

Global Standards and Local Ambitions across Green Taxonomies:

Climate change mitigation from the European Union to South Africa

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Abstract

Country-level green finance taxonomy standards have emerged to provide clarity on environmentally-sustainable economic activities to attract investment, protect financial services consumers, and counteract greenwashing. This paper adopts the Global Production and Financial Network (GPFN) approach and analyses factors affecting the climate change mitigation ambition level of the South African Green Finance Taxonomy (RSA GFT) in comparison with the EU taxonomy, which served as a model for South Africa's (RSA) regulators. It accounts for (i) the interplay between EU's and RSA's production and financial networks, and (ii) RSA's willingness to attract European funding for sustainable development. We find that EU private investors hold more bonds in South African economic sectors with higher ambition level of greenness as determined by the South African green taxonomy. In contrast, EU-owned development banks finance South African economic sectors which have a lower green ambition in the RSA GFT compared to the EU taxonomy. In addition, South African sectors exporting more to the EU signal their virtues with a higher green ambition. The launch of RSA GFT has re-allocated bond investment, bank loans, and trade exports from economic activities excluded from the taxonomy to those which are included. Our study shows that a joint financial geography and GPN approach can explain regulatory choices in the Global South which adopt the EU model for green finance taxonomy development.

Keywords: standards; green taxonomy; sustainable finance; financial networks; production networks.

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1. Introduction

Climate change is a global “tragedy of the commons”. Despite the efforts of countries, companies and entire global value chains (GVCs) to decarbonise, global emissions have continued to increase over the past two decades (Cojoianu, Ascui, et al., 2021; UN Environment Programme, 2019). The reasons for this include ineffective legislation around the world, the commitment to finance new fossil fuel infrastructure (Pfeiffer et al., 2018), a lack of standardisation on what sustainable economic activities are and how they should work to help achieve the goals of the Paris Agreement (European Commission, 2024).

Economic geographers and innovation scholars have studied standards, focusing on their geography and implications for the environment, particularly within the framework of global production networks (GPNs). However, we have a limited understanding of how global financial networks (GFNs) engage with these standards and allocate funding to sustainable GPNs, which is crucial for spreading and upscaling environmental solutions around the world (Alessi et al., 2024; Wójcik et al., 2024). Green bonds and sukuk, and sustainability-linked bonds are all examples of standards in the GFN, but in addition to criticism of their vague requirements (Lai, 2025), their transferability and adoption across jurisdictions remain ineffective (F. H. M. Liu et al., 2019).

Coe & Yeung (2019) argue that a major research gap persists at the intersection of GPNs, GFNs and environmental and social issues. This intersection has major practical implications, particularly for sustainable finance standards. Green finance taxonomy standards have emerged exactly at this intersection of GPNs, GFNs and the environment with the goal to clarify which economic activities should be considered sustainable. A green taxonomy is generally a data dictionary defining sustainable economic activities, serving as a reference for corporates, investors, and policymakers to make informed decisions regarding investments. The UN estimates that over 40 jurisdictions have developed green finance taxonomy standards with different types of design and targeted activities (UN Environment Programme, 2024). Theoretically, we adopt the Global Production and Financial Network (GPFN), proposed by Grote et al. (2024), to frame the dynamic interaction of financial networks and production networks in setting climate change mitigation targets.

The geography of standardisation in finance is an area which has been understudied by geographers (Clark et al., 2006) and accounting and finance scholars (Lorraine et al., 2001). Our paper aims to fill this gap by examining the adoption of the EU Green Taxonomy by South Africa, and how this adoption has maintained, weakened or strengthened the EU approach in relation to specific economic activities. We also study the influence of different types of GFN and GPN flows and stocks, including equity, bond, commercial and development bank loans, private equity and venture capital, and RSA – EU trade, on the adoption. Given that green taxonomies are very recent, we follow (Cojoianu et al., 2020; Feldman et al., 2019; Moeen & Agarwal, 2017) and use an exploratory research design that allows a nuanced investigation of our questions without committing to explicit hypotheses.

We find that GFN actors, particularly bondholders, and commercial and development banks are instrumental in shaping the ambition of the green finance taxonomy adoption in South Africa. GPNs also matter, particularly the relative size of RSA's exports to the EU across different sectors. In addition, the adoption of the green taxonomy positively influences capital flows from EU to South Africa across economic activities included in the taxonomy. A key implication of our findings is that GPNs and GFNs should be studied together when seeking to understand the standardisation, diffusion and performance of sustainable finance.

The paper is structured as follows. Section 2 explores the literature on cross-border green standards adoption, and how this is shaped by GPNs and GFNs. Section 3 outlines our data and methodology. Section 4 and 5 provide a descriptive and statistical analysis of our findings, with implications and conclusions in Section 6.

2. Theoretical framework

2.1. Sustainable finance taxonomies: between production and financial networks

Climate change and broader environmental issues have become critical drivers of international standardisation efforts (Blind et al., 2023). Majority of research on environmental standards in geography has focused on GPNs, with regard to green office buildings (Eichholtz et al., 2010; Simcoe

& Toffel, 2014), energy-efficient appliances (Houde & Aldy, 2017; Houde & Myers, 2021) or emissions standards (Cojoianu et al., 2020; Dechezleprêtre & Sato, 2017). Scholars have also addressed compatibility issues within GPNs and how environmental standards may promote innovation in GPNs (Li, 2019; Wiegmann et al., 2017). However, we know little about standards in finance, particularly those addressing sustainable development challenges, possibly because they are a recent phenomenon with the literature on the emergence of weather-related insurances (Johnson, 2013), scaling climate finance (Christophers et al., 2020), standards in green municipal bonds (Hilbrandt & Grubbauer, 2020; F. H. Liu & Lai, 2021), sustainability in real estate finance (Wainwright & Demirel, 2023), and adaptation finance (Webber, 2013).

The intersection of GPNs and GFNs is a nascent field of research, with examples exploring how GFNs fund different configurations of GPNs, and GFN impacts on corporate sustainability (Clark et al., 2006; Hoepner et al., 2024). Although the second generation of GPNs includes finance as one of the key drivers (Coe & Yeung, 2019), it risks under-representing the many facets of finance. Grote et al., (2024) propose combining both GPNs and GFNs approaches into the Global Production and Financial Network (GPFN) to account for the growing importance of GFNs actors, especially institutional investors, in the network dynamics (Clark & Hebb, 2005). Furthermore, the GPFN approach considers the role of governments in regulating markets.

One major research gap from these extant studies is that standards at the intersection of finance and production have been approached from the perspective of corporate governance (Clark et al., 2006), but less through the lens of sustainable finance standards such as green taxonomies. The objective of this paper is to study green taxonomies in terms of the ambition with which they tackle the climate crisis, and ways in which this ambition is adopted in the Global South. Furthermore, our paper explores the drivers of green taxonomy standard design considering factors related to both GFNs and GPNs. Finally, the paper asks whether the RSA GFT adoption has enhanced funding opportunities for economic activities covered in the taxonomy.

Another research gap is that previous studies do not explicitly operationalise production and financial networks in their analysis. We fill this gap by operationalising GPFN actors through relevant

proxies. This, to our knowledge, not only extends the scope of the GPFN approach to analyse a sustainable finance outcome, but also empirically advances it methodologically.

Overall, economic and financial geographers have much to contribute to the adoption of green finance standards worldwide and showing how the cross-border relations between the EU as the most sophisticated architect of green taxonomies to date and early adopters in the Global South influence the adoption level of the green finance taxonomy. This approach underscores our overarching exploratory research question:

RQ1. How do global production and financial networks shape the ambition level of green finance taxonomy adoption?

In what follows we define a standard as a widely accepted norm or behaviour encompassing rights and obligations (Lorraine et al., 2001). Diffusion, in turn, is the process through which the standards established by one organization are adopted by another organization. Finally, we refer to adoption as the outcome of the diffusion process.

2.2. EU Green Taxonomy standard emergence

Standard emergence can occur through different processes (Blind et al., 2023; Farrell & Simcoe, 2012): de facto, with standards developed by individual firms and diffused in a decentralised manner or, de jure, with standards initiated by governments to provide market clarity as guidance or as legally mandated regulations. In our study, we explore the de jure approach to green finance taxonomy development, led by the EU Commission and the South African Treasury in their respective jurisdictions.

The EU Taxonomy Regulation (TR)¹ entered into force in July 2020. It sets out six environmental objectives and conditions an economic activity must satisfy to qualify as environmentally sustainable. One of the conditions is aligning with the technical screening criteria (TSC). Our paper focuses on the climate change mitigation objective, the TSC of which was included in

¹ EU Taxonomy Regulation (Regulation (EU) 2020/852)

the first Delegated Act². This was also the delegated act available to South African authorities at the time when their own taxonomy was designed (please see OA.1 and OA.2 for more background).

From the supply side, standards address a market failure (Hudson & Jones, 2003; Swann, 2010), which in our case is climate change mitigation. While the EU cannot directly regulate green industries in other countries, with a green taxonomy it creates an incentive mechanism for economic activities in other countries to align with the standard, driven by the need to access funding through financial instruments marketed as green in the EU. This cross-border incentive mechanism of the taxonomy is important as traditional environmental policies and national social movements struggle to constrain environmentally unsustainable corporate activities of their home companies operating abroad (Cojoianu, Ascui, et al., 2021). From the demand side, the EU has introduced the taxonomy given the high demand for sustainable financial products across Europe, but also to address lack of standardisation among financial product providers on what green means. This dynamic has been discussed as a reaction of regulators to aid product innovation (Georgallis et al., 2019; Su et al., 2015).

2.3. Green taxonomy diffusion and adoption: The Case of RSA

The potential dynamics of diffusion and adoption of green taxonomies are somewhat predictable. International standards have been particularly successful in periods of market expansion and globalisation, which applies to the growth of environmental finance and green technologies after the Paris Agreement (Blind et al., 2023; Swann, 2010). Meanwhile, expansion in cross-border trade has enabled and been enabled by national and international standards development (Bernhofen et al., 2016; Brooks et al., 2021; Levinson, 2016). The EU has been a standard setter in green finance development, given the robustness of its taxonomy, but also the desire of many Global South trading partners to attract financial flows from Europe. In April 2022, RSA became the first African country to publish a Green Finance Taxonomy³. Its first version was endorsed by the National Treasury. It defines the same environmental objectives as the EU Taxonomy, and includes criteria for eligible economic activities for the first two goals.

² EU Climate Delegated Act (Delegated Regulation (EU) 2021/2139)

³ National Treasury (2022): the first edition of South African Green Finance Taxonomy (Accessed on 24 October 2023)

Literature has shown that standard diffusion is shaped by cross-border flows of trade, labour, and finance. Lorraine et al. (2001) argue that the greater the volume and types of cross-border linkages between two jurisdictions, the stronger the cross-border diffusion. However, prior research does not specify which interdependencies may be more important and in what context. Our study puts GPN and GFN links side by side, proposing that economic geographers can understand standards adoption and diffusion much better when the effects of GFNs are taken into account.

Given that RSA decided to follow the EU taxonomy, our goal is to understand how ambitious the South African taxonomy is compared to the EU's, for each economic activity covered by both taxonomies. In addition, the study investigates whether the adoption of the green taxonomy has enhanced capital flows between the EU and South Africa, and whether this has been influenced by the stringency of adoption. RSA did not opt for a full harmonisation, but instead pursued a standard-setting approach, referred to as national treatment (Lutz & Pezzino, 2012).

As both the EU Taxonomy and the RSA GFT define sustainability standards for each individual economic activity, the discretion in RSA's adoption of the taxonomy is exercised with regard to individual economic activities, reflected in the degree to which RSA adopts the EU criteria with similar, more or less ambition. As the RSA GFT aims to attract green capital flows from Europe, we could suspect that when the EU-RSA GFN connections at the individual economic activity level are more intense, the more likely RSA is to adopt a similar or higher sustainability ambition for this economic activity, and that this impact is stronger for GFN than for GPN connections. This could be explained by the fact that RSA, by issuing a green taxonomy, aims to provide investors with clarity to finance green projects in the country. Hence, the second research question is:

RQ2: How do EU-RSA GFN connections compare with their GPN connections in terms of their impact on the ambition of green taxonomy standard adoption in South Africa?

2.4. Green taxonomy standards – primary capital markets and adoption effects

Sustainable economic activities are financed through primary capital markets, i.e. the issuance of new bonds, loans, or equity. Debt is important for capital-intensive sectors, (Ascui & Cojoianu, 2019; Cojoianu, Ascui, et al., 2021; Cojoianu, Hoepner, et al., 2021; Steffen, 2018). Debt instruments,

especially green bonds, with lower cost of capital, have become increasingly prevalent in financing sustainable economic activities (Flammer, 2021). Research on GFNs has shown that the prominence of many leading financial centres rests on investment banking services (Wójcik et al., 2019). In addition, whereas the geography of production can be shifted by technology in a few years, the geography of financial networks takes much longer to develop, and as a result, GFNs stay in power and affect GPFN for longer (Grote et al., 2024).

For many developing countries, development banking has been a prime driver of foreign direct investments for both sustainable development purposes (Yuan & Gallagher, 2018) and for derisking GPNs to attract follow-on funding from other investors such as commercial banks (Eslava & Freixas, 2021). Given this background, we anticipate that GFNs related to the debt channel are more influential in shaping the ambition level of the RSA GFT than equity-related GFNs (public or private equity). Furthermore, given that EU commercial banks are required to report the proportion of their lending book to green taxonomy aligned activities, and EU development banks are not, we further explore two related questions:

RQ3: Are debt-related GFNs more impactful than equity-related GFNs in ensuring an ambitious green taxonomy standard adoption?

RQ4: Are commercial banking GFNs more impactful than development banking GFNs in ensuring an ambitious green taxonomy standard adoption?

Finally, our study contributes to the literature on standard adoption effects, in the guise of capital flows and enhanced GFN activity between the two jurisdictions. Nadvi (2008) highlights that many standards and governance structures, particularly related to GPNs, have not necessarily delivered the expected changes. Cojoianu, Ascui, et al. (2021) shows that GFNs can easily navigate pollution havens and finance economic activities in economies with the least ambitious environmental policy stringency. In this respect, our final question is:

RQ5: Has RSA GFT adoption enhanced debt capital flows from the EU towards South Africa?

Table 1 summarises key contributions of this paper and previous literature.

[Insert Table 1 here]

3. Data and methodology

3.1. Dependent variables

We identify similar activities based on their names and descriptions in the two taxonomies⁴, and compare the substantial contribution criteria of the climate change mitigation objective of the RSA GFT's activities to those of the EU Taxonomy in quantitative and qualitative terms.

Three authors of the paper have independently reviewed all substantial contribution criteria leading to four categories⁵: incomparable; similar; the RSA GFT is more ambitious/ more detailed than the EU Taxonomy; and the RSA GFT is less ambitious/ less detailed than the EU Taxonomy. The first category applies to criteria for the agriculture sector as the two jurisdictions refer to different standards. The second category is applicable in cases in which both taxonomies have a similar number of requirements and thresholds. The third category applies when the RSA GFT has a higher number of requirements and/or more detailed requirements. The fourth means that the RSA GFT has fewer requirements and/or less detailed requirements. As we are interested in comparing the level of ambition between the RSA GFT and the EU Taxonomy, we exclude the "incomparable" category. A total of 87 activities were categorised^{6 7}.

3.2. Independent variables

In theory, the taxonomy allows for mapping companies to multiple types of economic activities they conduct. However, given the lack of data on the distribution of activities within each company, we map the taxonomy to their main economic activity proxied by the sub-industry classification. Detailed definitions of all variables are presented in OA.4.

3.2.1. Global Financial Network Factors

EU investors' holdings of bonds ("EU bonds") and equities ("EU equities") in South African companies

⁴ Our comparison of the two taxonomies is based on the criteria set out in the first version of the South Africa Green Finance Taxonomy and the EU Climate Delegated Act (C/2021/2139)

⁵ Detailed methodology is provided in Appendix OA.3. In case the three authors came to diverging results, these cases were resolved in the ex-post validation with staff of the South African National Treasury and the European Commission's DG INTPA.

⁶ Cojoianu, Hoepner & Vu (2022) 'Comparison of the EU Green Taxonomy with South Africa's Green Taxonomy' Brussels: European Union Directorate General for International Partnerships.

⁷ [Sustainable Finance Taxonomy Mapper](#)

Both variables are on an economic activity level. We consider all long-term bonds (with at least 5 years of maturity as of 31 December 2021 – the year before the RSA GFT publication) listed by South African companies on the JSE as of 31 December 2021. After matching the issuing companies to the taxonomies based on their primary industry, we aggregate firm-level data that have been matched to economic activity level and calculate the share of EU investors in total bond holdings.

We use information from LSEG Workspace on the shareholders of 143 South African companies listed on the JSE as of 31 December 2021. The holdings data are available on a quarterly basis from 2016 to 2020. The variable is aggregated on economic activity level from firm-level data that have been matched to economic activity level and measured as the share of EU investors in total equity ownership.

EU investors' venture capital investments in South African companies

The variable is on an economic activity level. We obtained a list of South African companies receiving venture capital in 2016 to 2020 from Preqin. We matched these companies to eligible taxonomy activities based on the description of their activities, and measured the share of EU-based investors in these deals, taking a five-year average percentage ("EU VC") to account for the volatile flows of venture capital from the EU to South Africa.

EU commercial banks' and EU development banks' underwriting of financing deals for South African companies

For this economic-activity-level variable, we employ the Dealogic database on primary market deals. From 2016 to 2020, there were 3,921 deals for South African companies. EU-based banks underwrote 17.5% of them. We matched South African companies with the taxonomies and quantified the proportion of financing that EU banks underwrote, aggregated on activity level, and averaged to arrive at the five-year proportion of EU banks providing underwriting services to South African companies ("EU commercial banks"). We use the same database and calculation process for the variable "EU development banks". We collated a list of development banks worldwide and found their matches in the Dealogic database.

3.2.2. Global Production Network Factors

GVA and market capitalisation structure by sector

We include EU's and South Africa's gross value added (GVA) by sector from MarketLine. We quantify the share of each sector in each jurisdiction's GVA and take the average for the five-year period 2016 to 2020. These are both sector-level variables.

Additional variables are the proportions of taxonomy-eligible sectors defined as the ratio of the aggregated market capitalisation of companies listed in a taxonomy-eligible sector divided by all listed companies in the most prominent EU ("EU stock exchange") and South African stock exchange – Johannesburg stock exchange ("JSE") indices. We operationalise these variables by obtaining data from MSCI World's EXSA Fund (EU) and EZA Fund (South Africa) holdings as of December 31, 2022.

RSA's export to the EU

Using data from UN Comtrade, we focus on the export of from South Africa to the four biggest economies in the EU by size (Germany, France, Italy, and Spain), and to the Netherlands, given its historical ties to South Africa. We take the share of South African exports to those five EU countries in total South African exports to the world for each economic activity matched with the taxonomies. The economic-activity-level variable ("RSA export") is calculated as an average for 2016-2020. Finally, we also control for employment by sectors in both jurisdictions, which are obtained from the International Labour Organisation (ILO).

3.3. Model specification

The ambition level variable is ordinal, so our first model is:

$$\text{ComparisonOfAmbitionLevel}_i^* = \beta_1 + \beta_2 \text{GFN_Factors}_i + \beta_3 \text{GPN_Factors}_i + \varepsilon_i \text{ (Equation 1)}$$

Next, we run difference-in-difference regressions for the period from 1 April 2020 to 31 March 2024. The analysis focuses on: (i) whether there is an increase in financing flows and trading flows in taxonomy-eligible economic activities and (ii) whether there is a reallocation, among the taxonomy-eligible activities, from the less ambitious activities to activities with at least the same ambition as the EU Taxonomy. We include 24 months on each side of the launch date of the RSA GFT (1 April 2022) to create panel datasets.

The two equations (excluding firm controls and fixed effects) for (i) and (ii) are

$$\text{FinancingFlowsOrTradingFlows} = \beta_0 + \beta_1 \text{EligibleActivities} + \beta_2 \text{AfterRSAGFT} + \beta_3 \text{EligibleActivities} * \text{AfterRSAGFT} \text{ (Equation 2)}$$

$$\text{FinancingFlowsOrTradingFlows} = \beta_0 + \beta_1 \text{ActivitiesSameOrHigherAmbition} + \beta_2 \text{AfterRSAGFT} + \beta_3 \text{ActivitiesSameOrHigherAmbition} * \text{AfterRSAGFT} \text{ (Equation 3)}$$

For bond holdings and equity holdings^{8 9}, our dependent variable is EU private investors' percentage of ownership of outstanding bonds or shares of each South African company included in our sample. The date of disclosure of investor ownership is used to determine whether the ownership is before or after the launch of the RSA GFT. For syndicated loans, we use data from Workspace. The dependent variable is the percentage of the loan package amount for each commercial bank involved in the syndicate managing the loan for South African companies. The date to determine whether a loan is post-RSA GFT is the date when the loan was originated. For South African exports to the EU, the data are from UN Comtrade. We use data on exports aggregated on a monthly basis. The dependent variable for the difference-in-difference model is the estimated value amount free on board (FOB).

4. Descriptive statistics

Table 2 displays the distribution of each comparison level across sectors for climate change mitigation. Out of 87 sets of criteria, 60% of them in the RSA GFT are at least similar to those in the EU Taxonomy. The energy sector is the sector in which the RSA GFT has the largest number of more ambitious/more detailed criteria than the EU Taxonomy. This is mainly due to the declining thresholds of greenhouse gas (GHG) emissions criteria specified in the RSA GFT. Another sector in which the RSA GFT has more ambitious/more detailed criteria than the EU Taxonomy is water and waste management. These criteria are for two activities that involve capturing emissions included in the RSA GFT but not in the EU Taxonomy.

⁸ For bond holdings and loan underwriting, the controls are asset-to-liability ratio, credit ratings, sector, whether the issuer is listed, default probability, beta, profit, and interest coverage ratio (Hu et al., 2024; Zaghini, 2024)

⁹ For equity holdings, the controls are same as the above plus market capitalisation, book-to-market value, leverage ratio, capital expenditure, property plant and equipment (PPE), and long-term growth estimates (Bolton & Kacperczyk, 2023)

Table 3 shows the 20 largest South African companies by market capitalisation and their potential inclusion in the two taxonomies based on primary industrial classifications. Three companies can be identified as a match with the manufacturing of iron and steel. 12 companies could not be matched with any activities in both taxonomies, which is not unreasonable given that even the EU Taxonomy is still being developed as of March 2025. German and French commercial and development banks are among those underwriting most financing for South African companies in 2016-2020 (OA.5 and OA.6).

[Insert Table 2 and 3]

Figure 1 demonstrates that for both bond and equity of EU investors in South African companies, the construction and real estate sector has the largest holdings. The manufacturing and financial sectors also feature prominently. Figure 2 shows that while most EU bond holdings are in South African sectors with similar criteria, half of EU equity exposure to South Africa is in sectors with less ambitious criteria than those of the EU Taxonomy. We perform the same analysis with EU commercial and development banks (OA.7 and OA.8). EU commercial banks underwrite financing deals for South African companies across many sectors, whereas EU development banks focus on ICT, energy, and finance sectors. Figure 4 highlights that almost all the deals underwritten by EU development banks are in sectors with less ambitious criteria.

[Insert Figure 1 and 2]

5. Statistical analysis

Table 4 demonstrates that the more important a sector is in the JSE equity index, the less ambitious its criteria are as compared to those of the EU Taxonomy. This may be an indicator of corporate lobbying, whereby listed companies in sectors with high market capitalisation reduce the number of substantial criteria applicable to their primary industries in comparison with the EU Taxonomy. For example, in the JSE equity index, the ICT and financial sectors combined account for more than 50% of total market capitalisation, but on aggregate, the level of ambition of the RSA GFT in these two sectors is consistently lower than that of the EU Taxonomy. In addition, the relationship between the

ambition level and the proportion of sectors in the EU equity index is significantly positive. This suggests that typically for sectors more prominent in the EU equity index (e.g. energy, waste), the RSA GFT has a higher ambition level than the EU Taxonomy. This may be interpreted as an attempt by South Africa to signal its green virtues.

The result for “EU GVA” indicates that for an activity or sector contributing significantly to the EU’s gross value added, the criteria of the RSA GFT are less ambitious than those of the EU Taxonomy. In addition, the relationship between the ambition level and the proportion of sectors in the EU GVA is significantly negative. This suggests that for sector less prominent in the EU GVA, the RSA GFT has higher ambition level than the EU Taxonomy (e.g. energy, waste). This may also be interpreted as an attempt by South Africa to signal its green virtues.

Another finding is the role of exports from South Africa to the EU in determining the level of ambition of the RSA GFT. It is shown that the more South Africa exports a particular good to the EU, the higher the likelihood that South Africa assigns a high level of ambition for the particular economic sector in the GFT. This reflects the importance of manufacturing in South Africa, a sector in the RSA GFT that has more detailed than and similar criteria to those of the EU Taxonomy.

Overall, listed companies in South Africa seem to be exposed to less ambitious criteria in the GFT, but at the same time, the GFT, as a market-led initiative, sets higher requirements in sectors that account for a large proportion of the EU equity index, possibly signalling South African green transitions in such sectors. This signal of green virtue can also be observed in the more ambitious criteria set for the country’s manufacturing of products exported to the EU. Since the EU is one of the most significant trade partners of South Africa, the results reflect a positive relationship between trade volume and the level of harmonisation of the two green taxonomies.

[Insert Table 4]

We conduct robustness tests, filtering for financing deals underwritten by EU commercial banks and EU development banks for RSA companies that have their bonds listed (OA.9) and their equities listed (OA.10) on JSE. Results reinforce evidence of the negative relationship between the proportion of sectors in JSE and the level of ambition of the RSA GFT. More consistently, the more

important a sector is in the GVA of the EU economy, the less ambitious the RSA GFT's criteria are compared with those of the EU Taxonomy. It is the case that the important sectors in the EU economy are not the same as in the South African economy, which is more focused on mining and manufacturing. For the equity-listed companies' model, EU commercial banks' financing into the South African economy helps shape the higher ambition level of the RSA GFT. This could be seen as a reflection of listed South African companies anticipating the effects of EU Taxonomy Regulation on relevant financial institutions operating both in the EU and in South Africa.

Regarding the difference-in-difference regressions, results from Table 5 show that two years after the launch of the RSA GFT, there seems to be a decrease in bond holdings in South African companies, whose activities may be eligible under the RSA GFT. However, among those eligible activities, the reallocation towards economic activities with similar or more ambitious criteria than those of the EU Taxonomy is consistently not significant (Table 6).

[Insert Table 5 and 6]

For equity holdings, Table 7 and 8 demonstrate that although there is a statistically significant decrease in shareholdings of listed South African companies after the launch of the RSA GFT, investors seem to increase their holdings in companies that operate in activities with lower ambition level criteria than the criteria of the EU Taxonomy.

[Insert Table 7 and 8]

Finally, Table 9 demonstrates that commercial banks seem to underwrite more loans for companies operating in activities eligible under the RSA GFT, but the volume of underwriting by commercial banks for South African companies whose activities have the same criteria as or more ambitious criteria than those of the EU Taxonomy seems to decrease after 1 April 2022 (Table 10). These results indicate that while bondholders are ambition agnostic, banks increase loans in activities the South African taxonomy classifies as green, particularly when the ambition level is lower. Results with trading flows from South Africa to the EU also confirm the role of the RSA GFT in South African economy. After the launch of the RSA GFT, exports of RSA products to the EU increase in activities that are eligible under the Taxonomy (Table 11), but similarly to the results of syndicated loans

underwriting, the increase is in activities with lower ambition level than that of the EU Taxonomy (Table 12).

[Insert Table 9, 10, 11, and 12]

6. Implications and conclusions

Building on literature on the role of GPNs and GFNs in standards adoption, our study shows that production and financial networks between the EU and RSA are important in ensuring an ambitious adoption of the green finance taxonomy. We find that in sectors or economic activities where more EU investors hold bonds in South African companies, the RSA GFT's criteria are likely to be more ambitious or more detailed than those of the EU Taxonomy. This may be due to the favourable impacts of foreign investors on the corporate governance of companies, which in turn play a large role in developing a bottom-up green taxonomy initiative in South Africa¹⁰.

Second, exports from RSA to the EU's biggest economies seem to positively affect the ambition level of the RSA GFT as compared with the EU Taxonomy, which reinforces the critical role of manufacturing in the South African transitions to sustainability in the context of climate change mitigation. Third, while the constructive role of development banks' investments in emerging economies is not to be underestimated, their financing deals in South African companies do not appear to influence the ambition of the RSA GFT vis-a-vis the EU Taxonomy. Fourth, additional analysis from difference-in-difference regressions highlights the role of GFNs in South Africa after the launch of the RSA GFT. Results indicate that although there is an increase in activities eligible under the RSA GFT in relation to bond holdings and loan underwriting, the reallocation to activities with criteria that at least match the ambition level of the EU Taxonomy remains unchanged.

For economic and financial geographers, the results highlight that green finance standards are an important setting for studying how GFNs and GPNs collide to shape sustainability outcomes. As more and more jurisdictions will be introducing green taxonomies, further research into the diffusion and adoption processes of green taxonomies may be extended based on the present study. As such,

¹⁰ As note 6 above.

our paper provides a step towards addressing Coe & Young's (2019) call to study GPNs, GFNs, and sustainability outcomes in an integrated way.

For policymakers considering adopting a green taxonomy, it is important to recognise the role of financial and trading ties with other jurisdictions in shaping the ambition level in the adoption process. Policymakers at development banks can review their financing facilities to emerging countries to accelerate the low-carbon transition in these countries by ensuring an ambitious adoption of green taxonomies.

This research could be extended in many directions. One would be to consider other features of the GFN, such as the role of offshore jurisdictions and financial secrecy they afford potentially obscuring the application of green taxonomies by corporations. Furthermore, as a policy, albeit not mandatory yet in the RSA, the green taxonomy is affected by more than just economic and financial relationships. Subsequent studies could expand the scope of independent and control variables to include such factors as institutional governance and social awareness and acceptance of the policy. Finally, for the green taxonomy to become an effective tool to scale up sustainable finance, it would be beneficial to examine how existing sustainable finance initiatives could contribute to creating a comprehensive regulatory framework built on a green taxonomy.

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7. Figures and Tables

7.1. Figures

Figure 1: EU investors' bond and equity exposure to South African companies by sectors

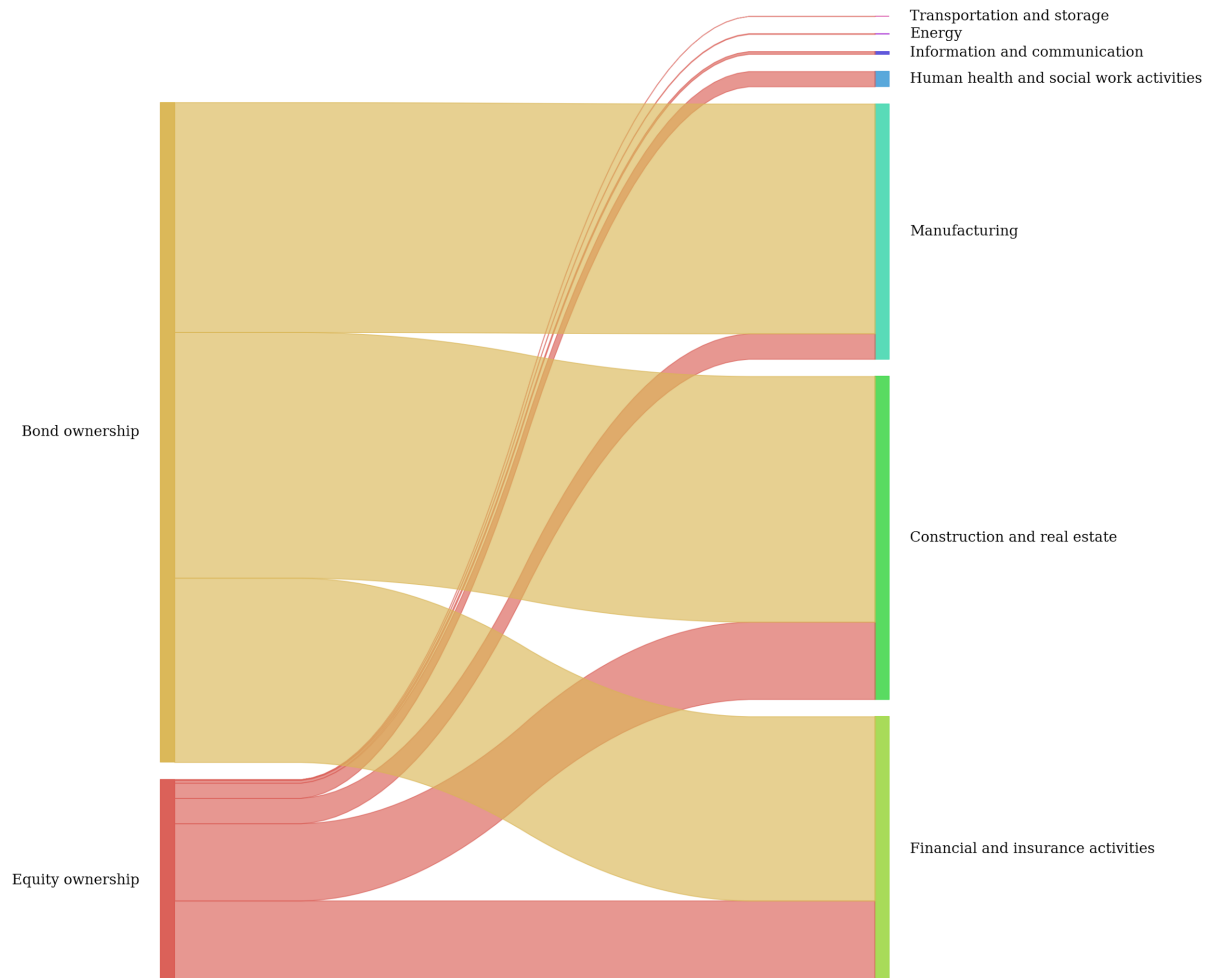
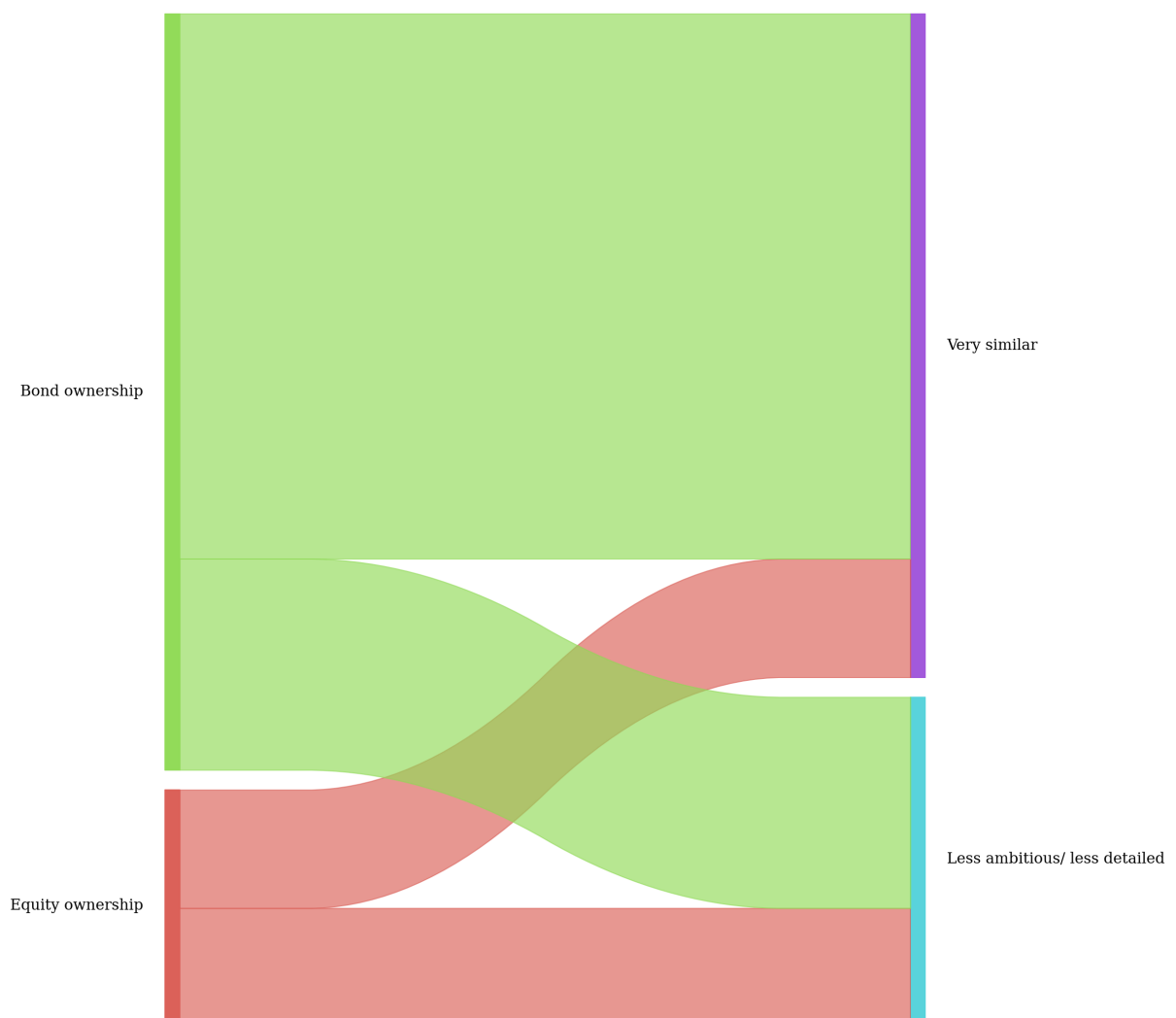


Figure 2: EU investors' bond and equity exposure to South African companies by ambition levels



7.2. Tables

Table 1: Comparison of related papers' and this paper's theoretical and empirical contributions

	Clark and Hebb (2015)	Liu, Demeritt, and Tang (2019)	Liu and Lai (2021)	Grote, Wójcik and Zook (2024)	This paper
Research objective	Explaining the role of institutional investors in encouraging firms to adopt higher corporate social and environmental standards	Examining the effectiveness and transferability of international sustainability reporting standards on the stock markets of Hong Kong and Singapore	Analysing Malaysian green sukuk's standard setting, developments and limitations	Evaluating the evolution of oil trading networks from its beginning and price anomalies since 2010	Analysing factors affecting the climate change mitigation ambition level of the South African green finance taxonomy in comparison with the EU' taxonomy
Methodology	Case study	Case study and interviews	Case study and interviews	Analysis of data, historical accounts, and relevant reports	Ordered probit and difference-in-difference
Theoretical contributions	<ul style="list-style-type: none"> - Providing an economic geography account of firms that are light on tangible assets and liabilities, which is an under-researched topic in the field - Arguing that those firms, which derive more value from corporate reputation, are more likely to be incentivised by institutional investors to adopt higher standards 	Conceptualising the imposing sustainability reporting standards on firms in Hong Kong and Singapore as a form of libertarian paternalism	Theorising green sukuk's developments from financial ecologies' perspective, whereby components ecologies compete to achieve the status of robust 'green' standards	<ul style="list-style-type: none"> - Combining the Global Production Network (GPN) with the Global Financial Network (GFN) into the Global Production and Financial Network (GPFN) to analyse the oil trading networks - Opening the way that future researchers can use the GPFN approach to other products and sectors 	Integrating sustainability standards into the GPFN approach to explain the ambition level of the adoption of the EU taxonomy – an emerging standard to define sustainable economic activities – by South Africa
Key findings/ Empirical contributions	<ul style="list-style-type: none"> - Standards aimed at improving greater information transparency in corporate governance must be sustained by regulators. - Improving such standards would help grow the market for corporate ratings and beyond. 	Because of Asia-specific political economies and business traditions, the adoption of Western sustainability reporting standards is limited.	<ul style="list-style-type: none"> - Green sukuk is an emerging a standard for Islamic green bond - Despite the international acceptance of the Green Bond Principles (GBP), adopting GBP makes green sukuk more prone to greenwashing 	<ul style="list-style-type: none"> - Highlighting the stickiness of power by several actors and geographies - Demonstrating how inseparable the GFNs and GPNs are in explaining oil price anomalies 	<ul style="list-style-type: none"> - EU investors hold more bonds in South African economic sectors with higher ambition level of greenness. South African sectors exporting more to the EU signal their virtues with a higher green ambition. - The launch of South Africa's taxonomy has re-allocated bond investment, bank loans, and trade exports from economic activities excluded from the taxonomy to those which are included.

Table 2: The number and proportion of three ambition level categories across sectors

Sector	Less ambitious (number of activities)	Similar (number of activities)	More ambitious (number of activities)	Less ambitious (%)	Similar (%)	More ambitious (%)
Construction and real estate	3	4	0	8.57%	10.00%	0.00%
Energy	6	12	7	17.14%	30.00%	58.33%
Environmental protection and restoration activities	1	0	0	2.86%	0.00%	0.00%
Information and communication	2	0	0	5.71%	0.00%	0.00%
Manufacturing	3	13	1	8.57%	32.50%	8.33%
Professional, scientific and technical activities	3	0	0	8.57%	0.00%	0.00%
Transportation and storage	11	7	0	31.43%	17.50%	0.00%
Water supply; sewerage, waste management and remediation activities	6	4	4	17.14%	10.00%	33.33%
Grand Total	35	40	12	100.00%	100.00%	100.00%

Table 3: Top 20 listed RSA companies as of 2021 by market caps as of 2021 and their possible match with the taxonomies

Ticker	Name	Possible match with taxonomy
PRX SJ Equity	Prosus NV	Not matched
BHP SJ Equity	BHP Group UK LTD	Not matched
ANH SJ Equity	Anheuser-Busch InBev SA/NV	Not matched
2251506D SJ Equity	Cie Financiere Richemont SA	Not matched
BTI SJ Equity	British American Tobacco PLC	Not matched
NPN SJ Equity	Naspers Ltd	Motion picture, video and television programme production, sound recording and music publishing activities
GLN SJ Equity	Glencore PLC	Not matched
AGL SJ Equity	Anglo American PLC	Manufacture of iron and steel
AMS SJ Equity	Anglo American Platinum Ltd	Manufacture of iron and steel
FSR SJ Equity	FirstRand Ltd	Non-life insurance: underwriting of climate-related perils
MTN SJ Equity	MTN Group Ltd	Data processing, hosting and related activities
VOD SJ Equity	Vodacom Group Ltd	Not matched
CPI SJ Equity	Capitec Bank Holdings Ltd	Not matched
SBK SJ Equity	Standard Bank Group Ltd	Non-life insurance: underwriting of climate-related perils
MNP SJ Equity	Mondi PLC	Not matched
IMP SJ Equity	Impala Platinum Holdings Ltd	Not matched
SOL SJ Equity	Sasol Ltd	Electricity generation from renewable non-fossil gaseous and liquid fuels
GFI SJ Equity	Gold Fields Ltd	Not matched
KIO SJ Equity	Kumba Iron Ore Ltd	Manufacture of iron and steel
SSW SJ Equity	Sibanye Stillwater Ltd	Not matched

Table 4: Full model for climate change mitigation criteria

Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EU equity holding of RSA companies	-13.823 (30.347)	-13.934 (31.432)	-10.003 (31.876)	-10.351 (32.046)	4.487 (33.611)	12.669 (37.137)	13.163 (35.691)	14.785 (35.881)	21.701 (37.100)	29.575 (34.016)	29.475 (34.010)	29.674 (34.710)
EU bond holding of RSA companies		0.491 (0.804)	0.466 (0.806)	0.473 (0.804)	0.726 (0.819)	0.151 (0.919)	0.839 (1.005)	0.800 (1.003)	0.934 (0.970)	1.068 (0.956)	1.040 (0.939)	1.881 (1.431)
JSE			-1.707 (4.059)	-1.896 (3.901)	-1.348 (4.488)	-0.622 (4.748)	-6.610* (3.449)	-7.601** (3.782)	-7.596** (3.814)	-6.756* (3.746)	-7.092 (4.443)	-8.559** (4.055)
EU stock exchange				0.352 (2.042)	0.057 (2.043)	1.509 (2.407)	7.873** (3.597)	8.377** (3.802)	8.277** (3.819)	6.955* (4.173)	7.100 (4.529)	5.504** (4.847)
RSA Gross Value Added by sectors					-3.759 (2.421)	-3.437 (2.571)	-3.893 (2.629)	-3.863 (2.621)	-4.146 (2.581)	-5.775** (2.806)	-5.713** (2.799)	-5.532* (2.884)
EU Gross Value Added by sectors						-6.654* (3.972)	-13.561*** (4.782)	-13.508*** (4.791)	-14.103*** (4.847)	-14.039*** (4.734)	-14.164*** (4.896)	-10.757* (6.039)
RSA export to EU							13.381*** (3.799)	13.687*** (3.884)	13.304*** (3.907)	10.972** (4.611)	11.160** (5.048)	7.733** (5.896)
EU VC in RSA companies								-2.113 (1.819)	-1.857 (1.843)	-1.445 (1.717)	-1.558 (1.914)	-2.194 (1.579)
EU commercial banks underwriting financing deals for RSA companies									2.938 (3.345)	3.617 (3.464)	3.604 (3.461)	3.750 (3.354)
EU development banks underwriting financing deals for RSA companies										-10.594 (9.137)	-10.603 (9.127)	-7.882 (8.515)
EU employment by sector											-2.265 (11.554)	0.463 (12.671)
RSA employment by sector												18.974 (15.234)
/cut1	-0.249* (0.137)	-0.250* (0.138)	-0.250* (0.138)	-0.250* (0.138)	-0.676** (0.322)	-0.653** (0.333)	-0.575* (0.340)	-0.581* (0.339)	-0.617* (0.341)	-0.811** (0.362)	-0.804** (0.365)	-0.822** (0.374)
/cut2	1.091*** (0.168)	1.094*** (0.167)	1.095*** (0.166)	1.095*** (0.167)	0.689** (0.339)	0.749** (0.342)	0.901** (0.361)	0.897** (0.361)	0.872** (0.361)	0.703* (0.370)	0.711* (0.376)	0.715* (0.379)
Observations	87	87	87	87	87	87	87	87	87	87	87	87

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The dependent variables are the ambition levels of the RSA GFT against the EU Taxonomy (e.g. RSA GFT less ambitious than EU Taxonomy; RSA GFT similar to EU Taxonomy; RSA GFT more ambitious than EU Taxonomy)

Table 5: Difference-in-difference model for bond holdings in eligible economic activities after the launch of RSA GFT

Independent variables	(1)
Eligible activities	-0.192 (0.251)
After RSA GFT launch	0.237 (0.213)
After RSA GFT launch * Eligible activities	0.053 (0.216)
Constant	1.132 (0.778)
Investor FE	Y
Issuer controls	Y
Observations	3,867
R-squared	0.3518
Log-likelihood	-6084

Note for Table 5 & 6: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Issuer controls include current credit ratings, assets-to-liabilities ratio, sector, whether the issuer is listed as of 31 December 2021, default probability, beta, profit, and interest coverage ratio.

Table 6: Difference-in-difference model for bond holdings in eligible economic activities with at least the same ambition level as the EU Taxonomy after the launch of RSA GFT

Independent variables	(1)
Same ambition and more ambitious activities	-0.224 (0.387)
After RSA GFT launch	0.271*** (0.054)
After RSA GFT launch * Same ambition and more ambitious activities	0.075 (0.245)
Constant	1.099 (0.821)
Investor FE	Y
Issuer controls	Y
Observations	3,687
R-squared	0.3458
Log-likelihood	-5842

Table 7: Difference-in-difference model for equity holdings in eligible economic activities after the launch of RSA GFT

Independent variables	(1)
Eligible activities	-0.016** (0.007)
After RSA GFT launch	0.034*** (0.005)
After RSA GFT launch * Eligible activities	-0.039*** (0.008)
Constant	-0.073*** (0.022)
Shareholder FE	Y
Issuer controls	Y
Observations	345,283
R-squared	0.5281
Log-likelihood	-512035

Note for Table 7 & 8: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Issuer controls include sector, market capitalisation, book-to-market value, leverage ratio, capital expenditure, property plant and equipment (PPE), long-term growth, default probability, beta, profit, and interest coverage ratio.

Table 8: Difference-in-difference model for equity holdings in eligible economic activities with at least the same ambition level as the EU Taxonomy after the launch of RSA GFT

Independent variables	(1)
Same ambition and more ambitious activities	0.250*** (0.015)
After RSA GFT launch	0.020*** (0.008)
After RSA GFT launch * Same ambition and more ambitious activities	-0.047*** (0.011)
Constant	-0.780*** (0.076)
Shareholder FE	Y
Issuer controls	Y
Observations	163,459
R-squared	0.554
Log-likelihood	-237135

Table 9: Difference-in-difference model for syndicated loans in eligible economic activities after the launch of RSA GFT

Independent variables	(1)
Eligible activities	-0.244*** (0.038)
After RSA GFT launch	-0.052*** (0.008)
After RSA GFT launch * Eligible activities	0.062*** (0.009)
Constant	0.137*** (0.021)
Loan arranger FE	Y
Issuer controls	Y
Observations	562
R-squared	0.9344
Log-likelihood	1151

Table 9 & 10: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Issuer controls include current credit ratings, assets-to-liabilities ratio, sector, and whether the issuer is listed as of 31 December 2021.

Table 10: Difference-in-difference model for syndicated loans in in eligible economic activities with at least the same ambition level as the EU Taxonomy after the launch of RSA GFT

Independent variables	(1)
	(0.037)
After RSA GFT launch	0.012***
	(0.002)
After RSA GFT launch * Same ambition and more ambitious activities	-0.317***
	(0.023)
Constant	0.181***
	(0.008)
Loan arranger FE	Y
Issuer controls	Y
Observations	410
R-squared	0.9749
Log-likelihood	1075

Table 11: Difference-in-difference model for RSA exports to the EU in eligible economic activities after the launch of RSA GFT

Independent variables	(1)
Eligible activities	1.414*** (0.027)
After RSA GFT launch	-0.074*** (0.013)
After RSA GFT launch * Eligible activities	0.077** (0.037)
Constant	11.207*** (0.010)
Country FE	Y
Observations	256,694
R-squared	0.1777
Log-likelihood	-660211

Note for Table 11 & 12: Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 12: Difference-in-difference model for RSA exports to the EU in in eligible economic activities with at least the same ambition level as the EU Taxonomy after the launch of RSA GFT

Independent variables	(1)
Same ambition and more ambitious activities	-0.805*** (0.052)
After RSA GFT launch	0.217*** (0.064)
After RSA GFT launch * Same ambition activities	-0.207*** (0.071)
Constant	13.118*** (0.047)
Country FE	Y
Observations	33,589
R-squared	0.449
Log-likelihood	-77797

Online Appendices

Online Appendix OA. 1: EU Taxonomy alignment: top-level view and an example showing a company is a collection of different economic activities



Climate change mitigation		
Technical Screening Criteria		
Company A	Substantial Contribution	Do no significant harm
Activity 1: Manufacture of batteries	The economic activity manufactures rechargeable batteries, battery packs and accumulators (and their respective components), including from secondary raw materials, that result in substantial GHG emission reductions in transport, stationary and off-grid energy storage and other industrial applications. The economic activity recycles end-of-life batteries.	DNSH on climate change adaptation: The activity complies with the criteria set out in Appendix A to this Annex. DNSH on water: The activity complies with the criteria set out in Appendix B to this Annex. DNSH on circular economy: For manufacturing of new batteries, components and materials, the activity assesses the availability of and, where feasible, adopts techniques that support reuse and use of secondary raw materials and reused components in products manufactured; design for high durability, recyclability, easy disassembly and adaptability of products manufactured; information on and traceability of substances of concern throughout the life cycle of the manufactured products. Recycling processes meet the conditions set out in Article 12 of Directive 2006/66/EC of the European Parliament and of the Council (91) and in Annex III, Part B, to that Directive, including the use of the latest relevant Best Available Techniques, the achievement of the efficiencies specified for lead-acid batteries, nickel-cadmium batteries and for other chemistries. These processes ensure the recycling of the metal content to the highest degree that is technically feasible while avoiding excessive costs. Where applicable, facilities carrying out recycling processes meet the requirements laid down in Directive 2010/75/EU of the European Parliament and of the Council (92). DNSH on pollution prevention: The activity complies with the criteria set out in Appendix C to this Annex. Batteries comply with the applicable sustainability rules on the placing on the market of batteries in the Union, including restrictions on the use of hazardous substances in batteries, including Regulation (EC) No 1907/2006 of the European Parliament and of the Council (93) and Directive 2006/66/EC. DNSH on biodiversity: The activity complies with the criteria set out in Appendix D to this Annex.
Activity 2: Storage of electricity	The activity is the construction and operation of electricity storage including pumped hydropower storage. Where the activity includes chemical energy storage, the medium of storage (such as hydrogen or ammonia) complies with the criteria for manufacturing of the corresponding product specified in Sections 3.7 to 3.17 of this Annex. In case of using hydrogen as electricity storage, where hydrogen meets the technical screening criteria specified in Section 3.10 of this Annex, re-electricification of hydrogen is also considered part of the activity.	DNSH on climate adaptation: The activity complies with the criteria set out in Appendix A to this Annex. DNSH on water: In case of pumped hydropower storage not connected to a river body, the activity complies with the criteria set out in Appendix B to this Annex. In case of pumped hydropower storage connected to a river body, the activity complies with the criteria for DNSH to sustainable use and protection of water and marine resources specified in Section 4.5 (Electricity production from hydropower). DNSH on circular economy: A waste management plan is in place and ensures maximal reuse or recycling at end of life in accordance with the waste hierarchy, including through contractual agreements with waste management partners, reflection in financial projections or official project documentation. DNSH on pollution prevention: N/A. DNSH on biodiversity: The activity complies with the criteria set out in Appendix D to this Annex.

Online Appendix OA. 2: EU Taxonomy Development

The EU's journey toward sustainable finance classification began in 2016 with a High-Level Expert Group of 20 specialists from various sectors. Their work informed the European Commission's March 2018 "Action Plan: Financing Sustainable Growth," which prioritized creating a standardized classification system (taxonomy) for sustainable activities. The cornerstone EU Taxonomy Regulation took effect in July 2020, establishing six key environmental objectives:

- Climate change mitigation
- Climate change adaptation
- Sustainable use/protection of water and marine resources
- Transition to circular economy
- Pollution prevention/control
- Protection/restoration of biodiversity and ecosystems

For an activity to qualify as environmentally sustainable, it must:

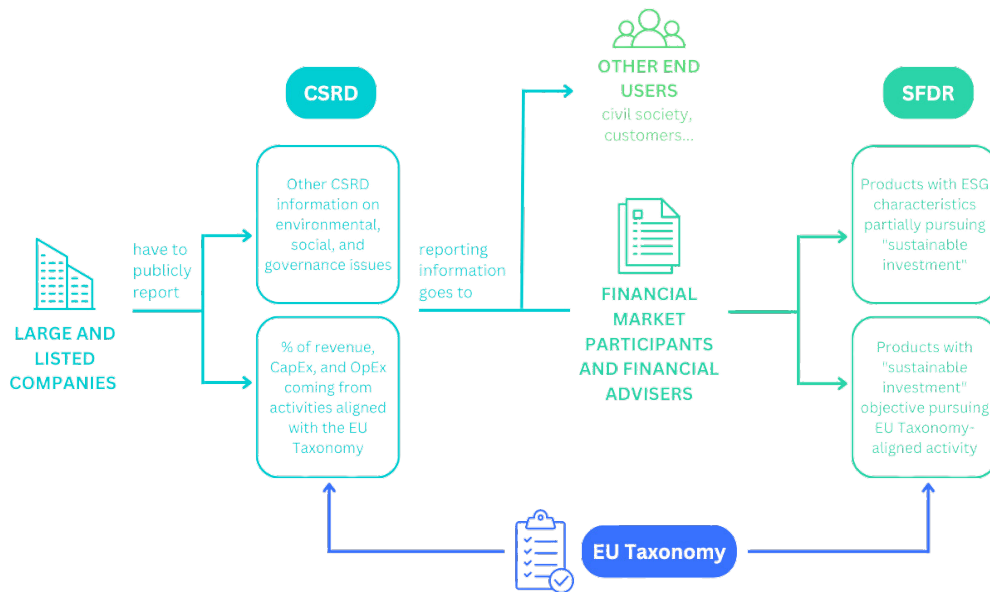
- Substantially contribute to at least one environmental objective
- Avoid significant harm to any objective
- Meet minimum safeguards
- Comply with technical screening criteria

To develop these technical criteria, the Commission formed a 35-member Technical Expert Group (TEG), followed by the permanent Platform on Sustainable Finance in 2020. The implementation has progressed through several key Delegated Acts:

- December 2021: First Act defining criteria for climate objectives (effective January 2022)
- July 2022: Complementary Act including specific nuclear and gas activities (effective January 2023)
- December 2021: Article 8 supplementary Act on disclosure requirements (effective January 2022)

- June 2023 Environmental Delegated Act, which extends the Taxonomy across all six environmental objectives.

The EU taxonomy is linked with other pieces of legislation which operationalise the use of the Taxonomy technical screening criteria and the disclosure of CAPEX, OPEX and REVENUE metrics for each of the economic activities which fall under the taxonomy.



Online Appendix OA. 3: Detailed methodology for constructing the dependent variable

- **Incomparable:** this category applies to criteria for the Agriculture, forestry and fishing sectors
While the RSA GFT follows the Climate Bonds Initiative’s Forestry and Land Conservation & Restoration Criteria and South African Sustainable Forest Development Policy, the EU taxonomy refers to European standards.
- **Similar:** both taxonomies have a similar number of requirements and thresholds:
 - Reference to local laws or regulation: We classify the two criteria as similar for economic activities with criteria that have similar or identical overall criteria and thresholds with reference to respective local laws. An assessment of the details of respective laws and regulations applicable to South Africa and the EU is beyond the scope of this study.
 - Reference to international standards and industry standards: For economic activities with criteria that have identical requirements and thresholds with reference to international standards or industry standards, we then specifically compare them, and if they are similar, we classify the two criteria as similar.
- **More ambitious and/or more detailed:** the RSA GFT’s criteria are more ambitious and/or more detailed, as demonstrated by a higher number of more detailed requirements and/or higher thresholds.
 - Reference to local laws or regulation: For economic activities in the RSA GFT with criteria that have a higher number of requirements we classify the RSA GFT criteria as more ambitious. An assessment of the details of respective laws and regulations applicable to South Africa and the EU is beyond the scope of this report.
 - Reference to international standards and industry standards: For economic activities with criteria that have a higher number, more detailed requirements, or higher thresholds, we classify the RSA GFT criteria as more ambitious.

- **Less ambitious and/or less detailed:** the SA GFT's criteria are less ambitious and/or less detailed as demonstrated by fewer or less detailed requirements and/or lower thresholds.
 - Reference to local laws or regulation: For economic activities in the RSA GFT with fewer requirements, we classify the RSA GFT criteria as less ambitious. An assessment of the details of respective laws and regulations applicable to South Africa and the EU is beyond the scope of this report.

Reference to international standards and industry standards: For economic activities with criteria that have a lower number or less detailed requirements or lower thresholds, we classify the RSA GFT criteria to be less ambitious and/or less detailed.

Online Appendix OA. 4: Description of variables and data source

No.	Variable	Variable longer name	Description	Source
1	EU equities	Equity holdings of EU investors as of 31 December 2021 in RSA companies	Equity holdings of EU investors in RSA companies over Equity holdings of world investors in RSA companies	Bloomberg Terminal/Workspace
2	EU bonds	Bond holdings of EU investors as of 31 December 2021 in RSA companies	Bond holdings of EU investors in RSA companies over Bond holdings of world investors in RSA companies	Bloomberg Terminal/Workspace
3	RSA stock exchange (JSE)	Proportion of sector/ activity of listed companies in RSA as of 31 December 2021 in total market cap	Johannesburg stock exchange by sector as of 31 December 2022	iShares MSCI
4	EU stock exchange	Proportion of sector/ activity of listed companies in EU as of 31 December 2021 in total market cap	Eurostoxx 600 value by sector as of 31 December 2022	iShares MSCI
5	RSA GVA	Gross Value Added (GVA) proportions by sector in RSA (5-year average, from 2016 to 2020)	GVA proportions by sector in RSA	MarketLine
6	EU GVA	GVA proportions by sector in EU (5-year average, from 2016 to 2020)	GVA proportions by sector in the EU	MarketLine
7	EU VC in RSA companies	Venture capital by EU investors in RSA companies by sector/ activity (average from 2000 to 2021)	Venture capital by EU investors in RSA companies by sector/ activity over Venture capital by world investors in RSA companies by sector/ activity	Preqin
8	RSA export to EU	Products exports of RSA to the EU (5 economies – Germany, France, Spain, Italy, & the Netherlands, 5-year average, from 2016 to 2020)	Products exports of RSA to the EU over exports of RSA to world	UN Comtrade
9	EU banks underwriting financing deals for RSA companies	EU investment bank underwrite bonds /equities/ syndicated loans deals to RSA companies (5-year average, from 2016 to 2020)	Bonds underwritten by EU banks for RSA companies over bonds underwritten by all banks for RSA companies	Dealogic
10	EU development banks underwriting financing deals for RSA companies	EU development bank underwrite bonds /equities/ syndicated loans deals to RSA companies (5-year average, from 2016 to 2020)	Equities underwritten by EU banks for RSA companies over equities underwritten by all banks for RSA companies (5-year average, from 2016 to 2020)	Dealogic
11	EU employment proportion	The proportion of employees by sector in EU (5-year average, from 2016 to 2020)	Employment by sector in the EU	ILO
12	RSA employment proportion	The proportion of employees by sector in South Africa (5-year average, from 2016 to 2020)	Employment by sector in South Africa	ILO

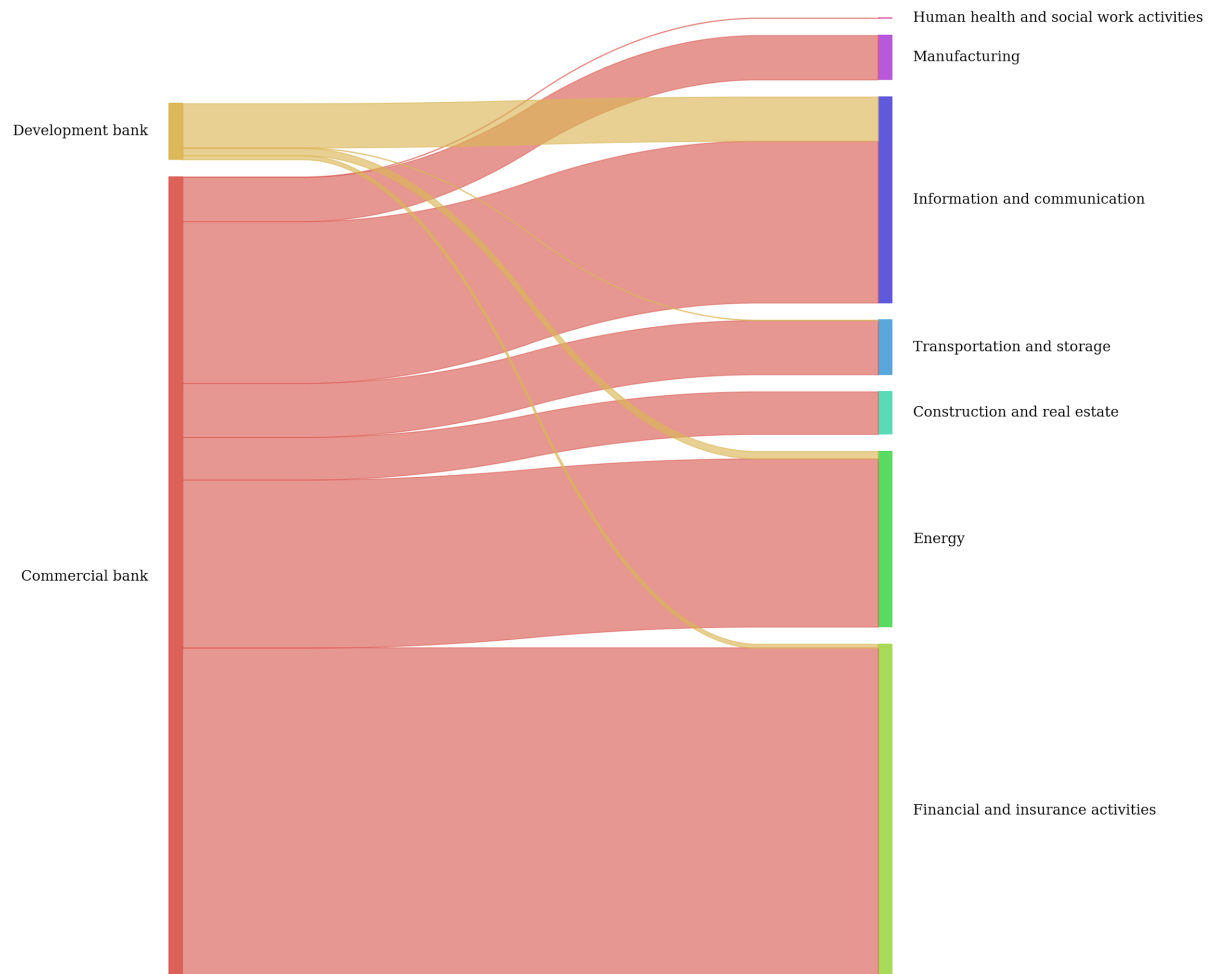
Online Appendix OA. 5: Top 10 EU commercial banks financing RSA companies (from 2016 to 2020)

No.	Bank Parent	Bank Parent Nationality	Total financing amount (USD)
1	Deutsche Bank	Germany	7,390,841,671
2	UniCredit	Italy	6,697,033,058
3	Credit Agricole CIB	France	4,325,077,480
4	BNP Paribas	France	3,222,117,201
5	SG Corporate & Investment Banking	France	1,598,533,061
6	Commerzbank Group	Germany	1,572,939,335
7	Banco BPM SpA	Italy	1,495,686,409
8	Erste Group Bank AG	Austria	1,131,735,367
9	BBVA	Spain	1,084,254,097
10	Intesa Sanpaolo SpA	Italy	982,725,584

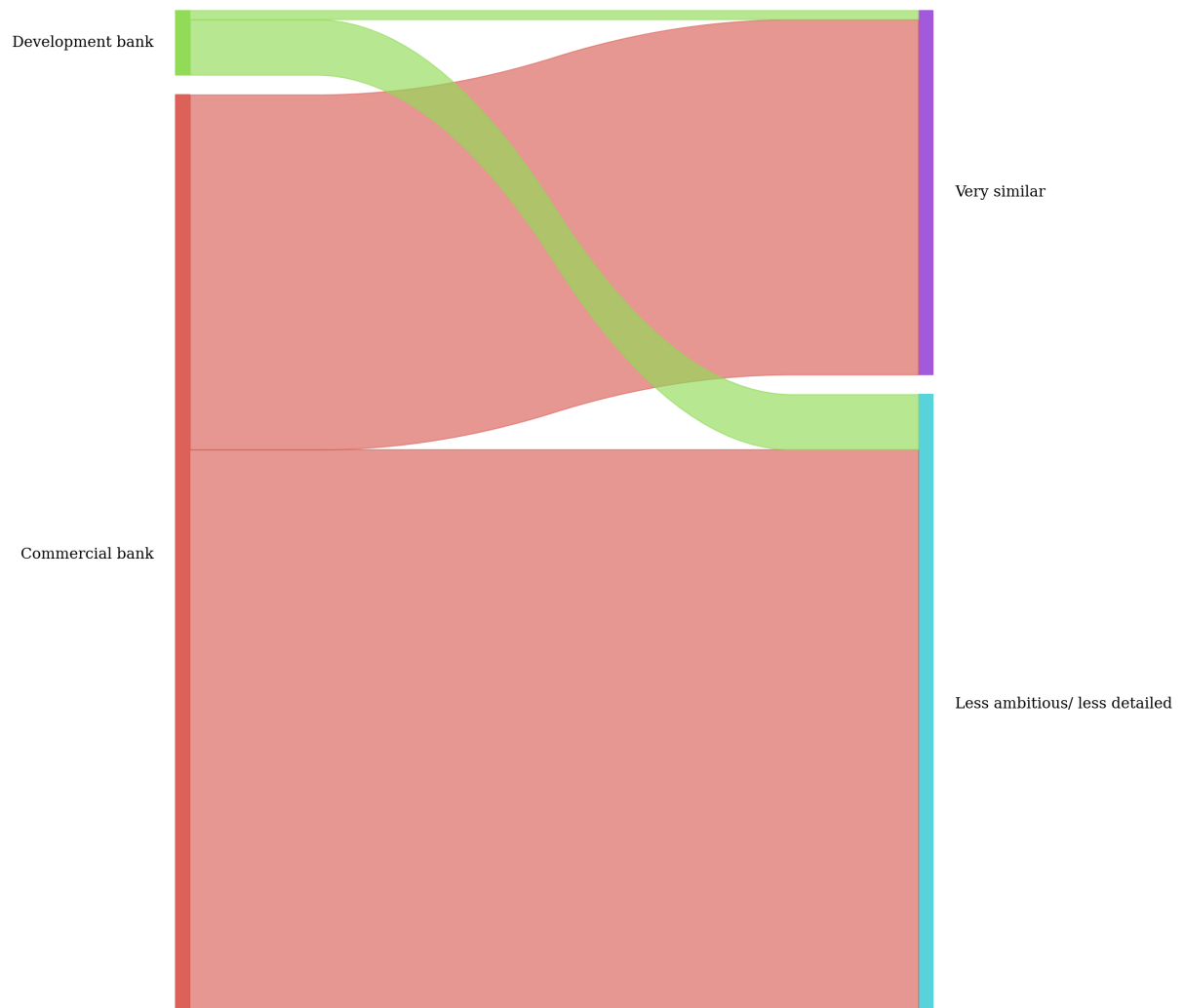
Online Appendix OA. 6: EU development banks financing RSA companies (from 2016 to 2020)

No.	Bank Parent	Bank Parent Nationality	Total financing amount (USD)
1	KfW	Germany	321,200,000
2	Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden NV - FMO	Netherlands	42,566,667
3	Agence Francaise de Developpement - AFD	France	8,400,000

Online Appendix OA. 7: EU development banks and commercial banks financing deals with South African companies by sectors



Online Appendix OA. 8: EU development banks and commercial banks financing deals with South African companies by ambition levels



Online Appendix OA. 9: Climate change mitigation criteria with financing deals for bond-listed RSA companies' full model

Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EU equity holding of RSA companies	-20.645 (35.007)	-20.604 (35.838)	-16.914 (37.684)	-17.447 (37.601)	-9.680 (38.319)	7.468 (39.099)	20.195 (34.553)	27.479 (35.525)	32.211 (36.473)	37.054 (36.675)	37.028 (36.699)	46.603 (34.691)
EU bond holding of RSA companies		0.487 (0.804)	0.472 (0.810)	0.480 (0.808)	0.722 (0.828)	0.141 (0.941)	0.806 (1.021)	0.747 (1.020)	1.093 (0.964)	1.164 (0.974)	1.125 (0.933)	2.326* (1.319)
JSE			-1.103 (4.150)	-1.299 (4.050)	-0.699 (4.655)	-0.635 (4.931)	-7.296** (3.574)	-8.725** (4.195)	-9.398** (4.263)	-9.672** (4.291)	-10.036** (4.900)	-12.106*** (4.408)
EU stock exchange				0.392 (2.031)	0.126 (2.026)	1.541 (2.416)	8.030** (3.616)	8.665** (3.863)	8.605** (3.911)	9.378** (3.974)	9.528** (4.320)	6.929 (4.862)
RSA Gross Value Added by sectors					-3.573 (2.388)	-3.266 (2.497)	-3.819 (2.579)	-3.818 (2.560)	-4.63 (2.397)	-5.001 (2.418)	-4.913 (2.341)	-5.324 (2.609)
EU Gross Value Added by sectors						-6.686* (4.048)	-14.088*** (4.800)	-14.252*** (4.832)	-14.434*** (4.846)	-15.912*** (4.894)	-16.062*** (5.059)	-11.592* (6.102)
RSA export to EU							13.609*** (3.778)	14.037*** (3.899)	13.803*** (3.877)	14.630*** (3.954)	14.826*** (4.421)	9.400*** (5.918)
EU VC in RSA companies								-2.461 (1.973)	-2.322 (2.007)	-2.382 (2.010)	-2.506 (2.165)	-3.273* (1.671)
EU commercial banks underwriting financing deals for RSA companies									13.556** (5.855)	14.344** (6.108)	14.239** (5.925)	15.958* (9.038)
EU development banks underwriting financing deals for RSA companies										-47.523*** (2.706)	-47.986*** (2.735)	-47.656*** (2.759)
EU employment by sector											-2.536 (11.538)	0.935 (12.533)
RSA employment by sector												26.075* (13.927)
/cut1	-0.248* (0.137)	-0.249* (0.137)	-0.249* (0.137)	-0.249* (0.137)	-0.656** (0.320)	-0.634* (0.325)	-0.567* (0.333)	-0.578* (0.330)	-0.670** (0.322)	-0.671** (0.323)	-0.660** (0.321)	-0.762** (0.352)
/cut2	1.093*** (0.169)	1.095*** (0.168)	1.095*** (0.168)	1.096*** (0.168)	0.710** (0.340)	0.768** (0.339)	0.914** (0.358)	0.907** (0.358)	0.827** (0.348)	0.865** (0.351)	0.876** (0.354)	0.816** (0.372)
Observations	87	87	87	87	87	87	87	87	87	87	87	87

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The dependent variables are the ambition levels of the RSA GFT against the EU Taxonomy (e.g. RSA GFT less ambitious than EU Taxonomy; RSA GFT similar to EU Taxonomy; RSA GFT more ambitious than EU Taxonomy)

Online Appendix OA. 10: Climate change mitigation criteria with financing deals for stock-listed RSA companies' full model

Independent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EU equity holding of RSA companies	-16.793 (31.206)	-18.146 (32.624)	-17.614 (33.201)	-17.748 (33.468)	-4.432 (33.408)	15.365 (34.384)	-1.826 (30.381)	-6.186 (31.160)	-10.797 (35.932)	6.920 (28.320)	6.914 (28.319)	4.433 (28.075)
EU bond holding of RSA companies		0.514 (0.800)	0.484 (0.803)	0.491 (0.802)	0.723 (0.825)	0.117 (0.922)	0.852 (1.018)	0.829 (1.018)	1.861** (0.916)	2.211** (0.893)	2.207** (0.895)	0.478 (1.013)
JSE			-2.018 (4.056)	-2.212 (3.896)	-1.224 (4.410)	-0.167 (4.590)	-6.236 (3.333)	-7.217 (3.663)	-9.032 (3.778)	-15.474 (5.254)	-15.992 (6.081)	15.646 (7.093)
EU stock exchange				0.338 (2.037)	0.086 (2.038)	1.595 (2.440)	7.889** (3.586)	8.401** (3.793)	8.069** (3.939)	-0.777 (6.462)	-0.747 (6.771)	-28.174 (7.519)
RSA Gross Value Added by sectors					-3.599 (2.446)	-3.411 (2.548)	-3.628 (2.637)	-3.513 (2.646)	-5.607** (2.335)	-11.659*** (3.102)	-11.663*** (3.089)	-41.053*** (3.376)
EU Gross Value Added by sectors						-6.916* (4.114)	-13.332*** (4.807)	-13.164*** (4.804)	-13.448*** (4.889)	-9.672* (5.701)	-9.690* (5.827)	-3.710 (5.729)
RSA export to EU							13.392*** (3.791)	13.757*** (3.899)	14.389*** (3.990)	1.322 (7.803)	1.363 (8.216)	-29.459 (8.899)
EU VC in RSA companies								-2.108 (1.839)	-1.620 (1.884)	-3.800** (1.695)	-3.993** (1.987)	8.005*** (2.431)
EU commercial banks underwriting financing deals for RSA companies									21.546*** (5.997)	20.302*** (6.712)	20.300*** (6.707)	16.076** (7.035)
EU development banks underwriting financing deals for RSA companies										-70.234*** (20.468)	-70.895*** (19.898)	- (31.917)
EU employment by sector											-0.740 (10.359)	-4.876 (7.892)
RSA employment by sector												- (124.599*** (15.201))
/cut1	-0.249* (0.137)	-0.250* (0.138)	-0.251* (0.138)	-0.251* (0.138)	-0.659** (0.323)	-0.650** (0.329)	-0.547 (0.337)	-0.543 (0.337)	-0.784** (0.326)	-1.457*** (0.428)	-1.454*** (0.429)	-4.454*** (0.471)
/cut2	1.091*** (0.167)	1.094*** (0.166)	1.096*** (0.166)	1.096*** (0.166)	0.707** (0.338)	0.752** (0.338)	0.930*** (0.358)	0.936*** (0.359)	0.775** (0.346)	0.184 (0.437)	0.186 (0.437)	-2.813*** (0.460)
Observations	87	87	87	87	87	87	87	87	87	87	87	87

Note: Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The dependent variables are the ambition levels of the RSA GFT against the EU Taxonomy (e.g. RSA GFT less ambitious than EU Taxonomy; RSA GFT similar to EU Taxonomy; RSA GFT more ambitious than EU Taxonomy)