Determinants of coal exit strategy in the banking industry

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I. Introduction

In 2019, coal still accounted for 26.8% of global energy supply, compared to 30.9% for oil and 23.2% for natural gas (in ktJ, IEA, 2021). At the same time, it was responsible for 44% of total CO2 emissions (all fuels combined) and for 72% of GHG emissions in the electricity sector (in Mt, IEA, 2021). However, to contain global warming within the limit of +1.5°C at the end of the century, it is necessary to reach carbon neutrality as early as 2050: the carbon intensity and life span of new projects make the exit from coal an essential lever to change the trajectory of international emissions. However, in their study of 425 "climate bombs", Kühne *et al.* (2022) identify 230 coal mines (compared to 195 oil and gas projects) with a CO2 emission potential higher than 1 gigaton, 93 of which were not yet active in 2020.

Coal sector financing is a complex issue. The sector is multifaceted (including thermal/energy, power plants, mining, infrastructure, transportation and other related industries), and the financing channels are both public and private. In the public sphere, coal-fired power plants can benefit from the support of national development banks and export credit agencies: these arrangements are often dictated by political considerations of the common benefits for the countries involved. Private financing is provided by commercial banks, insurance companies, or asset management firms in the form of loans, underwriting services, or investments through the purchase of stocks or bonds (Chan *et al.*, 2022). Funds can be directed to a specific project or firm.

The 2022 edition of the "Banking on Climate Chaos" report coordinated by 7 NGOs lists the financing granted by the 50 largest international banks to the 30 firms most active in the coal sector. For mining companies, cumulative financing reached $115.928 billion between 2016 and 2021, with 36% of banks increasing their financing volume over the period. For power generation companies, the amount is $264.793 billion, and 50% of banks show increased figures (Rainforest Action Network, 2022, pp. 60-63).

Yet, banks and financial institutions are increasingly talking of excluding coal from their investment portfolios and making an exit from the industry altogether. In their sample of 56 international private banks, Chan *et al.* (2022) identify 29 banks that have formally blocked new coal expansion financing. As of February 2019, the Institute for Energy Economics and Financial Analysis identified more than 100 financial actors formally engaged in coal (mining and power plant) restriction policies: 7 multilateral development banks, 35 export credit agencies, 9 development finance institutions and 34 private banks (IEEFA, 2019, p. 11). Thus, even though the financial sector is displaying ambitious coal exit targets, it must be noted that there remains a significant gap between intentions and reality. This paradox is mainly due to the partial exit strategies announced by commercial banks. The level of disengagement depends on the nature of the beneficiary, the infrastructure, or the financing vehicle.

This paper focuses on the determinants of international banks' coal exit strategies and attempts to answer the following research questions: 1) Why do some banks have global policies and others only partial commitments? 2) What are the internal (i.e., intrinsic characteristics of banks) and external (i.e., institutional variables related to the bank's national context) determinants of exit scores? The distinction between internal and external variables is based on the assumptions of economic and sociopolitical theories of voluntary environmental disclosure. Using the Coal Policy Tool scores (Reclaim Finance, 2021) collected in December 2021, the tests are performed on a sample of 111 banks from 31 countries. The methodology is based on Partial Least Squares - Path Modeling (PLS-PM) and Bootstrap analysis (due to the high number of proxies and the size of the sample). The construction of the latent variables reflects the main internal characteristics of the banks (such as exposure to the coal sector, risk, profitability, and size) and the national dimensions of an institutional approach (e.g., an individual country's dependence on the coal sector, progress in the energy transition, overall environmental policy and performance, and level of development). Robustness tests are conducted with logistic regression models. Do banks take into account the specific risk of coal financing and their overall level of risk in their decision to exclude coal? Is the exit strategy driven by institutional characteristics that influence banks' managerial decisions (normative

isomorphism and search for legitimacy: DiMaggio & Powell, 1983; Suchman, 1995)?

The descriptive analysis reveals very low exit scores (mean 8.85/50), with commitments geared toward stopping project financing, not the financing of firms. The results show that banks' coal exit scores (CES) are influenced primarily by external country context variables. The degree of home country dependence on coal (in energy supply) has a negative impact on the value of the score. Progress in the energy transition and the country's level of environmental performance positively influence the banks' score. Among the internal variables, only bank size has a positive influence on the score level. These results are stable after Bootstrap and after taking the 'country' effects into account (potential bias related to countries overrepresented in the sample: China and the United States). They are also confirmed by the results of the logistic regressions.

The risk variables have no impact on the banks' exit scores: not only are the financial risk indicators (solvency, liquidity and credit) found to be insignificant, but the specific risk linked to exposure to the coal sector (Global Coal Exit List, GCEL, Urgewald, 2022[1]) has insignificant coefficients. Thus, banks do not seem to take into account the risks of depreciation of the sector's assets (stranded assets), which have been identified in the literature (Edwards *et al.*, 2022; Zhang *et al.*, 2022). The current revenues from coal financing and the absence of constraints and penalties may explain this result. Finally, the bank's profitability, which is necessary to finance the transition does not influence the exit scores.

The prominence of institutional factors is synonymous with strong regulatory and policy implications: getting out of coal at the national level and improving overall environmental performance appear to be prerequisites for banks' virtuous strategies. The banks adopt "defensive" strategies and react to changes in the national context: this is very clear in the case of the banks with the highest exit scores. The conclusions of this study support the hypotheses of institutional and legitimacy theories and underline the crucial role of governments in influencing banks' environmental decisions. They are also consistent with the specificities of the coal sector, which is highly dependent on national energy choices (e.g., fossil versus renewable), the pace of development (and energy demand) and domestic political and economic issues.

The contributions of this research are multiple. First, the determinants of banks' coal exit strategies, whether internal or external, have not been studied in the literature to a significant degree. A small number of articles analyze the typologies of banks' coal exit strategies (Chan *et al.*, 2022), the impact of these divestments for firms (Green & Vallée, 2022), and the geography of the private financing of the coal sector (Manych *et al.*, 2022; Zhao & Alexandroff, 2019). This article positively contributes to the general literature on the determinants of environmental disclosure (Boura *et al.*, 2020; Grauel & Gotthardt, 2016; Luo, 2019; Velte *et al.*, 2020), and especially supplements the literature on the banking sector (Bose *et al.*, 2018; Caby *et al.*, 2020; Kiliç & Kuzey, 2019).

Researching the determinants of banks' coal exit strategies is a major environmental issue, closely linked to issues such as the weight in emissions (fossil fuel sector, electricity sector), international energy supplies and the negative impact on GHG reduction targets, as well as a pertinent geopolitical issue, particularly in light of the existing tensions on international energy markets and the recent restart of coal-fired power plants in Europe.

The PLS-PM methodology allows for the calculation and mobilization of multiple measurement indicators that reinforce the scope and robustness of the results, particularly in terms of the national dimensions (i.e., environmental performance, coal dependency, and progress in the energy transition).

As with any original and exploratory study, this research has several limitations. The sample size and the study period are limited due to the regular updating of the coal exit scores on the Coal Policy Tool website. Some internal explanatory factors are not included in the models, as they are complex to collect and formalize: the ownership structure, the description of governance bodies (especially environmental), and the geographical distribution of net banking income would increase the quality of the models.

In the first section, the theoretical dimension and hypotheses are developed. The methodology (sample, variables and descriptive statistics) is detailed in the second. The third part is devoted to the empirical results. Finally, a discussion offers perspectives for future research.

II. Literature and hypotheses

II. 1. COAL EXIT STRATEGIES

In addition to climate issues, there is no shortage of arguments for a rapid divestment from coal (Climate Transparency, 2019): health benefits (coal is the main contributor to air pollution), an increasingly unfavorable production cost differential compared to renewables, a growing imbalance between capacity and utilization in developing countries, the risk of depreciation of the industry's assets, energy independence, and fiscal benefits (by moving away from dependence on imports in a context of growing geopolitical tensions).

The pace of announcements of exit and disengagement from coal is accelerating in developed countries. At the European level (Europe Beyond Coal, 2021), 3 countries have already banned coal (Belgium, Austria and Sweden), 5 have announced an exit by 2025 (Portugal, France, United Kingdom, Italy, Ireland) and 6 are scheduled to withdraw by 2030 (Greece, Finland, Netherlands, Denmark, Hungary, Slovakia). The announcements in 2021 by South Korea and Japan to cease public funding for coal-fired power plants will have a greater impact on the sector, as 95% of international public funding for coal projects came from three countries in 2020: China 65%, Japan 23% and South Korea 8% (Global Energy Monitor, 2021). Institutional funding, often bilateral, is still supported (Chen *et al.*, 2021). Rich countries also provide technological support (i.e., construction, operation and maintenance) to the

industry in developing countries (Edianto *et al.*, 2022), bringing these opportunities to domestic equipment manufacturers, utilities, and energy providers. While Powering Past Coal Alliance (PPCA) member countries have reduced their coal-related emissions, they account for just 3% of global coal consumption in 2018 (Zhao *et al.*, 2019); instead, they are home to financial institutions that support power plant development abroad (Manych *et al.*, 2021).

At the same time, the main multilateral development banks seem to be gradually withdrawing from the sector (Climate Policy Initiative, 2021): The World Bank and European Investment Bank (2013), the European Bank for Reconstruction and Development (2018), the African Development Bank (2019), Inter-American Development Bank, Asian Infrastructure Investment Bank (2020) and Asian Development Bank (2021).

These positive advances should not mask the reality of the sector, which is marked by the support of private banks and financial institutions, Chinese public banks, and a geography of financing that distorts the net contribution of countries when it comes to efforts to reduce CO2 emissions: investors based in the United States, Japan, United Kingdom and Canada are the main providers of funds to the sector at the international level, exporting their emissions via the installation of power plants in developing countries (Urgewald, 2021).

Several recent studies and articles have identified the coal exit strategies of private banks and financial institutions (Chan *et al.*, 2022; CPI, 2021; IEEFA, 2019). A thorough analysis shows that the exclusion criteria remain partial and rarely cover all firms, related industries, and financial services. The selectivity of the criteria still paves the way for new production capacities around the world. Distinctions are made according to: the nature of the infrastructure, the technology or the link in the production process (coal-fired power plants, thermal coal mining, production, transport), the beneficiary (project finance, corporate finance, existing client, new client), the financial product (loans, underwriting services, bonds, shares), the constraints imposed (revenue cap in the sector, emission reduction thresholds, imposed carbon capture and storage technology). The loopholes are therefore numerous and the overall policies marginal. In their analysis of the 56 largest international banks, Chan *et al.* (2022) identified best practices for coal exit policies: the optimal combination of criteria includes an absolute halt to financing (projects and firms), a requirement to limit coal-related revenues from existing customers, and a target year for effective exit. Only 12 banks appear to meet these conditions.

Yet, a 2020 Carbon Disclosure Project study shows that among their environmental disclosure strategies, the argument of excluding coal is widely used by commercial banks (CDP, 2020).

NGOs and civil society groups now provide statistics and reports on the coal policies of financial actors: they offer data on the amounts and terms of financing (Urgewald and Rainforest Action Network) and the assessment of exit strategies (Reclaim Finance). Thus, the availability of secondary data, the observation of a gap between ambition and reality, the particular geography and political stakes of the sector, and a strong trend of disengagement at all levels are arguments for focusing on the internal and external determinants of banks' coal exit strategies.

II. 2. HYPOTHESES

The disclosure of an exit strategy can be the result of economic motivations and socio-political considerations. At the theoretical level, the voluntary disclosure (financial and extra-financial) is explained by two paradigms that respond to different but complementary interpretations of managerial decisions. For economic theories (such as signaling theory, agency theory and private information theory), the decision responds to a profit maximization objective (Akerlof, 1970; Jensen & Meckling, 1976). For sociopolitical theories, the dissemination of information is dictated by institutional pressures leading to isomorphism phenomena (convergence of managerial practices in a given institutional context: DiMaggio & Powell, 1983; Meyer & Rowan, 1977) and by a search for legitimacy of firms vis-à-vis society (Cho & Patten, 2007; Deegan, 2002; Suchman, 1995).

The specificities of banks and the coal sector allow us to mobilize the hypotheses of both theoretical fields and to identify the potential internal (i.e., economic) and external (i.e., sociopolitical) determinants of coal exit strategies.

The coal sector is highly capital intensive and largely financed by international private banks: a rapid disengagement could cause major economic and financial imbalances. Stranded assets are a risk factor for both industry players and financial institutions, particularly banks. By definition, these assets can suffer rapid and unpredictable declines in value due to external factors (e.g., unusable fossil reserves due to restrictive climate regulations). The risks of value depreciation are exacerbated by the accumulated delays in environmental policies and the creation of new infrastructure (Edwards *et al.*, 2022). Several papers and studies have attempted to estimate stranded assets for the coal industry via economic losses from plant decommissioning (Cui *et al.*, 2020), and residual values of stranded assets in China (Caldecott *et al.*, 2017), the impact of plant utilization rates on financial results in the Philippines (Ahmed & Logarta, 2017), or the capital loss in power generation internationally (Carbon Tracker Initiative, 2020). In the Chinese market, Zhang *et al.* (2022) point out that half of the measured value loss will be borne by banks. The study by Edwards *et al.* (2022) shows that if we take into account the location of the owning firms and not the geographical location of the power plants (mainly in Asia), China, the United States, Europe, Japan and South Korea are largely impacted by the holding of stranded assets.

Thus, the disclosure of coal exit strategies can be a lever to signal to investors the stranded asset risk, which is proportional to the bank's exposure to the sector. The extent and speed of implementation of the bank's exit policy would minimize future losses.

H1: A bank's coal exposure positively influences the sector exit score.

Other internal determinants of voluntary environmental disclosure have been identified in the literature (Velte *et al.*, 2020), although tests focusing on the banking sector remain scarce (Bose *et al.*, 2018; Caby *et al.*, 2020; Kiliç & Kuzey, 2019). Hypotheses H2 through H4 retain bank financial risk, size, and profitability as explanatory factors. Riskier banks are expected to minimize their exposure to the coal sector, with stranded assets accentuating their risk level[2]. Larger banks are more internationalized, face multiple stakeholders and have to respond to legitimate public expectations on climate issues. Finally, the most profitable banks could more easily absorb the transition and exit costs of the sector[3].

H2: The bank's risk level positively influences the coal exit score.

H3: The size of the bank positively influences the coal exit score.

H4: The bank's profitability level positively influences the coal exit score.

The role of the banking sector in the real economy makes it both a lever for economic development and a major player in the environmental transition, in particular concerning savings, loans, investments and asset management. Subject to strict regulations (such as prudential rules and central bank supervision), highly exposed to the media and the financial markets, and weakened by the jolts of financial crises, international banks are exposed to institutional pressures, both coercive and normative, and make stringent efforts to manage their image and legitimacy in the eyes of the general public. Several articles have shown a positive link between: 1) national institutional contexts (i.e., the strength of legal systems) and firms' environmental disclosure (Cahan *et al.*, 2016; DeVilliers & Marques, 2016; Garcia-Sanchez *et al.*, 2016; Mateo-Marquez *et al.*, 2020) and 2) national environmental policies and firms' environmental disclosure (Boura *et al.*, 2020; Grauel & Gotthardt, 2016; Luo, 2019). In the specific case of coal exit strategies, institutional pressures and the quest for legitimacy are reinforced by the pace of disengagement announcements at all levels (countries, multilateral banks, export credit agencies), the multiplication of actors analyzing the evolution of the sector (Urgewald, Global Energy Monitor, Carbon Tracker, Carbon Brief) and the generalization of carbon trading schemes (ETS) and Carbon Taxes (IEA, 2020). Thus, the exogenous factors of the bank's national context weigh on their environmental commitments. The anticipation of more restrictive regulations in the future is also a relevant motivation for financial actors (Lyon & Maxwell, 2002).

Among the national dimensions identified in the literature, Steckel & Jakob (2021), Svobodova *et al.* (2020) and Zhao *et al.* (2019) mention the country's dependence on the coal sector as a major obstacle to a rapid exit from the sector. The geography of coal is particularly notable for the following: 1) the largest producers are also the largest consumers (China, India, United States, Japan, Russia, South Korea, South Africa, Germany), 2) countries export their technology and finance the development of capacity abroad to support their national firms (China, Japan, South Korea), 3) rapid growth in consumption is noted in countries that have historically not consumed much (Indonesia, Turkey, Vietnam, Malaysia, Kenya, The Philippines.) [4]

Several parameters may justify the maintenance and development of energy policies oriented towards coal (Edianto *et al.*, 2022; Gallagher *et al.*, 2021; Steckel & Jakob, 2021; Zhao *et al.*, 2019): security of supply, weak support for renewable energies, pressure for cheap energy, protection of private interests, energy control, centralization and independence, governance problems posed by renewables, protection of jobs and related industries (e.g., steel, rail, as well as other industrial sectors) and support for growth and development.

Hypotheses H5 to H8 thus assume that coal dependence, progress in the energy transition, environmental policies and performance, and the level of development of the home countries exert an influence on banks' coal exit strategies. The pressure of the national context plays a key role in shaping managerial decisions. The positive impact of country environmental performance on firms' environmental disclosure has been confirmed by Boura *et al.* (2020) and Caby *et al.* (2020). The studies by Kühn *et al.* (2018) and Maama (2020) highlight a positive impact of the country's level of development on firms' extra-financial disclosure.

H5: The home country's dependence on coal negatively influences the bank's coal exit score.

H6: Home country progress in energy transition positively influences the bank's coal exit score.

H7: Home country environmental policy and performance positively influences the bank's coal exit score.

H8: The level of development of the home country positively influences the bank's coal exit score.

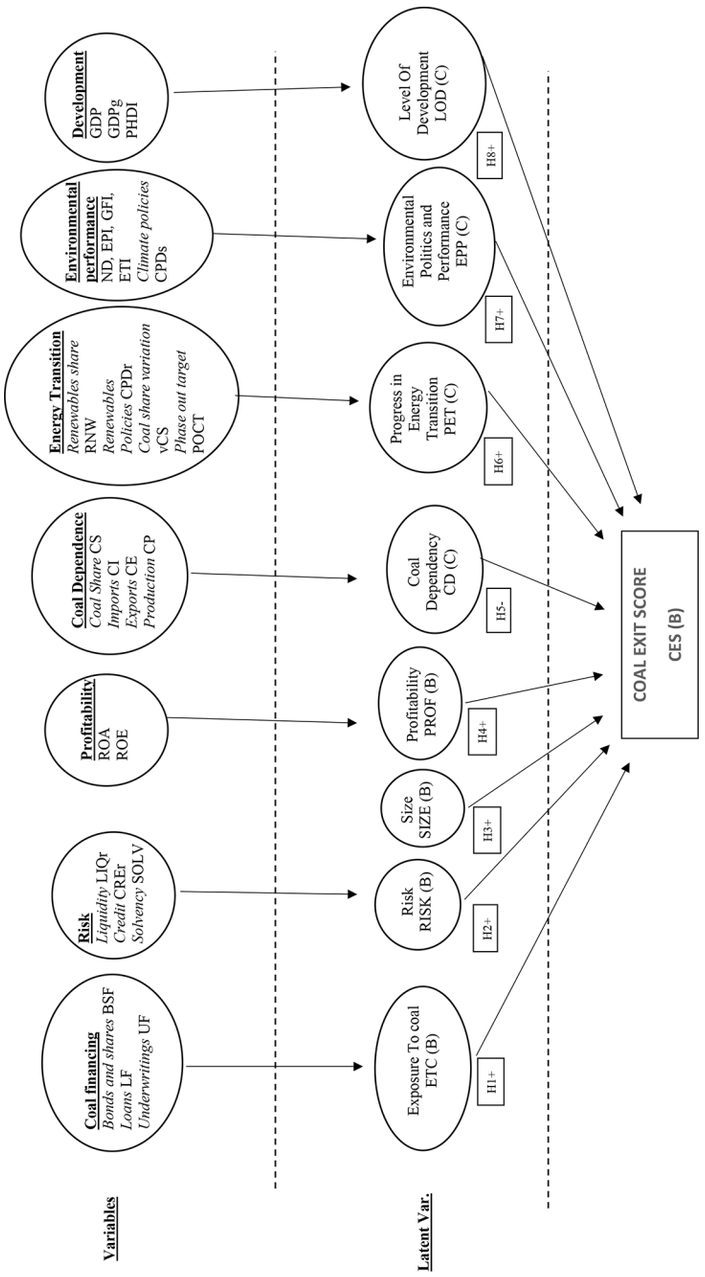
Figure 1 summarizes the overall design of this research.

III. Methodology

III. 1. SAMPLE AND METHOD

The sample is taken from the Coal Policy Tool website maintained by Reclaim Finance (accessed December 2nd 2021). This tool aims to evaluate the coal exclusion policies of financial actors. A score based on 5 criteria is attributed to: the end of all support for coal projects (mines, plants and infrastructure), the exclusion of companies developing new coal projects, the exclusion of companies with high exposure to coal, the exclusion of the biggest coal companies, and the adoption of a robust exit strategy (closure of existing coal assets). The information collected comes from the press, websites, and banks' annual reports. The sampling method consists of three steps: 1) the extraction of banks from the Coal Policy

Figure 1. Research design (B=Bank, C=Country).



Coal financing: Global Coal Exit List (GCEL). (BSF): stocks and bonds held by coal companies in Nov. 2021. (LF): amounts of loans. (UF): amounts related to underwritings transactions, between Jan. 2019 and Nov. 2021. **Risk**: Banks' financial risk. (LIQr1): total loans/total assets. (LIQr2): total loans/total deposits. (CREr): loan loss provisions/total loans. (SOLV): equity/total assets. **Size**: Banks' size. (SIZE): Log total assets. **Profitability**: (ROA): pretax profit/total assets. (ROE): net profit/total equity. 2020 financial data from annual report and Wall Street Journal website. **Coal Dependence**: IEA data (2019). (CS): the share of coal in the overall energy supply. (CI), (CE), (CP): the volume (in ktJ, Log) of the home country's imports, exports and production. **Progress in Energy Transition**: (RNW): score out of 60 linked to the ranking of the countries in the sample according to the share of renewable energy at the end of 2019 and the change in this share between 1990 and 2019 (IEA data, 30 countries excluding Taiwan). (CPDr): the number of policies in favor of renewables at the end of 2020 (Climate Policy Database, 2021). (vCS): the evolution in the share of coal between 1990 and 2019 (IEA data). (POCT): dichotomous variable that takes on a value of 1 if the country has announced a target year of coal phase-out at the end of 2020, and 0 otherwise. **Environmental Policy and Performance**: (ND): the Notre Dame Gain score in 2019. EPI: the Environmental Performance Index. (GFI): the Green Future Index (MIT Technology Review). (ETI): the Energy Transition Index (World Economic Forum). (CPDs): global score out of 30 for climate policies from the Climate Policy Database. **Level of Development**: (GDP): Log GDP. (GDPg): GDP growth % between 1990 and 2019 (The World Bank). (PHDI): Planetary pressures-adjusted Human Development Index. **Coal Exit Score**: CES: the coal exit score out of 50 points attributed to the bank (Reclaim Finance).

Tool (Reclaim Finance, 2021) excluding asset owners, asset managers, insurers and reinsurers: 141 banks, 2) the exclusion of banks for which one of the dimensions of the score is not filled in, and subsidiaries of other banks from the sample: 125 banks, 3) the exclusion of banks for which coal financing from the GCEL database (Urgewald, 2022) is not available: 111 banks. The final sample therefore includes 111 banks from 31 countries. As commercial entities, they collect savings and make loans to individuals, companies, and projects. They also have investment and asset management activities. The exit and exclusion score includes project and firm financing. The financing allocated to the coal industry consists of equity, bonds, loans, and underwriting services.

The geographical distribution of the sample is detailed in Table 1. 2 regions are overrepresented: Asia-Pacific with 40% of the banks (and 29% of the countries listed) and Europe with 28.2% (equating to 42% of the countries). On the other hand, 3 regions rarely appear in the sample: Africa Middle East with 5.5% of total banks (2 countries: Qatar and South Africa), Latin America with 3.6% of the number of banks (1 country: Brazil) and Eurasia and Eastern Europe with 2.7% (2 countries: Poland, Russian Federation).

Two countries account for almost a quarter of the banks in the sample: China (13.5%) and the United States (9.9%). 8 countries have only one bank: Belgium, Denmark, Greece, Norway, Portugal, Qatar, Russian Federation and The Philippines.

Table 1. Geographical distribution (Regions/Countries).

Region/Country	Country, frequency (%)	Bank, frequency (%)
Africa – Mid East (AME)	**2 (6,45%)**	**6 (5,5%)**
Qatar		1 (0,9%)
South Africa		5 (4,5%)
Asia-Pacific (AP)	**9 (29%)**	**44 (40%)**
Australia		4 (3,6%)
China		15 (13,5%)
India		2 (1,8%)
Japan		10 (9%)
Malaysia		2 (1,8%)
Singapore		3 (2,7%)
South Korea		5 (4,5%)
The Philippines		1 (0,9%)
Taïwan		2 (1,8%)
East Europe & Eurasia (EEE)	**2 (6,45%)**	**3 (2,7%)**
Poland		2 (1,8%)
Russian Federation		1 (0,9%)
Europe (EUR)	**13 (42%)**	**31 (28,2%)**
Austria		2 (1,8%)
Belgium		1 (0,9%)
Denmark		1 (0,9%)
Finland		2 (1,8%)
France		6 (5,4%)
Germany		6 (5,4%)
Greece		1 (0,9%)
Italy		2 (1,8%)
Norway		1 (0,9%)
Portugal		1 (0,9%)
Spain		3 (2,7%)
Sweden		2 (1,8%)
The Netherlands		3 (2,7%)
Latin America (LA)	**1 (3,2%)**	**4 (3,6%)**
Brazil		4 (3,6%)
North America (NOA)	**2 (6,45%)**	**15 (12,7%)**
Canada		4 (3,6%)
United States		11 (9,9%)
Other Europe (OE)	**2 (6,45%)**	**8 (7,3%)**
Switzerland		3 (2,7%)
United Kingdom		5 (4,5%)
TOTAL	**31 (100%)**	**111 (100%)**

From this sample, two dependent variables are defined. The first (CES) corresponds to the coal exit score out of 50 points attributed to the bank (the more ambitious and detailed the bank's commitments, the higher the score). The second is a dichotomous variable (CES01) taking the value 1 if the exclusion score is higher than 5 (i.e., 10% of the total attributed) and 0 otherwise.

The tests of the hypotheses in Figure 1 are based on a Partial Least Squares - Path Modeling (PLS-PM, Sanchez, 2013) approach. This approach is part of the latent variable structural equation models for modeling complex interacting systems. It is particularly suitable for predictive causal analyses in a context of weak theoretical information (Fernandes, 2012). It consists of a succession of regressions and the definition of several latent constructs (Crocetta *et al.*, 2021). In the framework of a normative model (design of this research) where the latent variables (central part of figure 1) are generated by their own manifest variables (upper part of figure 1), the PLS-PM method avoids the limitations of covariance-based methods (LISREL for example). It requires few preliminary assumptions (e.g., multinormality of variables is not required, while allowing the possibility of using nominal or continuous variables).

The choice of the PLS-PM method stems from the large number of manifest variables to construct the latent variables (particularly the "country" variables: coal dependence, progress in the energy transition, environmental performance), the sample size and the normative nature of the model (univocal relationship between manifest and latent variables, and between latent variables and dependent variable). The trade-off between PLS model and covariance-based structural equation techniques is based on the following criteria (Hsu *et al.*, 2006): formative indicators, small sample size (111 observations), predictive objective (predicting the coal exit score of banks), and the exploratory nature of this research (no existing tests on determinants of coal exit strategies and few tests on banks' carbon disclosure).

The outer model is evaluated on the basis of the criteria of internal consistency (Cronbach's Alpha, Dillon-Goldstein's rhô), the unidimensionality of the constructs (a manifest variable must be more correlated with the latent variable it is intended to measure than with the others), the convergent validity (correlation between manifest and latent variables) and the discriminant validity (discrimination between latent variables). The overall quality of the models is estimated by an R^2 (predictive relevance of the latent variables) and a fit index, Goodness of Fit. In order to obtain significant regression coefficients, a Bootstrap resampling method (500 iterations) is used. By calculating the error, the stability of the model can be estimated. The Bootstrap corresponds to a random resampling of the 111 observations of the sample: several observations may be retained at each trial and others may not be included.

The specification of the PLS-PM model consists of two steps:

1/ Latent variables (*LVi*) are estimated as a linear combination of their manifest variables (*Xj*),

$$LV_i = \lambda_{0,i} + \sum_{j \longrightarrow i} \lambda_{j,i} X_j$$

2/ The model treat structural relationships between Y (CES) and latent variables (*LVi*) as linear relationships:

$$Y = \beta_0 + \sum_i \beta_i LV_i + \epsilon$$

III. 2. VARIABLES

Variables estimating banks' exposure to the coal sector were calculated using GCEL data (Urgewald, 2022). This includes amounts held in stocks and bonds as of November 2021 in coal firms, amounts of loans made between January 2019 and November 2021, amounts related to underwriting transactions, and the aggregate total of these funding sources. The set of variables (BSF, LF, UF, and TF) is the ratio of the different types of financing to the bank's total assets in 2020.

Other bank financial data was collected from annual reports and, if missing, from the Wall Street Journal website. Following Caby *et al.* (2022), the latent risk variable (RISK) is derived from 4 indicators: liquidity risk (LIQr1, total loans/total assets; LIQr2, total loans/total deposits), credit risk (CREr, loan loss provision/total loans) and solvency (SOLV, equity/total assets). Bank size (SIZE) is estimated by the logarithm of total assets in millions of $ at the end of 2020. Finally, profitability (PROF) is estimated by two classical measures: Return On Assets (ROA: pretax profit/total assets) and Return On Equity (ROE: net profit/total equity).

Four dimensions have been defined to measure the impact of the national context on the banks' coal exit strategy: the home country's dependence on coal, the progress made in the energy transition, the country's overall environmental policy and performance, and the level of economic and human development.

The home country's dependence on the coal sector (CD) is constructed from 4 variables (IEA data 2019, the most recent year available for the entire sample): the share of coal in the overall energy supply (CS), the volume (in ktJ, Log) of the home country's imports (CI), exports (CE) and production (CP).

Progress in energy transition (PET) is measured using 4 indicators: a score out of 60 linked to the ranking of the countries in the sample according to the share of renewable energy at the end of 2019 and the change in this share between 1990 and 2019 (RNW, IEA data, 30 countries excluding Taiwan), the number of policies in favor of renewables at the end of 2020 (CPDr, Climate Policy Database, 2021), the evolution in the share of coal between 1990 and 2019 (vCS, IEA data), and a dichotomous variable that takes on a value of 1 if the country has announced a target year of coal phase-out at the end of 2020, and 0 otherwise (POCT).

Environmental policy and performance (EPP) is based on 5 proxies: the Notre Dame Gain score in 2019 (ND, out of 100, University of Notre Dame, 2021: vulnerability and readiness), the Environmental Performance Index (EPI, out of 100, Yale University, 2021: ecosystem vitality and environmental health), the Green Future Index (GFI, out of 10, MIT Technology Review, 2021: carbon emissions, energy transition, green society, clean innovation, climate policy), the Energy Transition Index (ETI, World Economic

Forum, 2021, score out of 100 including two dimensions: system performance imperatives and transition readiness) and the global score out of 30 for climate policies from the Climate Policy Database (CPDs: general, electricity & heat, industry, buildings, land transport, agriculture and forestry).

The last two dimensions include not only "means" variables (general environmental policies, CPDs, renewable policies, CPDr), targets (exit year, POCT), but also "outcome" measures (ETI, ND, EPI, GFI). The source variables are sometimes very close to several latent variables. The reasoning behind the construction of the model is based on the idea of grouping all indicators measuring the current role of coal in the country's energy mix and economy in (CD), all variations in the energy supply mix (coal and renewables) in (PET) and all current performance proxies in (EPP).

Finally, the country's level of development is calculated by the GDP (2020) and the GDP average growth (GDPg, between 1990 and 2019, The World Bank, 2021), and the PHDI, Planetary pressures-adjusted Human Development Index (HDR United Nation Development Program, 2021).

Even though the collected data is secondary, it comes either from organizations widely recognized in the academic world (IEA for national energy mixes, MIT for GFI, Yale University for EPI, World Bank and UNDP for development indicators, World Economic Forum for ETI) or from NGOs that are references for banks and international organizations (Urgewald for GCEL and Reclaim Finance for CES).

III. 3. DESCRIPTIVE STATISTICS

The coal exit scores of the banks is very low: the average (median) is 8.85/50 (5). 27% of the banks have a score of zero[5] and 51.4% have a score below 5 (CES01). A more detailed analysis of the 5 score criteria shows that only the end of support for coal project has an average score of 4.85/10. The other 4 criteria have extremely low averages: exclusion of companies with high exposure to coal (1.42), adoption of an exit strategy (1.10), exclusion of companies developing new coal project (1.01) and exclusion of the biggest coal companies (0.468). Thus, the financing of new projects and the relative exclusion of certain firms to a lesser extent are the strategies put forward by the banks in the sample. It should be noted that these criteria are not part of the good practices determined by Chan *et al.* (2022). 8 banks (including 5 French banks) have scores above 25/50. The most virtuous (scores of 49 or 50: Desjardins, Crédit Mutuel and Banque Postale) are cooperative, mutualist or public structures. The scores of the other 5 (between 31 and 36) show some flaws: 0 to 3/10 for exclusion of the biggest coal companies (Danske Bank, Crédit Agricole, Unicredit, Société Générale) and 2/10 on exclusion of companies with high exposure to coal (BNP).

The banks provided $1.134 trillion in cumulative financing to the coal industry between January 2019 and November 2021 (GCEL, Urgewald, 2022). This amount breaks down as follows: $153 billion in bonds and shares (14%), $296 billion in loans (26%) and $685 billion in underwritings (60%). 2 banks exceed $60 billion in cumulative financing: ICBC and Mizuho. This finding must be qualified to account for the possible weight of stranded assets: on average, coal financing (TF) represents only 1.44% of the banks' total assets.

In 2019, the share of coal in the energy mix of countries (CS) is on average (median) 23.6% (15.1%). Two countries stand out for their high dependence: China (61.1%) and South Africa (72.2%). The change in proportion between 1990 and 2019 (vCS) is negative overall (-4.03% on average), with marked extremes: Denmark (-30.8%) and The Philippines (+23.4%). The share of renewables at the end of 2019 averages (median) 14.1% (9.8%) with a minimum of 0 (Qatar) and a maximum of 48.8% (Norway).

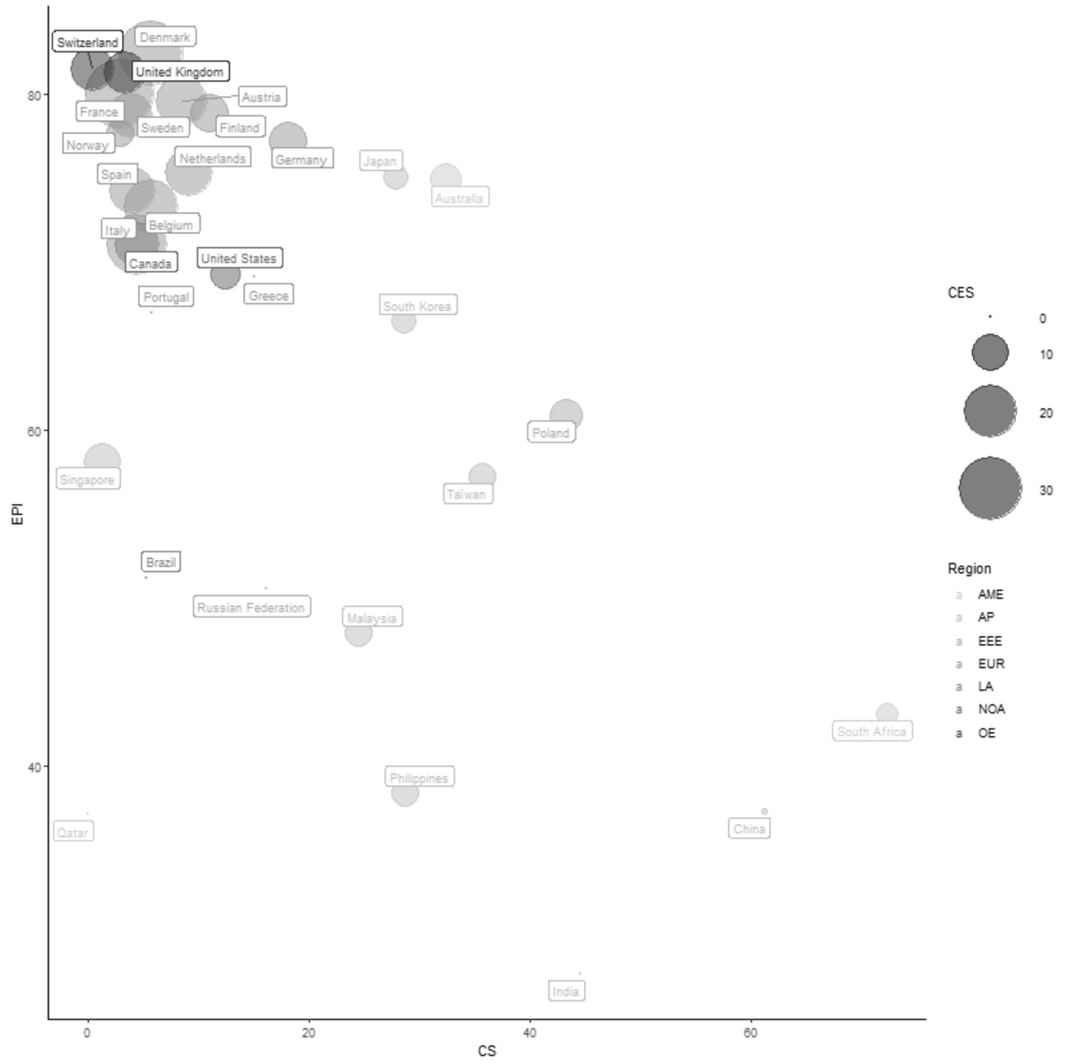
Thirteen of the 31 countries are no longer coal producers, including 9 European countries: these countries host only 27.9% of the banks in the sample. 38.7% of the countries (12/31) have announced a target year for coal phase-out (POCT), the vast majority of which are European countries.

Figures 2 and 3 cross country variables by representing the average CES of banks. They lead to identical comments: European countries (and Switzerland and the UK) show both high EPI and GDP scores, and low coal use (CS). Conversely, countries in the AME and AP regions show more heterogeneous, and indeed lower, EPI and GDP scores and coal shares above 20% (excluding Singapore). The size of the circles (CES) is globally higher in countries with low coal use.

Figure 4 summarizes the coal financing modalities of banks and their CES: the levels of commitment differ according to the sources of financing (e.g., underwritings versus loans). Hierarchical clustering was done with the heatmap() function of R on the centered-reduced data, applying an agglomeration by the Ward method to the square of Euclidean distances. The CES score is weighted by the number of banks per country. The method allows us to visualize the proximity of countries according to the four variables studied. The light boxes correspond to high values of the variables. Among the lowest scores (bottom part of the figure), three groups of countries stand out according to the preferred source: The Philippines, Malaysia, South Korea, China and Greece (UF, underwritings), Taiwan, Portugal and Brazil (BSF, bonds and shares) and Qatar, the Russian Federation, Norway, Poland, Japan, Australia and South Africa (LF, loans). 80% of these countries are coal producers (12/15) and 60% are both producers, importers and exporters: these groups are therefore made up of countries that are highly dependent on coal (7 of the 9 Asian countries belong to this first group). Among the high scores (upper part), the situation is more heterogeneous: Danish, Finnish, Swiss and German banks tend to use bonds and shares, while Belgian, Swedish, Dutch, Italian, Spanish and Austrian banks prefer loans.

The list of banks, the details on variables, the database, the descriptive statistics per variable, the correlation matrix and the R scripts for the graphs are available in the appendices: https://github.com/benoitjamet/BanksCoal.git.

Figure 2. Coal Share CS, Environmental Performance Index EPI and Coal Exit Score CES.



111 banks. 31 countries. (CS): the share of coal in the overall energy supply (2019, IEA). (EPI): the Environmental Performance Index (Yale University). (CES): the coal exit score out of 50 points attributed to the bank (Reclaim Finance). AME: Africa Mid East. AP: Asia Pacific. EEE: East Europe & Eurasia. EUR: Europe. LA: Latin America. NOA: North Europe. OE: Other Europe.

IV. Results

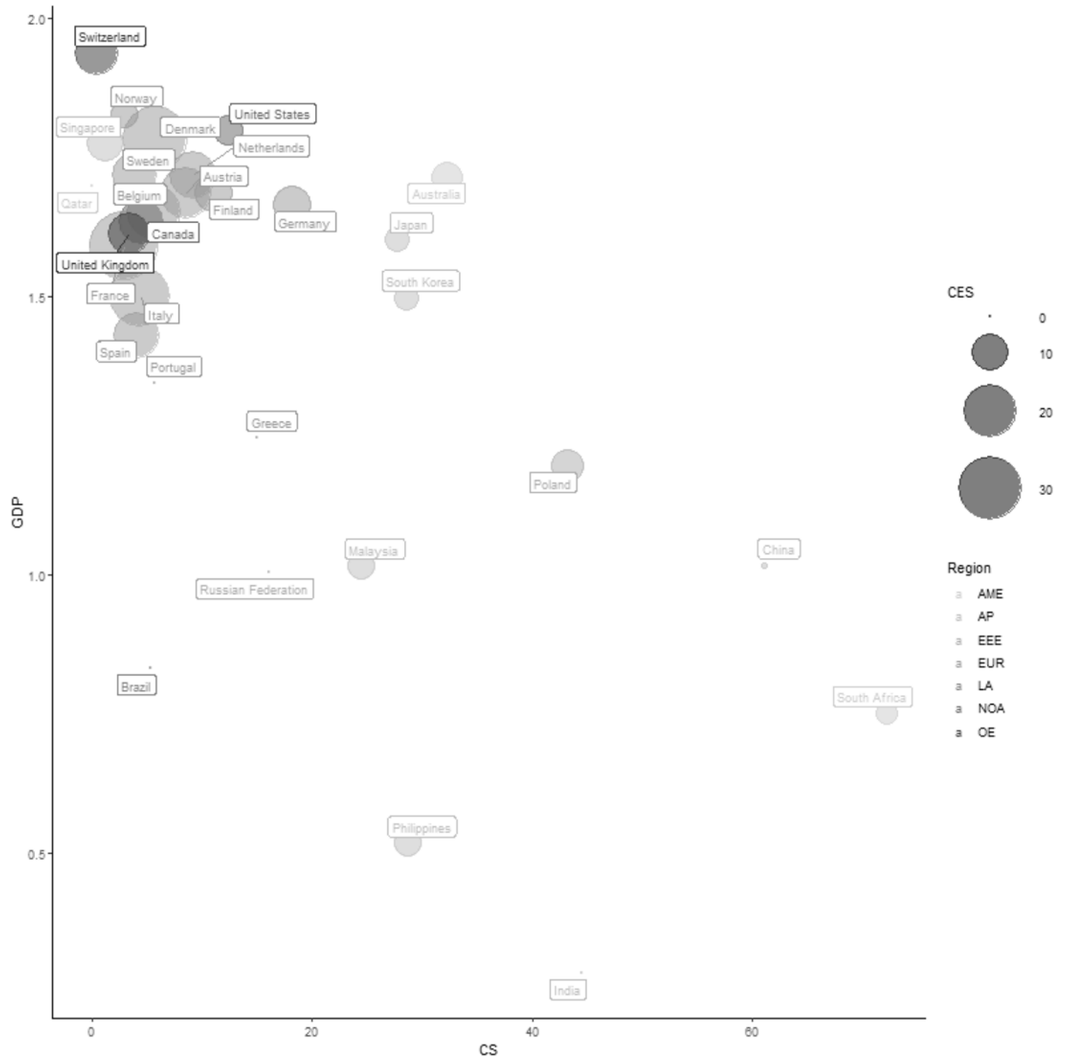
The evaluation of PLS-PM models tested on R (Sanchez, 2013) is based on several methodological steps: 1) verification of the reliability of the models: cross contributions of the variables to each latent and factor loadings, 2) analysis of the internal consistency (Cronbach's Alpha > 0.7), homogeneity (Dillon-Goldstein's Rhô > 0.7) and convergent validity (Average Variance Extracted AVE > 0.5) of the latent variables, 3) the study of the coefficients of the latent variables and their significance, 4) comments on the quality of the models (Goodness of Fit, GoF, and R^2).

The R methodology used also performs a Bootstrap (500 iterations) on the calculated coefficients to ensure their robustness and to limit the effect of the small number of observations. The results are presented for 109 banks from 30 countries: the two Taiwanese banks are excluded from the tests because they have several missing data (ND, ETI, GDP, PHDI).

The iterations of the model in Figure 1 highlight[6]:

1/ A problem of reliability (low loadings between 0.1 and 0.2) and cross contribution (with Coal Dependence in particular) for the variables (CPDs) and (CPDr). These "means" variables are correlated with several latent variables; when they proved overly cross-sectional, they

Figure 3. Coal Share CS, Gross Domestic Product GDP and Coal Exit Score CES.



111 banks. 31 countries. (CS): the share of coal in the overall energy supply (2019, IEA). (GDP): Log GDP (The World Bank). (CES): the coal exit score out of 50 points attributed to the bank (Reclaim Finance). AME: Africa Mid East. AP: Asia Pacific. EEE: East Europe & Eurasia. EUR: Europe. LA: Latin America. NOA: North Europe. OE: Other Europe.

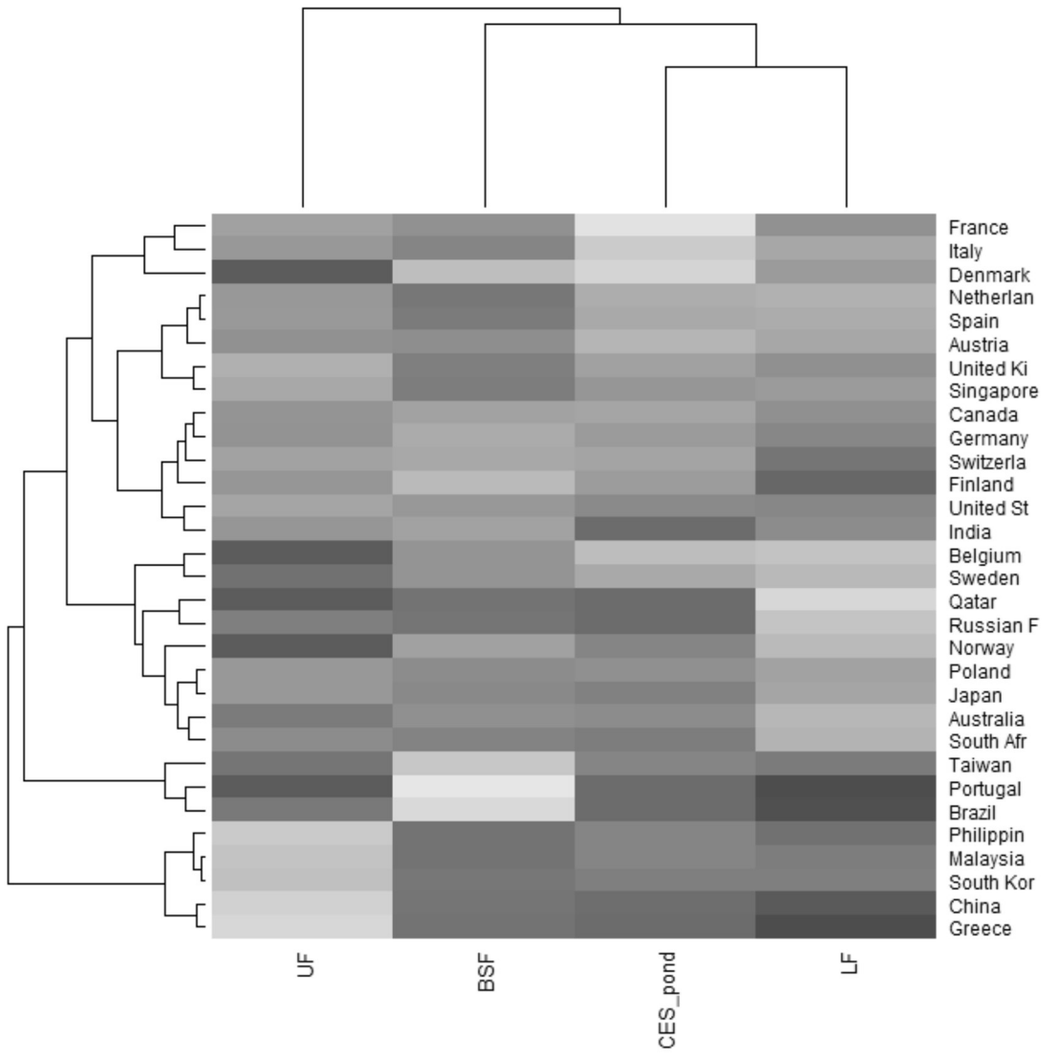
were removed from the models. Indeed, the volume of national regulations on climate and renewable energy can influence both the dependence on coal, the progress of energy transition and the environmental performance of countries. Low reliability of the variable (BSF) to estimate the bank's level of exposure to the coal sector. Bonds and shares financing represent only 14% of the total financing granted by the banks in the sample to the coal industry. (BSF) is discarded (model 2).

2) An internal consistency problem (Cronbach's Alpha α low between 0.1 and 0.5) for the latent variable (RISK) when the different measurement indicators are associated. The risk variables (LIQr1, LIQr2, CREr and SOLV) were therefore removed progressively (models 3): the successive coefficients are very small and insignificant. The overall risk level of the bank does not seem to influence the coal exit score: this result allows us to reject hypothesis 2.

3) A weak loading for (CI), the volume of coal imports, for the overall sample and especially on the subsample excluding China (models 4 and 4.1). Only 3 indicators are retained in the latent variable (CD): (CS), (CE) and (CP).

Tables 2 and 3 summarize the main results. Among the internal variables, only bank size has a significant positive influence on CES (H3). This result is consistent with the findings of other tests in the banking sector. For Caby *et al.* (2020), size increases the volume (but not the quality)

Figure 4. Heatmap – GCEL Financing (/country). Underwriting UF, Bonds and Shares BSF, Coal Exit Score CES, Loan financing LF.



111 banks. 31 countries. Hierarchical clustering was done with the heatmap() function of R on the centered-reduced data, applying an agglomeration by the Ward method to the square of Euclidean distances. The method allows us to visualize the proximity of countries according to the four variables studied. The light boxes correspond to high values of the variables. (BSF): stocks and bonds held by coal companies in Nov. 2021, (LF): amounts of loans and (UF): amounts related to underwritings transactions, between Jan. 2019 and Nov. 2021 (GCEL, Urgewald). (CES_pond): the coal exit score out of 50 points attributed to the bank (Reclaim Finance), score weighted by the number of banks per country.

of environmental disclosure (117 international banks); on a sample of 24 Turkish banks (2010-2016), Kiliç & Kuzey (2019) obtain the same result on an environmental disclosure index. The size indicator is synonymous with visibility, exposure on financial markets, and pressure from multiple stakeholders: the search for legitimacy is thus reinforced for the largest banks and encourages them to announce coal exit strategies compatible with ambitious GHG reduction targets. Conversely, the bank's exposure to the coal sector (H1) does not seem to impact the variable (CES). Several interpretations are possible: the relative weight of coal financing in the banks' total assets (1.44% on average in the sample) and therefore relatively low future value losses, a transition risk and economic consequences that are too distant, the still high profitability of certain coal investments or a minimal regulatory risk due to the absence of sanctions. Similarly, the financial risk (i.e., liquidity, credit and solvency) and profitability variables show no significant coefficient. The intuition that the combination of financial risk and specific risk related to coal financing could lead banks to quickly exit the sector is not verified (H2). This result

is consistent with the result on sector exposure (ETC) and the findings of Caby *et al.* (2020) on the quality of environmental disclosure. Reputational risk related to bank size appears to be more relevant than financial risk in explaining variations in the exit score. Moreover, the most profitable banks should more easily absorb the costs of exiting the sector: the variable (PROF) is however insignificant. The influence of profitability on environmental disclosure remains ambiguous, including in the bank samples. Bose *et al.* (2018) find a negative relationship, while Caby *et al.* (2020) and Kiliç & Kuzey (2019) come to the opposite conclusion. Two opposing arguments are thus identified in the literature: on the one hand, if more profitable firms tend to easily bear the cost of collecting and disseminating environmental information, conversely, investors may demand more transparency from less profitable firms (Caby *et al.*, 2020; Grauel & Gotthardt, 2016).

Among the institutional variables, (CD), (PET) and (EPP) are all significant (H5, H6 and H7). The energy (overall supply) and economic (production and exportation) weight of coal (CD) negatively influences the exit scores. Energy

Table 2. PLS-PM, Model evaluation.

Latent Variable	Model 1 Total Sample	Model 2 Total Sample	Model 5 Total Sample	Model 5.1 Without China	Model 5.2 Without USA
	All variables	Without BSF, CPDr, CPDs	Without CI & RISK	Without CI & RISK	Without CI & RISK
ETC – (Bank) Exposure To Coal					
Cronbach's alpha (α)	0,34	0,77	0,77	0,84	0,77
Dillon-Goldstein's rhô (ρ)	0,63	0,89	0,89	0,92	0,90
Average Variance Extracted (AVE)	0,53	0,80	0,80	0,85	0,80
RISK – (Bank) Risk					
Cronbach's alpha (α)	0,18	0,18			
Dillon-Goldstein's rhô (ρ)	0,46	0,46			
Average Variance Extracted (AVE)	0,24	0,24			
SIZE – (Bank) Size					
Cronbach's alpha (α)	1	1	1	1	1
Dillon-Goldstein's rhô (ρ)	1	1	1	1	1
Average Variance Extracted (AVE)	1	1	1	1	1
PROF – (Bank) Profitability					
Cronbach's alpha (α)	0,92	0,92	0,92	0,92	0,92
Dillon-Goldstein's rhô (ρ)	0,96	0,96	0,96	0,96	0,96
Average Variance Extracted (AVE)	0,92	0,92	0,92	0,86	0,92
CD – (Country) Coal Dependence					
Cronbach's alpha (α)	0,76	0,76	0,86	0,82	0,90
Dillon-Goldstein's rhô (ρ)	0,85	0,85	0,92	0,89	0,94
Average Variance Extracted (AVE)	0,61	0,61	0,78	0,74	0,83
PET – (Country) Progress in Energy Transition	0,63	0,82	0,82	0,81	0,85
Cronbach's alpha (α)	0,78	0,89	0,89	0,89	0,91
Dillon-Goldstein's rhô (ρ)	0,54	0,73	0,73	0,71	0,76
Average Variance Extracted (AVE)					
EPP – (Country) Environmental Politics and Performance					
Cronbach's alpha (α)	0,72	0,89	0,89	0,87	0,89
Dillon-Goldstein's rhô (ρ)	0,84	0,92	0,92	0,91	0,93
Average Variance Extracted (AVE)	0,61	0,75	0,75	0,72	0,76
LOD – (Country) Level Of Development	0,81	0,81	0,81	0,71	0,83
Cronbach's alpha (α)	0,89	0,89	0,89	0,84	0,90
Dillon-Goldstein's rhô (ρ)	0,73	0,73	0,73	0,63	0,75
Average Variance Extracted (AVE)					

Excluding Taïwan: 109 banks, 30 countries. (CES): Bank – Coal Exit Score. (ETC): Bank - Exposure To Coal. (SIZE): Bank – Size. (PROF): Bank – Profitability. (CD): Country – Coal Dependence. (PET): Country – Progress in Energy Transition. (EPP): Country – Environmental Politics and Performance. (LOD): Country – Level Of Development. Cronbach's alpha (α), Dillon-Goldstein's rhô (ρ): internal consistency. Average Variance Extracted (AVE): convergent validity.

transition progress (change in coal share, renewable share, and country exit announcement) and environmental performance of the bank's home country (Boura *et al.*, 2020; Grauel & Gotthardt, 2016) have a positive impact on (CES). These results imply that banks adjust their exit strategy according to changes in energy policies and national environmental performance. This finding supports the assumptions of institutional theory, in addition to its legitimacy: countries' energy and environmental progress and efforts can serve as a catalyst for managerial decisions on environmental issues. The use of multiple measures in each latent variable reinforces the significance of the results. Bank managers thus seem to take into account several national context parameters to define and disseminate coal exit strategies: an instantaneous and evolving view of the energy mix (coal and renewables), the economic weight of coal, national commitments to exit coal (synergy between countries' and firms' decisions, signaling and anticipation of future binding regulations) and overall environmental performance that normally reflects the aspirations of public opinion.

Finally, the country's level of development (LOD) is not significant (H8): this result contradicts Grauel & Gotthardt (2016), Kühn *et al.* (2018), and Maama (2020), but these authors use only one measure of development. The cross contribution of development level to other latent variables may also explain this finding.

Models 5, 5.1 and 5.2 show satisfactory fit indicators for an exploratory study: R^2 between 0.368 and 0.427 and GoF between 0.521 and 0.582. The country effects are quite weak: Chinese banks slightly increase the quality of the model (R^2 and GoF).

To reinforce the robustness of the previous results, a series of logistic regressions was tested (Jamovi, 2020). The dependent variable (CES01) takes the value 1 if the exit score is greater than 5, and 0 otherwise. Explanatory variables are retained if: 1) their latent variable is significant, 2) their contribution to the latent variable is high, 3) their

Table 3. Results of the PLS-PM model.

	Model 1 Total Samples	Model 2 Total Sample	Model 5 Total Sample	Model 5.1 Without China	Model 5.2 Without USA
Latent Variable → CES	**All Variables**	**Without BSF, CPDr, CPDs,**	**Without CI & RISK**	**Without CI & RISK**	**Without CI & RISK**
ETC → CES (β) Bootstrap [0,025;0,975]	0,096 [-0,069;0,227]	0,085 [-0,076;0,200]	0,087 [-0,120;0,194]	0,100 [-0,107;0,218]	0,077 [-0,119;0,190]
RISK → CES (β) Bootstrap [0,025;0,975]	0,141 [-0,225;0,284]	0,143 [-0,226;0,303]			
SIZE → CES (β) Bootstrap [0,025;0,975]	0,142* [-0,013;0,268]	0,152** [-0,002;0,293]	0,186** [0,039;0,331]	0,225** [0,052;0,377]	0,171** [-0,011;0,312]
PROF → CES (β) Bootstrap [0,025;0,975]	-0,034 [-0,181;0,148]	-0,048 [-0,218;0,132]	-0,020 [-0,241;0,087]	0,011 [-0,241;0,133]	-0,021 [-0,234;0,090]
CD → CES (β) Bootstrap [0,025;0,975]	-0,240** [-0,499;-0,073]	-0,230** [-0,458;-0,078]	-0,222** [-0,405;-0,039]	-0,164* [-0,358;0,018]	-0,202** [-0,403;-0,027]
PET → CES (β) Bootstrap [0,025;0,975]	0,263** [0,079;0,463]	0,187* [-0,015;0,368]	0,228** [0,036;0,383]	0,250** [0,046;0,425]	0,214** [0,024;0,388]
EPP → CES (β) Bootstrap [0,025;0,975]	0,280 [-0,086;0,578]	0,335* [-0,026;0,641]	0,365** [0,047;0,719]	0,338** [0,012;0,711]	0,386** [0,053;0,774]
LOD → CES(β) Bootstrap [0,025;0,975]	-0,108 [-0,318;0,144]	-0,109 [-0,367;0,168]	-0,117 [-0,354;0,144]	-0,166 [-0,487;0,077]	-0,110 [-0,413;0,143]
Goodness of Fit (GoF)	0,512	0,538	0,575	0,521	0,582
R^2	0,461	0,448	0,427	0,368	0,425
N	109	109	109	109	109

p-significance at 10% *; 5% **; 1% ***. [ ]: β value 0,95 for Bootstrap 500 iterations. Excluding Taïwan: 109 banks, 30 countries. (CES): Bank – Coal Exit Score. (ETC): Bank - Exposure To Coal. (SIZE): Bank – Size. (PROF): Bank – Profitability. (CD): Country – Coal Dependence. (PET) : Country – Progress in Energy Transition. (EPP): Country – Environmental Politics and Performance. (LOD): Country – Level Of Development.

correlation with the variable (CES) is high and significant. The results are detailed in Table 4. All the conclusions concerning the "country" variables are confirmed. The coefficients of the variable (SIZE) are positive but not very significant. With the exception of model 5, the reclassification percentages are higher for scores above 5. Overall, the prediction quality is satisfactory: between 75.4 and 82.5% for banks with scores below 5, and between 74.1 and 92.6% for banks with scores above 5.

The strong influence of national context variables explains the "defensive" strategies adopted by banks: the decision to communicate an exit policy is a response to an institutional context sensitive to environmental and energy issues. To illustrate this, the 13 banks with a score above 20 are all from countries that have set a target year for coal phase-out. These countries of origin have a very low share of coal in their energy mix (on average 4.8% compared to 23.6% in the total sample), and environmental performance indicators well above average (EPI: 77.6 > 64.2; GFI: 5.78 > 4.96; ETI: 68.1 > 60.7; ND: 68.3 > 64.1).

The legal status and ownership of the banks can also influence their coal exit strategies: two dichotomous variables allowed us to identify cooperative and mutual banks (COOP) and public banks (PUB). For the former, governance is geared more towards stakeholder expectations and less towards profit maximization. For the latter, the porosity between national policies and managerial decisions is accentuated. 7.2% of the banks in the sample (8/111) are cooperative and mutual structures and 25.2% (28/111) are controlled by a public entity. When entered into the models in Table 4, these variables have no significant coefficients.

Identifying international initiatives to monitor and measure GHG emissions (Network for Greening the Financial System, NGFS, Net-Zero Banking Alliance, NZBA) and those specific to the coal industry (Powering

Table 4. Logit regressions (Y = CES01).

	1	2	3	4	5	6
SIZE	0,631 (0,209)	- -	0,894* (0,097)	0,451 (0,400)	1,100** (0,022)	- -
CS	-0,048** (0,017)	-0,039** (0,041)	- -	- -	- -	-0,036** (0,027)
CP	-	-	-0,622*** (0,001)	-		
RNW	- -	- -	- -	- -	0,072** (0,017)	- -
vCS	- -	- -	-0,166*** (0,001)	-0,107*** (0,001)	- -	-0,080** (0,016)
POCT	- -	1,384** (0,022)	- -	- -	- -	- -
ND	- -	0,109** (0,018)	- -	- -	- -	- -
EPI	0,080*** (0,002)	- -	- -	- -	- -	- -
ETI	- -	- -	- -	0,207*** (0,001)	- -	- -
GFI	- -	- -	- -	- -	1,667*** (0,002)	1,094** (0,036)
Intercept	-8,064** (0,013)	-6,778** (0,032)	-4,382 (0,145)	-15,68*** (0,001)	-16,60*** (0,001)	-5,069* (0,067)
VIF	[1,03 ; 1,05]	[1,07 ; 1,30]	[1,11 ; 1,24]	[1,01 ; 1,01]	[1,10 ; 1,36]	[1,16 ; 1,38]
R^2 McF	0,356	0,351	0,375	0,416	0,325	0,375
R^2 CS	0,390	0,385	0,405	0,438	0,363	0,405
R^2 N	0,520	0,514	0,540	0,585	0,484	0,541
Predicted = 0	75,4%	81,8%	82,5%	81,8%	81,8%	75,4%
Predicted = 1	90,7%	87%	85,2%	92,6%	74,1%	87%

p-significance at 10% *; 5% **; 1% ***. VIF: Variance Inflation Factor. R^2 McF: MacFadden's R^2. R^2 CS: Cox & Snell's. R^2. Nagelkerke's R^2. Predicted: % Correct. (CES01): =1 if coal exit score > 5, 0 otherwise. (SIZE): log of total assets. (CS): coal share in total energy supply. (CP): coal production (log volume). (RNW): ranking of renewables share and variation of renewables share (1990-2019). (vCS): variation of coal share (1990-2019). (POCT): =1 if the country has announced a phase-out target year, 0 otherwise. (ND): Notre-Dame gain score. (EPI): environmental performance index. (ETI): energy transition index. (GFI): green future index.

Past Coal Alliance) would enable the willingness and environmental efforts of governments to be estimated. 27 of the 31 countries in the sample are members of the NGFS (central banks, other financial regulatory organizations): the 4 non-member countries represent very few banks in the sample (The Philippines, Taiwan, Poland, Qatar). The NZBA alliance includes only a few European national banking federations (6 countries in the sample: Spain, France, Portugal, Germany, UK and Switzerland). 15 countries are members of the PPCA, including 13 European countries, Canada and Singapore: one variable (PPCA) was tested in the logistic regressions: like (POCT), another « objective/target » variable, it turns out to be positive and significant. The national energy context is also marked by the use of nuclear power, which can substitute for coal and sometimes slow down the deployment of renewables (with notable impacts on CD and PET): the share of nuclear power is zero for 12 countries and more than 10% of the total energy supply for only 8 countries. A variable measuring the share of nuclear power in the country's energy mix (NUCL) was introduced into the models in Table 4 but the coefficients remain insignificant. Progress in the energy transition may also depend on carbon tax mechanisms and emissions trading systems. However, it is extremely complex to compile the information in a coherent variable, due to differences in the geographical perimeter considered: e.g., The European Union, individual countries, provinces, cities, etc.).

V. Discussion

The study of the determinants of banks' coal exit strategies initially reveals a less than optimistic picture. The exit scores of the banks in the sample are very low: 8.85/50 on average, with a high weighting of the exclusion criterion related to project financing. In this respect, commercial banks follow the trend of announcements by public actors (governments and development banks). However, two criteria that are essential for a significant environmental impact have averages close to 0, paving the way for further development of the sector's capacities: the exclusion of firms developing new coal projects (1.01/10) and the adoption of a real exit strategy (1.10/10). The last point raises the issue of monitoring the banks' commitments. Several problematic cases of non-compliance with set targets have been identified recently: Crédit Agricole's March 2020 coal exit commitments, and banks that are members of the Net-Zero Banking Alliance (NZBA) that continue to finance the sector to a large extent (Les Amis de la Terre, 2022). Thus, NGOs are calling for regulatory control and possible sanctions against financial actors deviating from the announced trajectories.

The question of the banks' compliance with environmental commitments deserves to be explored further. Several recent articles show that banks are now integrating climate issues into their credit decisions, demonstrating an active policy of respecting their environmental commitments. Delis *et al.* (2019) point out that banks are increasing the rates on syndicated loans to fossil fuel firms according to their levels of fuel reserves, future stranded assets (the size and maturity of the loan accentuate the phenomenon). In a sample of European banks, Reghezza *et al.* (2022) show that the share of loans to the most polluting firms decreased by 3% after 2015 (the decrease is more pronounced for banks with large capitalization and less profitability). Degryse *et al.* (2021) show that "green" banks offer reduced rate loans to "green" firms, the trend being valid only after 2015 (international sample over the period 2011-2019). Finally, in the French context, Mésonnier (2022) finds that banks with ambitious climate targets (2011-2017 period) have slowed down their credit flows to large firms in the 5 most emitting sectors. All these empirical results tend to prove that: 1) thanks to their credit policy (volume and rates), banks penalize firms in the most polluting sectors and favor "greener" firms, 2) they try to adapt their credit policies to their environmental commitments, 3) the Paris Agreement has been an important exogenous shock for the consideration of climate issues.

This article shows that the environmental strategies and communication of banks are sensitive to the national energy and environmental context, which is the consequence of the policies adopted by the countries. Yet, variables related to the number of climate policies (CPDs) and renewable policies (CPDr) have no effect. This finding could be refined by: 1) specifying the date of implementation of the texts, their geographical and sectoral scope of application, 2) completing the analysis with global governance indicators, including the degree of enforcement of laws, at the national and sectoral level (banking sector regulations).

National institutional contexts provide incentives for banks to define an exit strategy from coal. A question remains about the nature of this incentive. Several interpretations are possible. Banks may be responding to a regulatory constraint, which does not appear to be the case in this study because national climate and energy policies do not include a coal exit obligation. They can also anticipate future regulations (Lyon & Maxwell, 2002), which seems consistent with the influence of the variables (POCT) and (PPCA): banks' exit scores are higher in countries that have set exit targets themselves, as this national target may lead to new binding regulations in the future. Finally, exit strategies may be driven by non-coercive institutional pressures: this argument also seems valid in view of the influence of countries' environmental performance variables (reflecting climate policies and especially the aspirations of the general public).

The regulatory aspect is complex because it highlights the tension between climate urgency and pragmatism. In the banking sector, the immediate total exclusion comes up against the problem of loans already granted with remaining lifetimes of 10 to 20 years. Banning companies in the sector that also finance renewable energies to a large extent would be counterproductive: banks must ensure a gradual transfer of fossil fuel financing to renewable financing. Exit deadlines should be adapted to the evolution of each country's energy mix. The feasibility of coal phase-outs depends on market conditions (availability of affordable energy substitutes, energy prices, geopolitical tensions). Excluding investment portfolios can break up shareholder dialogue, the only alternative for influencing

the strategies of companies. Finally, coal companies themselves do not announce exit strategies, if at all. Faced with these realities, institutional actors are tending to reduce public financing while encouraging banks to disengage quickly: the drying up of public funds could also explain in part the high level of private financing.

Another question also arises: channel through which climate policy impact bank's coal exit? National climate policies can impact the profitability of coal companies and thus cause banks to divest (indirect influence). Conversely, climate policies can directly impose new regulations on banks: disclosure rules, supervisory climate stress testing, integration of climate-related risks into banks' capital requirements, integration of climate criteria into monetary policy frameworks, macroprudential instruments. Unfortunately, the Urgewald GCEL data do not allow for a precise reconciliation of coal companies and bank financing: the indirect channel cannot therefore be tested in this paper.

The tests do not include geographic data on the distribution of bank activity and do not estimate the effects of shifting financing to other countries when home country climate policies become more stringent. However, Benincasa *et al.* (2022) show that banks increase cross-border lending in response to higher climate policy stringency in their home countries, especially large, lowly capitalized banks with high NPL ratios.

The tests do not take the relative costs of different energy sources compared to coal into account (oil, natural gas and renewables). Yet this parameter can influence both the exit strategy of banks (coal prices impact the profitability of companies in the sector, their creditworthiness and thus their relationship with financiers) and two of the latent 'country' variables, i.e. the country's dependence on coal (relative prices impact the costs and revenues for the country) and the progress in the energy transition (a low price of coal and other fossil fuels can delay the energy transition). Unfortunately, prices are highly dependent on national contexts and country-specific data are not available.

Beyond analyzing the determinants of coal exit strategies, it is critical to note the lack of academic literature on the future consequences for sector firms and financiers. Green & Vallée (2022) study the effect of bank disengagement on firms in the sector (exclusively focusing on loans, with a sample of 333 firms and 82 banks, from 2012-2021). Their results show that coal firms have more difficulty raising funds and have lower debt levels. The authors do not find a substitution effect between disengaged banks and others. These findings therefore underline the effectiveness of the strategies actually deployed. On the banks' side, existing articles attempt to quantify the potential losses in value linked to stranded assets; there is no research looking at the real financial consequences (on net banking income, on profits) of recent exit policies and at possible transfers of fossil fuel financing to renewable energy sources.

VI. Conclusion

The study of coal sector financing is a crucial and timely topic in many ways: 1) coal is a large part of remaining fossil reserves, 2) coal operations are highly capital intensive, 3) scarcity of data in coal financing is a main issue.

This paper proposes a novel study of the determinants of international banks' coal exit strategies. Significant conclusions emerge from the models tested. First of all, the exit scores are very low for the banks in the sample: a substantial effort is needed in the future to define more ambitious objectives, in particular on the financing of firms and the setting of conditions of a real exit. The lack of a link between internal determinants and exit strategies leads to reflections that constitute future avenues of research to be explored. With respect to sector exposure and overall risk, estimating stranded assets and comparing them to the revenues generated by current financing, exploring the complementarity of financial and environmental risks, and closely analyzing the distribution of net banking income, both in terms of activity and geography, are all research questions to be studied. This paper shows that external variables explain the heterogeneity of exit scores better than internal variables. The influence of country dimensions demonstrates that banks adapt their exit strategies to the energy and environmental context of the country. This result provides a new perspective on managerial decision making on the issue of fossil fuel financing and climate target setting by banks. It also highlights the driving role of policy decisions on the trajectory of the energy mix and environmental performance in prompting banks to establish an action plan. This finding tends to confirm Lyon & Maxwell's (2002) hypothesis that banks anticipate the emergence of new regulations based on changes in the national context (declining dependence on coal, energy transition, announcement of the country's coal exit).

There are two major problems in studying coal financing. Primary data are scarce and complex to collect; although the number of organizations interested in the subject has increased, the reliability and completeness of the data may be questionable. Moreover, the ambiguity of the intentions and actions of the various actors, both public and private, could hinder a real decline in coal production and use: countries announce dates for exiting the sector but do not regulate private financial flows or export their technology to install capacity abroad and offer growth relays to national firms in the sector.

The main limitations of this research lie in the small sample size due to data availability (exit scores are updated regularly on the Coal Policy Tool platform) and the choice of proxies used for external and internal variables.

For the internal variables, linking the number of international initiatives to which banks adhere (e.g., Net-Zero Banking Alliance, Carbon Disclosure Project, GHG Protocol, Green Bond Principles, FSB TFCD, etc.) and their environmental disclosure (including coal exit strategies) would allow us to judge the consistency of their commitments. Future articles could complete the analysis by integrating the dimensions of governance and ownership structure of banks. For example, the nature and composition of environmental governance bodies and the presence of institutional investors could be potential explanatory factors for banks' climate risk perception, environmental communication and fossil fuel financing strategies. Extending the field of research to other financial

actors, such as asset owners, asset managers, and insurers, would also be an interesting avenue.

1. The list, which is released annually, includes investments and financing provided to 1,031 coal companies. Of these, 503 companies are still planning to develop new power plants, mines or infrastructure: these projects would increase thermal coal production by 27% and coal-fired power generation by 23%. Only 49 of the 1,030 companies have announced a date for exiting coal.
2. Only financial risk is taken into account and not risk aversion, which is more difficult to measure.

x4. Steckel & Jakob (2021) classify the 15 countries in their study into 4 families: eliminating countries (Germany, Bulgaria, Chile, the United States, and the United Kingdom), introducing countries (Kenya, The Philippines, Vietnam), established users (China, India, Turkey), and exporting countries (Australia, Colombia, Indonesia, South Africa).
5. Including all Brazilian, Chinese (except 1), and Indian banks.
6. The R script and the successive iterations of the PLS-PM model are available at: https://github.com/benoitjamet/BanksCoal.git

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