1997; Scholtens, 2008). Lin et al. (2019) employ a panel vector autoregressive (VAR) model to investigate both directions in an integrated framework. They assess the potential effectiveness of prior ESG ratings in predicting future financial performance. Simultaneously, they explore the impact of financial performance on future ESG ratings.

Conversely, studies focusing on the banking sector are still scarce. Examining the available literature on the latter, some studies find a positive association between ESGP and CFP in different geographical contexts such as sub-Saharan countries (Siueia et al., 2019), US (Ersoy et al., 2022), and in emerging economies (Azmi et al., 2021). Other studies find no evidence (Soana, 2011) or even a negative impact of ESG compliance on the financial performance in the banking sector in Europe (Bătae et al., 2021) and in Italy (Menicucci and Paolucci, 2022). The use of different indicators and samples could explain the divergence in the past findings. More importantly, the regression models adopted in the majority of papers studying ESGP-CFP dynamics in the banking sector may not be suitable for a situation where the two variables may mutually influence each other simultaneously as suggested by the theoretical framework. We intend to fill this gap by using a Bayesian Panel Vector Autoregressive model (BPVAR) to investigate the potential for bidirectional linkage between a market-based financial performance indicator (price-to-book ratio) and an ESG reputational risk exposure metric based on evidence from the European banking sector. Furthermore, we include cross-sectional heterogeneity in the model, as different banks may exhibit diverse behaviors and responses to shocks. Ignoring cross-sectional heterogeneity assumes that all entities in the panel respond similarly to changes in variables over time. Accounting for heterogeneity allows for the estimation of bank-specific responses, capturing the variations in reactions.

We contribute to the existing literature in a set of ways. First, we present and discuss a comprehensive literature review on interactions between ESGP and CFP, hence we offer an ordered representation of the debate taking place about the causality direction and its nature. The second contribution is related to the use of a BPVAR approach, which addresses endogeneity concerns by modeling the simultaneous relationships among variables without relying on strict exogeneity assumptions. To our knowledge, the current body of literature investigating ESGP-CFP relationship in the banking sector adopts standard regression models. In the presence of endogeneity, these models can lead to biased and inconsistent parameter estimates. Furthermore, the BPVAR model allows for the assessment of causality and impulse response functions, enabling us to analyze the direction and magnitude of the effects between variables. This is essential when investigating complex relationships where causality is not straightforward. The third contribution involves the inclusion of cross-sectional heterogeneity. Compared to other studies adopting a panel VAR approach in this context (Anderson et al., 2013; Chollet and Sandwidi, 2018; Lin et al., 2019), we account for bank-specific responses to shocks. This is beneficial when dealing with a diverse set of entities, each of which may exhibit unique behaviors and responses. The model estimates the heterogeneous traits associated with individual banks by allowing the VAR coefficients and residual variances to be bank specific.

Our findings show an inverse bi-directional ESGP-CFP relationship by which the ESG reputational risk exposure inversely influences the market valuation for a given bank and vice versa. Moreover, our results suggest that banks with higher levels of ESG risk exposure when witnessing a shock (increase in the ESG risk level), exhibit a larger response (decrease) in terms of market valuation compared to low-exposed banks.

We argue that these results are coherent with both the instrumental stakeholder theory and the slack resources theory. Banks investing in ESG tend to be less exposed to ESG reputational risks which, according to the instrumental stakeholder theory, results in a stronger brand identity and leads to better market valuation. On the other hand, our findings support the second direction illustrated by the significant impact of past financial performance on ESG investments and consequently ESG risk exposure, which is in coherence with the implications of slack resources theory.

The rest of the paper is organized as follows. The second section discusses a comprehensive literature review on the association of ESGP and CFP. The third section presents the data and sample selection. The fourth section explains the methodology used for the study. Then, in section five we discuss the main empirical findings, and we conclude the paper in the last section.

2. Literature review

Over the last decade Corporate Social Responsibility, which evolved into ESG compliance has been extensively studied from different approaches. Scholars struggled in the beginning with the non-financial performance measurements. As a result, a variety of indexes and measurement tools have been developed subsequently to capture the extent to which a subject company is performing in terms of ESG criteria (Choda and Teladia, 2018; Clément et al., 2022).

With the technological advancements, new measurement tools are implemented to extract not only numerical data to measure non-financial performance, but also textual data such as corporate disclosures, news, media, and financial analysts' comments and are integrated to provide more comprehensive indexes (Baier et al., 2020). Still, scholars are debating the accuracy and reliability of these measurements along with novel issues and challenges to be further investigated.

Navigating the literature, a wide range of studies can be found examining ESG in terms of its legal framework (Camilleri, 2015), and its impact on consumer behavior (Park et al., 2014). More finance-oriented studies examine ESG disclosures in terms of the content quality (Aureli, 2017), the impact on investors' sentiment (Riedl and Smeets, 2017), the market reaction (Wang et al., 2022), etc. On the other hand, the interaction between ESG and financial performance has been the subject of a lively debate among scholars,

managers, and policymakers for decades. More recent studies examine the dynamics between ESG and financial performance in terms of earnings (Anderson et al., 2013), firm valuation (Carnevale and Mazzuca, 2014), cost of debt and access to financing (Apergis et al., 2022), and risk reduction (Jo and Na, 2012).

Thousands of papers investigate the dynamics between corporate financial and non-financial performance without reaching a conclusive result. Friede et al. (2015) summarize the findings of more than 2000 studies that investigate the dynamics between ESGP and CFP showing that 90% of the studies find a non-negative relation with a large majority reporting a positive association. Alshehhi et al. (2018) find similar results by conducting a meta-analysis of 132 papers published in top journals in the field. The study shows that 78% of the examined papers report a favorable relationship between ESGP and CFP. Similar conclusions emerge when examining the literature within the banking sector, as evidenced by La Torre et al. (2021).

The evidence suggests that the relationship between ESGP and CFP can be positive, negative, neutral, and even bidirectional (Lin et al., 2019), which, in turn, could be explained by the different ESG measurements adopted, the models used in the analysis, or even the financial performance indicators considered. In order to have a comprehensive background about the dynamics studied so far in the academic literature, it is convenient to divide the existing papers according to their objectives.

2.1. Impact of ESGP on financial performance

The first section deals with the positive impact of ESGP on financial performance. According to the instrumental stakeholder theory, the management framework should consider the importance of all stakeholders in an organization's decision-making process (Freeman, 2010). This theory suggests that companies should take into account the interests of all stakeholders, including employees, customers, shareholders, suppliers, and the wider community, when making business decisions. One of the key benefits of the instrumental stakeholder theory is that it helps companies develop a more sustainable business model. By considering the interests of all stakeholders, companies can create a more balanced approach to decision-making, which reduces the risk of short-term decision-making that may harm the company's reputation or financial stability in the long run. Moreover, the instrumental stakeholder theory can help companies build stronger relationships with their stakeholders, which can lead to increased loyalty, trust, and support. This can be particularly beneficial for companies operating in highly competitive markets, as it can help them differentiate themselves from their competitors and build a stronger brand identity.

A significant number of studies provide evidence supporting the positive impact of ESG activities on CFP in different sectors and geographic areas (Waddock and Graves, 1997; Chen and Wang, 2011; Aydoğmuş et al., 2022; Naeem et al., 2022). Alfalih (2022) finds a linear and non-linear impact of ESG initiatives on financial performance when divided into three separate pillars which suggests the existence of direct and indirect effects of ESG pillars on CFP. Naeem et al. (2022) argue that the positive impact of ESG activity of environmentally sensitive corporations on financial performance is greater and more significant in developed countries than in emerging countries. Moreover, banks appear to receive positive rewards for being socially responsible as financial performance is positively and significantly related to ESG scores (Cornett et al., 2016; Albuquerque et al., 2019a; Buallay, 2019; Azmi et al., 2021).

On the other hand, the traditional shareholder theory, also known as the shareholder primacy model, is a management framework that places the interests of shareholders at the center of a company's decision-making process (Friedman, 2007). According to this theory, the primary goal of a company is to maximize shareholder value by generating profits and increasing share prices. Proponents of this theory argue that by focusing on shareholder value, companies would create a more efficient and competitive market, which would ultimately benefit all stakeholders (Wright and Ferris, 1997; López et al., 2007).

Going through the rather large body of literature dealing with the effect of ESGP on CFP, the number of scientific contributions finding a negative effect is way lower than those finding a positive one. Such studies are not absent in the literature, and some researchers suggest that ESG engagement can, in fact, result in a negative impact on corporate financial performance (Brammer et al., 2006; Marsat and Williams, 2011; Nollet et al., 2016; Landi and Sciarelli, 2019; Garcia and Orsato, 2020; Duque-Grisales and Aguilera-Caracuel, 2021).

According to Barnett (2007), it makes sense to predict that investing in ESG may have a negative impact on a firm financial performance since it implies a reallocation of funds to other stakeholders from shareholders. Folger-Laronde et al. (2022) consider the interaction between ESG ratings and financial returns of ETFs (Exchange Traded Funds) and raise concerns about the capacity of high ESG performance to hedge ETFs returns during the market's severe downturns.

2.2. Impact of financial performance on ESGP

Slack resources theory is a management framework that suggests that companies should maintain a level of unused or underutilized resources, known as slack resources, in order to increase their ability to adapt to changes in their environment and to take advantage of new opportunities. In fact, slack resources resulting from good past financial performance enable the company to provide and enhance corporate social performance (Waddock and Graves, 1997). A company's social engagement and ESG compliance can be aimed at improving its competitive advantage through reputation, and long-term cost-saving (Fauzi and Idris, 2009). Results show that a company's antecedent financial performance, given by both stock-market returns and accounting-based measures, seems to be more closely associated with ESGP than subsequent performance. Furthermore, examining a sample of 289 US companies from 1991–2004, Scholtens (2008) suggests the direction of the 'causation' mainly goes from financial to social performance. However, the specific interaction patterns tend to vary along different ESG pillars.

In the same direction, though proving the opposite sign, Hirigoyen and Poulain-Rehm (2015) perform a causality test to understand the nature of the interaction between social and financial performance based on a sample of 329 listed companies in the United States,

Europe and the Asia-Pacific region. The results evidence that not only greater social responsibility engagement does not result in better financial performance, but also that financial performance negatively impacts corporate social responsibility.

2.3. Bidirectionality

In the previous sections, we explore the literature in both directions. Numerous studies investigate the impact of ESGP on CFP and vice versa, examining the nature of the relationship and the dynamics of interaction. Consequently, one can assume that it is possible to have a complex and simultaneous ESGP-CFP relationship, where the effect of each on the other is reciprocal.

To our knowledge, very few studies in the literature have investigated this hypothesis. In fact, in their paper, Waddock and Graves (1997) find that ESGP is positively associated with prior CFP in favor of the slack resources theory. On the other hand, ESGP is shown to be positively associated with future CFP, supporting the theory that good management and ESGP are positively related. Interestingly, Preston and O'Bannon (1997) argue that there is strong evidence of positive correlations in both contemporaneous and lag-lead formulations.

Nakamura (2015), on the other hand, finds controversial mixed results based on a sample of 185 Japanese firms. In fact, the author argues that investing in environmental activities has a negative impact on corporate economic performance while investing in labor-oriented activities does not have a significant effect. Furthermore, the paper shows that a strong economic performance leads to a decrease in environmental investments and an increase in social investments.

In order to analyze the ESGP-CFP dynamics, some studies adopt a panel VAR approach to overcome the endogeneity problem (Anderson et al., 2013; Chollet and Sandwidi, 2018; Lin et al., 2019). Anderson et al. (2013) find a positive influence of ESGP on CFP and a negative influence of CFP on ESGP, suggesting more effective and less opportunistic use of corporate social responsibility. Chollet and Sandwidi (2018) examine ESG engagement and financial risk interaction. The authors show that there is a virtuous circle between ESGP and financial risk. The results demonstrate that good ESGP tends to reduce a company's financial risk which, in turn, reinforces corporate ESG engagement. A more recent paper by Lin et al. (2019) examines the causality effect between CFP and ESGP in 100 of the Fortune Most Admired Companies. The authors show that higher CFP leads to more ESGP engagement however the opposite direction is not systematic. Besides, a significant and considerable negative impact has been observed on ESGP and the three CFP measures, namely, return on equity, return on assets, and return on invested capital. Research articles studying bidirectionality are noticeably scarce in the literature and mostly in the banking sector, which seems very interesting and worth verifying.

In this paper, we aim at modeling the bidirectional interactions between ESGP and CFP using a dataset composed of 19 European listed banks. Previous studies opt for different measures of the ESGP (Roberts and Dowling, 2002), which could be one of the reasons for which the past findings are divergent. The ESGP indicators include impact measurements, MSCI ESG global index (Kilic et al., 2022), ESG scores from Refinitiv (Aydoğmuş et al., 2022; Ersoy et al., 2022; Naeem et al., 2022), corporate social responsibility ratings (Lin et al., 2020), and ESG information from the RepRisk database (Fafaliou et al., 2022).

Following the work of the latter, we use ESG reputational risk exposure index which is a novel more comprehensive tool that captures not only the company's past ESG performance, but also its risk exposure to ESG issues. As a matter of fact, the ESG reputational risk exposure index is used to assess a company's exposure to ESG risks. It is designed to help investors and other stakeholders evaluate companies based on their ESG reputation and identify potential risks that could affect a company's future reputation and financial performance.

On the other hand, the financial performance indicators used in the literature are quite varied and can be accounting-based measurements and/or market-based measurements. In fact, scholars tend to use return on asset, return on equity, return on investment, earnings management, Tobin's Q, or price-to-book ratio (La Torre et al., 2021). In this study, we opt for the price-to-book ratio which has the price component as a market-based indicator, and the book value which is an accounting-based indicator. The choice is motivated by the fact that it combines investors' opinions on the bank's performance (for which reputation plays a central role) with the accounting assessment of the previous. In this sense, we believe that for the banking sector, the price-to-book ratio can properly reflect the impact of the ESG reputational risk by capturing the market valuation for a subject bank through the price component while including the book value as a bank-related measure (Galant and Cadez, 2017).

3. Data

Our variables of interest are the price-to-book ratio (PTB), obtained from the Eikon platform of Refinitiv, and the RepRisk Index (RRI) provided by RepRisk, which is a global leader firm in data science specialized in measuring ESG risk and quantitative solutions.

The PTB is a market-based metric and reflects the investors' expectations of how much profits and shareholder value the company's management will be able to generate in the future. In this regard, PTB is the ratio of the market value of a bank's equity to its accounting, or book, value. We opt for a market-based parameter for a set of reasons, among which: a) in the banking sector actors are required to provide prominent levels of transparency, we can therefore assume that the market is generally well informed about price-sensitive news; b) investors tend to be rather reactive to news, therefore, a market-based measure is frequently updated, promptly reflecting changes compared to accounting-based measures such as Return on Asset (ROA) or Return on Equity (ROE); c) it is a straightforward measure in assessing market valuations and expectations on short/medium term investors' expectations on banks' fundamental values; d) it is simple to interpret and to collect. Accordingly, it is more suitable for the purpose of this study aiming also at exploring the short-term relationship between market valuation and ESG reputational risk exposure.

The ESG reputational risk exposure is measured by the RRI. The latter is a proprietary algorithm developed by RepRisk that dynamically captures and quantifies a company's reputational risk exposure to ESG issues by screening different sources of information

and evaluating each ESG risk incident according to its severity, novelty, and the quality and credibility of the information source. The RRI ranges from zero (lowest) to 100 (highest). The higher the value is, the higher the risk exposure will be. RRI is calibrated by RepRisk in a specific way that denotes low ESG reputational risks exposure from 0 to 24, medium ESG reputational risks exposure from 25 to 49, high ESG reputational risks exposure from 50 to 59, very high ESG reputational risks exposure from 60 to 74, and extremely high ESG reputational risks exposure from 75 to 100 providing the necessary information to identify the exposed companies.

For the empirical analysis, we construct a sample of 19 listed banks operating in the European Union using monthly data ranging from January 2012 to February 2020. In order to ensure the stability of the model, we limit the sample to pre-covid data as including post-pandemic data may bias the results. The banks have been selected based on the EURO STOXX BANK EUR PRICE INDEX constituents within the specified period of analysis. Since 1998 the index has witnessed a varying number of listed banks and has been frequently updated. We choose the banks that had been constantly included in the index throughout the entire period under examination. The selected banks with higher market capitalizations and trading volumes in the eurozone, are also included in the list of significant financial institutions under the direct supervision of the ECB.[1]

The EURO STOXX Banks is a stock index that tracks the performance of the banking sector in the eurozone. It provides a snapshot of the overall health of the banking industry and can be used to gauge investor sentiment towards the sector. Therefore, we consider the sample of banks constituting the index to be particularly suitable for the objectives of the analysis.Top of FormBottom of Form.

In the euro area, we observe that banks working within similar economic conditions and structures while adhering to identical regulations exhibit a similar trend and show a similar pattern of change over time. The macroeconomic outlook, the financial market sentiment and the regulatory environment, where the banks operate, can have an impact on the broad performance of the banks and their valuations (Bogdanova et al., 2018; Rodriguez d'Acri et al., 2019). The PTB as a market-based measure, inevitably incorporate systematic (non-bank-specific) and market characteristics. Consequently, we also include three exogenous variables in the model aiming at capturing the overall banking sector sentiment and the macroeconomic outlook in the Eurozone: (i) the EURO STOXX Banks Index (ESB), obtained from the Eikon platform of Refinitiv, the Euro area GDP annual growth (GDP) from the Federal Reserve Economic Data (FRED) database, and the Harmonized Index of Consumer Prices annual growth (HICP) from the ECB Statistical Data Warehouse (SDW).

4. Methodology

The existent literature mainly relies on regression models to study the nature and the magnitude of the relationship between ESGP and CFP in the banking sector (Cornett et al., 2016; Shen et al., 2016; Miralles-Quirós et al., 2019; Buallay et al., 2020). Moreover, to our knowledge, the relationship between ESGP and CFP in the banking sector has been examined in both directions, but not conjunctively (Hu and Scholtens, 2014; Cornett et al., 2016; Buallay, 2019; Buallay et al., 2020). In a context of bidirectional causality, as suggested by the stakeholder and slack resources theories we discussed, OLS regression might not effectively capture this simultaneity, leading to biased estimates.

Based on this background, we consider the panel vector autoregressive model more suitable for investigating the relationship between bank valuation and ESG reputational risk exposure. We employ a Bayesian Panel Vector Autoregressive model with cross-sectional heterogeneity. This model can capture both the static and dynamic interdependencies between the PTB and RRI, treating each of the variables as endogenous to its own past values, as well as to the other variables under consideration. It also estimates the heterogenous responses of banks to the imposed shocks.

The BPVAR is built with the same logic as standard VARs, but it adds a cross-sectional dimension. VARs have been extensively used in monetary and fiscal policy literature to address policy-related questions and estimate the impact of the actions implemented by the competent authorities (Sims, 1980). More recently, they have been also employed in a variety of fields, including banking and finance. Koutsomanoli-Filippaki and Mamatzakis (2009) adopt this methodology to study the relationship between risk and efficiency in the European Banking sector. Jouida (2018) investigates the dynamic interaction between diversification, capital structure, and profitability. Ciccarelli et al. (2015) employ a Bayesian random effect panel VAR model to test the credit channel theory of the monetary policy, and Huljak et al. (2022) estimate the impact of changes in non-performing loan (NPL) ratios on aggregate banking sector variables and the macroeconomy.

Overall, the selection of a panel VAR model involves a careful consideration of the research question, data characteristics, and appropriate statistical methods to ensure that the model is appropriate for the analysis.

Assuming dynamic homogeneity in the data-generating process, the standard classical approach to estimate the model parameters involves pooled estimation with fixed effects, which may capture constant but idiosyncratic heterogeneities across variables and/or units (Canova and Ciccarelli, 2013). The Arellano and Bover (1995) GMM approach has frequently been employed and it is proven to be consistent even when T is small, and N is large (Love and Zicchino, 2006; Love and Turk Ariss, 2014; Abrigo and Love, 2016; Lin et al., 2019). However, the GMM approach requires specification differencing, which discards sample information and may result in less accurate inference if the discarded information is relevant to the parameters of interest. Furthermore, given the suspected

[1] The final sample includes the following institutions: Banco BPM Spa (BAMI.MI), Banco Bilbao Vizcaya Argentaria SA (BBVA.MC), Bank of Ireland Group PLC (BIRG.I), Bankinter SA (BKT.MC), BNP Paribas SA (BNPP.PA), Caixabank SA (CABK.MC), Credit Agricole SA (CAGR.PA), Commerzbank AG (CBKG.DE), Unicredit SpA (CRDI.MI), Deutsche Bank AG (DBKGn.DE), Erste Group Bank AG (ERST.VI), ING Groep NV, (INGA.AS), Intesa Sanpaolo SpA (ISP.MI), KBC Groep NV (KBC.BR), Mediobanca (MDBI.MI), Raiffeisen Bank International AG (RBIV.VI), Banco de Sabadell SA (SABE.MC), Banco Santander SA (SAN.MC), Société Générale SA (SOGN.PA).

cross-sectional heterogeneity, along with a sufficiently large T and a moderate N of our data, we have decided to employ a form of partial pooling that can enhance the accuracy of the model's coefficients estimates. With the introduction of cross-sectional heterogeneity, the BPVAR can be thought as a collection of bank-specific VARs, where the coefficients and residual variances are allowed to be unit-specific, while drawn from a distribution with similar mean and variance (partial pooling). Specifically, we follow the hierarchical prior identification scheme proposed by Jarociński (2010) and the model estimation has been implemented relying on the BEAR toolbox and MATLAB codes developed by Dieppe et al. (2016), which also provide a detailed description of the methodology.

The reduced-form BPVAR model we use is as follows:

$$y_{it} = A_{1,i}(L)y_{it-1} + C_i x_t + u_{it} \tag{1}$$

where i is an individual bank ($i = 1, 2, \ldots, N$), t is time ($t = 1, 2, \ldots, T$), y_{it} is a vector of two endogenous variables, market valuation (PTB) and ESG reputational risk exposure (RRI), $A(l)$ is a 2×2 matrix of coefficients, x_t is the $m \times 1$vector of exogenous variables, and C_i is the $n \times m$ matrix relating the endogenous variables of unit i to the exogenous ones. The exogenous variables included in the model are a constant term, the ESB, which captures the banking sector market sentiment, and GDP along with HICP, which serve as proxies of the economic outlook. The model we estimate allows for bank-specific coefficients. Specifically, the random coefficient model estimated here assumes that A_i can be expressed as $A_i = a + a_i$ where it is assumed that a_i is normally distributed as follows $a_i \sim N(0, \Sigma_a)$. Consequently, the coefficients in the VAR will differ across banks while being drawn from the same distribution, centered around a common mean for all euro area banks. This helps to account for similarities across banks' coefficients by identifying a shared component among different banks while also allowing for cross-sectional heterogeneity in how they respond to shocks. This is important in our context because the PTB and RRI variables in our sample display distinct dynamics across units. The bank-specific constant terms imply we have bank-fixed effects. By including them, we get rid of any variation between banks, and we control for any bank-specific variable which do not change over time. Finally, it is assumed that the error term is normally distributed as follows $u_{it}|y_{it-1} \sim N(0, \Sigma_i)$ that is a multivariate white-noise vector of i residuals.

Given the short sample and the high dimensionality of the model, which also includes cross-sectional heterogeneity, we opt for using one lag to balance the need for capturing relevant dynamics with the risk of overfitting. Experimenting with a longer lag length (up to 12 lags due to the monthly frequency of the data) results in a decline in the quality of the estimations. Both the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) suggest that the optimal choice is one lag. Furthermore, it appears that the variables exhibit a first-order autoregressive process by examining the autocorrelation and partial autocorrelation plots for each endogenous variable.

VAR methods are very useful in analyzing temporal relationships in an integrated model and we consider them particularly well-suited to address our research question which requires disentangling the dynamics of interrelated factors over time and across units (in our case, banks). The estimation and analysis of the impulse response functions (IRFs) are used to implement dynamic simulations of the variables' behavior.

4.1. Prior of the Bayesian estimation

Bayesian estimation allows for the inclusion of prior information. In our case, where data is limited and there are a large number of parameters to estimate, Bayesian estimation can be especially advantageous due to its ability to combine prior information with the information contained in the data, thereby improving the accuracy and precision of the estimates.

Our approach in setting the priors is based on a hierarchical prior identification scheme which essentially follows that of Jarociński (2010). The primary advantage of applying this identification methodology stems from treating not only the set of vectors A_i ($i = 1, 2, \ldots, N$), but also the residual covariance matrices Σ_i ($i = 1, 2, \ldots, N$), and the common mean and variance of the VAR coefficients a and Σ_a as random variables and including all of them in the estimation process. One of the main benefits of this is that the model can now endogenously estimate the series of Σ_i's that are defined within it.

The full posterior distribution for the model is equal to the product of the data likelihood function $\pi(y|\alpha, \Sigma)$, with the conditional prior distribution $\pi(\alpha|a, \Sigma_a)$ for α and the prior $\pi(\Sigma)$ for Σ, along with the two hyperpriors $\pi(a)$ and $\pi(\Sigma_a)$.[2] Essentially, the posterior distribution combines the prior belief on the model parameters with the information contained in the data defined by the likelihood function.

In our case, priors incorporate the belief that the endogenous variables included in the model follow an autoregressive process of order one (this prior belief is generally referred as Minnesota prior). The prior distribution and the set of λ parameters controlling the tightness of the prior are those typically assumed in the literature. Specifically, λ_1 that captures the overall tightness of the priors is set to 0.1, λ_2 that controls the tightness for the cross-variable parameters is set to 0.5, λ_3 that is a scaling coefficient controlling the speed at which coefficients for lags greater than 1 converge to 0 is set to 1, and λ_4 that relates to the exogenous variables is set to 100.

4.2. Identification of the shocks

To estimate the causal relationship between market valuation and ESG reputational risk and identify the structural disturbances in a simultaneous equations system, assumptions must be made about the contemporaneous relationship between the two endogenous

[2] The details of the specific forms of the likelihood functions and prior distributions can be found in (Dieppe et al., 2016; Jarociński, 2010).

variables. We choose to adopt the Cholesky decomposition identification method, which involves imposing a set of recursive zero restrictions on the contemporaneous coefficients.

This method, also known as "triangularization", is introduced by Sims (1980) and we consider it to be the most appropriate approach for estimating the relationship we are interested in. Its straightforward and intuitive logic make it the most used identification method in VARs literature.

With only two endogenous variables, we only need to impose one zero restriction. Specifically, we assume that the ESG Reputational Risk Index has a contemporaneous effect on the Price to Book ratio, with banks experiencing a simultaneous decline in stock prices after an unanticipated ESG risk incident captured by the RRI. Since the PTB is a market-based performance measure, it should capture any changes in RRI contemporaneously.

However, we posit that the PTB has not an immediate impact on the ESG reputational risk, which does not respond within the same period (zero restriction). Our hypothesis is that bank's performance might have a longer-term effect on the RRI. Therefore, we assume a sluggish response from the bank's ESG engagement after an unexpected change in the financial performance. In other terms, we suppose that an improvement or a decay in the bank's performance may take time to be converted into changes in the ESG corporate strategies adopted by the bank, which could increase or decrease the likelihood of ESG risk incidents occurring in the future. This assumption is coherent with the proposition of the slack resources theory according to which past financial performance can enhance non-operational investments among which ESG ones.

To technically describe the identification strategy of the structural relationship, we can re-write the reduced-form model from Eq. (1) as the vector moving average representation of y_{it}, which expresses y_{it} in terms of current and past values of the residuals u_{it}:

$$y_{it} = B_i(L)u_{it} \tag{2}$$

where $B_i(L) = I + B_{1,i}(L) = (I - A_{1,i}(L))^{-1}$. This representation omits the presence of exogenous variables as they do not affect the identification of the structural shocks.

The structural VAR model describes y_{it} not in terms of its residuals u_{it}, but rather in terms of a vector of the underlying structural shocks ε_{it}, which features the unexpected exogenous disturbances to the structural relationship. The structural VAR model assumes that the residuals are a linear combination of the structural shocks as follows:

$$u_{it} = H\varepsilon_{it} \tag{3}$$

The identification of the full matrix H solves the problem of identifying the structural shocks and, consequently, the structural impulse response functions.

Assuming that the structural shocks have unit effect (i.e., the diagonal elements of H are unity) and are uncorrelated, we can write the system in Eq. (3) as:

$$u_{RRI,it} = b_{RRI,PTB}u_{\mathrm{PTB,it}} + \varepsilon_{RRI,it}$$

Table 1
Median coefficient's value, median coefficient's standard deviation, maximum and minimum coefficient's values across the 19 unit-specific reduced-form VARs. The last column reports the number of unit-specific VARs where the parameter is significantly different from zero with a 0.95 interval confidence.

VAR coefficients:						
	Variable	*Median value*	*Median std dev*	*Highest value*	*Lowest value*	*Unit-specific VARs*
Endogenous: RRI						
	RRI (t-1)	0.721	0.015	0.723	0.720	19/19
	PTB(t-1)	-0.014	0.006	-0.014	-0.014	19/19
	Constant	6.590	1.999	14.016	3.211	18/19
	ESB (t)	0.018	0.017	0.082	-0.033	8/19
	GDP (t)	0.052	0.467	1.818	-0.869	7/19
	HICP (t)	0.032	0.620	2.789	-1.364	2/19
Avg R-squared:	0.582					
Avg adj R-squared:	0.559					
Endogenous: PTB						
	RRI (t-1)	-0.044	0.008	-0.043	-0.044	19/19
	PTB(t-1)	0.687	0.011	0.689	0.686	19/19
	Constant	-2.814	2.254	1.913	-6.282	8/19
	ESB (t)	0.182	0.019	0.296	0.083	19/19
	GDP (t)	1.154	0.527	8.339	-2.777	13/19
	HICP (t)	0.263	0.692	5.609	-3.749	8/19
Avg R-squared:	0.914					
Avg adj R-squared:	0.909					
Observations:	1862					
Unit-specific VARS:	19					

$$u_{PTB,it} = b_{PTB,RRI} u_{\mathrm{RRI},it} + \varepsilon_{PTB,it} \quad (4)$$

To identify the structural shocks to RRI and PTB according to the hypothesis previously discussed, we constrain the coefficient $b_{RRI,PTB}$ to be zero.

5. Empirical results

5.1. Stability of the Bayesian panel VAR

The stability of BPVAR model is determined by establishing the standardized conditions for the moduli of all eigenvalues of every estimated unit-specific model. According to Hamilton (1994), VAR stability is implicated when every modulus in the companion matrices returns values lower than one. Panel VAR stability ensures an invertible and infinite-order vector moving-average interpretation. The stability condition is examined for each unit-specific VAR. The modulus of each eigenvalue is completely less than 1, satisfying the condition for eigenvalue stability for each model. The eigenvalues are nearly identical for each model because the estimated parameters associated with the endogenous variables are centered around a common mean for all units and exhibit a minor variation. The two eigenvalues obtained from the 19 unit-specific VARS are concentrated around the values of 0.674 and 0.734.

5.2. BPVAR coefficients

Table 1 shows the median values of the 19 reduced form bank-specific VAR coefficients. Both the endogenous variables display a strong positive relationship with their own past values. The magnitude of the coefficients (a median value of 0.72 for RRI and 0.69 for PTB) suggests a high degree of persistence in the variables' behavior. In addition, the negative and statistically significant values of the cross-variable lag coefficients indicate a negative relationship between the PTB and RRI that goes in both directions, from RRI to PTB and vice versa. This suggests that changes in one variable lead to changes in the opposite direction in the other variable.

It is worth noting that the parameters related to the coefficients of the endogenous variables' past values are significantly different from zero with an interval confidence equal to 0.95 for all the bank-specific VARS. Moreover, the estimated model displays slight differences across banks in terms of endogenous variables' coefficients. It implies that the relationship between the endogenous variables exhibits a minor cross-sectional heterogeneity across the banks included in the analysis.

On the contrary, there is a much greater level of cross-sectional heterogeneity observed among the coefficients associated with the exogenous variables that assess their influence on the endogenous ones. Specifically, when the PTB is the endogenous variable, all the estimated VARS exhibit a positive and significant relationship with the ESB, indicating that an increase in the ESB results in a corresponding increase in the PTB. Additionally, in most cases, GDP growth also has a positive and significant impact on the PTB. However, the estimates do not reveal a strong and consistent direction for the relationship between the HICP and the PTB.

On the other hand, the impact of the exogenous variables on the RRI is more difficult to interpret and mixed across banks.

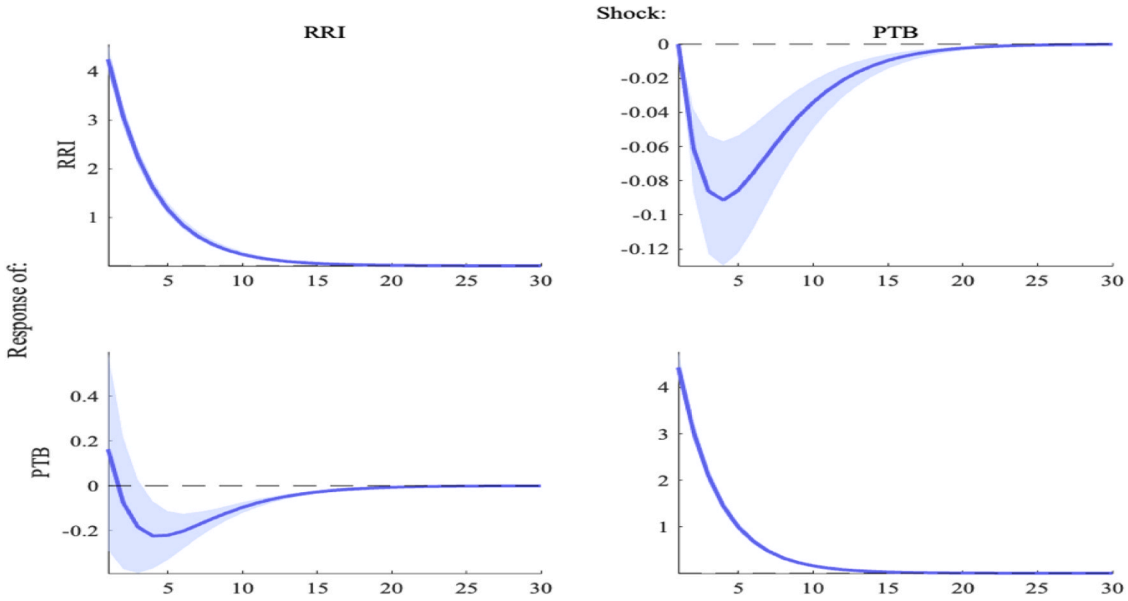

Fig. 1. Median Impulse Response Functions (structural identification by Choleski ordering) across the 19 unit-specific VARS. The first row reports the response of RRI to a one standard deviation shock to RRI (first column) and to a one standard deviation shock to PTB (second column). The second row reports the response of PTB to a one standard deviation shock to RRI (first column) and to a one standard deviation shock to PTB (second column).

Particularly, there are instances where a significant relationship is detected between the RRI and exogenous variables, namely GDP and ESB, but there is no unique direction that connects GDP or ESB to RRI.

5.3. Impulse response functions

Based on the identified structural model, we generate the impulse responses of the endogenous variables to the structural shocks for each individual bank. In Fig. 1, we present the median impulse response functions (IRF) of the endogenous variables to a one standard deviation shock in both the RRI and PTB, derived from the model. These impulse responses are illustrated over a 30-month time horizon following the shock, assumed to occur at time 0. The median of the accepted draws is depicted alongside the 16% and 84% Bayesian credibility intervals. We prefer to use the median values of the impulse response functions instead of the mean because it is less sensitive to extreme values. In case of a skewed distribution, choosing the median permits avoiding the risk of illustrating an IRF being far from the center of the distribution.

From the first column of the graph, it seems that an unexpected increase in the ESG reputational risk exposure leads to a decrease in market valuation. The price-to-book ratio reaches its lowest point, or trough, after a period of five months of decline. Subsequently, it takes a year and a half to fully recover to the previous level. It is important to note that the response of the PTB to a shock in RRI is relatively minor in magnitude. For instance, if we consider moving from a medium level of ESG reputational risk exposure to a high

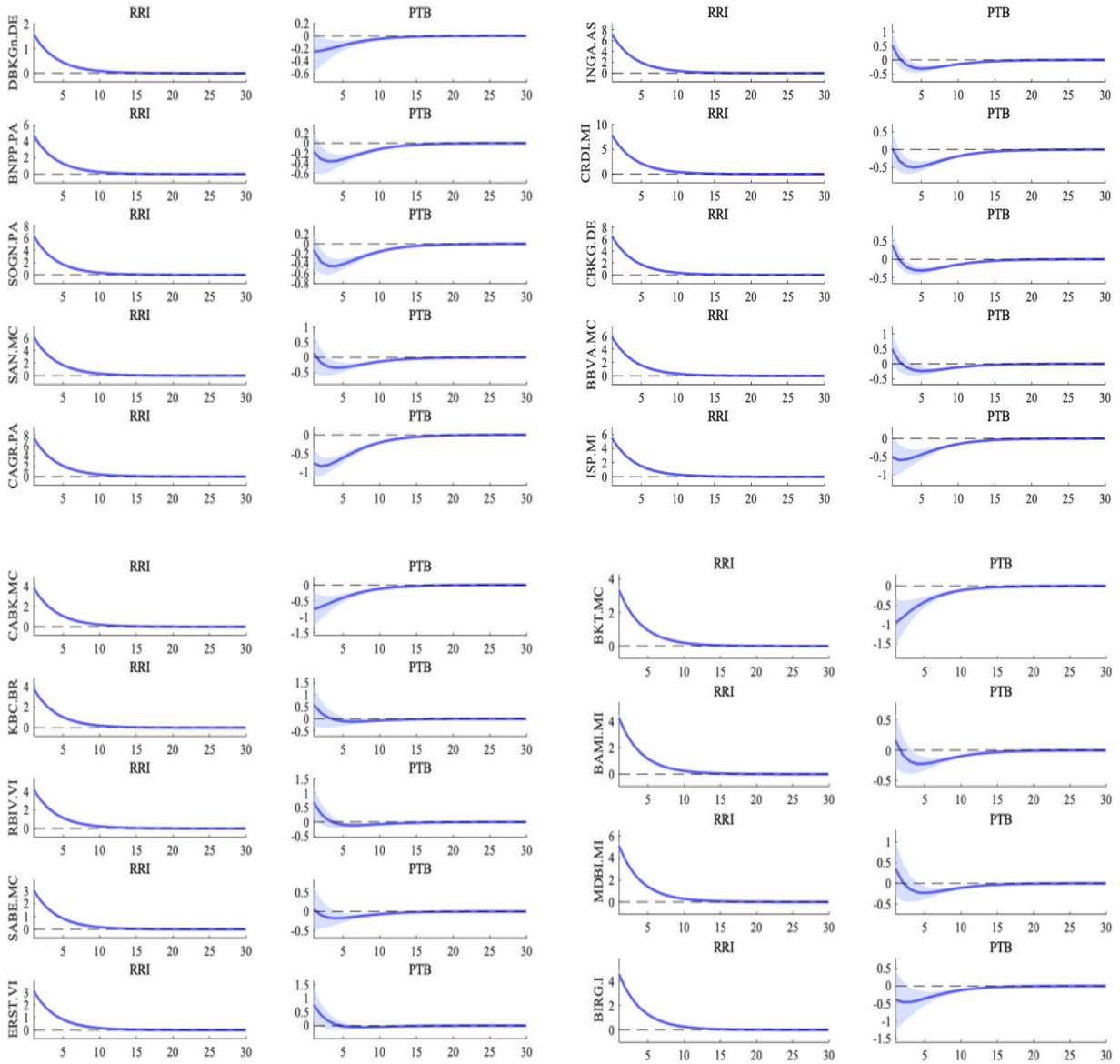

Fig. 2. Individual IRFs to a one standard deviation shock to RRI.

level, which equates an increase of about 20 points in RRI, the corresponding decline in PTB would be approximately 1%.

On the other hand, the second column of the graph shows the response of the ESG reputational risk index to a one standard deviation shock to the PTB. The plot illustrates that a structural shock to the PTB results in a subsequent decline in the ESG reputational risk exposure. Following an unpredicted increase in a bank's price-to-book ratio, the exposure to ESG reputational risk decreases continuously for 5 months. However, the positive impact of the improvement in the bank's performance on the risk exposure to ESG issues vanishes after one year and a half. The magnitude of the RRI response to a PTB structural shock is minimal in this scenario as well. If the price-to-book ratio unexpectedly increases by 5%, the corresponding decrease in the RRI is approximately 0.1, which can be considered a low value since the RRI ranges from zero to 100.

Fig. 2 reports the impulse responses of the PTB to a one standard deviation RRI structural shock for each individual bank. The banks are reported in the rows, while the variables are displayed in the columns. Additionally, the plots are arranged in a descending order based on the average Reputational Risk Index over the full period, from the Deutsche Bank (DBKGn.DE) which exhibits the highest average exposure to ESG reputational risk to the Bank of Ireland Group (BIRG.I) displaying the lowest one.

According to the RepRisk calibration, Deutsche Bank, BNP Paribas and Société Générale have been classified as having a high ESG reputational risk exposure for most of the period from 2012 to 2020. On the other hand, the group of banks composed of Santander Bank, Credit Agricole, ING, Unicredit, Commerzbank, BBVA, Intesa Sanpaolo, and Caixabank remain in the category of medium ESG reputational risk exposure for most of the time. Finally, KBC, Raiffeisen Bank International, Sabadell, ERSTE Bank, Bankinter, Banco BPM, Mediobanca, and Bank of Ireland have predominantly exhibited a low ESG reputational risk exposure according to RepRisk

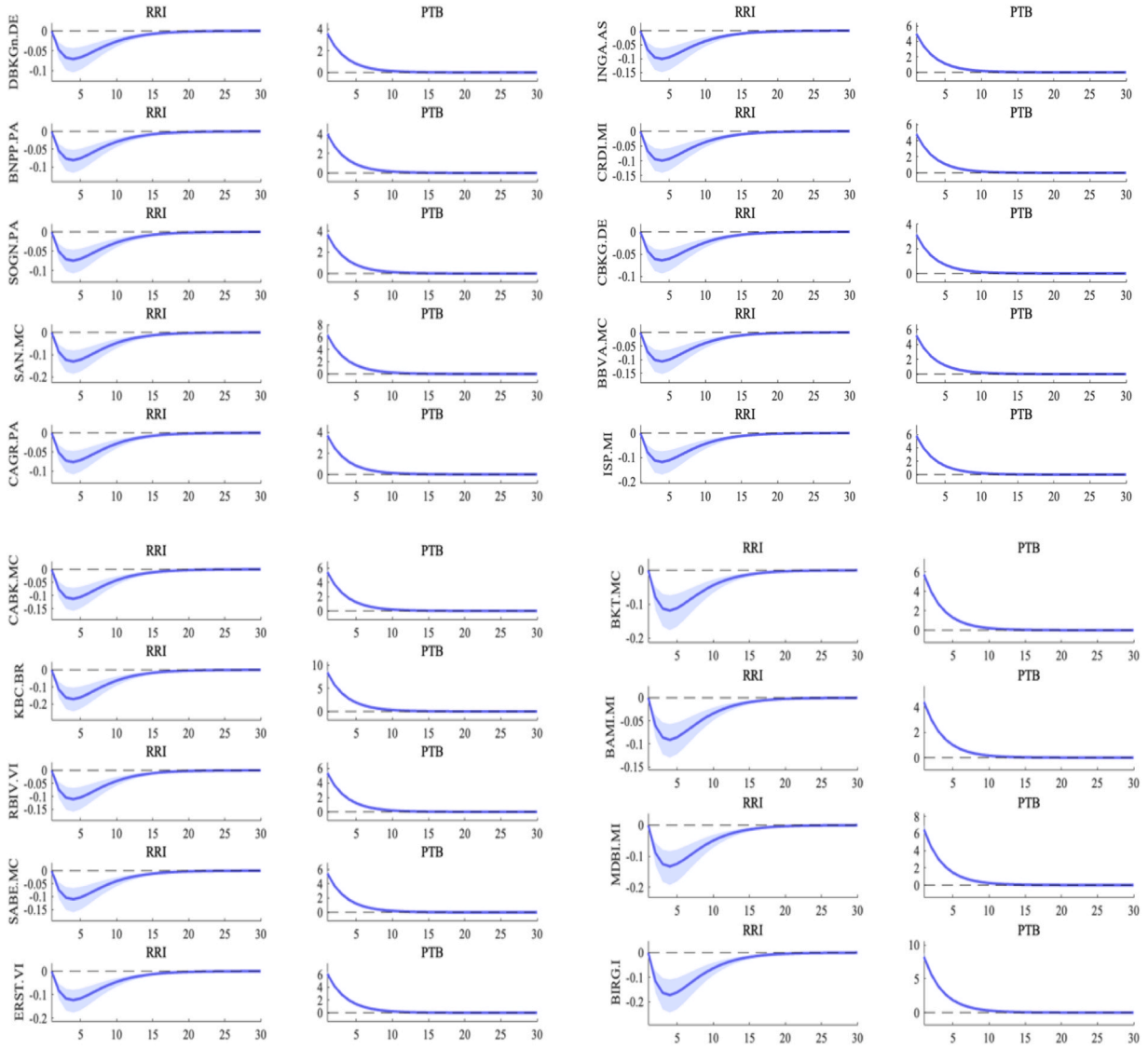

Fig. 3. Individual IRFs to a one standard deviation shock to PTB.

classification.

The impulse response analysis reveals heterogeneity across the banks in the impact of a structural shock to RRI on the PTB. This heterogeneity may be driven by variations in the bank-specific VARS regarding the posterior estimates of the residual covariance matrix Σ_i and the resulting structural decomposition matrix, where the contemporaneous effect of RRI on PTB is estimated. It seems that an unexpected increase in the exposure to ESG issues, as measured by the RRI, has a more significant effect on the market valuation when the bank is already highly exposed to ESG reputational risk. In other terms, a highly exposed bank would experience a significant impact on its price-to-book ratio in the event of an ESG reputational risk shock, whereas a bank with low exposure to such risk would be less affected.

The magnitude of the response for highly exposed banks such as BNP Paribas, Société Générale, Credit Agricole, Caixabank, Unicredit, and Intesa Sanpaolo is considerably higher compared to the median response previously discussed. For instance, if we consider an increase of about 20 points in RRI, the corresponding decline in PTB would be approximately 2%, which is twice the size of the median response. Conversely, banks with a low exposure to ESG reputational risk such as KBC, Raiffeisen Bank International, Sabadell, and ERSTE Bank show a non-significant reaction in terms of PTB when hit by an RRI shock.

Also, the evolution of the PTB reaction to an RRI shock differs across banks. The PTB appears to immediately incorporate the RRI shock in certain instances, such as Credit Agricole, Caixabank, Intesa Sanpaolo and Bankinter. Conversely, in most cases, the price-to-book ratio reaches its trough five months after the RRI shock and completely recover within 15 months.

Unlike the impulse responses previously illustrated and discussed in the findings, the impulse responses of RRI to a PTB structural shock, presented in Fig. 3, exhibit a much higher degree of homogeneity across banks. The observed homogeneity may be caused by the zero restriction that we imposed on the contemporaneous effect of PTB on RRI in the identification strategy we employ. Consequently, the dynamic and the magnitude of each individual bank's impulse response are mainly driven by the reduced-form model coefficients linked to their own lag and the cross-variable lags of the endogenous variables, which present a minor cross-sectional heterogeneity across the individual banks' models. Accordingly, the individual impulse response of the RRI to an unexpected increase in the PTB displays a high degree of similarity across banks in terms of both their evolution and magnitude. As a result, the size and the direction of the estimated impact resemble the median impulse response discussed in the previous section of findings.

6. Discussion

To our knowledge, the relationship between ESGP and CFP in the banking sector has been examined in both directions, but not conjunctively (Hu and Scholtens, 2014; Cornett et al., 2016; Buallay, 2019; Buallay et al., 2020). The use of the panel VAR model, in the context of bidirectional causality, accounts for the dynamic interactions between the variables of interest over time and structurally handles the endogeneity issue.

Our results support such a dynamic relationship between ESG reputational risk exposure as an indicator of ESGP and the price-to-book ratio as a market valuation indicator. In coherence with the existing literature related to the banking sector (Hu and Scholtens, 2014; Miralles-Quirós et al., 2019), the findings suggest a positive link whereby an increase in the ESG reputational risk exposure leads to a decrease in the price-to-book ratio and vice versa. As a matter of fact, La Torre et al. (2021) summarize the debate about the ESGP and CFP connection in the banking sector claiming that the majority of studies confirm a positive relationship between the two variables of interest with differences in the magnitude. Conversely, few studies argue a negative or no relationship. This could be related to the diversity of the models (Wu and Shen, 2013; Buallay et al., 2020), the differences in samples (Do and Kim, 2020; Duque-Grisales and Aguilera-Caracuel, 2021), or in the variables used as indicators for ESGP and CFP (Koh et al., 2014; Lo and Kwan, 2017; Albuquerque et al., 2019a).

This collocates our results in the framework of the stakeholder theory, which suggests that a proper active approach to ESG satisfies contemporarily all the interested parties in the considered financial institution, contributing, to a certain extent, to the perception of value enhancement (Chen and Wang, 2011). We support the idea that ESG strategies signal to the market potential variations in expected cashflows which the market perceives, recognizes, and prices. Arguably the magnitude of such perceptions cannot be disproportionate compared to the set of other information normally reaching the market, in fact, our results indicate a relatively minor impact, though persistent, and statistically significant. Furthermore, the reverse direction by which an increase in the PTB leads to a decrease in the ESG reputational risk exposure provides evidence in concordance with the slack resources hypothesis which suggests that slack resources generated from good past financial performance enable the company to provide and enhance ESGP (Albuquerque et al., 2019b).

A second matter of discussion is provided by the effect measured through the simulation of exogenous shocks involving the two studied variables. As shown above, the induced shock to the RRI, generates quite an immediate reaction in the PTB, which reaches its trough in a 5-month period. On the other hand, our results suggest that it takes 12 months for a subject bank to recover after the shock has fully affected the market value. This is a rather significant asymmetry. We interpret such an asymmetry in the frame of the existing literature on trust. Namely, reaction times highlight that the PTB response to an ESG-related shock leads financial institutions to potentially face a trust issue associated with ESG reputational risk. In fact, the recovery period may explain the implications of such a trust issue and provide an idea about the market adjustment period. Indeed, a well-known fact is that trust is hard to build and fast to ruin (Olsen, 2012). As also shown by our results, recovering requires more than twice the time it takes to lose the trust of counterparts (Guiso et al., 2008; Thakor and Merton, 2023).

The previous findings also pave the way for some further considerations, involving prospect theory (Kahneman and Tversky, 1979). Following this framework, we set the diagram's horizontal axis as RRI and the vertical one as PTB. Subsequently, we place each bank on the RRI axis based on its ESG reputational risk level at the time the shock is imposed. We then observe the effect of identical RRI

shocks on the PTB hitting each bank positioned on the RRI axis. We highlight an asymmetric market response among individual banks, influenced by the initial reputational risk level. In other terms, when exposed to an RRI shock, banks characterized by a high reputational risk exposure face a more significant PTB response compared to lower-exposed banks. This insight recalls a substantial implication of prospect theory by which for the same variation in RRI, the market, as expected, penalizes more intensely the banks that are in the "negative domain" branded by a high ESG reputational risk exposure.

We expand the existing literature by adopting a more informative approach by which we examine the dynamic interaction across variables and heterogeneity across banks contemporarily. Our findings are in line with the majority of empirical studies investigating the matter and support four consolidated theories.

7. Conclusions

Although many studies investigate the ESGP-CFP relationship in different sectors, the literature on the banking sector is still scarce. The existing studies mainly rely on regressive models to estimate the impact of each of the variables of interest on the other. The dynamics between both variables have a consolidated theoretical background supported by the stakeholder and slack resources theories. Our concern is that the endogeneity issue has not yet been adequately addressed. Furthermore, based on prospect theory, we expect that markets may have different reactions to banks' ESG reputational risk exposure whereby banks' valuation may exhibit heterogeneous responses to ESG reputational shocks. We intend to fill this gap in the literature by examining the bidirectional causality between banks' exposure to ESG risks and market valuation. In fact, the present study is grounded on the need to investigate the dynamic interaction between the ESG reputational risk index and the price-to-book ratio using evidence from a selected sample of 19 European listed banks between 2012 and 2020. For this purpose, we use a Bayesian Panel Vector Autoregressive model along with cross-sectional heterogeneity to investigate the dynamic behavior of the variables of interest.

Our research reveals an inverse bidirectional causality between RRI and PTB in which the bank's ESG reputational risk exposure impacts its market valuation, and in turn, the market valuation affects the level of ESG reputational risk exposure. Our results support the instrumental stakeholder theory, which suggests that banks investing in ESG tend to have a stronger brand identity and better market valuation due to lower exposure to ESG reputational risks. Additionally, our findings align with the slack resources theory, whose implications suggest that past financial performance can impact ESG investments and ESG risk exposure.

Furthermore, we show that an exogenous shock to the RRI, leads to quite an immediate reaction in the PTB, which hits its trough in a 5-month period. On the other hand, our results suggest that more than a 12-month period is required for a subject bank to recover after the shock has completely affected the market value. This is a rather significant asymmetry that we think can be potentially explained by trust theory which states that trust is hard to build and fast to ruin (Olsen, 2012). According to our results, restoring the trust of investors needs more than twice the time it takes to lose it.

To our knowledge, the heterogeneity across banks in this context has not been taken into account so far. Our results suggest that banks with higher levels of ESG risk exposure exhibit a larger decrease in market valuation in response to an ESG risk shock compared to those with lower levels of exposure. This evidence recalls the involvement of prospect theory according to which for the same variation in RRI, the market punishes more severely the banks that are in the "negative domain" featured by a high ESG reputational risk exposure.

The contribution of this paper lies in the fact that the approach adopted permits the investigation of different facets of the issue (bidirectionality) conjunctively and accounting for the heterogeneity across banks when facing an ESG reputational shock. Stakeholder theory and slack resources theory are both consolidated pillars on which the debate on the ESGP-CFP interaction is taking place. This methodology reassembles both theories in a cohesive framework and also provides empirical support to prospect theory and trust theory.

The implications of our findings suggest that banks may be encouraged to engage further in ESG compliance as it reduces their ESG reputational risk exposure and consequently, positively impacts their market valuation. Banks' boards could also take advantage of the implications of slack resources theory in this context as it argues that past positive financial performance can add a significant degree of flexibility to face business threats particularly ESG reputational risk exposure by investing in ESG initiatives. On the other hand, the heterogeneous market valuation to RRI shocks suggests that management should pay attention to their level of ESG risk exposure and try to keep their RRI level as low as possible to prevent market penalization in case of an ESG RRI shock.

Further analysis could be performed by taking wider datasets including other geographical areas. Also, this methodology could be applied to different types of financial institutions such as islamic banks or insurance companies, to name just two, to investigate the ESGP-CFP interaction and its implications. It would be advised to use different measures for ESGP and CFP to check the validity and the robustness of our results.

CRediT authorship contribution statement

Riccardo De Lisa: Conceptualization, Investigation, Supervision, Validation, Writing – original draft, Writing – review & editing. **Luca Piras:** Conceptualization, Investigation, Supervision, Validation, Writing – original draft, Writing – review & editing. **Oumaima Lahmar:** Conceptualization, Investigation, Methodology, Resources, Software, Writing – original draft, Writing – review & editing. **Marco Mandas:** Conceptualization, Data curation, Methodology, Software, Validation, Writing – original draft, Writing – review & editing.

Data Availability

Data will be made available on request.

Appendix. : Sources, descriptive statistics and visualization of the variables

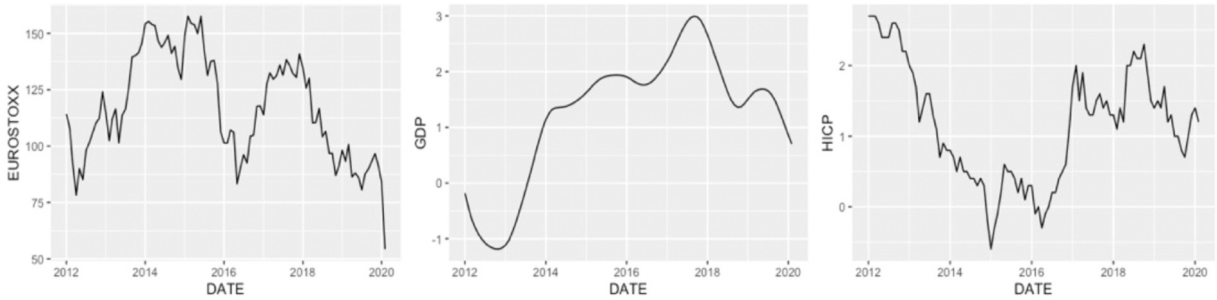

Figure A.1. Exogenous variables (ESB, GDP annual growth and HICP annual growth).

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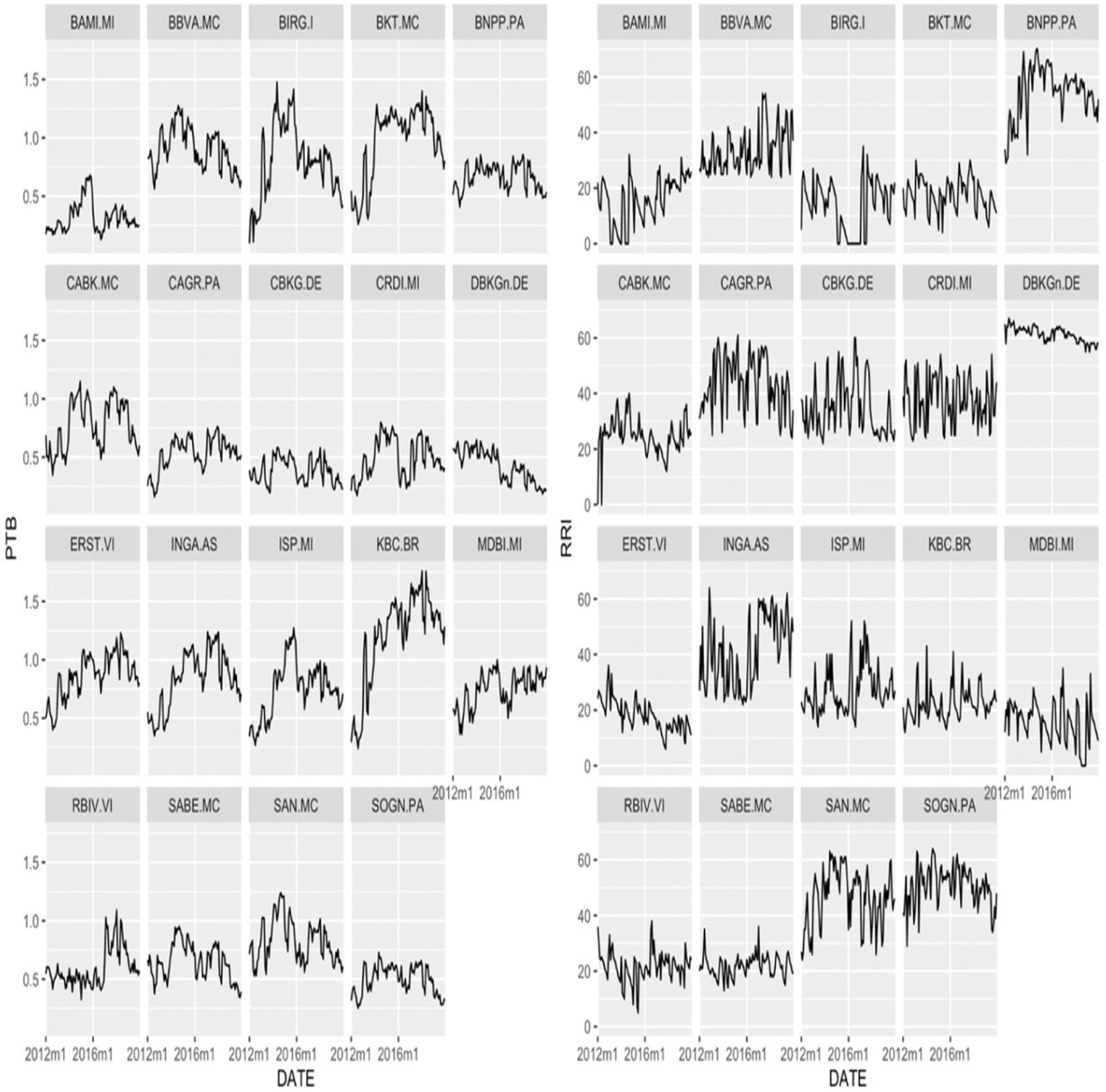

Figure A.2. PTB (on the left) and RRI (on the right) by bank.

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Table A.1
Data sources.

Variable	*Source*
RRI	Reprisk Database
PTB	EIKON REFINITIV
ESB	EIKON REFINITIV
GDP	FRED
HICP	SDW

Table A.2
Summary statistics of the endogenous variables by bank.

BANK	*RRI*				*PTB*			
	Mean	*Std dev*	*Max*	*Min*	*Mean*	*Std dev*	*Max*	*Min*
DBKGn.DE	61.03	2.88	67	53	0.42	0.14	0.65	0.19
BNPP.PA	54.08	9.55	70	29	0.66	0.11	0.86	0.41
SOGN.PA	50.33	7.69	64	26	0.49	0.12	0.73	0.25
SAN.MC	46.48	10.31	63	24	0.82	0.19	1.24	0.53
CAGR.PA	43.36	10.20	61	24	0.53	0.14	0.76	0.16
INGA.AS	41.35	12.73	64	22	0.83	0.24	1.24	0.35
CRDI.MI	37.69	8.57	54	23	0.49	0.17	0.80	0.17
CBKG.DE	34.50	9.86	60	21	0.38	0.11	0.58	0.20
BBVA.MC	33.54	8.02	54	24	0.90	0.18	1.27	0.56
ISP.MI	27.27	8.48	52	14	0.75	0.23	1.27	0.27
CABK.MC	24.62	6.51	40	0	0.77	0.21	1.15	0.35
KBC.BR	22.13	5.79	43	12	1.19	0.39	1.76	0.24
RBIV.VI	21.67	5.53	38	5	0.59	0.16	1.09	0.33
SABE.MC	21.60	4.06	36	12	0.64	0.16	0.95	0.35
ERST.VI	18.01	5.60	36	6	0.86	0.19	1.23	0.40
BKT.MC	17.39	6.06	30	4	0.96	0.31	1.40	0.26
BAMI.MI	15.98	8.31	32	0	0.32	0.13	0.68	0.13
MDBI.MI	15.73	7.46	35	0	0.75	0.15	1.00	0.36
BIRG.I	13.87	9.25	35	0	0.79	0.31	1.48	0.09

Table A.3
Summary statistics of the exogenous variables.

Exogenous Variables	*Mean*	*Std dev*	*Max*	*Min*
ESB	117.26	23.26	157.65	54.34
GDP	1.25	1.16	3.00	-1.19
HICP	1.15	0.82	2.7	-0.6

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