Strategic competition and donor interests: An econometric approach to the market for the allocation of climate development aid for renewable energy projects

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Abstract

The transition to decarbonised economies is essential for economic development in developing economies and it opens venues for developed countries to think strategically about energy and foreign policy in a changing geopolitical context in which energy security and climate targets need to go hand in hand. Analysing how bilateral aid for renewable energy projects is allocated is crucial to understand if donor countries prioritize social and environmental goals or if their motives are less altruistic and focused on their own economic and strategic benefits in the context of the geopolitics of the energy transition and therefore, if they favour targeted development. To examine how official development aid for renewable energy projects (RE ODA) is allocated across countries we pay attention to donor and recipient characteristics and interactions but also to donor-donor strategic relationships. We use an estimation strategy that combines quantitative social network analysis and panel data models (pplmhdfe, Heckman selection and an IV strategy) to examine the technical, economic or geopolitical motives determining the allocation of bilateral aid for projects on non-emitting energy sources from 2009 to 2018 with OECD-CRS data. Using the degree centrality of the recipient, the Herfindahl index and the market share of the donors' RE ODA on the recipients to measure the concentration of RE ODA and, therefore, the importance of a donor within the recipient's network, we analyse the motivations behind the strategic donations of countries. We find that both political and strategic trade interests connected to the access to critical minerals, energy resources and policy drivers are factors affecting the targeted provision of ODA for low-and-middle income countries while, generally, recipients' needs are not relevant factors driving the reception of RE ODA.

Keywords: official development aid, networks, climate aid, renewable energy investment, strategic competition, critical minerals

1. Introduction

The access to affordable and clean energy is one of the global goals in the Agenda 2030. The energy transition is essential for economic development in developing economies and it opens venues for developed countries to think strategically about energy and foreign policy in the context of the transition to decarbonised economies. The reception of official development aid (ODA) is crucial to the renewable energy deployment above all in developing countries (Wang et al. 2021) where ODA still represents an important source for financing capital accumulation and public spending (Wang et al. 2022; Calleja and Rowlands, 2015). The characteristics of renewable energy investments make necessary the role played by catalytic finance above all in developing countries where the transition to decarbonised economies needs also to facilitate energy access, economic opportunities and reduce emissions at the same time (Han and Cheng, 2023). In low-and-middle income countries, the scarcity of local public funding and investments make the role of the

international community indispensable (Donastorg et al. 2017). Also, in order to channel climate finance, to generate crowding-in effects and to ensure the investments pursued respond to national needs and priorities, climate policy is needed. In this landscape ODA for renewable energy projects (RE ODA) represents a key source of support to enable poorer countries to shift towards low carbon economies and climate resilient development pathways (UNDP 2016). Indeed, models have predicted that without public support and energy policies, investments in the power sector would mainly be directed towards fossil fuels especially in less developed countries.

The signature of the Copenhagen Accord in 2009 created the bases of the Green Climate Fund (GCF) signed by 194 countries with the main objective to provide financial aid to developing countries to mitigate and adapt to climate change (Depledge et al. 2022). While climate finance does not only directly imply the provision of financial resources to the energy sector, energy represents around a quarter of the total climate-related development finance provided to recipient countries from 2009 to 2019 (OECD CRS database, 2020). Over the period 2009 to 2019, ODA commitments for climate related energy purposes totalled approximately US$ 117.75 billion. The increase in the provision of funds for energy purposes has been substantial and the provision of aid for energy ten folded in a decade, moving from barely US$1.61 billion in 2009 to US$17.54 billion in 2019 while other mitigation aid did not increase at the same rate, showing the targeted interests (Bermeo, 2017). Bilateral energy development assistance from DAC members represents approximately 52% of the funding of all aid for energy, totaling over US$ 60.91 billion during the period 2009 to 2019. Therefore, focusing the attention on climate-related development finance for energy development and in particular for the generation of energy with renewable energy sources[1] is justified (Peñasco, 2023).

In a context of transition from fossil fuel-based economies to renewable energy-based economies, understanding the reasons behind the decisions on how to allocate mitigation bilateral aid for the development of renewable energy projects is key. While the Copenhagen accord clearly states that ODA needs to serve the needs of developing countries (UNFCCC, 2009), a more pragmatic international perspective makes feasible the hypothesis that the interest of donors play a key role in how they allocate their funds (Calleja and Rowlands, 2015). Understanding the logic behind the attribution of these financial resources is relevant to maximize the effectiveness and efficiency in the use of ODA (Carfora and Scandurra, 2019; Bourguignon and Platteacu, 2015, Pickering et al. 2017). Analysing therefore, how bilateral aid for renewable energy projects is allocated is crucial to understand if donor countries prioritize social and environmental goals or if their motives are less altruistic and more focused on their own economic and strategic benefits. We could expect that, unlike broader climate interventions that may span from policy adjustments to conservation efforts, renewable energy projects require significant upfront capital for the deployment of technologies. From an economic perspective, these projects facilitate entry into new markets for domestic industries and create export opportunities for renewable technology, thus serving national economic agendas of industrialized countries (REN21, 2024). At the same time, the provision of RE ODA is often accompanied by a transfer of technology and expertise, establishing long-term dependencies and influence over energy policies in low- and middle-income countries. This aspect of renewable aid ensures at the same time the alignment of recipient countries' energy infrastructures with the technological standards of the donor countries (Goldthau & Witte, 2010).

[1] This includes: 1. energy generation from multiple renewable sources in which donors' have not classified the particular source beyond its renewable nature; 2. hydro-electric power plants; 3. solar energy for centralised grids and for isolated grids both with PV technologies and concentrated solar power systems; 4. solar energy with thermal application; 5. Wind energy, either onshore and/or offshore; 6. marine energy; 7. geothermal energy and; 8. biofuel-fired power plants. This research does not cover aid activity comprehensively, for example energy efficiency projects are not captured by this particular analysis of RE ODA.

Despite the critical role of renewable energy aid in global climate policy, the literature still lacks a thorough examination of the strategic motives behind such aid. The literature on the role of ODA in the transition to decarbonised economies has focused mostly on understanding the factors influencing the allocation decisions of climate finance for adaptation issues. In this case, it becomes clearer the dichotomy between donor interests and recipient needs (See, e.g., Betzold and Weiler, 2017; Weiler et al., 2018). Less attention has been put on mitigation given that mitigation transfers, while aiming at reducing emissions in the recipient country, can be considered as a public good with global benefits (Altaghlibi and Wagener, 2019). Therefore, it seems plausible to think that, while literature has generally analysed determinants associated to the characteristics of recipients, donors and the relationships between both (Petersen and Skovvgard, 2019); for mitigation the separation between those determinants might be blurred. Yet, DAC countries, above all the EU countries, are increasingly being aware of their energy dependencies, above all upon natural gas from Russia, Norway and the US. This is not less true for the US whose energy dependency relies on supply from Canada, Colombia or Saudi Arabia just to mention few (Crow and Saran, 2021). The transition toward net-zero carbon economies, both in developed and developing countries plays a central role as cooperation in energy matters can spur win-win situations. However, as pointed by Viñuales (2021), the shift from fossil fuel-based economies to cleaner economies with an energy production based on renewable sources, moves the geopolitical problems to a different part of the energy mix. DAC countries might see and use ODA as the way to foster and strengthen the links to countries that can secure the critical materials for the energy transition.

Considering this, the goal of this paper is to analyse and understand how bilateral aid for renewable energy projects is allocated by donor countries to recipients. To examine how RE ODA is allocated across countries, we do pay attention not only to donor-recipient interactions but also to donor-donor interactions. We analyse the strategic investments of donor countries and in which ways they are related to economic or geopolitical motives associated to the access to resources and critical materials needed to fulfil their low-carbon transition supply chain interests.

We use a two-step strategy based on, first quantitative social network analysis (SNA) and, second, panel data models -ppmlhdfe, Heckman selection and an IV strategy- to examine the technical and geo-political drivers for bilateral aid for projects on non-emitting energy sources from 2009 to 2018 with OECD-CRS data. In international development, SNA presents a potentially useful tool for understanding a range of network relationships including levels of collaboration and exchange, the existence of central actors, excluded populations, and absent connection among individuals, organisations or groups (Johnson and Chew, 2021). Following Weiler and Kloeck (2021), by conceptualizing renewable energy aid allocation as a network in which the provision of mitigation aid for renewable energy is a network tie, we can directly assess donor interactions/concentration. Using as the main independent variable the indegree centrality of the recipient to measure the importance of a donor within the recipient's network -the Herfindahl index and the market share of the donors' RE ODA on the recipients are also used as alternative measures of the concentration and importance of a donor-, we analyse the strategic investments of donor countries and in which ways they are related to economic or geopolitical motives.

Overall, our estimations suggest that countries of strategic importance for donors receive more RE ODA. Donor countries seem to be making strategic investments based on a range of factors—mostly motivated by their willingness to balance risks and influence on the ODA network of donor and recipients and by the geo-political advantages of stable trade partnerships of materials essential for the energy transition. Our paper is one of the first in considering and showing quantitatively that the access to those critical minerals is a pivotal driver for the reception of RE ODA in low- and middle-income recipients, in particular cobalt and rare earths whose trade and production seems to be concentrated in few countries with unstable political and regulatory governance

contexts. This confirms that donor countries look at a much broader canvas than just climate change mitigation when deciding their ODA allocation strategies. Our estimates are robust to different estimation strategies.

This paper contributes to the current debate on ODA in several ways. First, using network analysis, we disentangle the current bilateral links in terms of RE ODA among countries and the evolution of this network during the last decade. Second, using the indegree centrality of the recipient to measure the importance of a donor within the recipient's network, we analyse the strategic investments of donor countries and in which ways they are related to the level of competition/rank in the recipient country regarding the presence of other donors. To the extent of the author's knowledge this is the first paper quantitatively analysing this donor-donor interactions for mitigation aid. This is an important contribution given that the use of the indegree centrality of the recipient allows us to proxy the level of 'popularity' of the recipient countries in the RE ODA network. This provides at the same time a measure of the density of the network, i.e., if donor countries increase their provision of ODA when they can secure 'monopolistic' relationships with the recipients or, on the contrary, if focusing on the same recipients as other donors is a better strategy. Third, we derive policy implications associated to the use of bilateral development aid for mitigation to foster the development of renewable energy projects in developing contexts.

The rest of the paper is structured as follows. In the next section we review the literature and outline the research hypotheses. In section 3, we define the foreign aid network for renewable energy projects and includes a description of the data used. Section 4 explains the empirical strategy. Results are summarized and discussed in section 5, including the robustness checks. Finally, section 6 concludes with a discussion, policy implications, limitations and future research directions.

2. Literature review and research hypotheses

2.1. The economics and geopolitics of official bilateral aid

The interest in understanding the motivations behind the country allocation of development aid is not new. McKinlay (1978), McKinlay and Little (1977, 1978a, 1978b, 1979) and Maizels and Nissanke (1984) among others, determined empirically how, during the cold war, development assistance was guided by interests beyond the humanitarian criteria and how bilateral aid allocation decisions were made in support of donor's perceived foreign economic and political interest (Maizels and Nissanke, 1984). While this view changed in the years after the Cold War, and some researchers have concluded that nowadays ODA decisions follow more clearly the needs of the recipient, instead of the interest of the donors; McGillivray (2003) challenged this result concluding that still ODA is motivated largely by economic and political interests. Export promotion, trade links and/or political and cultural hegemony i.e., factors associated to the political economy of individual donor countries, are mentioned frequently as motives behind the strategic allocation of development aid (Michaelowa and Michaelowa 2007). Indeed, a well-known concept in international relations but sometimes a poorly understood one in political economy is that of strategic competition (Wrinkler, 2023). Strategic competition among donor countries refers to the phenomenon where donor countries compete with each other to gain influence and achieve their own political and economic objectives through foreign aid. This competition can shape the behaviour of both the donor and recipient countries (Zheng & Li, 2022).

Donor competition can be driven by various factors. First, we find the competition for export markets among donor countries. Donors may strategically allocate aid to recipient countries based on their own economic interests and the potential for economic benefits, such as access to markets

and resources (Barthel et al., 2014). This competition for export markets can influence the allocation of aid for economic infrastructure and productive sectors (Barthel et al., 2014). This could potentially be exacerbated when it comes to the energy transition. Another factor is the pursuit of enough power to influence pro-donor policies. Donors may understand that being the primary donor in a recipient country can provide them with additional compensation in the form of influence and the ability to shape policies in their favour (Calleja & Rowlands, 2015). Donors may compete to establish themselves as the primary donor in key recipient countries in order to further their own interests and objectives (Calleja & Rowlands, 2015). Donor competition can have both positive and negative effects. On one hand, competition can lead to increased aid flows and resources for recipient countries. Donors may increase their aid efforts in order to outcompete other donors and gain influence (Kilama, 2016). On the other hand, competition can also lead to fragmentation and inefficiency in aid delivery. Donors may prioritize their own interests and objectives over the overall effectiveness and coordination of aid efforts (Calleja & Rowlands, 2015). The rise of non-traditional donors, such as China, has further intensified donor competition. These newcomers have different motives for providing development assistance compared to traditional donors, which challenges the ability of traditional donors to influence policy within aid recipients (Kohno et al., 2021). Yet, this area falls beyond the scope of this paper.

The literature has not been conclusive on the strategic decision of donors regarding their interactions with other donors in certain recipient countries. Following Weiler and Kloeck (2021) who analysed donor interactions in the allocation of adaptation aid; the importance of the interactions between donors might be even more relevant when talking about mitigation efforts, and in particular, to projects for the promotion of the generation of energy with renewable energy sources. The changing dynamics of global aid, marked by the emergence of non-traditional donors such as China, have introduced new competitive pressures in the international aid landscape. As aforementioned, these donors often operate under different strategic imperatives, challenging the traditional influence of Western donors and reshaping the strategies for aid allocation. This evolving scenario necessitates a deeper understanding of how donor presence and interactions within a recipient country can influence strategic decisions about aid allocation. How a donor distributes its development aid may be influenced therefore by how other donor distributes its own one in turn. However, research is not conclusive on that front and few studies has focused on this issue (Weiler and Kloeck, 2021; Calleja and Rowland, 2015; Powell and Bobba, 2006). These studies identify two contrasting effects. On the one hand, the presence of other donors may increase the likelihood of donor *i* also investing in a particular set of recipients. For example, donor countries might be more inclined to help recipient countries that have more investment from other donor countries with the ultimate purpose of using aid funds to promote the adoption of policies and regulation that are more conducive to foreign investment (Wang et al. 2021). On the other hand, there are also reasons to expect the opposite: the presence of other donors in a particular recipient may reduce the likelihood of a donor to invest also in that recipient.

Based on this we propose our first hypothesis:

H1: The level of importance of a donor in the bilateral ODA mitigation network of a recipient plays a role in the amount of ODA received by the recipient, i.e. a donor country will provide a larger amount of ODA if they perceive they are in a position of power in the network of the recipient.

2.2. Differentiating factors in the allocation dynamics of ODA for the transition to decarbonised economies

By definition, ODA represents all the funding and financing provided by public agents in high income countries to developing countries with the main objective of improving development, welfare and the living conditions of the later (OECD 2017). However, the effectiveness of climate finance is measured in terms of meeting climate objectives. Indeed, the term can be understood as public finance that promotes multilateral efforts to combat climate change through the UN Framework Convention on Climate Change (UNFCCC). Because of these divergences in goals, some authors argue that we cannot assume that the allocation of climate development aid, and specifically the allocation of RE ODA, is leveraged by the same determinants that the general development assistance (Peterson and Skovvgard, 2019; Alesina and Dollar 2000; Berthelemy, 2006; Hicks et al. 2008; Halimanjaya, 2016). While the development focused of aid improved during the first decade of the 21st century (Beerthelemy, 2006), economic and political interest may be reinforced in the context of the energy transition.

The allocation of development aid for renewable energy projects is inherently strategic, influenced by a confluence of economic, geopolitical, and environmental factors. Donors consider the geopolitical significance of the recipient countries, particularly those endowed with critical resources necessary for renewable energy technologies. The studies by Vakulchuk et al. (2020) and Bazilian (2018) emphasize that developing countries with large reserves of minerals like lithium and cobalt become strategically important not only for their resource potential but also as key players in the global supply chain of renewable technologies. The access to these critical materials might be one of the reasons why countries decide to provide ODA to developing countries with high reserves of minerals like lithium, cobalt and/or rare earths.

In terms of access to critical resources needed for the energy transition, it seems plausible to hypothesize that donor countries will increase their interest in donating money to countries where the level of competition in the recipient space is lower and/or the relative importance of the donor over the total amount of ODA received by the recipient is higher. In either case, the donors can increase their influence on individual recipient countries given there are strategic interests in those contexts (Calleja and Rowlands, 2015). Indeed, some authors suggest that overseas development assistance projects may be focusing on gaining access to resources (Shapiro 2019). This could transform the traditional aid model of cooperation into one of competition where donor countries may begin to compete among them on the bases of non-price attributes beyond the amount and conditions of the aid provided (O'Keefe, 2007). In the current context, therefore, the geopolitics of the energy transition can play an important role in how countries allocate bilateral ODA on the particular field of renewable energy investments.

Based on this we propose our second hypotheses:

H2: Recipient countries with access to critical material are more likely to receive bilateral ODA for the development of renewable energy projects, i.e. resource-rich countries will be more likely to receive ODA for RE projects as these projects create export opportunities for renewable technology, thus serving targeted national economic agendas of high income countries.

Michaelowa and Michaelowa (2007) discuss how export promotion and trade links often dictate aid allocation, further emphasizing the economic motivations behind strategic aid allocation and arguing about how such strategic considerations are often intertwined with economic interests, such as securing, as aforementioned, future markets for clean technologies produced by donor countries. Indeed, one of the most recent contributions to the field investigates, in particular, the effect of trade links between donor and recipients as explanatory drivers of the amount of climate bilateral aid using econometric regression analyses (Bayramoglu et al. 2023). The authors predict a

positive relationship between donor countries' exports to and imports from recipient countries and their climate aid transfers.

H3. The more relevant the recipient is to a donor, the more probable is that a recipient receives mitigation aid from that donor for developing renewable energy projects.

In regards to this third hypothesis, beyond the direct economic and resource-based benefits, there is a significant environmental strategic component to the allocation of renewable energy aid. Donors often allocate this type of aid to help recipient countries leapfrog to cleaner technologies, thereby contributing to global efforts to reduce greenhouse gas emissions. This approach aligns with international commitments under agreements like the Paris Agreement, where developed countries are expected to support less developed nations in their transition to sustainable energy sources. This is not just about aiding development but also about reducing global emissions, which supports Hypothesis 3 (H3) where the relevance of the recipient in the donor's strategic framework enhances the likelihood of receiving aid.

These three hypotheses reflect on the complex interplay of donor competition and strategic relevance, emphasizing the importance of strategic alignment and competitive positioning in donor decisions in the field of renewable energy aid.

The counterpart of this ODA often involves not only the development of infrastructure but also policy reforms and capacity building in the recipient countries. Recipient countries are often expected to implement regulatory reforms and policy measures that facilitate the transition to a green economy, as part of the aid agreement. Aid effectiveness in these contexts is expected to be enhanced by robust governance structures and coherent environmental policies, as noted by Dollar and Levin (2006) and Epstein and Gang (2009). Yohe (2001) was one of the first proposing that drivers like the policy instruments implemented by recipient countries and/or the general governance status may impact the decisions of donor countries for the provision of mitigation aid. Without good governance developing countries may find it difficult to comply with an expansive and administratively demanding measurement, reporting and verification system (Bierbaum and Fay 2010; Halimanjaya 2015). More recent studies have found that donors are increasingly allocating aid based on the policy conditions of recipient countries (Berthelemy and Tichit, 2004; Sundberg and Gelb, 2006; Claessens et al., 2009; Dietrich, 2012), suggesting that donor behaviour is increasingly influenced by recipient-specific factors and behavior (Calleja and Rowlands, 2015). Indeed, Calleja and Rowlands (2015) elaborate on how donors compete to establish dominance in recipient countries to shape policies in their favour, illustrating the political calculations in aid distribution. Some authors also argue that for the case of environmental aid, the economic and political interests of donors are often much stronger determinants than the environmental needs of the recipient countries (Lewis 2003). All in all, this set the bases for our Hypothesis 4 (H4) below suggesting that countries with better-developed policy frameworks are more likely to attract aid for renewable energy projects.

H4. Recipient countries with an established framework of national climate and environmental policies are more likely to receive bilateral ODA for the development of renewable energy projects.

While the determinants of aid mitigation and adaptation have been studied in the past (see Table A1 in the Appendix for a summary former papers in the field), a focus on renewable energy projects aid is lacking. The strategic allocation of renewable energy aid shapes the broader landscape of global climate change mitigation and energy transition. By focusing aid on strategically important countries or those with specific needs that align with global climate goals, donors can significantly influence the pace and effectiveness of global decarbonization efforts. Therefore, a

nuanced approach to understanding aid allocation is critical in highlighting the multifaceted motivations of donors, encompassing economic interests, strategic competition, policy alignment, and environmental considerations. The question of whether and why different donor countries prioritize different recipient countries, i.e. what is the relative importance of the characteristics of the donor, the recipients and the relationships between both remains open. This paper tries to fill this gap in the literature.

3. Data and descriptive statistics

The proposed hypotheses in section 2 are tested using a newly compiled data that covers donor and recipient countries of development aid for mitigation projects associated to renewable energy technologies from 2009 to 2018. We complement the information provided by the OECD Development Aid Committee (DAC) data with data for independent and control variables coming from the US Geological Survey –compiling production of critical materials in recipient countries, the REN21, Comtrade, CEPII, and the Worldwide Governance Indicators, Our world in data (See Table A2 in the appendix).

3.1. Strategic interests of the donor

Network analysis of aid flows can be used to quantify the proportionate size of impact a donor can have on recipients in the aid flow network. Our first hypothesis reads that the level of importance of a donor in the bilateral RE ODA network of a recipient plays a role in the amount of ODA received by the recipient i.e., a donor country will provide a larger amount of ODA if they perceive they are in a position of power in the network of the recipient. This position of power can be reflected by several 'market' structure indicators e.g., the level of concentration of donors in the recipient countries and/or the rank of donors in the recipient country regarding the amount of ODA provided.

In order to test this hypothesis, we need a measure to calculate the degree of importance of the donor in the network of RE ODA of the recipient. We use a network approach to find such measure.

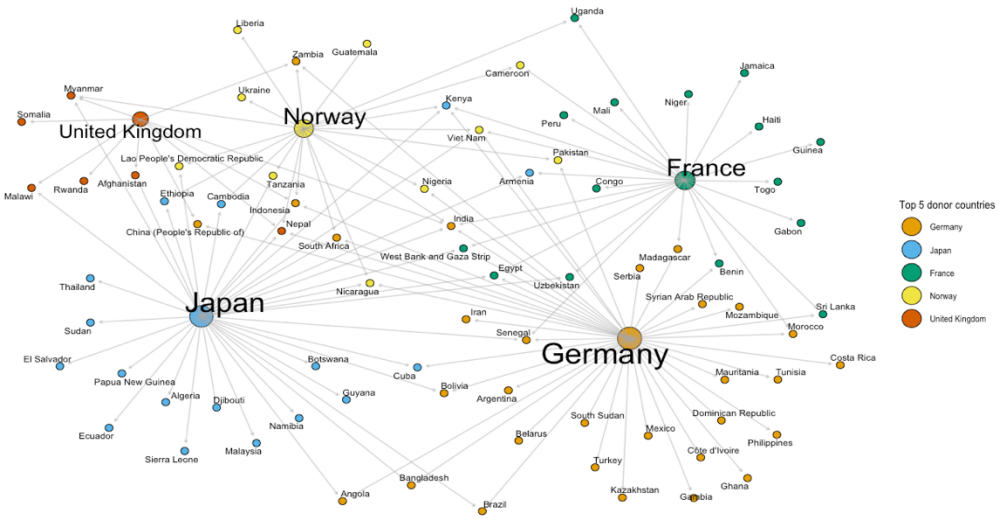
The study of the level of centrality of nodes and the identification of the relative level of importance of certain nodes in network analysis has been an area of interest since the early years of the discipline (Opshal et al., 2010). In terms of interlinkages between donor and recipient countries, a country that has high centrality indicates that it has many significant interlinkages with other countries. This allows us to identify the number of donor countries in a recipient network to test our first hypothesis.

To quantify the relative importance of a recipient in the bipartite node, we will calculate the simplest form of centrality measure which is the degree measure. The degree measure of centrality is the number of nodes that a focal node is connected to and measures the involvement of the node in the network (Opshal et al., 2010). Given that our purpose is to explore the effect of the relative power of a donor regarding the flows of ODA into the recipient, the degree of centrality, in particular, the indegree level of centrality of the recipient as a focus node allows us to quantify how many different donors are giving aid to a recipient i.e., how many edges come into the recipient. Freeman (1978) asserted that the degree of a focal node is the number of adjacencies in a network, i.e. the number of nodes that the focal node is connected to. Following the nomenclature used by Opshal et al. (2010), this measure can be formalized as:

$$C_D(i) = \sum_j^N x_{ij} \quad [1]$$

where *i* is the focal node, *j* represents all other nodes, N is the total number of nodes, and *x* is the adjacency matrix, in which the cell x_{ij} is defined as 1 if node *i* is connected to node *j*, and 0 otherwise. Translating this into the nature of our network, a node is connected to another if $x_{ij} = 1$ in each yearly network i.e., if $aid_{ijt} > 0$ where aid_{ijt} is the climate-related development aid for renewable energy projects received by recipient *i* i.e., our focal node; from donor *j* in year *t*. This relationship can only exist between recipients and donors. $x_{ij} = 0$ between recipient countries and when there is no aid provided from a donor country to a recipient country. The distribution of degree centrality can vary depending on the size of the network over the years as the number of donors and recipients change over time. Due to the nature of bipartite graph, the degree centrality for the recipient is also the indegree centrality – the number of links going to the recipient nodes. This measure will represent our main independent variable measuring the level of competition in a recipient country. As such, there are two interpretations of a high indegree centrality. One interpretation is that the recipient has a strong case for aid in their renewable energy development and that many donor countries are rallied to support it. From this perspective, degree centrality can also be interpreted as a strong and compelling demand for aid. From the perspective of the donor, this is a measure of donor-donor relationships and represent the level of concentration and/or fragmentation of the ODA for renewable energy projects in the recipient country. Figure 1 summarizes the network of RE ODA provision for recipients of the top 5 donors in 2018 (For the definition of the foreign development aid network for renewable energy projects in the period of analysis 2009-2018 see Box 1 Appendix).

Figure 1 Illustrative network for top 5 donors in 2018

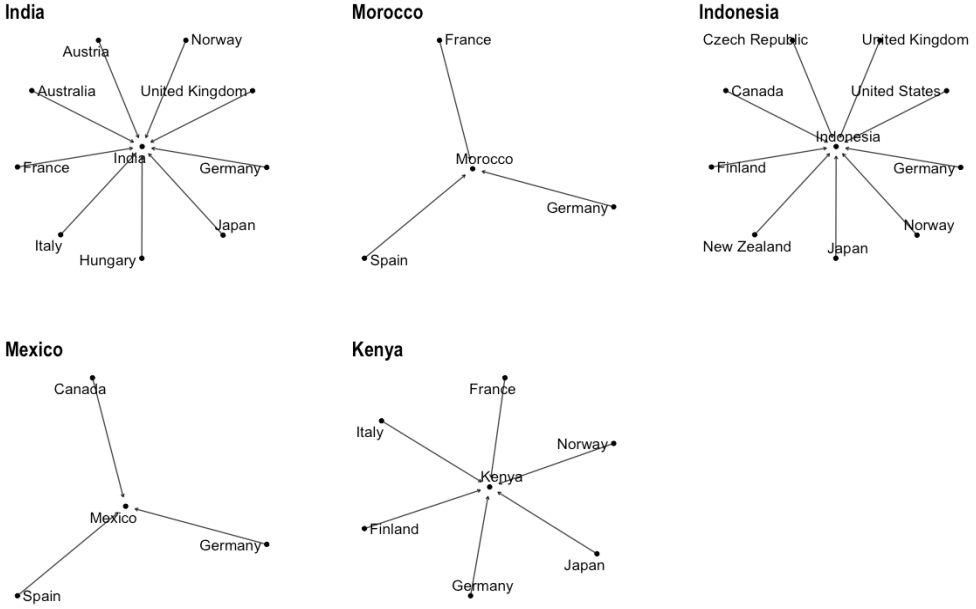


Source: Own elaboration with data from OECD-CRS.
Note: The colours of the network show the principal donor for each recipient – i.e. the donor providing the highest share of aid for that recipient. The labels are greyed for recipients and black for donors. The size of the bubble is proportionate to the aid donated/received.

Figure 2 shows the top 5 **recipient's** aid network in 2018. For the purpose of testing H1 i.e. test the impact of the relative strength of a donor in a recipient network, we are interested in comparing donor importance within each recipient network and therefore a measure of the position of power of a particular country in a recipient's aid network. Using this approach, we can quantify and identify the donors providing RE ODA to recipient countries. This metric is included in our panel regression as a main independent variable to test the hypothesis whether donor countries would

provide higher aid if they were in a position of power e.g. if they are the solo donor, in a recipient's aid network[2].

Figure 2. Top 5 recipient's aid network in 2018



Source: Own elaboration with data from OECD-CRS

Traditionally, to measure market concentration, literature has used the well-known Herfindahl–Hirschman Index (HHI) (Herfindahl, 1950). For each triadic donor-recipient-year we can calculate both, first a market share of each donor in the RE ODA market per year i.e., the size of donation in relation to the total aid on renewable energy projects in a particular recipient and, second, the HHI as a common measure of market concentration of an industry can be used to determine market competition.

$$HHI \quad (i) = \sum_{j=1}^{J} \left(\frac{w_{ij}}{C_D^w(i)}\right)^2 = \sum_{j=1}^{J} \left(\frac{aid_{ij}}{\sum_{j=1}^{J} aid_{ij}}\right)^2 \qquad [2]$$

These metrics are included in our panel regression as market structure variables to test the hypothesis whether donor countries would provide higher amounts of aid if they are in a position of power in a recipient's aid network.

[2] Although for the analysis of weighted networks a weighted degree of centrality of the recipients has been the preferred measure in the literature (see e.g. Opsahl et al., 2008), this metric only takes into consideration a node's total level of involvement in the network, and not the number of other nodes to which it is connected. This measure is formalised as $C_D^w(i) = \sum_j^N w_{ij}$ where i is the focal node, j represents all other nodes, N is the total number of nodes, w is the weighted adjacency matrix, in which w_{ij} is greater than 0 if the focal node i is connected to node j, and the value represents the weight of the tie, in this case the amount RE ODA received in year t by recipient i from donor j. Therefore, as it is and for the purposes of our research, this would not be a sufficient metric for us given that our interests are related to understanding the power of a particular donor j in a recipient's i network and that does not come only influenced by the amount of aid donated but also by how much that donation represents in the total amount of aid received by the recipient. Yet, we will use w_{ij} for the calculation of alternative indicators that help proxy the market structure of RE ODA.

Additionally, we use Comtrade data to extract information on the level of trade (imports by donors) of lithium, cobalt and rare earths between donors and recipients in Kg (See Table A5 in the appendix for a list of the HS codes of the commodities included in these variables). As detailed in the literature review, these minerals are of vital importance for the political economy of the energy transition. While there is no consensus on the level of criticality, some studies converge in thinking that cobalt, lithium and rare earths are between those more critical minerals essential for the transition to decarbonised economies (see e.g. Gielen, 2021; Valhuhk et al., 2020; IRENA, 2023)[3]. We also add the energy trade exchanges, i.e. the energy imports and exports between donors and recipients. We hypothesize that the larger the energy dependency of the donor, the larger will be the interest in providing development aid for renewable energy projects in the recipient country as a way to strengthen the trade relationships between both economies.

3.2. Recipient needs

To capture the recipient needs we include the amount of CO2 emissions of the recipient country, the current share of renewable energy (% of total electricity generation) and the environmental vulnerability index of the recipient provided by the ND-Gain Framework (ND-GAIN, 2023). This index is a time variant measurement developed by the University of Notre Dame Global Adaptation Initiative to provide insights on the current vulnerabilities to climate disruptions in 182 UN countries[4]. While the index includes different measures, we use for the purposes of this research the vulnerability index which measures the propensity of human societies to be negatively impacted by climate hazards.

3.3. Recipient policies

A set of dummy variables have been included to represent the level of policy support in each of the recipient countries. This study focuses on those policy instruments that can catalyse the transition to decarbonised economies through fostering the adoption and deployment of low carbon renewable energy sources. For the purpose of this paper, we focus on demand-side regulatory and economic and financial instruments. We include those demand-side policies that focus on the promotion of renewable energy deployment. We select 4 independent variables intended to examine the policy landscape in the recipient countries in the sample. The assessed policies are: FITs, auctions, tax credits and carbon pricing[5]. Data on the policies that have been implemented in different countries have been extracted from REN21 (2021).

3.4. Other Controls

In addition to the independent variables explained above, we control for recipient merit with three measures. First, we use the political stability and the regulatory quality of the low- and middle-income recipient countries. These indicators are extracted from the Worldwide Governance Indicators database. As Bertzold and Weiler (2017) we use these variables as an indicator of the capacity of the countries to use effectively the funds provided by donor countries. We also introduce information about the colonial ties between recipients and donors and the variables

[3] We also use data from the US Geological Survey to extract information on the production of lithium, cobalt and rare earths by the recipient countries in metric tonnes. Regressions with these explanatory variables are included in the Appendix as an alternative metric to the strategic interest of the donor to test our H2.

[4] For some of the recipient countries in the database vulnerability index was not available, e.g. some pacific islands. We have proxied the vulnerability index in those cases with the index of the closest available geographic neighbour.

[5] Renewable portfolio standards and emission trading systems are not included as policies as they have been barely used by recipient countries.

traditionally included in Gravity Models (Head and Mayer, 2014; Bermeo, 2017). These control variables are the GDPpc- ppp of both donors and recipients, the distance between capitals, the existence of regional trade agreements between donor and recipient and the countries that have signed the General Agreement on Tariffs and Trade (GATT). These variables have been extracted from CEPII (See Table A1 in the appendix for a list of sources).

Table 1 summarizes the descriptive statistics. A correlation matrix can be found in Fig. A3. in the appendix.

Table 1. Descriptive statistics

Variables	Description	Obs.	Mean	Std.	Min	Max
Dependent variables						
$REODAd_{ijt}$	1=yes 0=no	10340	0.2685	0.4432	0	1
$REODA_{ijt}$	Million $2017 c.	10340	2.3546	21.7087	0	815.2189
Independent and control variables						
$Centrality_{it}$	See section 3.3	10340	2.8591	2.1983	0	12
HHI_{it}	See section 3.3	10340	0.6609	0.3403	0	1
$Market\ share_{ijt}$	See section 3.3	10340	0.1004	0.2690	0	1
Lithium production $rec._{it}$	Metric tonnes	10340	1471.8420	7946.1700	0	81378.0000
$Lithium\ imports_{ijt}$	Kg	10340	168.8472	8593.9400	0	638000.0000
Rare earths production rec.it	Metric tonnes	10340	1784.8510	13730.3400	0	130000.0000
$Rare\ earths\ imports_{ijt}$	Kg	10340	610.7416	17994.2300	0	1183228.0000
Cobalt production $rec._{it}$	Metric tonnes	10340	411.0749	2683.5190	0	73000.0000
$Cobalt\ imports_{ijt}$	Kg	10340	1188.3330	14480.8300	0	785584.0000
$Energy\ imports_{ijt}$	US$ curr.	10340	211000000	1480000000	0	44400000000
$Energy\ exports_{ijt}$	US$ curr.	10340	96100000	862000000	0	34500000000
$FITs_{it}$	1=yes 0=no	10340	0.1009	0.3012	0	1
$Auctions_{it}$	1=yes 0=no	10340	0.3034	0.4597	0	1
$Tax\ credits_{it}$	1=yes 0=no	10340	0.1837	0.3872	0	1
$Carbon\ tax_{it}$	1=yes 0=no	10340	0.0250	0.1560	0	1
Vulnerability $rec._{it}$	ND-GAIN index.	9860	0.4828	0.0754	0.3240	0.6880
CO2pc $rec._{it}$	Production-based emissions CO_2 (Kg/kWh) of primary energy consumption.	10340	1.9895	2.4435	0.0200	17.3190
RE% elec. Rec.it	% RE generation in electricity mix	10128	0.3847	0.2950	0	1
Multilateral ODA $rec._{it}$	Million $2017 c.	10340	516.5628	665.4714	0	4896.9300
Access electricity $rec._{it}$	%	10249	72.6862	30.6042	1.5000	100.0000
$Colonial\ link_{ijt}$	1=yes 0=no	10324	0.0746	0.2627	0	1
$Political\ stability_{it}$	Index WRI	10340	-0.5224	0.8969	-3.3149	1.5509
$Regulatory\ quality_{it}$	Index WRI	10340	-0.4663	0.6232	-2.5553	1.5385
GDP pcppp $don._{jt}$	Thousand $ per capita ppp	10291	44.5168	11.9381	15.5020	116.7860
GDPpcppp $rec._{it}$	Thousand $ per capita ppp	9681	7.5031	5.9063	0.6190	37.4970
Coal phase out target $rec._{it}$	1=yes 0=no	10180	0.5177	0.4997	0	1
Capitals $Dist._{ijt}$	Km	10324	7377.8680	3815.1210	394.7470	18600.7000
$GATT_{it}$	1=yes 0=no	10340	0.6286	0.4832	0	1
RTA_{ijt}	1=yes	10324	0.2475	0.4326	0	1

0=no

4. Empirical strategy

In order to answer to our hypotheses, we use a methodology in two steps. First, we use the foreign aid data for renewable energy projects to develop, using network-based measures our main independent variables: the indegree of centrality of the donor in the network of the recipient, the market share and the HHI (see section 3 and Box 1 in Appendix). Second, we fit a gravity equation model and use panel data regression techniques relevant for identifying the drivers behind donor-recipient relationships and importantly donors' level of concentration in the recipient countries on the allocation of official development aid. We follow a static and a dynamic strategy taking into consideration that the econometrics of aid allocation is technically challenging due to the large number of zeroes included in a triadic dataset where not all donors provide aid to all recipient countries in every single year (Betzold and Weiler, 2017). For the goals of this study, we will apply certain economic concepts and analytical frameworks to the study of ODA provision and reception, defining it as a market. Modelling ODA as a market involves treating ODA as a commodity that is traded between donor countries and recipient countries. In this sense, ODA can be viewed as a supply-demand market, where donor countries supply ODA to recipient countries, and the latter demand ODA. The market for ODA can be characterised by the factors that influence the supply and demand for ODA, such as the economic conditions of donor and recipient countries, political stability, development needs, and aid effectiveness. On the one hand, modelling ODA as a market allows us to understand the incentives and motivations of donor countries. Donor countries have their own interests in providing ODA, which can range from promoting their foreign policy objectives to accessing new markets for their goods and services. It also becomes easier to understand the underlying incentives that drive donor countries to provide aid. While there are additional considerations with this conceptualisation, we can examine the factors that drive the demand for aid (e.g., development needs or economic conditions) and factors that determine the supply of aid (e.g., donor policies, political considerations).

4.1. The model

A gravity model is proposed as follows:

$$X_{ij} = \frac{Y_i E_j}{Y}\left(\frac{t_{ij}}{S_i P_j}\right)^{1-\sigma} \quad [3]$$

In this equation, X_{ij} is the value of RE ODA from country *i* to country *j*, Y_i is country *i*'s total ODA provision, E_j is country *j*'s total ODA reception, *Y* is global ODA available, t_{ij} is the bilateral cost of ODA flows between country *i* and country *j*, and σ is the elasticity of substitution among ODA from varying source countries. The structural terms S_i and P_j represent multilateral resistance within the donor and recipient countries (frictions). When applying equation (3) to data using PPML, a variety of fixed effects are possible (Santos Silva and Tenyero, 2011; Head and Mayer, 2014). One theory-consistent and flexible empirical form of the gravity equation when using panel data is:

$$X_{ijt} = \exp\left[\gamma_{it} + \eta_{jt} + \lambda_{ij} + \beta Z_{ijt}\right] + \varepsilon_{ijt} \quad [4]$$

Where γ_{it} are donor time-varying fixed effect, η_{jt} are recipient time-varying fixed effects, λ_{ij} are donor-recipient time-invariant fixed effects, and Z_{ijt} is the vector of time-variant bilateral determinants of ODA.

While traditional trade models have provided significant insights into global economic interactions, their application to the analysis of development aid, particularly in sectors like renewable energy, is limited due to their inability to handle zero flows effectively. Traditional approaches assume continuous market interactions and rely heavily on econometric techniques such as ordinary least squares, which are ill-equipped to process the absence of trade or aid flows in this case (Santos Silva and Tenreyro, 2006). Gravity models are adapted to include methods such as Poisson pseudo-maximum likelihood estimations (see below), which address zero flows by treating them as meaningful data points, reflecting strategic non-engagement or barriers to aid (Martin and Pham, 2020). This capability is particularly relevant in renewable energy projects, where factors like resource availability, technological readiness, and specific infrastructural needs play significant roles in shaping aid flows. Gravity models have proven superior due to their flexibility in incorporating a range of economic and non-economic factors, such as political relationships or cultural ties which are crucial in the distribution of development aid (Anderson, 2011). Indeed, gravity models allow for the introduction the variables of interest for the analysis of targeted provision of ODA (Bermeo, 2017). Therefore, gravity models not only offer a methodologically robust framework for analyzing aid distribution but also enhance our understanding of the dynamics at play in targeted RE ODA.

Unlike in an analysis of trade flows, a gravity model of ODA flows has two particularities. First, ODA is only provided from donor countries to recipients, and not the other way around. Second, this model suggests that the amount of economic interaction between two countries is positively related to the economic size of the donor but negatively related to the economic size of the recipient and to the distance between donor and recipient. By incorporating this negative correlation between recipient GDP and ODA flows, the revised model aligns with the expectation that countries with lower GDPs are likely to receive higher amounts of ODA. The actual relationship between these variables can vary based on various factors and specific empirical analyses.

4.2. The estimation strategy

We use a Poisson pseudo maximum likelihood regression with high dimensional fixed effects (PPMLHDFE) (Correia et al. 2019) with a dependent variable in levels to prevent concerns associated to the zero values. With this econometric strategy we avoid biased and inefficient OLS estimates of log-linearized models. The use of PPML estimators present a set of advantages: they are consistent in the presence of heteroscedasticity, they deal better with zero values of the dependent variable, and they are consistent in the presence of fixed effects. (Couharde et al 2020; Santos Silva and Tenreyro, 2006).

Our model that takes the following form:

$$REODA_{ijt} = \exp\left(\alpha_{ij} + \beta_1 \ln\left(C_{it}\right) + \sum_{k=2}^{4} \beta_k \ln\left(CMT_{ijt}\right) \quad + \sum_{k=5}^{6} \beta_k \ln\left(ET_{ijt}\right) + \sum_{k=7}^{10} \beta_k (Pol_{it-1}) + \delta X_{it} + \zeta Z_{ijt} + \theta Y_{jt} + \varphi W_t + \eta_i + u_j + \lambda_t\right) + \varepsilon_{ijt} \quad [5]$$

where subscripts *i, j* and *t* indicate the recipient country, the donor country and the time period,

respectively. The dependent variable, $REODA_{ijt}$, is defined as the aid in millions that recipient *i* in a year *t* receives from each donor country *j* as climate mitigation aid for the development of renewable energy projects. C_{it}[6], CMT_{ijt}[7], ET_{ijt} and Pol_{it-1} represents the main independent variables 'centrality', the critical materials trade vector– rare earth, lithium and cobalt – between donors and recipients, the energy trade vector between donors and recipients and the policy vector – auctions, fits, tax credits and carbon pricing mechanisms- in the recipient countries.

X_{it} is a k-dimensional vector of variables that control for recipients' needs. Z_{ijt} is a vector of variables that reflect strategic links between donor and recipient countries. The variable Y_{jt} is k-dimensional vector of variables representing time varying characteristics of donors. The policy related explanatory variables are lagged one year to avoid possible endogeneity problems. Country-fixed effects for recipient (η_i) and donor (u_j) countries and time-invariant dyad-specific effect (α_{ij}), are included in order to control respectively fixed spatial characteristics and unobserved spatial heterogeneity. Time fime-fixed effects, λ_t, are also integrated to capture global shocks that may affect the modelled relationship. Finally ε_{it} is an independent and identically distributed (i.i.d.) error random term.

We use a Poisson pseudo maximum likelihood with high dimensional fixed effects (PPMLHDFE) estimator to estimate our nonlinear model of aid allocation. Poisson regressions are gaining popularity as an alternative for the estimation of multiplicative models where the dependent variable is nonnegative and with pseudo-Poisson maximum likelihood models, the application is not restricted to count data (Gourieroux et al., 1984). Here, the obvious reason for the adoption of a PPML is the inadequacy of the log-transformation to deal with the large number of zeros typical in the study of ODA flows[8].

Furthermore, although the dependent variable for the Poisson regression is specified in levels rather than in logarithms, the coefficients of any independent variables entered in logarithms can still be interpreted as simple elasticities (Couharde et al. 2020). Given the multiplicity of FE included in our equation and in order to avoid problems like the incidental parameter problem (see Neyman and Scott (1948)), the use of a PPLMHDFE is justified (Correia et al. 2019).

4.3. Additional estimation concerns

In addition to resolving the incidental parameter problem, research has pointed to the possibility of facing omitted variable bias issues due to the complexity of donor motivations and/or recipient needs behind the aid flows. However, as pointed by Bermeo (2017), variables involved in these decisions can be numerous and empirical literature diverges when it comes to the specification of related variables. Following Couharde et al (2020), our analysis includes a variety of independent and control variables widely used in ODA studies.

To address further the omitted variable bias, we can measure the relative importance of selection on the unobservable bias by investigating how the coefficient of our main variable of interest – changes with the inclusion of the additional explanatory variables and different types of FE. If including controls substantially attenuates the estimated coefficient, then it is possible that the

[6] The regression analysis is also performed with MS_{ijt} representing the market share in the total amount of RE ODA of a particular donor j in a recipient i in year t, and with HHI_{it} as the Herfindahl Index measuring the concentration of the 'market' for RE ODA in a recipient country *i* in year *t*.

[7] The regression analysis is also performed with CMP_{it} representing the critical materials production vector– rare earth, lithium and cobalt – of a recipient *i* in year *t*.

[8] 73% of the values in our dependent variable are zeros.

inclusion of more controls would reduce the estimated effect even further. If, on the other hand, the inclusion of controls has no effect on the estimated magnitude of the coefficient, then we can be more confident in suggesting a causal interpretation for the estimated relationship.

More formally, it is possible that in the context of official development aid with data at the country level, key unobserved individual heterogeneity comes from the differences in the capacity to attract ODA among countries. This can be captured by the past history of ODA reception defined as the pre-sample mean of the dependent variable,

$$REODA_{ijp} = \frac{1}{TP}\sum_{r=0}^{TP-1} REODA_{ij0-r} \quad [6]$$

where TP is the number of pre-sample observations. For the purpose of this research the pre-sample period goes from 2000 to 2011[9]. We use the PSM estimation to correct for that unobserved individual heterogeneity when there are correlated individual effects and predetermined regressors that would make ppml estimations inconsistent (Blundell. et al. 2000; Bosch et al. 2005) (See section 5.2 for further details and results).

In addition to unobserved individual heterogeneity concerns in regards to potential selection biases derived from traditional ODA estimations in two stages i.e. a selection stage and an allocation stage and endogeneity concerns may also arise. See section 5.2. for an explanation and results of robustness checks considering these potential sources of econometric concern. The final strategy is to explore the data with multiple estimation strategies to assess the robustness of our findings.

5. Results

5.1. Baseline results - PPMLHDFE

Table 2 provides the results obtained by using the PPMLHDFE estimator[10]. The first columns (1-5) report the results for the regressions with the variables of interests i.e. the indegree centrality of the recipients and therefore the number of countries providing official development aid to a particular recipient country, the critical mineral level of imports from recipients to donors, the level of trade in energy products and the public policies in place in recipient countries plus additional controls associated to the needs of the recipients and/or other frictions and control variables in the gravity model. Columns 6 to 10 provide results with the market share as independent variable. The more parsimonious result from regressions without controls can be found in Table A5 in the appendix.

Results show that the decision of a donor country to provide bilateral ODA to a recipient country is tied to both geopolitical and economic reasons. In regards to the number of donors providing RE ODA, results show that the higher the number of donors in a particular country, the higher the amount of official development aid provided by a particular donor. Specifically, an additional 1% in the number of donors in a recipient country would increase the amount of ODA donated by a particular donor on a 1.14% in our preferred model (Column 5)[11]. Results (coefficients) are

[9] For the pre-sample estimations the period of analysis will run from 2012 to 2018.

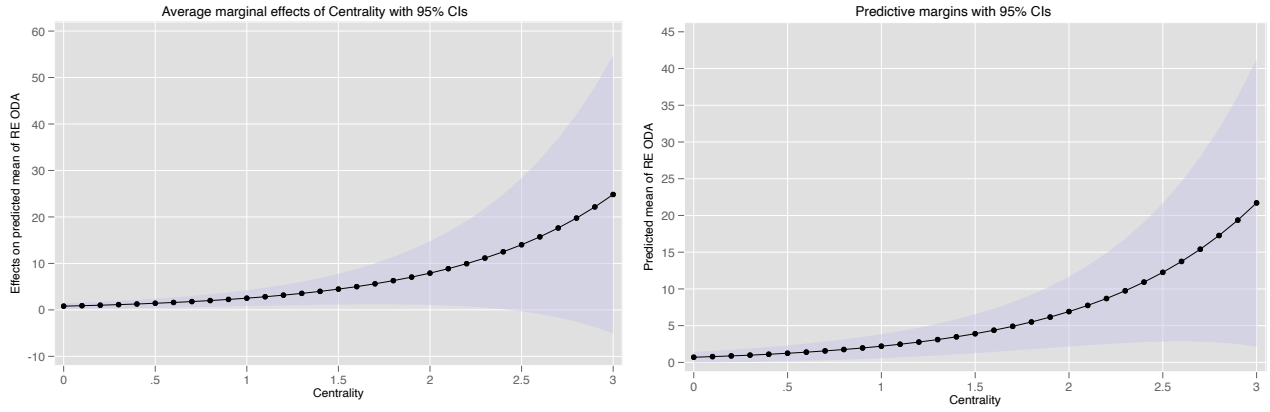
[10] The regressions shown in Table 2 are those including the controls of the gravity model for two of the three market structure variables considered in this paper i.e. centrality and market share. The HHI regressions are included in table A4 in Appendix due to space reasons. This table includes the coefficient of the gravity model controls too. Specifications by column differ in the type of fixed effects included. We introduced fixed effects by year, recipient and donor and different combinations of these effects.

[11] We choose the model with year, donor and recipient FE as our preferred one to find the right balance between R2 and number of observations.

consistent across different specifications when considering as an explanatory variable the number of donors in a particular recipient country i.e. the centrality. This can be the case due to strategic priorities i.e., the donor may aim to strengthen its influence, build alliances, or secure access to renewable energy resources by providing assistance in regions where other donors are also active. In this sense, the country providing RE ODA may view its assistance as an opportunity to foster capacity building and knowledge exchange. By supporting renewable energy projects in collaboration with other donors, it can contribute to the development of local skills, institutions, and policies in the recipient country. This capacity building approach aims to create self-sustaining systems that can continue to advance renewable energy even after the external assistance has ended. These results demonstrate the importance of additionality and shared responsibility. The provision of ODA by multiple donors does not necessarily imply redundancy. It can often complement and supplement existing efforts by other donors. Each donor may have its own funding priorities and expertise. By participating alongside other donors, the country providing ODA can leverage existing initiatives, enhance project implementation capacity, demonstrates its commitment to international cooperation and burden-sharing in achieving common goals and increase the overall impact of renewable energy projects.

Fig. 3 shows the average marginal effects (left-hand side) revealing that when the number of donors is over 4 [~exp(1.5)] the effect on the reception of RE ODA becomes markedly stronger. The right-had side, which shows the predictive margins, aligns with this interpretation by demonstrating a progressive increase in the expected mean of RE ODA as centrality rises. This non-linear relationship highlights that entities at higher centrality levels are not just marginally more influential but potentially exponentially more impactful. The findings suggest potential threshold effects where once centrality surpasses certain levels.

Fig. 3. Predicted mean and effect on predicted means of RE ODA by indegree of centrality



Source: Own elaboration
Note: the variable centrality is introduced in natural logarithms, the y-axe, RE ODA, is measured in Million USD 2017c. The effects shown in this figure are those corresponding to the regression included in Column 5 of Table 2.

Interestingly, when considering the level of concentration of the ODA market, measured by the HHI, this variable turns not to be significant (See Table A4 and A5 in the SI). In the context of ODA, the Herfindahl Index can be used to assess the concentration of aid flows from different donor countries to a recipient country. While the number of donors seems to be a relevant metric, the HHI in the ODA market is not significant. Yet, if we consider the market share i.e., the amount of ODA provided by a donor to a recipient in a particular year normalised by the total amount of ODA received by the recipient in such year, the indicator turns significant as in the case of the number of donors (See Columns 6 to 10). Significant coefficients on the range between [0.23-

0.45] can be found. This means that an additional 1% increase in the market share generates an increase in the amount of ODA donated for renewable energy projects in a particular recipient and year in between 0.22% and 0.45%. This result is very interesting in itself as it shows that donor countries are concerned with risk sharing i.e. financial, political and implementation risks in the provision of ODA for renewable energy projects. Financial and implementation risks are very relevant when dealing with renewable energy infrastructure. In particular contexts and with high risks upfront investments in renewable energy projects, delays, inadequate capacity, or corruption are risks that donor countries may prefer to share with other donors.

Table 2 Baseline PPMLHDFE regression– Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.023***	1.303***	1.160***	1.152***	1.144***					
	(0.185)	(0.154)	(0.247)	(0.244)	(0.233)					
Market share						0.223***	0.276***	0.296***	0.416***	0.447***
						(0.0331)	(0.0473)	(0.0400)	(0.0539)	(0.0593)
Lithium imports	0.0708	-0.0329	0.106*	-0.00817	0.0174	0.0899	0.00255	0.138**	0.0361	0.0657
	(0.0586)	(0.0515)	(0.0587)	(0.0478)	(0.0468)	(0.0619)	(0.0614)	(0.0615)	(0.0502)	(0.0512)
Rare earths imports	0.159***	0.0439	0.196***	0.0355	0.0396	0.172***	0.0758**	0.206***	0.0397	0.0410
	(0.0411)	(0.0349)	(0.0392)	(0.0360)	(0.0349)	(0.0397)	(0.0336)	(0.0371)	(0.0342)	(0.0342)
Cobalt imports	0.124***	0.0768**	0.141***	0.0587*	0.0721**	0.143***	0.102***	0.146***	0.0490*	0.0637**
	(0.0379)	(0.0303)	(0.0388)	(0.0321)	(0.0347)	(0.0385)	(0.0328)	(0.0381)	(0.0294)	(0.0309)
Energy exports	-0.0422	-0.0217	-0.0426	-0.0207	-0.0215	-0.0318	0.00954	-0.0489	-0.00258	0.00585
	(0.0343)	(0.0304)	(0.0359)	(0.0321)	(0.0343)	(0.0339)	(0.0346)	(0.0315)	(0.0262)	(0.0282)
Energy imports	0.0592**	0.0136	0.0833***	0.0190	0.0192	0.0639**	0.00822	0.0919***	0.00893	-0.000448
	(0.0257)	(0.0259)	(0.0272)	(0.0309)	(0.0326)	(0.0256)	(0.0252)	(0.0263)	(0.0288)	(0.0313)
Auction rec.	0.853***	0.896***	0.727**	0.700**	0.645**	1.182***	1.355***	0.636**	0.599**	0.524*
	(0.321)	(0.266)	(0.325)	(0.323)	(0.322)	(0.362)	(0.320)	(0.313)	(0.299)	(0.298)
FIT rec.	0.232	0.322	0.157	0.0975	0.0939	0.593*	0.691***	0.231	0.0404	0.0620
	(0.311)	(0.225)	(0.334)	(0.335)	(0.326)	(0.314)	(0.246)	(0.370)	(0.297)	(0.291)
Carbon tax rec.	0.0899	0.137	0.874	0.599	0.510	0.474	0.260	1.030	0.673	0.600
	(0.934)	(0.801)	(0.783)	(0.777)	(0.908)	(0.848)	(0.867)	(0.766)	(0.727)	(0.877)
Tax credits rec.	-0.367	-0.219	0.124	0.162	0.169	-0.364	-0.302	0.00919	0.0464	0.0164
	(0.230)	(0.181)	(0.502)	(0.479)	(0.466)	(0.240)	(0.213)	(0.631)	(0.541)	(0.516)
CO2 pc rec.	0.294	0.560***	-0.498	-0.479	-0.419	0.425*	0.637***	0.0236	-0.0446	-0.0263
	(0.276)	(0.206)	(0.454)	(0.450)	(0.452)	(0.224)	(0.188)	(0.423)	(0.443)	(0.461)
% RE rec.	0.209	0.284**	0.237	0.192	0.221	0.297**	0.338***	0.283	0.166	0.214
	(0.150)	(0.113)	(0.191)	(0.185)	(0.197)	(0.121)	(0.0921)	(0.185)	(0.185)	(0.187)
Vulnerability rec.	-1.715	-0.0483	1.108	1.964	1.301	-0.202	1.224	-0.656	0.827	-1.819
	(2.274)	(1.306)	(12.93)	(12.46)	(12.91)	(2.306)	(1.735)	(13.11)	(10.42)	(10.17)
Gravity model controls	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Intercept	-2.621	-7.341	-2.447	0.779	12.45	-0.328	-5.390	-1.142	0.157	11.56
	(2.518)	(10.79)	(11.68)	(15.41)	(11.19)	(2.325)	(10.63)	(11.81)	(13.63)	(8.681)
Year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes			Yes		Yes	
Recipient FE			Yes	Yes	Yes			Yes	Yes	Yes
Year-Donor FE					Yes					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8374	8374	8330	8330	7868	8374	8374	8330	8330	7868
pseudo R^2	0.213	0.440	0.309	0.520	0.559	0.193	0.397	0.322	0.543	0.585
AIC	135120.2	96048.2	118415.0	82242.2	74264.3	138573.8	103468.3	116263.6	78295.3	69980.1
BIC	135275.0	96203.0	118569.6	82396.8	74410.7	138728.5	103623.0	116418.2	78450.0	70126.5
Wald Test (chi2)	166.4 (0.000)	349.7 (0.000)	92.75 (0.000)	73.56 (0.000)	76.12 (0.000)	147.2 (0.000)	231.4 (0.000)	172.1 (0.000)	131.9 (0.000)	124.9 (0.000)

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01 Note: Independent and control variables are included in logarithms. Policy dummy variables are lagged one period. For gravity model controls coefficients, see Table A4 in the appendix.

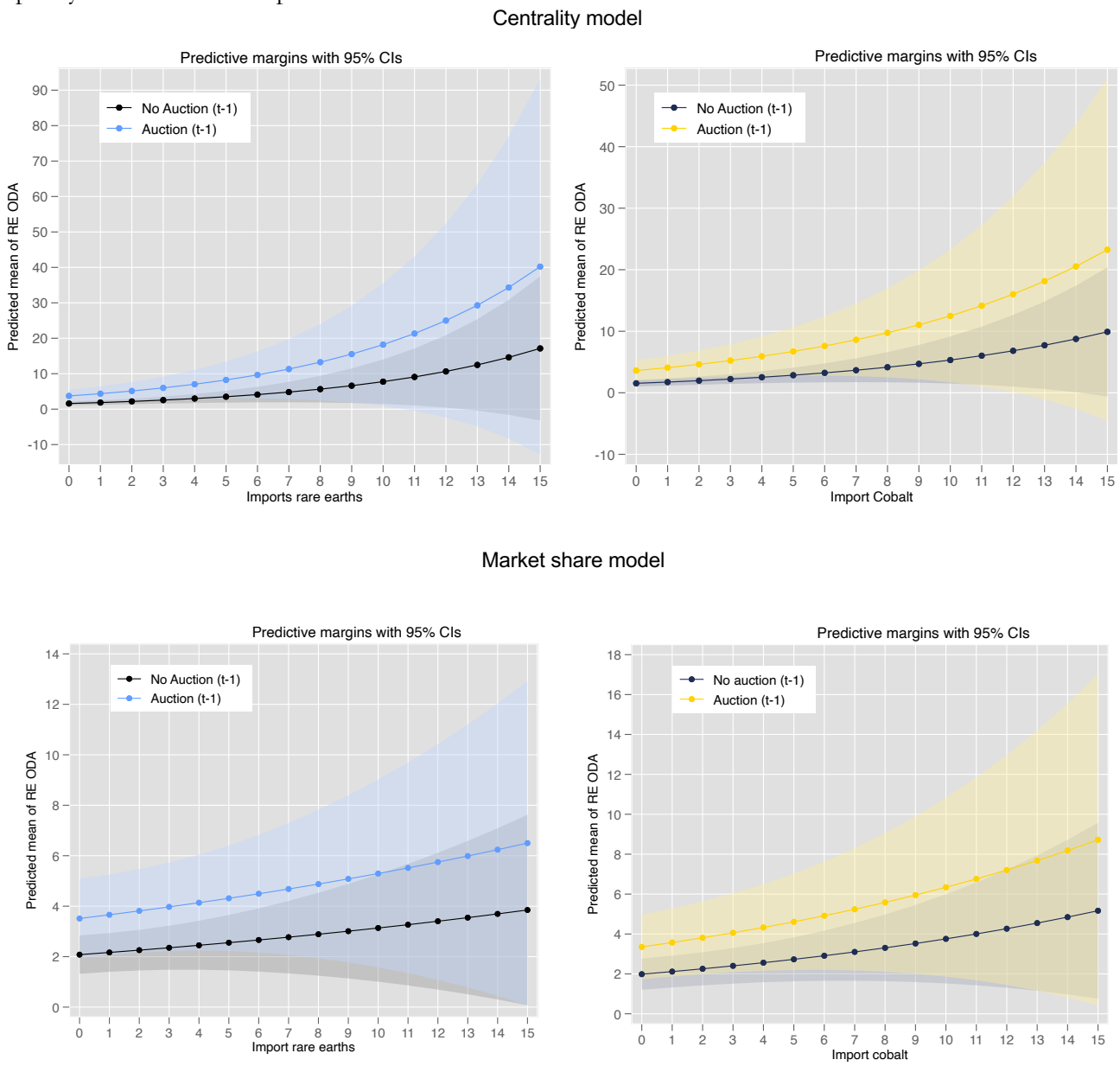
Very important when dealing with political risks is the establishment of stable and predictable policy frameworks in agreement between donors and recipients. That is the main reason why the policy variables have been introduced in this analysis lagged by one period. This lag allows us to avoid endogeneity issues associated to the potential influence exerted by donors in the establishment of particular policies in recipient countries. A clear example of this mechanism arises from the establishment of the Global Energy Transfer Feed-in Tariff (GET FiT) investment support scheme in Uganda, between the Ugandan Government, the Ugandan Electricity Regulatory Authority and the German Development Bank supported by an additional number of other donors. This programme improved the regulatory framework for setting up small hydro projects in Uganda, but importantly set up a feed-in tariff system generous enough to reduce the internal rate of return from 15% to 9% for private investors in just three rounds (Probst et al. 2021, Anadon et al. 2022). Results confirm that the amount of ODA for renewable energy projects provided by donors will be higher in those countries that have established deployment subsidies for renewable energy, in particular, in the form of auctions, very common among developing countries during the last decade .

In summary, the level of participation in recipient countries plays a positive role in attracting ODA for renewable energy projects from donor countries i.e., the larger the number of donors in the previous year, the larger the amount of money allocated. However, this preference for recipient countries with a larger participation (presence of other donors), does not translate in a preference for fragmented markets and the market share of the donor in the recipient is statistically significant i.e., the larger the power of the donor in relation to the total amount of ODA received by the recipient the higher the amount of money allocated contingent upon selection. How do we reconcile the preference for both, the presence of other donor countries and the preference for higher market shares? This shows that donors may compete for political and economic influence through the provision of ODA in the recipient countries. Yet, a donor country prefers being in a position of power in the network of the recipient, but at the same time they value the presence of other donors that can be beneficial to them for example in terms of additional trade links and/or risk sharing.

Results shows that variables associated to the strategic interests of the donors are of vital importance when deciding the amount of ODA provided to recipients. Table 2 shows the importance of the amount of imports of critical minerals, mainly rare earths and cobalt imports between donor countries and recipient countries. The provision of ODA to a receipt country for renewable energy projects will be higher if there are trade relationships, in particular if the donor country imports critical minerals like rare earths and cobalt from the recipient country. Trade flows of energy goods and services between donor and recipients are also a significant determinant of the amount of ODA received by low- and middle-income countries. An additional 1% in the amount of imports of rare earths or cobalt between a donor and a recipient country increases the sum of ODA provided in the range of [0.03-0.20] percent.

Fig. 4 shows the predicted mean in the reception of RE ODA by a particular recipient subjected to the level of imports of critical minerals i.e. rare earths and cobalt as they are the significant variables in our baseline regression; in those countries with and without an established framework of auctions for renewable energy showing a higher provision of RE ODA in those countries in which policy frameworks are present.

Fig. 4. Predicted mean of RE ODA by level of significant critical minerals imports in donors and policy framework in recipients.



Source: Own elaboration. Note: The variables in the x-axe are measured in natural logarithms. The dependent variable in they y-axe is measured in Mill. USD 2017 c. The graph represents the estimations derived from the regressions including recipients FE and year-donor FE. The two upper-part panels are the graphical representation of variables in Column 5 of table 2 (preferred regression with centrality as an independent variable) while the two lower-part panels represent the predicted mean of the RE ODA subjected to the natural logarithm of the imports of critical mineral in the x-axes and the policy framework included in Column 10 of Table 2 (preferred regression with market share as an independent variable.

Critical minerals such as lithium, graphite, rare earth elements and cobalt are essential building blocks for a clean economy; they are used in wind turbines and solar panels, EV batteries and motors, renewable energy transmission and more. Securing enough critical minerals to support a nationwide low-carbon transition poses a serious challenge (Barbanell, 2023). At present, countries like the United States is reliant on imports for virtually all of these minerals. In cases like that, inadequate mineral supply could result in more expensive, delayed or less efficient transitions (IEA 2021). According to the World Bank, in 2018, the European Union imported Cobalt ores and

concentrates from China ($48.37K, 502 Kg), Korea, Rep. ($9.91K, 4,315 Kg), United States ($8.66K, 9 Kg), Australia ($2.80K, 155 Kg), and Morocco ($2.06K, 1,476 Kg)[12]. Currently the EU imports most of the refined cobalt needed for batteries from third countries such as China and countries like the Democratic Republic of the Congo (DRC) for raw materials (Gregoir et al. 2022).Unlike cobalt and rare earths, lithium imports are not statistically significant in our baseline regression. Lithium is a crucial raw material in the production of lithium-ion batteries (LIBs), an energy storage technology pivotal to electrified transport systems and utility-scale energy storage systems for renewable energy (Graham et al. 2021). With the EU committed to making electric vehicles widely available by 2035, the demand for metals required to produce batteries, particularly lithium, is expected to explode. The market is currently dominated by a handful of countries, but Europe wants to join the club by exploiting its subsoil (Graham et al. 2021). In the context of this research lack of significance could be due to the fact that at present, imports from Australia cover the majority of the EU's demand for lithium concentrates, while Chile is the EU's largest supplier of refined lithium compound.

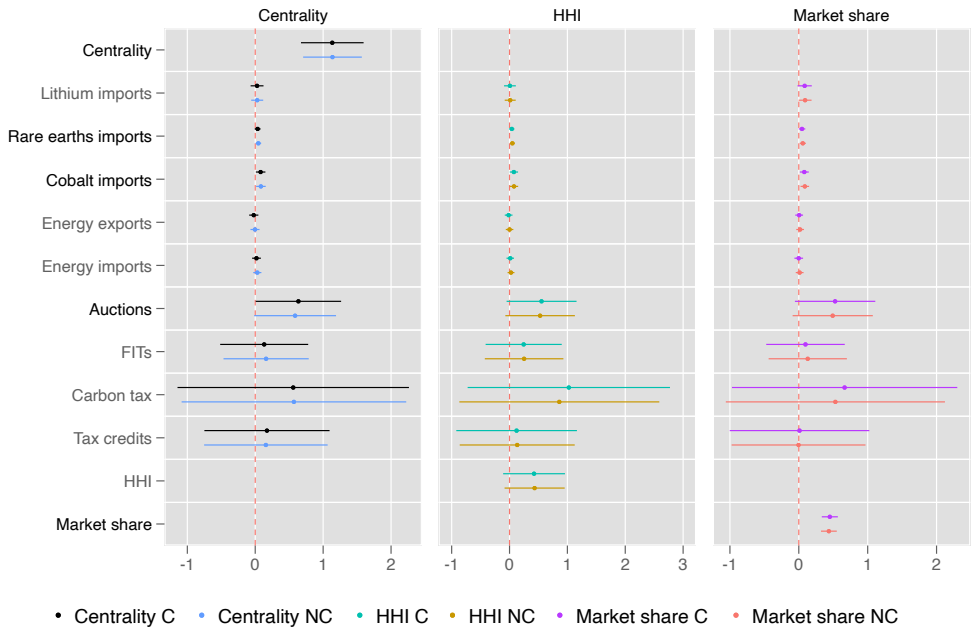
The econometric estimations also confirm that energy imports seem to be a determinant factor in regards to the amount of RE ODA donated by a particular country. Energy trade imports are statistically significantly positive in a handful of specifications with elasticities on the range of [0.06-0.09] percent. Yet results are not as conclusive as with direct trade flows of critical minerals. All in all, the provision of ODA seems to be guided by strategic and economic motives of donor countries. Variables related to the needs of the country do not place a role in the allocation of official development aid and results do not support the idea that those more vulnerable to environmental problems and with higher CO2 emissions per capita would receive higher amounts of ODA for the development of renewable energy projects. Policy implications can be derived from the analysis and are relevant in a context in which partner countries i.e. recipients of ODA, find more difficulties in accessing finance for capital intensive investments in renewable energy projects. ODA in those contexts can act as a catalyser to mobilize additional funds and reduce risks for private investments.

Fig. 5 compares the coefficients of Table 2, Table A4 and Table A5 to summarize graphically the relationship between the provision of ODA and the strategic and economic drivers included in our specification.

Results have been replicated using as explanatory variables the amount of production of critical minerals instead of only the trade flows. Estimation tables can be found in the Appendix (See Table A6 and A7). The level of production of critical minerals in recipient countries does not play a role as important as trade flows when it comes to the decisions of donors to provide ODA. This may be the case if the production of minerals may be under the control of foreign corporations or entities, meaning that the revenue may not significantly benefit the local economy or government. This makes it less of a factor in aid determination than trade.

[12] Data extracted from the World Integrated Trade Solution (WITS) of the World Bank.

Fig. 5. Baseline estimations summarizing the impact of the independent variables on the amount of RE ODA (elasticities)



Source: Own elaboration. Note: C means model with controls (coefficients as included in Table 2 and A4) and NC means model without controls (coefficients as included in Table A5). The graph represents the estimations derived from the regressions including recipients FE and year-donor FE. Values in the x-axe represents coefficients and can be interpreted as elasticities. Highlighted variables in the y-axe are statistically significant.

5.2. Robustness checks

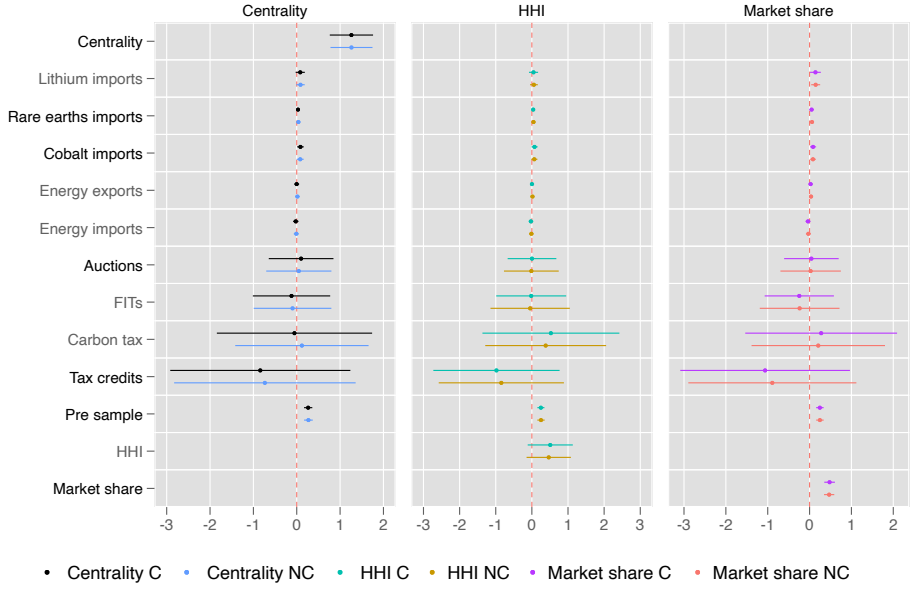
We next check the robustness of our results and offer some additional analyses to support the baseline estimates.

5.2.1. Pre-sample mean estimations

Unobserved individual heterogeneity refers to the differences that exist among countries that cannot be directly observed or measured. In the context of ODA, this could include factors such as the effectiveness of a country's institutions, governance structures, socio-economic conditions, or political stability, which may affect their ability to attract ODA. As mentioned in section 4, using pre-sample mean estimations we can analyze the unobserved individual heterogeneity that comes from the differences in the capacity to attract ODA among countries allowing to control for unobserved, time-invariant country-specific characteristics that may affect a country's ability to attract ODA. Pre-sample mean estimations involve estimating the average value or characteristic of a variable before the sample period begins. In this case, it refers to estimating the average capacity of countries to attract ODA before the observed time period. The specifications in these sections use as a pre-sample period the years 2000 to 2011. The PPMLHDFE with pre-sample means run for observations from 2012 onwards. Results are summarized in Table 3[13] and Fig. 6. Table A9 in the appendix includes the estimations without controls.

[13] Given that the pre-sample estimations are run to control by individual heterogeneity in the recipients, only year and donor FE are absorbed in the regressions included in this section. The regressions shown in Table 3 are those including the controls of the gravity model for two of the three market structure variables considered in this paper i.e. centrality and market share. The HHI regressions are included in table A8 in Appendix due to space reasons.

Fig. 6. Pre sample estimations summarizing the impact of the independent variables on the amount of RE ODA (elasticities)



Source: Own elaboration. Note: C means model with controls (coefficients as included in Table 3 and Table A8 in the Appendix) and NC means model without controls (coefficients as included in Table A9). The graph represents the estimations derived from the regressions including year-donor FE. Values in the x-axe represents coefficients and can be interpreted as elasticities. Highlighted variables in the y-axe are statistically significant

This table includes the coefficient of the gravity model controls too. Specifications by column differ in the type of fixed effects included. We introduced fixed effects by year, recipient and donor and different combinations of these effects.

Table 3. PPMLHDFE Pre sample mean estimations with controls – coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market structure									
Centrality	0.932***	1.158***	1.162***						
	(0.192)	(0.175)	(0.170)						
HHI				0.571**	0.403	0.364			
				(0.274)	(0.257)	(0.253)			
Market share							0.337***	0.355***	0.371***
							(0.0516)	(0.0575)	(0.0640)
Lithium imports	0.100*	0.00929	0.0200	0.106*	0.0158	0.0313	0.136**	0.0599	0.0876
	(0.0560)	(0.0505)	(0.0533)	(0.0588)	(0.0577)	(0.0604)	(0.0576)	(0.0607)	(0.0638)
Rare earths imports	0.115***	0.0506	0.0463	0.115***	0.0590*	0.0526	0.132***	0.0762**	0.0715*
	(0.0403)	(0.0374)	(0.0365)	(0.0371)	(0.0347)	(0.0346)	(0.0379)	(0.0388)	(0.0385)
Cobalt imports	0.128***	0.0870***	0.0955***	0.136***	0.0993***	0.105***	0.135***	0.107***	0.116***
	(0.0384)	(0.0328)	(0.0336)	(0.0383)	(0.0336)	(0.0348)	(0.0397)	(0.0356)	(0.0372)
Energy exports	-0.0102	0.00725	0.00571	-0.00293	0.0177	0.0206	-0.00587	0.0198	0.0203
	(0.0306)	(0.0256)	(0.0265)	(0.0300)	(0.0259)	(0.0271)	(0.0319)	(0.0275)	(0.0291)
Energy imports	-0.00979	-0.0296	-0.0295	-0.00782	-0.0297	-0.0341	0.00119	-0.0216	-0.0230
	(0.0262)	(0.0241)	(0.0250)	(0.0248)	(0.0235)	(0.0247)	(0.0264)	(0.0243)	(0.0268)
Auction rec.	0.568*	0.505*	0.495*	0.856**	0.862***	0.867***	1.079***	1.061***	1.058***
	(0.326)	(0.280)	(0.277)	(0.338)	(0.286)	(0.286)	(0.370)	(0.298)	(0.296)
FIT rec.	-0.307	-0.200	-0.202	0.0826	0.139	0.156	0.0565	0.0872	0.110
	(0.324)	(0.258)	(0.255)	(0.314)	(0.276)	(0.275)	(0.295)	(0.258)	(0.254)
Carbon tax rec.	0.403	0.266	0.242	1.286	1.107	1.105	0.900	0.672	0.594
	(0.946)	(0.815)	(0.826)	(0.856)	(0.744)	(0.768)	(0.854)	(0.772)	(0.830)
Tax credits rec.	-0.276	-0.0417	-0.0402	-0.427**	-0.232	-0.218	-0.543**	-0.407*	-0.384*
	(0.232)	(0.211)	(0.205)	(0.207)	(0.193)	(0.187)	(0.231)	(0.218)	(0.210)
CO2 pc rec.	0.293	0.428*	0.464**	0.411*	0.574***	0.592***	0.401*	0.531***	0.588***
	(0.276)	(0.228)	(0.229)	(0.247)	(0.217)	(0.221)	(0.218)	(0.195)	(0.206)
% RE rec.	0.0260	0.0843	0.0966	0.0976	0.147	0.144	0.115	0.138	0.146
	(0.149)	(0.123)	(0.122)	(0.135)	(0.117)	(0.118)	(0.124)	(0.100)	(0.0991)
Vulnerability rec.	-2.394	-1.494	-1.252	-1.111	-0.228	-0.0838	-0.890	0.00411	0.174
	(1.905)	(1.378)	(1.331)	(1.757)	(1.376)	(1.332)	(1.785)	(1.393)	(1.367)
Pre sample mean	0.496***	0.241***	0.247***	0.533***	0.311***	0.317***	0.547***	0.331***	0.335***
	(0.0668)	(0.0456)	(0.0445)	(0.0740)	(0.0535)	(0.0539)	(0.0745)	(0.0547)	(0.0544)
Gravity model controls	Included	Included	Included	Included	Included	Included	Included	Included	Included
Intercept	-4.719*	-3.962	2.846	-2.812	0.755	4.971***	-1.750	0.440	5.707***
	(2.820)	(11.81)	(1.831)	(2.731)	(11.60)	(1.927)	(2.527)	(11.54)	(2.085)
Year FE	Yes	Yes		Yes	Yes		Yes	Yes	
Donor FE		Yes			Yes			Yes	
Year-donor FE			Yes			Yes			Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6522	6431	6203	5784	5714	5506	6522	6431	6203
pseudo R^2	0.321	0.463	0.502	0.292	0.426	0.464	0.321	0.444	0.483
AIC	91685.6	72329.6	66268.5	92488.0	74773.9	68964.2	91758.9	74822.2	68788.3
BIC	91841.6	72485.3	66416.6	92641.2	74926.9	69109.7	91914.9	74977.9	68936.4
Wald Test (chi2)	420.5 (0.000)	379.1 (0.000)	378.3 (0.000)	409.5 (0.000)	374.6 (0.000)	349.6 (0.000)	550.4 (0.000)	415.5 (0.000)	364.2 (0.000)

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01. Note: Independent and control variables are included in logarithms. Policy dummy variables are lagged one period.

The first point to highlight is that regardless of the estimation strategy, results are broadly consistent. Controlling for heterogeneity through a PSM estimation, the results fluctuate approximately in the same range than with a PPMLHDFE without this correction exercise. For the pre sample estimations we found that tax credits in the HHI model and the market share model become statistically negatively significant. While tax credits have proved to be adequate policy instruments in developed countries in order to promote the deployment of renewable energy, they may not overcome on their own the risks associated to investments in those sources of energy in developing contexts. In particular, the pre-sample mean variable is found to be statistically significant. This suggests that the average value of that variable has a significant impact on the dependent variable, i.e. the amount of ODA received by a recipient from particular donor in a year independent of the time-varying effects captured by other variables. Therefore, the pre-sample mean variable is associated with a systematic change in the dependent variable that is consistent across all time periods and therefore generating some path dependencies also in the amount of ODA received by a particular low- and middle-income country.

5.2.2. Selection bias correction estimations

Also, we show that our results are robust to correcting for sample selection. Since our baseline results are estimated on a sample which includes both positive renewable energy aid flows but also those observations by year in which there is no provision of ODA between donors and particular recipients, we develop a two-stage model to account for potential selection biases—known also as a Heckman correction. This model will allow to estimate the probability to receive ODA for renewable energy projects in a first stage and distinguish between what literature has called the selection stage and the allocation stage.

In the first stage, we estimate the probability to receive climate aid using a set of models on rectangularized data which includes zero aid flows:

$$\Pr(REODA_{ijt} > 0) = \phi\left[\gamma_{it} + \eta_{jt} + \lambda_{ij} + \beta Z_{ijt}\right] \quad [7]$$

where $REODA_{ijt}$ is a binary variable indicating whether or not aid for renewable energy projects was transferred from country *i* to country *j* in the year *t*. In our model, the provision of ODA for renewable energy projects is determined by the existence of a foreign aid (ODA) relationship between the two countries and the set of variables traditionally used in the gravity model. We believe these constructs mainly determine the existence of aid flows for renewable energy projects, and to a lesser extent determine the amount of aid. Conditional on this set of determinants, and for robustness, we run the first stage with different estimators i.e. Probit and Cloglog[14], and with different combinations of fix effects and choose the specification with the lowest information (AIC) statistics. The results of the first stage and the estimations of the second stage with the production of critical minerals are presented in the appendix (Table A12 and Table A13).

In the second stage, we estimate our baseline equation, including a previously computed inverse Mills ratio (IMR_{ijt}), with an OLS estimation.

[14] For the latter, the nature of the data recommends the formulation and estimation of a model able to account for the skewed distribution of the dependent binary variable. Overall, Cloglog estimations are powerful tools for modelling binary outcomes with skewed data. This model is an extension of the traditional logit model and it models the probability of an event occurring by taking the complementary logarithm of the logarithm of the probability of the event not occurring. The cloglog model also includes an additional parameter, known as the dispersion parameter, which allows for over-dispersion in the data (Collet, 2002). While traditionally the IMR is calculated from Probit models, an equivalent metric has been estimated for the Cloglog. Results are consistent across estimators.

The results of the modified second stage are presented in Table 4. Overall, the coefficients are close to the baseline results which removes concerns over sample selection issues. The inverse Mills ratio (IMR) is negative, large and significant i.e., the error terms in the selection and outcome equations are negatively correlated, justifying the use of the Heckman model in the first place. In practical terms, this may mean that unobserved factors that make unit selection more likely also tend to lower the amount of ODA provided to a particular low income country, once other covariates are controlled for. As an example, we can see this in the coefficient of the colonial links (See tables 4 below). While in our baseline results the colonial links do not appear as statistically significant, a Heckman model in two steps would confirm that colonial links are relevant in the decision of providing ODA to particular countries. Yet, those who receive ODA for renewable energy projects would receive less than other countries without colonial links. This can be due to the fact that relationships with colonies may already be stable enough and do not precise of higher amounts of ODA to reinforce partnerships for other purposes.

Table 4. Heckman selection bias models (second stage) - coefficients OLS

	(1)	(2)	(3)	(4)	(5)	(6)
Market structure						
Centrality	3.509**			2.789*		
	(1.595)			(1.518)		
HHI		5.764***			6.112***	
		(2.185)			(2.201)	
Market share			2.899***			2.912***
			(0.418)			(0.418)
Lithium imports	-1.615**	-1.676**	-1.493**	-1.715**	-1.783**	-1.597**
	(0.768)	(0.789)	(0.762)	(0.764)	(0.783)	(0.756)
Rare earths imports	0.878	0.848	0.663	0.732	0.691	0.506
	(0.715)	(0.712)	(0.698)	(0.709)	(0.706)	(0.692)
Cobalt imports	1.870*	1.870*	2.007**	1.777*	1.764*	1.902**
	(0.958)	(0.957)	(0.928)	(0.931)	(0.928)	(0.899)
Energy exports	-0.672**	-0.664**	-0.420	-0.693**	-0.687**	-0.440
	(0.323)	(0.322)	(0.307)	(0.321)	(0.320)	(0.304)
Energy imports	0.490**	0.500**	0.294	0.461*	0.468**	0.260
	(0.241)	(0.241)	(0.228)	(0.237)	(0.237)	(0.225)
Auction rec.	8.566**	9.364**	10.35***	8.359**	9.085**	10.08***
	(3.865)	(3.970)	(3.961)	(3.829)	(3.922)	(3.910)
FIT rec.	6.493	7.787*	8.870**	6.486*	7.646*	8.708**
	(3.999)	(4.033)	(3.941)	(3.919)	(3.930)	(3.832)
Carbon tax rec.	1.420	4.207	3.281	1.590	4.313	3.300
	(8.087)	(7.772)	(7.502)	(7.857)	(7.506)	(7.271)
Tax credits rec.	-0.936	-0.417	-1.211	-0.678	-0.130	-0.962
	(3.309)	(3.280)	(3.248)	(3.274)	(3.239)	(3.205)
CO2 pc rec.	4.656**	5.674**	6.489***	4.594**	5.516**	6.305***
	(2.218)	(2.316)	(2.335)	(2.184)	(2.265)	(2.277)
% RE rec.	1.290*	1.760**	2.056***	1.253*	1.687**	1.981***
	(0.728)	(0.761)	(0.760)	(0.725)	(0.755)	(0.748)
Vulnerability rec.	4.565	8.511	11.63	2.693	6.106	9.164
	(19.15)	(18.65)	(18.56)	(19.08)	(18.57)	(18.45)
Reg. quality rec.	1.159	1.271	0.869	1.125	1.269	0.869
	(1.151)	(1.178)	(1.200)	(1.153)	(1.181)	(1.203)
Political stability rec.	0.0248	0.0446	0.0332	-0.131	-0.102	-0.110
	(0.626)	(0.632)	(0.642)	(0.629)	(0.632)	(0.637)
Colony	-12.78***	-15.35***	-17.08***	-14.80***	-17.04***	-18.68***
	(3.137)	(3.324)	(3.233)	(3.364)	(3.531)	(3.445)
RTA	1.584	1.618	1.544	0.986	1.003	0.954
	(2.999)	(3.010)	(2.955)	(2.915)	(2.915)	(2.861)
GATT	6.187**	6.299**	7.515**	6.308**	6.340**	7.561**
	(2.920)	(2.958)	(2.999)	(2.908)	(2.933)	(2.972)
Dist.	-3.901	-3.354	-2.404	-4.014	-3.538	-2.586
	(2.708)	(2.620)	(2.569)	(2.693)	(2.606)	(2.556)
GDP pc ppp rec.	-5.159	-6.920*	-7.806**	-5.008	-6.585*	-7.425**
	(3.354)	(3.569)	(3.616)	(3.301)	(3.483)	(3.520)

GDP pc ppp don.	16.91	11.43	6.416	15.38	10.23	5.378
	(22.38)	(21.40)	(21.38)	(22.19)	(21.23)	(21.21)
IMR	-23.23***	-28.66***	-29.78***	-94.76***	-109.3***	-111.6***
	(5.928)	(6.941)	(6.760)	(24.02)	(26.45)	(25.54)
Intercept	7.277	41.46	62.31	57.82	94.70	115.1
	(77.43)	(72.94)	(74.19)	(75.26)	(71.34)	(72.68)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Donor FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster Donor - recipient	Yes	Yes	Yes	Yes	Yes	Yes
First stage	Probit	Probit	Probit	Cloglog	Cloglog	Cloglog
N	2339	2339	2339	2339	2339	2339
R^2	0.1206	0.1212	0.1465	0.1246	0.1261	0.1513

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01. Note: Independent and control variables are included in logarithms. Policy dummy variables are lagged one period.

Although significant, the IMR does not affect the level of significance of the independent variables in the analysis. Yet, it emphasizes the size and impact of some the main explanatory variables. The variables associated to the market of ODA in recipient countries, the imports of cobalt and rare earths and the policy variable -in particular auctions- playing the most important role in the decision of how much to invest in particular recipient countries. Yet a couple of minor changes can be observed in the second stage of this Heckman specifications. First, those donor countries with higher levels of energy exports, seems to provide lower amounts of ODA for renewable energy projects in recipient countries. Technological reasons, budgetary constraints and/or public support reasons may explain such results. On the one hand, donor countries specializing in fossil fuel technologies might be more interested in exporting those technologies rather than renewables. This strategy can also serve as a way to open up new markets for their fossil fuel technologies (Gallagher et al. 2012). On the other hand, in countries that are large producers of fossil fuels and therefore exporters, public opinion may be less favourable toward spending on renewable energy projects abroad in contexts of budgetary constraints and when domestic needs in the same area are perceived to be unmet (Stokes et al. 2015). Second, when considering possible selection biases and corrected with a Heckman model in two stages, the variables associated to the needs of recipients in terms of CO2 emissions and actual renewable energy deployment appear to be significant in the second stage. This result, masked by one-stage models, implies that while not relevant in the decision of selecting a particular country as an ODA recipient, variables associated to the environmental needs of recipients may play a positive role in the allocation decision, being those in more need the countries that will receive higher amounts of ODA. This result is aligned with Carfora et al. (2021) (See section 2), who confirms that the reception of ODA seems to be positively influenced by the environmental vulnerability of the recipient countries but negatively related to its social development[15].

We include a third robustness check using an instrumental variable approach. Given that results are consistent with the main regression, we include the estimations in the Appendix (See Box 2 and table A14 to A16 in the Appendix)

[15] The coefficient of the control variable GDPpc of the destination (the recipient country) is statistically significant and negative.

6. Discussion and Conclusions

Our research contributes to the current literature by introducing a new framework to study the allocation of aid for renewable energy projects, using a combination of social network analysis and panel data models. While previous studies have largely focused on donor-recipient dynamics, with the exception of Weiler and Kloeck (2021), our approach has incorporated an approximation to the idea of donor interactions, revealing them to be a significant factor in aid allocation for renewable energy projects decisions. This suggests that the allocation of ODA is influenced by a myriad of factors that go beyond altruism and into the realms of geo-political relationships, and strategic investments in future technologies.

Our analysis highlights some intriguing patterns in the allocation of Official Development Assistance (ODA) for renewable energy projects. Our results support the stream of the literature suggesting that countries of strategic importance for donors receive more ODA for renewable energy projects. Donor countries seem to be making strategic investments based on a range of factors—mostly influenced by their willingness to balance risks and influence on the ODA network of donor and recipients and by the geo-political advantages of stable trade partnerships of materials essential for the energy transition. Critical minerals have become an area of exceptional relevance for the energy transition. Our paper is one of the first in considering and showing that the access to those critical minerals is a pivotal driver for the reception of ODA for renewable energy projects in low- and middle-income recipients, in particular cobalt and rare earths whose trade and production seems to be concentrated in few countries whose political and regulatory stability may difficult a fast-paced energy transition. This confirms our hypotheses 2 and 3 and indicates that donor countries might be looking at a much broader canvas than just climate change mitigation when deciding their RE ODA allocation strategies. The access to and use of critical minerals should be considered early on and governments may want to plan ahead to avoid potential delays to the energy transition due to critical materials shortfalls and also avoid emerging geopolitical challenges related to critical materials supply as well as price increases caused by scarcity (Gielen, 2021). While governments and international organisations are warning about the importance of looking at the supply chains for these essential minerals, the pursuit of critical materials for the energy transition appears to be still an under-studied driver for ODA allocation.

Yet, our results add another layer of complexity to this interaction. The use of Social Network Analysis (SNA) and equivalent metrics reveals that the market structure, as an approximation of donor interactions, also play a significant role in renewable energy aid allocation. Our results show that strategic competition, as defined in Section 2, is a driving force behind many aid programs for renewable energy development in low- and middle-income countries. The level of participation i.e. the number of donors in recipient countries, plays a positive role in attracting ODA for renewable energy projects from donor countries. The indegree level of centrality of recipients is statistically significant and positive confirming that the larger the number of donors, the larger the amount of money allocated to a particular recipient.

However, this preference for recipient countries with a larger participation (presence of other donors), does not translate in a preference for fragmented markets. Indeed, the market share of the donor in the recipient country is positive and statistically significant i.e., the greater the power of the donor in relation to the total amount of ODA received by the recipient, the larger amount of money allocated to a particular recipient for the development of renewable energy projects.

How do we reconcile the preference for both i.e., the presence of other donor countries and the preference for higher market shares? A donor country prefers being in a position of power in the

network of the recipient, but at the same time they value the presence of other donors that can be beneficial to them for example in terms of additional trade links and/or risk sharing. Confirming our first hypotheses, this aligns with former research on strategic competition in other fields that suggest that collusion allows lead donors to secure greater strategic advantages than would be possible in a more competitive aid environment (Steinwand, 2015).

It is important to highlight the role of policy instruments, and in particular of financial incentives, in fostering the reception of mitigation ODA for renewable energy projects. A stable policy framework is essential, and policy is perceived as extremely relevant in the allocation stage. Donors will be more generous when the recipient countries have put in place favourable policy frameworks that secure a return on investment. Results are consistent across different estimations and robustness checks confirming the last hypotheses of this analysis i.e. that recipient countries with an established framework of national climate and environmental policies are more likely to receive bilateral ODA for the development of renewable energy projects. In particular, results support that auctions for renewable energy projects play a pivotal role in making recipient countries more attractive for ODA allocation. Policy is necessary but the focus need to be moved from carbon pricing to subsidies for deployment that seems more effective in promoting deployment of renewable energy projects. Financial incentives can mitigate the risks associated with renewable energy projects, thereby increasing the willingness of donor countries to invest in these sectors. Interestingly, when considering the possible double causal relationship between ODA reception and the establishment of policy instruments to foster the transition to low carbon economies, tax credits gain some statistical significance. Usually, tax credits are not established alone in developing countries but tend to be a part of an integrated policy approach aimed at encouraging renewable energy adoption, along with other mechanisms like feed-in tariffs or energy tenders. When donor countries see that their aid is part of a comprehensive policy package, they may be more likely to contribute. Further research is needed to explore the effect of policy mixes.

Interestingly, variables associated to the needs of the recipients happen to be only relevant when considering an estimation strategy in two steps, separating a selection stage from an allocation stage. This result is important as the particularities of countries do not seem to be relevant in order to select a particular country for the provision of RE ODA but plays a role in the decision of how much money to allocate to a particular recipient.

Although this study sheds light on the dynamics of ODA allocation for renewable energy projects, certain limitations persist. The use of OECD-CRS data, while extensive, may not capture all nuances of the aid landscape, such as smaller donor-recipient relationships or non-traditional aid sources. Also, an importantly, our study does not fully capture the role of China as a donor. This opens a critical area of further research. The integration with local economies is another area that will require further exploration. How well do these renewable energy projects integrate with the local economies, and what is the role of ODA in facilitating this integration? Does ODA help create local job opportunities, transfer technical knowledge, and build local capacities for long-term sustainability? Also, given the relevance of strategic ODA provision decisions, attention must be paid to try to avoid negative environmental impacts associated to the massive extraction of critical materials in recipient countries. In that sense strengthen environmental, social and governance standards might be a good strategy to avoid the future concentration of donors in those countries. This is another area that will deserve further attention in the future.

Our study calls for a multi-dimensional approach to understanding aid dynamics, one that takes into account not just the needs of recipients but mostly the strategic considerations of donors. By doing so, policy makers can progress in their environmental, climate and development goals and create a more effective, efficient, and equitable framework for global aid. The transition to

renewable energy economies is critical, not just for climate change mitigation but also for fostering sustainable development. Yet, all in all, following the conclusion by McGillivray (2003) for ODA with general purposes, our results confirm that for mitigation aid, ODA provision is still motivated largely by economic and political interests. Our results prove relevant in the context of an increasing need for energy resources in both donors and recipient countries. In this context, cooperation will be essential among donor countries. The development of stable relationships not only between donors and recipients, but also among donors, might be crucial in the decision to donate aid for renewable energy projects. In that front, strengthen diplomatic connections might be a way to increase the probability of receiving mitigation aid for those types of projects.

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Appendix

Table A1. Summary of literature analysing the determinants of mitigation and adaptions aid

Paper	Methodology	Objective and variables studied	Time	N. Donors	N. Recipients
Carfora et al. (2021)	Dynamic panel regressions using System GMM estimator	Renewable energy generation, vulnerability index, social development, and the impact on ODA distribution	1995-2015	Multiple (n.a)	85
Klöck, et al. (2018)	Random effect regression models	Responsibility, capacity, greenness, and vulnerability of donors	2011-2015	23	143
Peterson and Skovgaard (2019)	Multiple regression analysis	Ministry involvement in policy processes, allocation of climate finance, donor and recipient country characteristics	2007-2015	11	Multiple (n.a)
Bayramoglu et al. (2023)	Fixed effects and IV-2SLS	Bilateral trade impacts on climate aid, terms of trade, income effects of climate aid	2002-2017	Multiple (n.a)	Multiple (n.a)
Halimanjaya (2015)	Two part model (Logit and OLS)	CO2 intensity, carbon sinks, governance, GDP per capita, and poverty aid allocation as variables influencing the inflow of mitigation finance	1998-2010	Multiple (n.a)	180
Halimanjaya (2016)	Two part model (Logit and OLS)	CO2 emissions, carbon sinks, governance, GDP per capita as determinants of mitigation finance allocation	1998-2010	5 (Japan, Germany, France, Norway, USA)	180
Weiler and Klöck (2021)	Bipartite Temporal Exponential Random Graph Models (TERGMs)	Donor-donor interactions, adaptation aid allocation, network ties	2010-2016	31	130

Source: Own elaboration based on review of literature

Table A2. Variables and data sources

Variables	Description	Source
$REODAd_{ijt}$	1=yes 0=no	OECD-CRS
$REODA_{ijt}$	Million $2017 c.	OECD-CRS
$Centrality_{it}$	See section 3.3	Own calculation based on SNA with OECD-CRS data
HHI_{it}	See section 3.3	
Market $share_{ijt}$	See section 3.3	
Lithium production $rec._{it}$	Metric tonnes	US Geological survey
Lithium $imports_{ijt}$	Kg	Comtrade
Rare earths production rec.it	Metric tonnes	US Geological survey
Rare earths $imports_{ijt}$	Kg	Comtrade
Cobalt production $rec._{it}$	Metric tonnes	US Geological survey
Cobalt $imports_{ijt}$	Kg	Comtrade
Energy $imports_{ijt}$	US$ curr.	Comtrade
Energy $exports_{ijt}$	US$ curr.	Comtrade
$FITs_{it}$	1=yes 0=no	REN21
$Auctions_{it}$	1=yes 0=no	
Tax $credits_{it}$	1=yes 0=no	
Carbon tax_{it}	1=yes 0=no	
Vulnerability $rec._{it}$	ND-GAIN index.	University of Notre-Dame (Notre Dame Global Adaptation Initiative)
CO2pc $rec._{it}$	Production-based emissions CO_2 (Kg/kWh) of primary energy consumption.	Our World in data
RE% elec. $Rec._{it}$	% RE generation in electricity mix	IRENA
Multilateral ODA $rec._{it}$	Million $2017 c.	OECD-CRS
Access electricity $rec._{it}$	%	World Bank
Colonial $link_{ijt}$	1=yes 0=no	CEPII
Political $stability_{it}$	Index WRI	World Governance Indicators
Regulatory $quality_{it}$	Index WRI	
GDP $pcppp\ don._{jt}$	Thousand $ per capita ppp	CEPII
GDP$pcppp\ rec._{it}$	Thousand $ per capita ppp	
Coal phase out target $rec._{it}$	1=yes 0=no	Our World in data
Capitals $Dist._{ijt}$	Km	CEPII
$GATT_{it}$	1=yes 0=no	
RTA_{ijt}	1=yes 0=no	

Box 1 Definition of the foreign development aid network for renewable energy projects

Climate-related development aid for renewable energy projects

This study uses the OECD Development Aid Committee (DAC) data at the country level collapsed to the triadic donor-recipient-year level[1]. We use the Rio Markers to filter for our dependent variable represented by the bilateral development aid from donor countries directed to energy generation with renewable sources i.e., biofuels, geothermal, hydro-electric, marine, solar for centralised grids and wind energy. The objective of the CRS Aid Activity database is to "provide a set of readily available basic data that enables analysis on where aid goes, what purposes it serves and what policies it aims to implement, on a comparable basis for all DAC members". The data reported by bilateral donors for climate-related finance includes 29 members of the OECD's Development Assistance Committee (DAC) plus the European Commission. The OECD data have been repeatedly criticised (Kono and Montinola, 2019) because it relies exclusively on donors own reporting. Several studies have found donors to over report and mislabelled projects (Michaelowa and Michaelowa, 2011; Weikmans and Robert, 2019; Carty et al. 2020). However, there is at present simply no more comprehensive database on ODA (Weiler and Klock, 2021).

Following previous research in development aid (Betzold and Weiler 2017; Weiler et al. 2018; Peterson and Skovgaard 2019), we use data on commitments i.e. the full amount of expected transfer, irrespective of the time required for the completion of disbursements; as it shows better the donor goals. Following authors like Betzold and Weiler (2017) or Horowitz (2021), among others, we consider both, flows coded as "principal" and as "significant", according to the OECD-DAC database, for this research. OECD-DAC data codes a project as "principal" when the declared fundamental motivation of the project and funding is the development or promotion of energy generation with renewable energy. A project will be declared as "significant" when the promotion of energy generation with renewable energy is an important part of the rationale for the funding but not the main one (OECD, 2021).

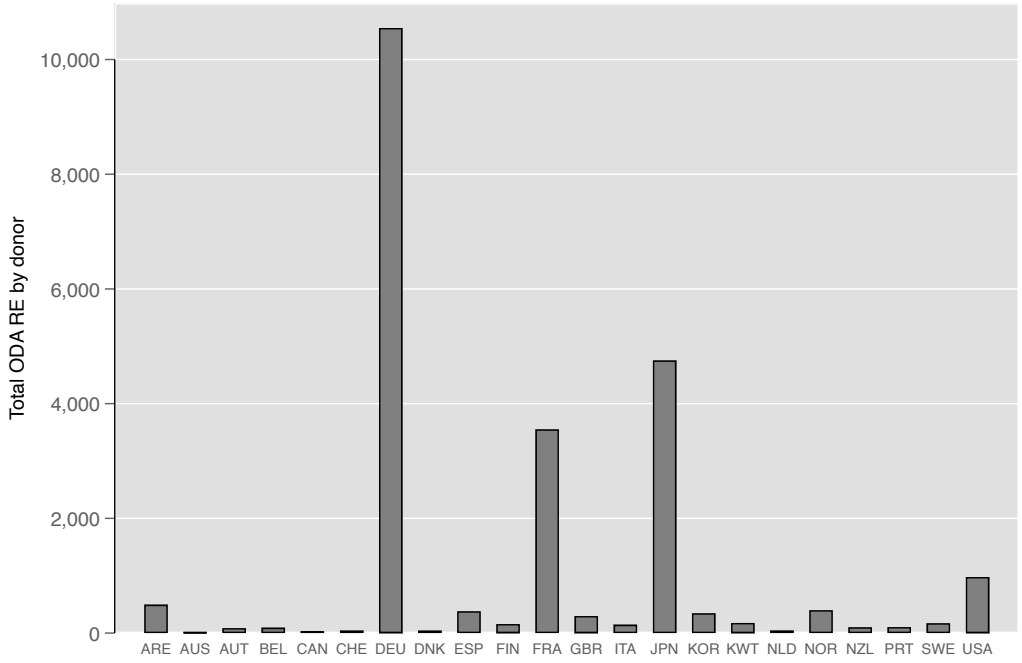
Table A3. Summary of donor counts and top 5 donor countries 2009-2018

Year	Number of donors	Total aid for renewable energy (USD M 2019)	Top 5 donor countries
2009	21	1,097	Germany, Spain, Japan, France, Norway
2010	24	3,113	Japan, Germany, France, Spain, Kuwait
2011	24	2,328	Germany, Japan, United States, Norway, France
2012	25	2,020	Germany, France, Norway, United Arab Emirates, Japan
2013	29	2,389	Germany, Japan, France, United Arab Emirates, Norway
2014	27	3,891	Germany, Japan, France, United Arab Emirates, New Zealand
2015	24	2,380	Germany, France, United States, Japan, Korea
2016	31	2,688	Germany, Japan, France, United States, Saudi Arabia
2017	27	3,760	Japan, France, Germany, United States, Italy
2018	30	3,473	Germany, Japan, France, United Kingdom, Norway

Source: Own elaboration with data from OECD-CRS.

Table A3 shows that on average, the number of donors has increased slightly over the years from 21 in 2009 to 30 in 2018. Total amount of aid for projects whose goal is to develop and increase the generation of energy from renewable sources has increased from USD $1.1bn in 2009 to USD $3.5bn in 2018. Germany, Japan and France are consistently among the top five donor countries in the past ten years by total amount of aid committed. In fact, the top five donor countries represent about 87%-94% of total development aid provided for this purpose over the decade. The average aid committed is around USD $10m while the median is around USD $1m, showing an important level of skewness on some of the bigger aid commitments (see Fig. A1).

Fig. A1. Evolution in RE ODA by donor (2009-2018). Mill $ c.2019



Source: own elaboration with data from OECD-CRS

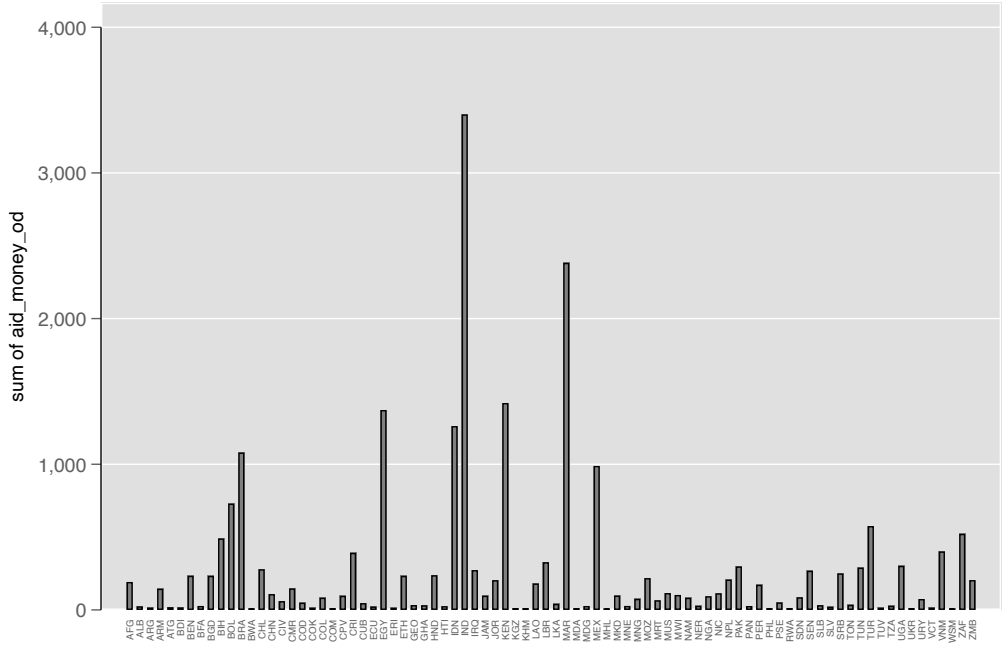
This aid flows into recipient countries to support local efforts for renewable energy projects. Table A4 and Fig. A2. show that aid is distributed to around 96-115 countries over the decade. Unlike the donor countries which are rather stable, the top five recipients change considerably from year to year.

Table A4. Summary of recipient counts and top 5 recipients 2009-2018

Year	Number of recipients	Top 5 recipient countries by volume of aid received
2009	96	Brazil, Tunisia, Morocco, Ethiopia, Chile
2010	97	Egypt, Kenya, Iraq, Tunisia, India
2011	101	India, Indonesia, Kenya, Zambia, Bosnia and Herzegovina
2012	98	Morocco, Mexico, India, Cameroon, Brazil
2013	108	South Africa, Turkey, Nepal, Egypt, Bangladesh
2014	106	Morocco, India, Brazil, Viet Nam, Turkey
2015	112	India, Indonesia, Liberia, Mexico, Honduras
2016	115	Kenya, Mexico, Morocco, Senegal, India
2017	112	Bolivia, Egypt, Brazil, Costa Rica, Benin
2018	100	India, Morocco, Indonesia, Mexico, Kenya

Source: Own elaboration with data from OECD-CRS.

Fig. A2. Evolution in ODA renewable energy projects by recipient (2009-2018). Mill $ c.2019



Source: Own elaboration with data from OECD-CRS

Bipartite Network representation

A network is defined as a collection of nodes and edges that connect the nodes. Each edge may also be weighted or unweighted. In the first case, the edge would indicate the strength of the association between two nodes. In the second, the link will only indicate the existence of the association (Yang et al. 2016). SNA has been used prolifically in fields like finance e.g. to identify relevant interlinkages between currencies or firms (see Mizuno et al., 2006; Anugerah et al. 2022 as examples); or to analyse relationships between different types of entities, e.g. sustainable development goals (Swain and Ranganathan, 2021) among others. As scholars are trying to understand more precisely the complex relationships between countries (nodes) in regards to the provision of development aid, network analysis is becoming a methodology that is growing in attention (Johnson and Chew, 2021, Weiler and Kloeck, 2021).

For the purpose of this analysis, countries i.e. either donors or recipients of climate-related development aid for renewable energy projects, are treated as nodes in the network. The flow of climate development aid between countries are modelled as edges in the network. For our purposes, there are two distinct sets of nodes i.e. donors and recipients and it is relevant to note the following assumptions: a) donors only donate to recipients and not among themselves; b) recipients only receive aid from donors and not from other recipients. In this context, if a country donates climate development aid for renewable energy projects to a recipient country, an edge exists between these two countries in the network.

In network science, this is considered a bipartite graph (Wilson, 1982). A graph is bipartite if the edges can be partitioned in exactly two mutually exclusive sets such that there are no ties entirely in each set. For example, only donors giving aid to recipients; only sellers selling things to buyers; and only authors producing papers etc. As in other papers that studied more generally development aid (e.g. Han et al. 2018); network analysis is used in this study because: (a) it provides a clean visualization and conceptualization of interlinkages between countries; (b) it allows us to use well-developed notions such as centrality that can be transferred easily to the domain of policy-maker.

Table A5. HS codes critical minerals included

HS Codes	Commodities
260500	Cobalt ores and concentrates
280530	Rare earths metals, scandium and yttrium whether or not intermixed or interalloyed
282200	Cobalt oxides and hydroxides, and commercial cobal oxides
282520	Lithium oxide and hydroxide
283691	Lithium carbonate
284690	Compounds, inorganic or organic, of rare-earth metals, of yttrium or of scandium or of mixtures of these metals (excl. cerium)
810520	Cobalt mattes and other intermediate products of cobalt metallurgy; unwrought cobalt; cobalt powders
810530	Cobalt waste and scrap (excl. ash and residues containing cobalt)
810590	Other cobalt products

Table A3. HS code energy trade

HS Codes	Fuel Commodities
2701	Coal; briquettes, ovoids and similar solid fuels manufactured from coal
2702	Lignite, whether or not agglomerated, excluding jet
2703	Peat (including peat litter), whether or not agglomerated
2704	Coke and semi-coke of coal, of lignite or of peat, whether or not agglomerated; retort carbon
2705	Coal gas, water gas, producer gas and similar gases, other than petroleum gases and other gaseous hydrocarbons
2706	Tar distilled from coal, from lignite or from peat, and other mineral tars, whether or not dehydrated or partially distilled, including reconstituted tars
2707	Oils and other products of the distillation of high-temperature coal tar; similar products in which the weight of the aromatic constituents exceeds that of the non-aromatic constituents
2708	Pitch and pitch coke, obtained from coal tar or from other mineral tars
2709	Petroleum oils and oils obtained from bituminous minerals, crude
2710	Petroleum oils and oils obtained from bituminous minerals, other than crude; preparations not elsewhere specified or included, containing by weight 70% or more of petroleum oils or of oils obtained from bituminous minerals, these oils being the basic constituents of the preparations; waste oils
2711	Petroleum gases and other gaseous hydrocarbons
2712	Petroleum jelly; paraffin wax, microcrystalline petroleum wax, slack wax, ozokerite, lignite wax, peat wax, other mineral waxes, and similar products obtained by synthesis or by other processes, whether or not coloured
2713	Petroleum coke, petroleum bitumen and other residues of petroleum oils or of oils obtained from bituminous minerals
2714	Bitumen and asphalt, natural; bituminous or oil shale and tar sands; asphaltites and asphaltic rocks
2715	Bituminous mixtures based on natural asphalt, on natural bitumen, on petroleum bitumen, on mineral tar or on mineral tar pitch (for example, bituminous mastics, cutbacks)
2716	Electrical energy (electricity)

Fig. A3. Correlation matrix

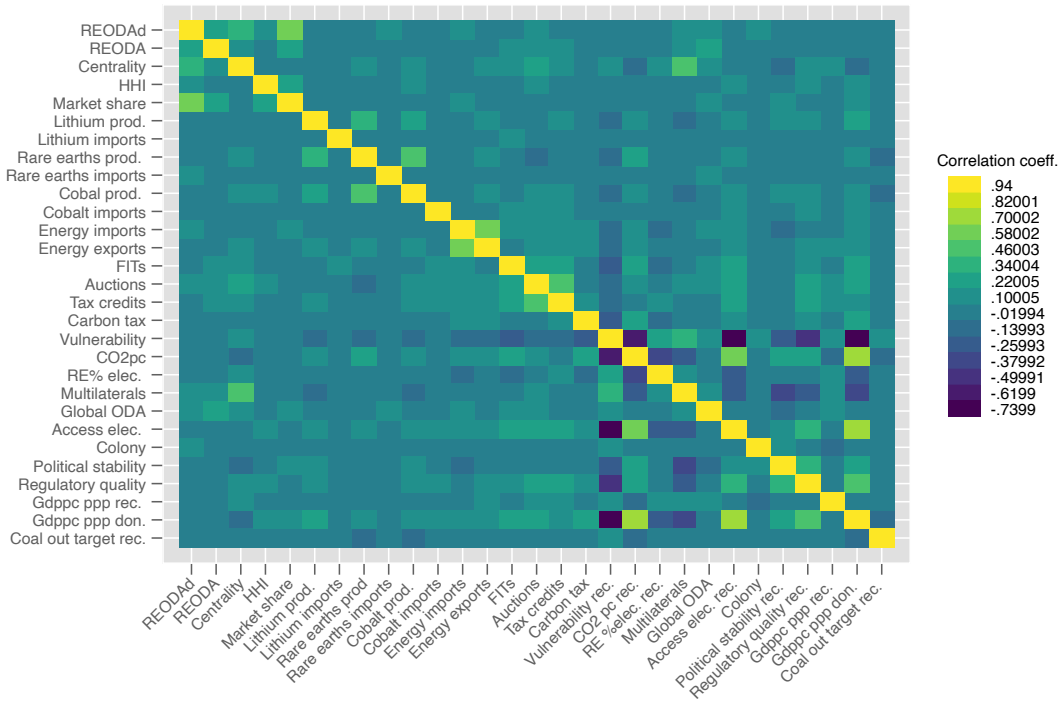


Table A4 Baseline PPMLHDFE regression – all coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.023***	1.303***	1.160***	1.152***	1.144***					
	(0.185)	(0.154)	(0.247)	(0.244)	(0.233)					
HHI						0.301	0.123	0.389	0.405	0.422
						(0.230)	(0.208)	(0.293)	(0.290)	(0.274)
Lithium imports	0.0708	-0.0329	0.106*	-0.00817	0.0174	0.0817	-0.0137	0.101*	-0.0188	-0.00574
	(0.0586)	(0.0515)	(0.0587)	(0.0478)	(0.0468)	(0.0601)	(0.0558)	(0.0588)	(0.0483)	(0.0502)
Rare earths imports	0.159***	0.0439	0.196***	0.0355	0.0396	0.162***	0.0624**	0.193***	0.0347	0.0398
	(0.0411)	(0.0349)	(0.0392)	(0.0360)	(0.0349)	(0.0398)	(0.0317)	(0.0395)	(0.0335)	(0.0330)
Cobalt imports	0.124***	0.0768**	0.141***	0.0587*	0.0721**	0.134***	0.101***	0.133***	0.0538	0.0653*
	(0.0379)	(0.0303)	(0.0388)	(0.0321)	(0.0347)	(0.0376)	(0.0300)	(0.0390)	(0.0333)	(0.0357)
Energy exports	-0.0422	-0.0217	-0.0426	-0.0207	-0.0215	-0.0341	-0.00551	-0.0435	-0.0197	-0.0149
	(0.0343)	(0.0304)	(0.0359)	(0.0321)	(0.0343)	(0.0343)	(0.0340)	(0.0350)	(0.0306)	(0.0339)
Energy imports	0.0592**	0.0136	0.0833***	0.0190	0.0192	0.0604**	0.0108	0.0848***	0.0192	0.0135
	(0.0257)	(0.0259)	(0.0272)	(0.0309)	(0.0326)	(0.0255)	(0.0255)	(0.0272)	(0.0297)	(0.0327)
Auction rec.	0.853***	0.896***	0.727**	0.700**	0.645**	1.092***	1.201***	0.663**	0.623**	0.561*
	(0.321)	(0.266)	(0.325)	(0.323)	(0.322)	(0.346)	(0.297)	(0.310)	(0.307)	(0.309)
FIT rec.	0.232	0.322	0.157	0.0975	0.0939	0.535*	0.652***	0.236	0.183	0.201
	(0.311)	(0.225)	(0.334)	(0.335)	(0.326)	(0.312)	(0.236)	(0.347)	(0.342)	(0.330)
Carbon tax rec.	0.0899	0.137	0.874	0.599	0.510	0.760	0.862	1.262	1.011	0.959
	(0.934)	(0.801)	(0.783)	(0.777)	(0.908)	(0.851)	(0.749)	(0.831)	(0.817)	(0.932)
Tax credits rec.	-0.367	-0.219	0.124	0.162	0.169	-0.364	-0.257	0.0797	0.125	0.122
	(0.230)	(0.181)	(0.502)	(0.479)	(0.466)	(0.229)	(0.186)	(0.561)	(0.551)	(0.529)
CO2 pc rec.	0.294	0.560***	-0.498	-0.479	-0.419	0.491*	0.733***	0.0898	0.101	0.105
	(0.276)	(0.206)	(0.454)	(0.450)	(0.452)	(0.251)	(0.201)	(0.432)	(0.439)	(0.432)
% RE rec.	0.209	0.284**	0.237	0.192	0.221	0.313**	0.388***	0.294	0.242	0.279
	(0.150)	(0.113)	(0.191)	(0.185)	(0.197)	(0.139)	(0.106)	(0.182)	(0.179)	(0.192)
Vulnerability rec.	-1.715	-0.0483	1.108	1.964	1.301	-0.0964	1.456	-3.884	-3.696	-3.138
	(2.274)	(1.306)	(12.93)	(12.46)	(12.91)	(2.231)	(1.576)	(12.41)	(11.83)	(12.29)
Reg. quality rec.	0.228	0.162	0.340	0.339	0.348	0.380**	0.334**	0.314	0.318	0.339
	(0.152)	(0.0990)	(0.209)	(0.217)	(0.213)	(0.181)	(0.142)	(0.219)	(0.228)	(0.230)
Political stability rec.	0.0708	0.0460	-0.0997	-0.109	-0.124	0.103	0.112	-0.155	-0.163*	-0.180*
	(0.0899)	(0.0890)	(0.111)	(0.104)	(0.107)	(0.106)	(0.115)	(0.0958)	(0.0937)	(0.0987)
Colony	-0.205	0.158	-0.357	0.381	0.329	-0.338	-0.259	-0.374	0.349	0.306
	(0.277)	(0.305)	(0.322)	(0.351)	(0.367)	(0.266)	(0.310)	(0.323)	(0.351)	(0.373)
RTA	0.515*	0.248	0.495	-0.0175	0.0539	0.494*	0.233	0.462	-0.0630	0.0372
	(0.301)	(0.211)	(0.455)	(0.263)	(0.275)	(0.285)	(0.208)	(0.456)	(0.262)	(0.280)
GATT	0.507	0.903***	-1.020**	-2.979**	-3.128**	0.626	1.065**	-0.976**	-2.946**	-2.875**
	(0.349)	(0.319)	(0.510)	(1.335)	(1.505)	(0.393)	(0.424)	(0.486)	(1.324)	(1.381)
Dist.	-0.0887	-0.568***	0.241	-0.706***	-0.707***	-0.115	-0.612**	0.213	-0.723***	-0.681***

	(0.240)	(0.212)	(0.311)	(0.257)	(0.262)	(0.249)	(0.270)	(0.305)	(0.250)	(0.254)
GDP pc ppp rec.	-0.639	-0.545*	-0.917	-0.813	-0.796	-0.858**	-0.841***	-0.951	-0.791	-0.576
	(0.484)	(0.324)	(1.026)	(0.988)	(1.077)	(0.432)	(0.316)	(0.898)	(0.856)	(0.883)
GDP pc ppp don.	0.545	3.331	0.809*	3.132	0	0.662	3.128	0.810*	3.087	0
	(0.415)	(2.852)	(0.472)	(2.842)	(.)	(0.417)	(2.841)	(0.475)	(2.850)	(.)
Intercept	-2.621	-7.341	-2.447	0.779	12.45	0.0420	-3.084	-4.314	-1.642	9.897
	(2.518)	(10.79)	(11.68)	(15.41)	(11.19)	(2.399)	(10.55)	(11.13)	(14.78)	(10.62)
Year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes			Yes		Yes	
Recipient FE			Yes	Yes	Yes			Yes	Yes	Yes
Year-Donor FE					Yes					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8374	8374	8330	8330	7868	7367	7367	7365	7365	6963
pseudo R^2	0.213	0.440	0.309	0.520	0.559	0.167	0.388	0.281	0.500	0.540
AIC	135120.2	96048.2	118415.0	82242.2	74264.3	138040.4	101498.8	119169.2	82876.9	75009.9
BIC	135275.0	96203.0	118569.6	82396.8	74410.7	138192.4	101650.7	119321.1	83028.8	75153.7
Wald Test (chi2)	166.4 (0.000)	349.7 (0.000)	92.75 (0.000)	73.56 (0.000)	76.12 (0.000)	167.2 (0.000)	218.1 (0.000)	106.8 (0.000)	57.51 (0.000)	56.38 (0.000)

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01
Note: Independent and control variables are included in logarithms. Policy dummy variables are lagged one period.

Table A4 (cont.) Baseline PPMLHDFE regression – Coefficients

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.223***	0.276***	0.296***	0.416***	0.447***
	(0.0331)	(0.0473)	(0.0400)	(0.0539)	(0.0593)
Lithium imports	0.0899	0.00255	0.138**	0.0361	0.0657
	(0.0619)	(0.0614)	(0.0615)	(0.0502)	(0.0512)
Rare earths imports	0.172***	0.0758**	0.206***	0.0397	0.0410
	(0.0397)	(0.0336)	(0.0371)	(0.0342)	(0.0342)
Cobalt imports	0.143***	0.102***	0.146***	0.0490*	0.0637**
	(0.0385)	(0.0328)	(0.0381)	(0.0294)	(0.0309)
Energy exports	-0.0318	0.00954	-0.0489	-0.00258	0.00585
	(0.0339)	(0.0346)	(0.0315)	(0.0262)	(0.0282)
Energy imports	0.0639**	0.00822	0.0919***	0.00893	-0.000448
	(0.0256)	(0.0252)	(0.0263)	(0.0288)	(0.0313)
Auction rec.	1.182***	1.355***	0.636**	0.599**	0.524*
	(0.362)	(0.320)	(0.313)	(0.299)	(0.298)
FIT rec.	0.593*	0.691***	0.231	0.0404	0.0620
	(0.314)	(0.246)	(0.370)	(0.297)	(0.291)
Carbon tax rec.	0.474	0.260	1.030	0.673	0.600
	(0.848)	(0.867)	(0.766)	(0.727)	(0.877)
Tax credits rec.	-0.364	-0.302	0.00919	0.0464	0.0164
	(0.240)	(0.213)	(0.631)	(0.541)	(0.516)
CO2 pc rec.	0.425*	0.637***	0.0236	-0.0446	-0.0263
	(0.224)	(0.188)	(0.423)	(0.443)	(0.461)
% RE rec.	0.297**	0.338***	0.283	0.166	0.214
	(0.121)	(0.0921)	(0.185)	(0.185)	(0.187)
Vulnerability rec.	-0.202	1.224	-0.656	0.827	-1.819
	(2.306)	(1.735)	(13.11)	(10.42)	(10.17)
Reg. quality rec.	0.406**	0.378**	0.336	0.330	0.355
	(0.198)	(0.166)	(0.241)	(0.237)	(0.241)
Political stability rec.	0.136	0.188	-0.184*	-0.162*	-0.174*
	(0.113)	(0.129)	(0.102)	(0.0940)	(0.0987)
Colony	-0.283	-0.381	-0.139	0.480	0.455
	(0.266)	(0.320)	(0.309)	(0.337)	(0.344)
RTA	0.496*	0.275	0.481	-0.00469	0.0590
	(0.277)	(0.208)	(0.497)	(0.265)	(0.285)
GATT	0.642	1.091**	-1.004**	-2.942**	-3.062**
	(0.395)	(0.462)	(0.462)	(1.364)	(1.307)
Dist.	-0.108	-0.555*	0.173	-0.695***	-0.701***
	(0.270)	(0.312)	(0.333)	(0.237)	(0.239)
GDP pc ppp rec.	-0.811**	-0.840***	-0.856	-0.540	-0.667
	(0.396)	(0.294)	(0.885)	(0.859)	(0.824)
GDP pc ppp don.	0.653	3.498	0.692	3.372	0
	(0.407)	(2.854)	(0.479)	(2.756)	(.)
Intercept	-0.328	-5.390	-1.142	0.157	11.56
	(2.325)	(10.63)	(11.81)	(13.63)	(8.681)
Year FE	Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes	
Recipient FE			Yes	Yes	Yes
Year-Donor FE					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes
N	8374	8374	8330	8330	7868
pseudo R^2	0.193	0.397	0.322	0.543	0.585
AIC	138573.8	103468.3	116263.6	78295.3	69980.1
BIC	138728.5	103623.0	116418.2	78450.0	70126.5
Wald test (chi2)	147.2 (0.000)	231.4 (0.000)	172.1 (0.000)	131.9 (0.000)	124.9 (0.000)

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Table A5. Baseline PPMLHDFE regression without control variables- Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.081***	1.350***	1.159***	1.151***	1.143***					
	(0.168)	(0.154)	(0.228)	(0.226)	(0.215)					
HHI						0.0484	-0.159	0.411	0.425	0.434
						(0.260)	(0.228)	(0.278)	(0.274)	(0.265)
Lithium imports	0.0648	-0.0170	0.0888	-0.00792	0.0172	0.0696	-0.0254	0.0857	-0.0182	-0.00291
	(0.0574)	(0.0472)	(0.0585)	(0.0456)	(0.0434)	(0.0598)	(0.0609)	(0.0584)	(0.0464)	(0.0467)
Rare earths imports	0.165***	0.0664**	0.188***	0.0469	0.0506	0.165***	0.0774***	0.185***	0.0450	0.0516
	(0.0379)	(0.0311)	(0.0370)	(0.0343)	(0.0326)	(0.0356)	(0.0299)	(0.0371)	(0.0330)	(0.0318)
Cobalt imports	0.126***	0.0866***	0.131***	0.0604*	0.0736**	0.131***	0.104***	0.123***	0.0530	0.0654*
	(0.0354)	(0.0303)	(0.0379)	(0.0332)	(0.0359)	(0.0343)	(0.0309)	(0.0387)	(0.0348)	(0.0371)
Energy exports	-0.0295	0.0136	-0.0438	-0.0000986	-0.00282	-0.0292	0.0190	-0.0441	0.000448	0.00201
	(0.0268)	(0.0236)	(0.0324)	(0.0305)	(0.0341)	(0.0261)	(0.0244)	(0.0320)	(0.0292)	(0.0332)
Energy imports	0.0532**	0.00472	0.0745***	0.0273	0.0320	0.0539**	0.00399	0.0760***	0.0273	0.0263
	(0.0241)	(0.0211)	(0.0265)	(0.0276)	(0.0304)	(0.0230)	(0.0223)	(0.0263)	(0.0264)	(0.0300)
Auction rec.	0.966***	0.979***	0.649**	0.657**	0.596*	0.984***	1.025***	0.610*	0.609**	0.537*
	(0.361)	(0.328)	(0.317)	(0.311)	(0.307)	(0.361)	(0.332)	(0.311)	(0.304)	(0.307)
FIT rec.	0.193	0.326	0.181	0.133	0.115	0.444	0.566**	0.239	0.194	0.201
	(0.324)	(0.232)	(0.317)	(0.317)	(0.312)	(0.308)	(0.236)	(0.345)	(0.342)	(0.336)
Carbon tax rec.	0.252	0.334	0.849	0.586	0.519	0.426	0.449	1.085	0.846	0.795
	(0.778)	(0.686)	(0.778)	(0.821)	(0.890)	(0.769)	(0.651)	(0.829)	(0.856)	(0.930)
Tax credits rec.	-0.469	-0.358	0.153	0.163	0.142	-0.195	-0.121	0.132	0.156	0.120
	(0.319)	(0.253)	(0.499)	(0.489)	(0.460)	(0.307)	(0.262)	(0.539)	(0.539)	(0.506)
Intercept	-1.107***	-0.507**	-0.965	0.207	0.386	0.178	0.954***	0.879*	2.051***	2.241***
	(0.275)	(0.245)	(0.622)	(0.535)	(0.518)	(0.245)	(0.225)	(0.465)	(0.399)	(0.399)
N	9306	9306	9270	9270	8756	8044	8044	8040	8040	7596
pseudo R^2	0.199	0.412	0.306	0.510	0.549	0.137	0.337	0.276	0.488	0.528
AIC	142061.2	104328.8	122970.9	86910.3	78603.9	147122.9	112975.3	123515.2	87381.2	79135.2
BIC	142139.8	104407.3	123049.3	86988.8	78681.8	147199.9	113052.3	123592.1	87458.2	79211.5
chi2	149.0	265.9	89.81	41.01	44.90	107.9	98.80	67.31	22.47	18.54
Year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes			Yes		Yes	
Recipient FE			Yes	Yes	Yes			Yes	Yes	Yes
Year-Donor FE					Yes					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses* p<.10, ** p<.05, *** p<.01

Table A5 (cont). Baseline PPMLHDFE regression without control variables- Coefficients

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.191***	0.198***	0.298***	0.406***	0.432***
	(0.0298)	(0.0380)	(0.0398)	(0.0532)	(0.0573)
Lithium imports	0.0775	-0.0172	0.124**	0.0418	0.0696
	(0.0614)	(0.0652)	(0.0631)	(0.0471)	(0.0468)
Rare earths imports	0.173***	0.0893***	0.201***	0.0515	0.0545*
	(0.0347)	(0.0303)	(0.0364)	(0.0317)	(0.0318)
Cobalt imports	0.138***	0.105***	0.137***	0.0527*	0.0692**
	(0.0343)	(0.0328)	(0.0364)	(0.0297)	(0.0305)
Energy exports	-0.0276	0.0218	-0.0482*	0.0151	0.0203
	(0.0265)	(0.0253)	(0.0288)	(0.0249)	(0.0279)
Energy imports	0.0563**	0.00691	0.0854***	0.0171	0.0130
	(0.0233)	(0.0224)	(0.0264)	(0.0253)	(0.0283)
Auction rec.	1.104***	1.197***	0.576*	0.569*	0.491*
	(0.373)	(0.350)	(0.312)	(0.294)	(0.299)
FIT rec.	0.475	0.559**	0.241	0.109	0.0870
	(0.318)	(0.247)	(0.355)	(0.276)	(0.285)
Carbon tax rec.	0.228	-0.0211	0.902	0.544	0.458
	(0.767)	(0.730)	(0.759)	(0.758)	(0.868)
Tax credits rec.	-0.139	-0.0818	0.0491	0.0772	-0.0133
	(0.330)	(0.293)	(0.604)	(0.527)	(0.496)
Intercept	0.0412	0.829***	0.871**	2.194***	2.422***
	(0.217)	(0.213)	(0.436)	(0.322)	(0.331)
N	9306	9306	9270	9270	8756
pseudo R^2	0.159	0.339	0.319	0.529	0.571
AIC	149125.3	117171.5	120747.5	83385.9	74755.2
BIC	149203.8	117250.0	120826.0	83464.4	74833.0
chi2	123.7	123.6	146.9	100.4	100.2
Year FE	Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes	
Recipient FE			Yes	Yes	Yes
Year-Donor FE					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses* p<.10, ** p<.05, *** p<.01

Table A6. Baseline PPMLHDFE regression – Coefficients with production

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.063***	1.314***	1.108***	1.132***	1.112***					
	(0.180)	(0.165)	(0.238)	(0.241)	(0.223)					
HHI						0.314	0.151	0.403	0.400	0.420
						(0.214)	(0.209)	(0.291)	(0.297)	(0.282)
Lithium prod	-0.0604	-0.0433	0.0932*	0.0976*	0.101**	-0.0522	-0.0387	0.136**	0.137**	0.143***
	(0.0600)	(0.0384)	(0.0530)	(0.0512)	(0.0400)	(0.0596)	(0.0419)	(0.0591)	(0.0565)	(0.0458)
Rare earths prod	0.0524	0.0695	0.131	0.132	0.139	0.0865	0.114**	0.158	0.159*	0.164*
	(0.0706)	(0.0445)	(0.102)	(0.0990)	(0.0955)	(0.0687)	(0.0491)	(0.0962)	(0.0940)	(0.0913)
Cobalt prod	-0.0220	-0.0163	-0.177**	-0.171**	-0.174***	-0.00228	0.0149	-0.165***	-0.158***	-0.168***
	(0.0414)	(0.0240)	(0.0695)	(0.0699)	(0.0624)	(0.0481)	(0.0307)	(0.0607)	(0.0612)	(0.0557)
Energy exports	-0.0413	-0.0149	-0.0516	-0.0138	-0.0177	-0.0377	-0.00559	-0.0533*	-0.0135	-0.0110
	(0.0326)	(0.0319)	(0.0324)	(0.0317)	(0.0329)	(0.0346)	(0.0376)	(0.0322)	(0.0302)	(0.0326)
Energy imports	0.0685***	0.00924	0.0944***	0.0160	0.0212	0.0708***	0.00821	0.0975***	0.0158	0.0156
	(0.0231)	(0.0254)	(0.0263)	(0.0302)	(0.0321)	(0.0237)	(0.0262)	(0.0263)	(0.0290)	(0.0325)
Auction rec.	0.892***	0.947***	0.795**	0.786**	0.753**	1.110***	1.212***	0.711**	0.686**	0.646**
	(0.322)	(0.267)	(0.312)	(0.318)	(0.320)	(0.324)	(0.277)	(0.293)	(0.297)	(0.298)
FIT rec.	0.379	0.320	0.123	0.0830	0.0816	0.711**	0.684***	0.174	0.133	0.148
	(0.306)	(0.217)	(0.330)	(0.337)	(0.320)	(0.322)	(0.247)	(0.337)	(0.341)	(0.322)
Carbon tax rec.	0.00164	0.114	0.930	1.006	0.897	0.684	0.860	1.339	1.410*	1.358
	(0.811)	(0.749)	(0.820)	(0.785)	(0.858)	(0.751)	(0.658)	(0.837)	(0.806)	(0.860)
Tax credits rec.	-0.271	-0.192	0.202	0.252	0.257	-0.352	-0.269	0.163	0.218	0.218
	(0.242)	(0.197)	(0.485)	(0.471)	(0.459)	(0.252)	(0.217)	(0.555)	(0.545)	(0.523)
CO2 pc rec.	0.311	0.416*	-0.584	-0.543	-0.509	0.441**	0.546***	-0.0679	-0.00346	-0.0167
	(0.244)	(0.221)	(0.459)	(0.459)	(0.457)	(0.223)	(0.201)	(0.424)	(0.429)	(0.414)
% RE rec.	0.225*	0.237**	0.191	0.176	0.199	0.297**	0.319***	0.252	0.235	0.268
	(0.130)	(0.107)	(0.185)	(0.186)	(0.193)	(0.118)	(0.0980)	(0.180)	(0.179)	(0.189)
Vulnerability rec.	-2.398	-0.962	2.778	2.667	2.694	-0.775	0.608	-2.995	-3.294	-2.576
	(2.516)	(1.467)	(12.69)	(12.48)	(12.82)	(2.495)	(1.599)	(11.78)	(11.52)	(11.79)
Reg. quality rec.	0.159	0.154	0.230	0.228	0.236	0.306	0.311**	0.235	0.232	0.247
	(0.155)	(0.100)	(0.189)	(0.185)	(0.190)	(0.188)	(0.150)	(0.211)	(0.210)	(0.219)
Political stability rec.	0.0490	0.0481	-0.105	-0.0998	-0.109	0.102	0.140	-0.144	-0.142	-0.153
	(0.0841)	(0.0858)	(0.105)	(0.0999)	(0.105)	(0.104)	(0.117)	(0.0917)	(0.0891)	(0.0936)
Colony	-0.251	0.174	-0.320	0.444	0.427	-0.394	-0.200	-0.332	0.438	0.418
	(0.292)	(0.309)	(0.339)	(0.344)	(0.356)	(0.290)	(0.321)	(0.342)	(0.342)	(0.358)
RTA	0.534*	0.311	0.524	0.0269	0.0660	0.553*	0.333	0.509	-0.0244	0.0531
	(0.302)	(0.205)	(0.434)	(0.257)	(0.268)	(0.287)	(0.208)	(0.436)	(0.257)	(0.274)
GATT	0.700**	0.908***	-0.815*	-3.033**	-3.273**	0.859**	1.083***	-0.851*	-2.996**	-3.055**
	(0.345)	(0.310)	(0.446)	(1.309)	(1.365)	(0.391)	(0.382)	(0.455)	(1.299)	(1.284)
Dist.	-0.0706	-0.499**	0.132	-0.651***	-0.646***	-0.101	-0.564**	0.131	-0.673***	-0.624***

	(0.214)	(0.209)	(0.293)	(0.244)	(0.245)	(0.234)	(0.258)	(0.288)	(0.241)	(0.238)
GDP pc ppp rec.	-0.599	-0.421	0.166	0.240	0.269	-0.769**	-0.670**	0.0547	0.137	0.352
	(0.381)	(0.319)	(1.086)	(1.113)	(1.157)	(0.337)	(0.281)	(1.009)	(1.036)	(1.048)
GDP pc ppp don.	0.339	3.032	0.413	2.729	0	0.421	2.653	0.423	2.657	0
	(0.364)	(2.846)	(0.408)	(2.821)	(.)	(0.362)	(2.837)	(0.410)	(2.855)	(.)
Intercept	-2.677	-7.747	-0.538	0.430	11.13	0.0628	-2.661	-3.203	-1.900	8.167
	(2.092)	(10.88)	(10.94)	(15.10)	(10.59)	(2.019)	(10.67)	(10.39)	(14.53)	(9.967)
Year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes			Yes		Yes	
Recipient FE			Yes	Yes	Yes			Yes	Yes	Yes
Year-Donor FE					Yes					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8374	8374	8330	8330	7868	7367	7367	7365	7365	6963
pseudo R^2	0.188	0.436	0.288	0.525	0.563	0.141	0.383	0.260	0.505	0.544
AIC	139273.1	96739.7	122062.3	81460.2	73630.9	142403.8	102198.0	122632.0	82122.8	74262.5
BIC	139427.9	96894.4	122216.9	81614.8	73777.3	142555.7	102349.9	122783.9	82274.7	74406.3
chi2	129.4	388.9	116.9	110.3	117.0	110.5	250.1	100.1	92.17	97.82

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Table A6 (cont.). Baseline PPMLHDFE regression – Coefficients with production

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.214***	0.294***	0.274***	0.414***	0.447***
	(0.0306)	(0.0554)	(0.0334)	(0.0568)	(0.0645)
Lithium prod	-0.0628	-0.0521	0.170**	0.171**	0.181***
	(0.0593)	(0.0434)	(0.0734)	(0.0727)	(0.0586)
Rare earths prod	0.106	0.138***	0.151	0.149*	0.154*
	(0.0698)	(0.0489)	(0.0921)	(0.0834)	(0.0798)
Cobalt prod	0.00684	0.0240	-0.188***	-0.178***	-0.178***
	(0.0512)	(0.0336)	(0.0625)	(0.0595)	(0.0482)
Energy exports	-0.0369	0.00824	-0.0591**	0.00238	0.0109
	(0.0344)	(0.0376)	(0.0295)	(0.0268)	(0.0284)
Energy imports	0.0755***	0.00552	0.108***	0.00779	-0.00189
	(0.0238)	(0.0262)	(0.0260)	(0.0288)	(0.0311)
Auction rec.	1.190***	1.363***	0.659**	0.655**	0.593**
	(0.338)	(0.295)	(0.284)	(0.281)	(0.278)
FIT rec.	0.758**	0.737***	0.182	-0.00457	0.0168
	(0.323)	(0.257)	(0.347)	(0.291)	(0.280)
Carbon tax rec.	0.421	0.353	1.324	1.391*	1.344*
	(0.749)	(0.738)	(0.813)	(0.749)	(0.814)
Tax credits rec.	-0.371	-0.318	0.0978	0.168	0.137
	(0.263)	(0.230)	(0.591)	(0.524)	(0.501)
CO2 pc rec.	0.353*	0.445**	-0.0684	-0.0785	-0.0797
	(0.209)	(0.188)	(0.423)	(0.443)	(0.458)
% RE rec.	0.275***	0.275***	0.247	0.171	0.223
	(0.106)	(0.0866)	(0.184)	(0.190)	(0.188)
Vulnerability rec.	-0.932	0.439	-1.585	0.194	-2.344
	(2.447)	(1.639)	(12.33)	(9.957)	(9.685)
Reg. quality rec.	0.317	0.351**	0.237	0.224	0.257
	(0.193)	(0.164)	(0.226)	(0.212)	(0.226)
Political stability rec.	0.145	0.208	-0.176*	-0.151*	-0.156
	(0.111)	(0.132)	(0.0987)	(0.0915)	(0.0946)
Colony	-0.319	-0.309	-0.113	0.549*	0.527
	(0.290)	(0.326)	(0.340)	(0.329)	(0.327)
RTA	0.575**	0.416**	0.514	0.0549	0.119
	(0.290)	(0.205)	(0.489)	(0.254)	(0.277)
GATT	0.882**	1.101***	-0.865*	-3.001**	-3.267***
	(0.396)	(0.407)	(0.453)	(1.350)	(1.228)
Dist.	-0.0975	-0.502*	0.0665	-0.694***	-0.682***
	(0.258)	(0.286)	(0.331)	(0.228)	(0.223)
GDP pc ppp rec.	-0.694**	-0.647**	0.0675	0.383	0.275
	(0.317)	(0.256)	(1.011)	(1.076)	(0.985)
GDP pc ppp don.	0.397	3.152	0.322	2.901	0
	(0.357)	(2.798)	(0.416)	(2.686)	(.)
Intercept	-0.332	-5.494	-1.128	-0.317	9.347
	(1.987)	(10.62)	(11.02)	(13.49)	(8.201)
Year FE	Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes	
Recipient FE			Yes	Yes	Yes
Year-Donor FE					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes
N	8374	8374	8330	8330	7868
pseudo R^2	0.166	0.397	0.301	0.551	0.591
AIC	143082.6	103441.3	119843.7	77023.3	68899.9
BIC	143237.4	103596.1	119998.3	77177.9	69046.3
chi2	116.3	312.5	148.9	164.5	180.6

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Table A7. Baseline PPMLHDFE regression without controls – Coefficients with production

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.081***	1.303***	1.129***	1.150***	1.127***					
	(0.163)	(0.153)	(0.226)	(0.225)	(0.210)					
HHI						0.147	-0.0521	0.410	0.398	0.411
						(0.229)	(0.206)	(0.277)	(0.276)	(0.269)
Lithium prod	-0.0420	-0.0617	0.0853	0.0838	0.0940**	-0.0771	-0.0991*	0.138**	0.136**	0.151***
	(0.0684)	(0.0468)	(0.0550)	(0.0545)	(0.0374)	(0.0694)	(0.0513)	(0.0555)	(0.0553)	(0.0403)
Rare earths prod	0.0321	0.0669*	0.121	0.126	0.129	0.0996*	0.141***	0.159*	0.163*	0.161*
	(0.0619)	(0.0376)	(0.110)	(0.110)	(0.108)	(0.0561)	(0.0397)	(0.0965)	(0.0966)	(0.0928)
Cobalt prod	-0.0113	-0.00819	-0.180***	-0.177***	-0.183***	0.00408	0.0182	-0.165***	-0.161***	-0.171***
	(0.0549)	(0.0461)	(0.0588)	(0.0594)	(0.0521)	(0.0547)	(0.0501)	(0.0480)	(0.0485)	(0.0418)
Energy exports	-0.0222	0.0248	-0.0508*	0.00463	-0.00300	-0.0222	0.0271	-0.0531*	0.00519	0.00350
	(0.0257)	(0.0256)	(0.0291)	(0.0298)	(0.0327)	(0.0261)	(0.0274)	(0.0295)	(0.0287)	(0.0316)
Energy imports	0.0638***	0.000970	0.0900***	0.0260	0.0362	0.0600***	-0.00391	0.0934***	0.0250	0.0296
	(0.0207)	(0.0200)	(0.0256)	(0.0268)	(0.0300)	(0.0210)	(0.0218)	(0.0252)	(0.0256)	(0.0294)
Auction rec.	1.078***	1.112***	0.760**	0.779***	0.739**	1.155***	1.194***	0.694**	0.697**	0.649**
	(0.364)	(0.328)	(0.300)	(0.299)	(0.297)	(0.346)	(0.313)	(0.287)	(0.284)	(0.287)
FIT rec.	0.357	0.319	0.0901	0.0530	0.0496	0.540*	0.535**	0.124	0.0892	0.100
	(0.327)	(0.240)	(0.317)	(0.320)	(0.303)	(0.317)	(0.242)	(0.339)	(0.344)	(0.326)
Carbon tax rec.	0.204	0.277	0.978	0.997	0.931	0.414	0.463	1.253	1.277	1.230
	(0.737)	(0.641)	(0.826)	(0.827)	(0.851)	(0.725)	(0.576)	(0.842)	(0.841)	(0.863)
Tax credits rec.	-0.334	-0.293	0.201	0.246	0.214	-0.198	-0.114	0.189	0.243	0.202
	(0.313)	(0.256)	(0.481)	(0.477)	(0.454)	(0.295)	(0.256)	(0.538)	(0.537)	(0.506)
Intercept	-1.096***	-0.439*	-0.600	0.291	0.502	0.216	1.002***	1.094**	2.031***	2.230***
	(0.271)	(0.240)	(0.577)	(0.480)	(0.457)	(0.234)	(0.208)	(0.458)	(0.376)	(0.359)
Year FE	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes			Yes		Yes	
Recipient FE			Yes	Yes	Yes			Yes	Yes	Yes
Year-Donor FE					Yes					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9306	9306	9270	9270	8756	8044	8044	8040	8040	7596
pseudo R^2	0.171	0.407	0.289	0.515	0.554	0.112	0.340	0.258	0.493	0.534
AIC	147064.8	105124.4	126047.6	85857.5	77664.5	151488.7	112594.8	126496.9	86419.9	78179.1
BIC	147143.4	105202.9	126126.1	85935.9	77742.3	151565.6	112671.7	126573.8	86496.8	78255.4
chi2	115.2	306.3	94.74	73.01	83.11	74.42	123.7	59.93	49.20	61.50

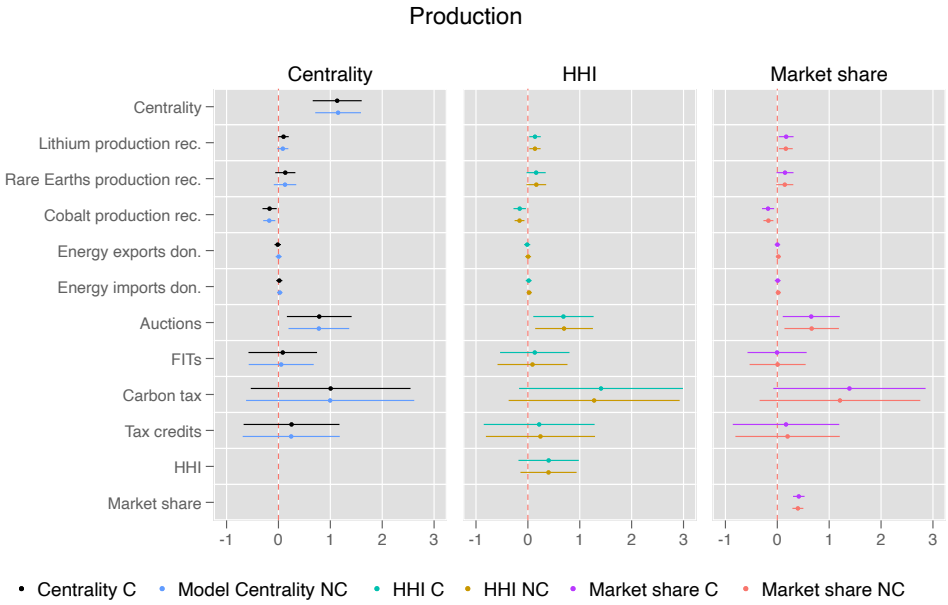
Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Table A7 (cont.). Baseline PPMLHDFE regression without controls – Coefficients with production

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.194***	0.228***	0.272***	0.397***	0.424***
	(0.0285)	(0.0445)	(0.0314)	(0.0538)	(0.0575)
Lithium prod	-0.0884	-0.116**	0.172**	0.164**	0.184***
	(0.0715)	(0.0533)	(0.0674)	(0.0680)	(0.0498)
Rare earths prod	0.120**	0.168***	0.146	0.144*	0.146*
	(0.0585)	(0.0424)	(0.0912)	(0.0840)	(0.0808)
Cobalt prod	0.0125	0.0341	-0.186***	-0.171***	-0.180***
	(0.0551)	(0.0528)	(0.0517)	(0.0491)	(0.0387)
Energy exports	-0.0211	0.0313	-0.0574**	0.0200	0.0247
	(0.0261)	(0.0282)	(0.0262)	(0.0249)	(0.0273)
Energy imports	0.0624***	-0.00369	0.105***	0.0181	0.0140
	(0.0214)	(0.0224)	(0.0262)	(0.0251)	(0.0278)
Auction rec.	1.286***	1.362***	0.641**	0.662**	0.605**
	(0.355)	(0.323)	(0.278)	(0.268)	(0.263)
FIT rec.	0.561*	0.542**	0.142	0.00614	-0.0107
	(0.323)	(0.244)	(0.343)	(0.276)	(0.272)
Carbon tax rec.	0.248	0.0903	1.233	1.208	1.166
	(0.734)	(0.637)	(0.822)	(0.790)	(0.841)
Tax credits rec.	-0.180	-0.0910	0.118	0.199	0.114
	(0.309)	(0.274)	(0.571)	(0.513)	(0.483)
Intercept	0.0489	0.851***	1.137***	2.178***	2.432***
	(0.211)	(0.202)	(0.440)	(0.316)	(0.305)
Year FE	Yes	Yes	Yes	Yes	
Donor FE		Yes		Yes	
Recipient FE			Yes	Yes	Yes
Year-Donor FE					Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes
N	9306	9306	9270	9270	8756
pseudo R^2	0.135	0.347	0.300	0.537	0.578
AIC	153474.2	115773.4	123968.0	82109.8	73578.2
BIC	153552.7	115852.0	124046.5	82188.3	73656.1
chi2	99.04	138.0	118.7	101.0	132.1

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Fig. A4. Baseline estimations summarizing the impact of the independent variables on the amount of RE ODA (elasticities) including production of critical minerals.



Source: Own elaboration. Note: C means model with controls (coefficients as included in Table A6) and NC means model without controls (coefficients as included in Table A7). The graph represents the estimations derived from the regressions including recipients FE and year-donor FE. Values in the x-axe represents coefficients and can be interpreted as elasticities. Highlighted variables in the y-axe are statistically significant.

Table A8. PPMLHDFE Pre sample mean estimations with controls – coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market structure									
Centrality	0.932***	1.158***	1.162***						
	(0.192)	(0.175)	(0.170)						
HHI				0.571**	0.403	0.364			
				(0.274)	(0.257)	(0.253)			
Market share							0.337***	0.355***	0.371***
							(0.0516)	(0.0575)	(0.0640)
Lithium imports	0.100*	0.00929	0.0200	0.106*	0.0158	0.0313	0.136**	0.0599	0.0876
	(0.0560)	(0.0505)	(0.0533)	(0.0588)	(0.0577)	(0.0604)	(0.0576)	(0.0607)	(0.0638)
Rare earths imports	0.115***	0.0506	0.0463	0.115***	0.0590*	0.0526	0.132***	0.0762**	0.0715*
	(0.0403)	(0.0374)	(0.0365)	(0.0371)	(0.0347)	(0.0346)	(0.0379)	(0.0388)	(0.0385)
Cobalt imports	0.128***	0.0870***	0.0955***	0.136***	0.0993***	0.105***	0.135***	0.107***	0.116***
	(0.0384)	(0.0328)	(0.0336)	(0.0383)	(0.0336)	(0.0348)	(0.0397)	(0.0356)	(0.0372)
Energy exports	-0.0102	0.00725	0.00571	-0.00293	0.0177	0.0206	-0.00587	0.0198	0.0203
	(0.0306)	(0.0256)	(0.0265)	(0.0300)	(0.0259)	(0.0271)	(0.0319)	(0.0275)	(0.0291)
Energy imports	-0.00979	-0.0296	-0.0295	-0.00782	-0.0297	-0.0341	0.00119	-0.0216	-0.0230
	(0.0262)	(0.0241)	(0.0250)	(0.0248)	(0.0235)	(0.0247)	(0.0264)	(0.0243)	(0.0268)
Auction rec.	0.568*	0.505*	0.495*	0.856**	0.862***	0.867***	1.079***	1.061***	1.058***
	(0.326)	(0.280)	(0.277)	(0.338)	(0.286)	(0.286)	(0.370)	(0.298)	(0.296)
FIT rec.	-0.307	-0.200	-0.202	0.0826	0.139	0.156	0.0565	0.0872	0.110
	(0.324)	(0.258)	(0.255)	(0.314)	(0.276)	(0.275)	(0.295)	(0.258)	(0.254)
Carbon tax rec.	0.403	0.266	0.242	1.286	1.107	1.105	0.900	0.672	0.594
	(0.946)	(0.815)	(0.826)	(0.856)	(0.744)	(0.768)	(0.854)	(0.772)	(0.830)
Tax credits rec.	-0.276	-0.0417	-0.0402	-0.427**	-0.232	-0.218	-0.543**	-0.407*	-0.384*
	(0.232)	(0.211)	(0.205)	(0.207)	(0.193)	(0.187)	(0.231)	(0.218)	(0.210)
CO2 pc rec.	0.293	0.428*	0.464**	0.411*	0.574***	0.592***	0.401*	0.531***	0.588***
	(0.276)	(0.228)	(0.229)	(0.247)	(0.217)	(0.221)	(0.218)	(0.195)	(0.206)
% RE rec.	0.0260	0.0843	0.0966	0.0976	0.147	0.144	0.115	0.138	0.146
	(0.149)	(0.123)	(0.122)	(0.135)	(0.117)	(0.118)	(0.124)	(0.100)	(0.0991)
Vulnerability rec.	-2.394	-1.494	-1.252	-1.111	-0.228	-0.0838	-0.890	0.00411	0.174
	(1.905)	(1.378)	(1.331)	(1.757)	(1.376)	(1.332)	(1.785)	(1.393)	(1.367)
Reg. quality rec.	-0.00950	0.0500	0.0499	0.139	0.221*	0.222*	0.170	0.245*	0.239*
	(0.106)	(0.0947)	(0.0954)	(0.120)	(0.117)	(0.114)	(0.145)	(0.143)	(0.142)
Political stability rec.	0.0290	0.00519	0.0165	0.0254	0.0188	0.0416	0.0932	0.113	0.138
	(0.130)	(0.124)	(0.125)	(0.129)	(0.127)	(0.131)	(0.134)	(0.136)	(0.144)
Colony	0.217	-0.109	-0.106	0.142	-0.446	-0.455	0.185	-0.463	-0.513
	(0.355)	(0.373)	(0.364)	(0.345)	(0.368)	(0.363)	(0.344)	(0.363)	(0.358)
RTA	0.290	0.232	0.295	0.328	0.267	0.327	0.357	0.302	0.342*
	(0.247)	(0.217)	(0.219)	(0.231)	(0.196)	(0.199)	(0.218)	(0.198)	(0.202)
GATT	0.669*	0.985***	0.993***	0.719*	1.004***	0.986**	0.745**	1.066***	1.106***

	(0.376)	(0.347)	(0.343)	(0.385)	(0.385)	(0.386)	(0.378)	(0.389)	(0.398)
Dist.	0.00398	-0.353	-0.365*	0.0349	-0.311	-0.299	-0.0103	-0.361	-0.378
	(0.225)	(0.215)	(0.212)	(0.236)	(0.246)	(0.248)	(0.252)	(0.273)	(0.275)
GDP pc ppp rec.	-0.505	-0.537	-0.553*	-0.679*	-0.800***	-0.808***	-0.687**	-0.800***	-0.865***
	(0.427)	(0.331)	(0.334)	(0.366)	(0.294)	(0.293)	(0.349)	(0.267)	(0.279)
GDP pc ppp don.	0.708	1.657	0	0.788	1.065	0	0.609	1.244	0
	(0.503)	(3.049)	(.)	(0.500)	(3.004)	(.)	(0.481)	(2.968)	(.)
Pre sample mean	0.496***	0.241***	0.247***	0.533***	0.311***	0.317***	0.547***	0.331***	0.335***
	(0.0668)	(0.0456)	(0.0445)	(0.0740)	(0.0535)	(0.0539)	(0.0745)	(0.0547)	(0.0544)
Intercept	-4.719*	-3.962	2.846	-2.812	0.755	4.971***	-1.750	0.440	5.707***
	(2.820)	(11.81)	(1.831)	(2.731)	(11.60)	(1.927)	(2.527)	(11.54)	(2.085)
Year FE	Yes	Yes		Yes	Yes		Yes	Yes	
Donor FE		Yes			Yes			Yes	
Year-donor FE			Yes			Yes			Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6522	6431	6203	5784	5714	5506	6522	6431	6203
pseudo R^2	0.321	0.463	0.502	0.292	0.426	0.464	0.321	0.444	0.483
AIC	91685.6	72329.6	66268.5	92488.0	74773.9	68964.2	91758.9	74822.2	68788.3
BIC	91841.6	72485.3	66416.6	92641.2	74926.9	69109.7	91914.9	74977.9	68936.4
Wald Test (chi2)	420.5 (0.000)	379.1 (0.000)	378.3 (0.000)	409.5 (0.000)	374.6 (0.000)	349.6 (0.000)	550.4 (0.000)	415.5 (0.000)	364.2 (0.000)

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

Table A9. Pre sample estimations with PPMLHDFE regression without controls – Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market structure									
Centrality	0.819***	1.070***	1.075***						
	(0.155)	(0.151)	(0.148)						
HHI				0.568**	0.361	0.316			
				(0.280)	(0.254)	(0.248)			
Market share							0.317***	0.301***	0.300***
							(0.0536)	(0.0556)	(0.0572)
Lithium imports	0.126**	0.0272	0.0341	0.122**	0.0244	0.0357	0.143**	0.0509	0.0646
	(0.0558)	(0.0439)	(0.0446)	(0.0575)	(0.0548)	(0.0565)	(0.0577)	(0.0588)	(0.0611)
Rare earths imports	0.134***	0.0690**	0.0633*	0.122***	0.0655**	0.0571*	0.137***	0.0772**	0.0707**
	(0.0405)	(0.0335)	(0.0326)	(0.0363)	(0.0306)	(0.0304)	(0.0336)	(0.0310)	(0.0310)
Cobalt imports	0.145***	0.102***	0.108***	0.142***	0.103***	0.106***	0.141***	0.104***	0.106***
	(0.0401)	(0.0338)	(0.0351)	(0.0384)	(0.0341)	(0.0354)	(0.0396)	(0.0367)	(0.0383)
Energy exports	0.00577	0.0263	0.0251	0.00342	0.0216	0.0233	0.00169	0.0194	0.0171
	(0.0251)	(0.0224)	(0.0248)	(0.0240)	(0.0218)	(0.0234)	(0.0252)	(0.0244)	(0.0275)
Energy imports	-0.00776	-0.0216	-0.0199	-0.00703	-0.0206	-0.0223	-0.000203	-0.0131	-0.0105
	(0.0260)	(0.0223)	(0.0228)	(0.0245)	(0.0217)	(0.0224)	(0.0258)	(0.0226)	(0.0240)
Auction rec.	0.975**	0.904***	0.893***	1.056***	1.036***	1.040***	1.252***	1.221***	1.215***
	(0.395)	(0.346)	(0.345)	(0.382)	(0.337)	(0.342)	(0.395)	(0.345)	(0.351)
FIT rec.	-0.373	-0.189	-0.184	0.0248	0.156	0.172	-0.00578	0.103	0.129
	(0.342)	(0.254)	(0.251)	(0.295)	(0.223)	(0.215)	(0.285)	(0.226)	(0.216)
Carbon tax rec.	0.719	0.571	0.557	1.263	1.078*	1.080	0.928	0.603	0.524
	(0.802)	(0.698)	(0.712)	(0.791)	(0.646)	(0.671)	(0.778)	(0.692)	(0.740)
Tax credits rec.	-0.487	-0.360	-0.363	-0.430	-0.311	-0.301	-0.528	-0.412	-0.393
	(0.339)	(0.293)	(0.288)	(0.304)	(0.265)	(0.263)	(0.332)	(0.300)	(0.299)
Pre sample mean	0.479***	0.241***	0.249***	0.541***	0.346***	0.352***	0.564***	0.379***	0.383***
	(0.0692)	(0.0487)	(0.0480)	(0.0795)	(0.0590)	(0.0604)	(0.0820)	(0.0606)	(0.0613)
Intercept	-0.636**	-0.0693	0.0615	0.486**	1.219***	1.337***	0.258	1.014***	1.147***
	(0.272)	(0.267)	(0.266)	(0.205)	(0.213)	(0.207)	(0.187)	(0.201)	(0.198)
Year FE	Yes	Yes		Yes	Yes		Yes	Yes	
Donor FE		Yes			Yes			Yes	
Year-donor FE			Yes			Yes			Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7238	7147	6895	6307	6237	6006	7238	7147	6895
pseudo R^2	0.304	0.439	0.476	0.275	0.399	0.435	0.301	0.410	0.445
AIC	96929.7	77850.7	71991.0	97302.9	80404.1	74754.7	97345.0	81862.1	76246.8
BIC	97012.4	77933.2	72073.1	97383.9	80485.0	74835.1	97427.6	81944.6	76328.9
chi2	296.8	264.7	289.2	282.9	204.5	205.4	404.4	240.5	248.3

Standard errors in parentheses* p<.10, ** p<.05, *** p<.01

Table A10. Pre sample estimations with PPMLHDFE regression– Coefficients with production of critical minerals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market share									
Centrality	0.971***	1.174***	1.167***						
	(0.196)	(0.187)	(0.180)						
HHI				0.600**	0.439*	0.434*			
				(0.269)	(0.261)	(0.251)			
Market share							0.337***	0.365***	0.382***
							(0.0578)	(0.0628)	(0.0709)
Lithium prod	-0.0370	-0.0331	-0.0279	-0.0262	-0.0215	-0.0149	-0.0269	-0.0196	-0.0126
	(0.0480)	(0.0379)	(0.0381)	(0.0463)	(0.0339)	(0.0350)	(0.0414)	(0.0307)	(0.0321)
Rare earths prod	0.0313	0.0522	0.0491	0.0573	0.0753	0.0757	0.0728	0.0955	0.0983
	(0.0720)	(0.0520)	(0.0516)	(0.0726)	(0.0572)	(0.0568)	(0.0738)	(0.0581)	(0.0598)
Cobalt prod	-0.00854	-0.000159	0.00188	0.0180	0.0333	0.0351	0.0284	0.0415	0.0454
	(0.0370)	(0.0285)	(0.0274)	(0.0411)	(0.0300)	(0.0311)	(0.0418)	(0.0294)	(0.0319)
Energy exports	-0.00824	0.0117	0.00935	-0.00304	0.0195	0.0203	-0.00463	0.0243	0.0242
	(0.0329)	(0.0279)	(0.0289)	(0.0330)	(0.0283)	(0.0297)	(0.0313)	(0.0279)	(0.0293)
Energy imports	-0.00286	-0.0296	-0.0290	-0.00109	-0.0296	-0.0328	0.00720	-0.0234	-0.0256
	(0.0258)	(0.0248)	(0.0255)	(0.0248)	(0.0241)	(0.0253)	(0.0243)	(0.0237)	(0.0253)
Auction rec.	0.556*	0.528*	0.522*	0.811**	0.842***	0.859***	1.022***	1.047***	1.049***
	(0.329)	(0.289)	(0.282)	(0.321)	(0.279)	(0.276)	(0.346)	(0.295)	(0.291)
FIT rec.	-0.227	-0.161	-0.147	0.197	0.215	0.248	0.171	0.198	0.244
	(0.352)	(0.295)	(0.281)	(0.365)	(0.340)	(0.336)	(0.346)	(0.315)	(0.312)
Carbon tax rec.	0.299	0.198	0.179	1.186	1.038	1.062	0.854	0.692	0.682
	(0.829)	(0.750)	(0.772)	(0.739)	(0.652)	(0.676)	(0.760)	(0.695)	(0.747)
Tax credits rec.	-0.0670	0.0383	0.0348	-0.293	-0.189	-0.193	-0.426	-0.375	-0.368
	(0.286)	(0.251)	(0.246)	(0.282)	(0.256)	(0.254)	(0.309)	(0.275)	(0.273)
CO2 pc rec.	0.296	0.336	0.366	0.347	0.452**	0.455**	0.317	0.400**	0.430**
	(0.244)	(0.235)	(0.238)	(0.222)	(0.210)	(0.212)	(0.197)	(0.189)	(0.195)
% RE rec.	0.0553	0.0617	0.0694	0.0936	0.107	0.100	0.0978	0.0996	0.0998
	(0.136)	(0.116)	(0.117)	(0.119)	(0.107)	(0.108)	(0.113)	(0.0917)	(0.0930)
Vulnerability rec.	-2.939	-2.199	-2.000	-1.643	-0.762	-0.658	-1.430	-0.397	-0.312
	(2.170)	(1.483)	(1.431)	(2.083)	(1.410)	(1.357)	(1.892)	(1.327)	(1.315)
Reg. quality rec.	-0.0362	0.0475	0.0529	0.114	0.219	0.222	0.130	0.238	0.236
	(0.109)	(0.0955)	(0.0984)	(0.137)	(0.136)	(0.137)	(0.143)	(0.146)	(0.148)
Political stability rec.	0.0246	-0.00117	0.0122	0.0385	0.0255	0.0467	0.0999	0.109	0.130
	(0.124)	(0.119)	(0.121)	(0.128)	(0.125)	(0.129)	(0.129)	(0.134)	(0.139)
Colony	0.276	-0.0503	-0.0164	0.189	-0.354	-0.333	0.233	-0.356	-0.378
	(0.351)	(0.369)	(0.363)	(0.351)	(0.368)	(0.371)	(0.354)	(0.359)	(0.355)
RTA	0.317	0.259	0.286	0.367	0.302	0.345	0.415	0.391*	0.426*
	(0.282)	(0.227)	(0.234)	(0.276)	(0.220)	(0.224)	(0.264)	(0.222)	(0.232)
GATT	0.804**	0.983***	0.993***	0.851**	1.002***	0.980***	0.890**	1.053***	1.079***

	(0.354)	(0.338)	(0.335)	(0.361)	(0.358)	(0.357)	(0.353)	(0.358)	(0.364)
Dist.	0.00954	-0.295	-0.313	0.0434	-0.276	-0.276	-0.0181	-0.312	-0.332
	(0.200)	(0.217)	(0.211)	(0.207)	(0.239)	(0.242)	(0.218)	(0.244)	(0.245)
GDP pc ppp rec.	-0.406	-0.446	-0.453	-0.541*	-0.676**	-0.674**	-0.527*	-0.648***	-0.695***
	(0.372)	(0.332)	(0.332)	(0.304)	(0.267)	(0.265)	(0.288)	(0.244)	(0.252)
GDP pc ppp don.	0.531	1.150	0	0.570	0.610	0	0.366	1.065	0
	(0.461)	(2.957)	(.)	(0.464)	(2.999)	(.)	(0.442)	(2.876)	(.)
Pre sample mean	0.515***	0.235***	0.238***	0.553***	0.304***	0.305***	0.574***	0.319***	0.320***
	(0.0696)	(0.0452)	(0.0437)	(0.0754)	(0.0518)	(0.0514)	(0.0745)	(0.0525)	(0.0511)
Intercept	-4.717*	-3.222	1.669	-2.715	1.584	4.133**	-1.515	0.121	4.648**
	(2.707)	(11.58)	(1.942)	(2.697)	(11.57)	(1.976)	(2.297)	(11.11)	(1.915)
Year FE	Yes	Yes		Yes	Yes		Yes	Yes	
Donor FE		Yes			Yes			Yes	
Year-donor FE			Yes			Yes			Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6522	6431	6203	5784	5714	5506	6522	6431	6203
pseudo R^2	0.302	0.457	0.495	0.272	0.421	0.458	0.301	0.440	0.479
AIC	94227.2	73069.0	67180.0	95158.0	75485.4	69736.0	94364.7	75307.5	69337.7
BIC	94383.2	73224.7	67328.1	95311.3	75638.4	69881.5	94520.7	75463.2	69485.9
chi2	302.8	379.2	353.5	285.0	411.9	399.2	283.8	377.2	361.7

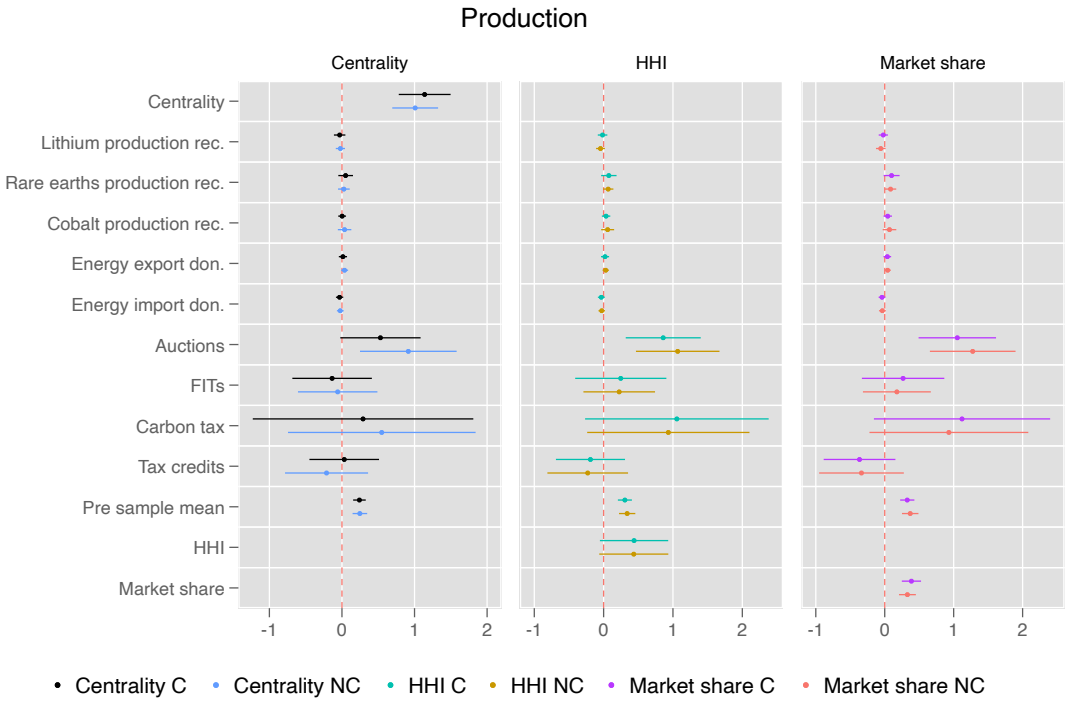
Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table A11. Pre sample estimations with PPMLHDFE regression without controls– Coefficients with production of critical minerals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market structure									
Centrality	0.806***	1.039***	1.036***						
	(0.170)	(0.164)	(0.159)						
HHI				0.669**	0.450*	0.429*			
				(0.283)	(0.257)	(0.254)			
Market share							0.323***	0.320***	0.322***
							(0.0609)	(0.0595)	(0.0627)
Lithium prod	0.0118	-0.0221	-0.0216	-0.0117	-0.0484	-0.0449	-0.0247	-0.0623*	-0.0586
	(0.0450)	(0.0316)	(0.0323)	(0.0443)	(0.0310)	(0.0323)	(0.0470)	(0.0342)	(0.0366)
Rare earths prod	0.00236	0.0271	0.0260	0.0440	0.0685*	0.0663*	0.0565	0.0884**	0.0872**
	(0.0601)	(0.0420)	(0.0411)	(0.0510)	(0.0385)	(0.0379)	(0.0548)	(0.0421)	(0.0417)
Cobalt prod	0.0274	0.0326	0.0354	0.0420	0.0560	0.0580	0.0559	0.0677	0.0707
	(0.0612)	(0.0469)	(0.0474)	(0.0597)	(0.0457)	(0.0479)	(0.0611)	(0.0467)	(0.0505)
Energy exports	0.0131	0.0351	0.0340	0.00882	0.0300	0.0314	0.0119	0.0342	0.0327
	(0.0262)	(0.0231)	(0.0248)	(0.0248)	(0.0219)	(0.0233)	(0.0230)	(0.0223)	(0.0246)
Energy imports	0.00307	-0.0216	-0.0209	0.00119	-0.0245	-0.0269	0.00405	-0.0232	-0.0226
	(0.0257)	(0.0228)	(0.0232)	(0.0250)	(0.0226)	(0.0239)	(0.0264)	(0.0233)	(0.0243)
Auction rec.	0.949**	0.914***	0.909***	1.065***	1.065***	1.071***	1.253***	1.262***	1.258***
	(0.399)	(0.342)	(0.339)	(0.363)	(0.306)	(0.307)	(0.364)	(0.310)	(0.316)
FIT rec.	-0.140	-0.0850	-0.0696	0.184	0.191	0.226	0.127	0.127	0.174
	(0.391)	(0.289)	(0.280)	(0.356)	(0.270)	(0.264)	(0.346)	(0.259)	(0.253)
Carbon tax rec.	0.712	0.463	0.457	1.207*	0.905	0.936	0.944	0.564	0.542
	(0.762)	(0.627)	(0.656)	(0.728)	(0.559)	(0.596)	(0.724)	(0.605)	(0.657)
Tax credits rec.	-0.241	-0.204	-0.215	-0.283	-0.223	-0.234	-0.405	-0.339	-0.343
	(0.354)	(0.293)	(0.293)	(0.340)	(0.291)	(0.297)	(0.361)	(0.312)	(0.321)
Pre sample mean	0.503***	0.239***	0.244***	0.560***	0.337***	0.338***	0.591***	0.364***	0.364***
	(0.0755)	(0.0518)	(0.0508)	(0.0812)	(0.0590)	(0.0600)	(0.0858)	(0.0594)	(0.0594)
Intercept	-0.617**	-0.0121	0.136	0.517**	1.270***	1.403***	0.253	1.043***	1.185***
	(0.285)	(0.273)	(0.274)	(0.204)	(0.204)	(0.201)	(0.183)	(0.193)	(0.191)
N	7238	7147	6895	6307	6237	6006	7238	7147	6895
Year FE	Yes	Yes		Yes	Yes		Yes	Yes	
Donor FE		Yes			Yes			Yes	
Year-donor FE			Yes			Yes			Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
pseudo R^2	0.279	0.432	0.467	0.252	0.395	0.430	0.279	0.410	0.444
AIC	100495.4	78934.5	73159.1	100373.2	80937.6	75311.5	100385.5	81981.8	76353.5
BIC	100578.0	79017.0	73241.1	100454.2	81018.5	75391.9	100468.1	82064.3	76435.6
chi2	240.1	247.3	251.7	216.0	246.1	228.6	242.3	236.0	260.6

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Fig. A5. Pre sample estimations summarizing the impact of the independent variables on the amount of RE ODA (elasticities) with production explanatory variables



Source: Own elaboration. Note: C means model with controls (coefficients as included in Table A10) and NC means model without controls (coefficients as included in Table A11). The graph represents the estimations derived from the regressions including recipients FE and year-donor FE. Values in the x-axe represents coefficients and can be interpreted as elasticities. Highlighted variables in the y-axe are statistically significant.

Table A12. First stage estimations (selection stage) Heckman– Coefficients

	(1) Cloglog	(2) Probit
Global ODA (-1)	0.179***	0.122***
	(0.0159)	(0.0113)
Reg. quality rec.	0.0404	0.0349
	(0.0437)	(0.0300)
Political stability rec.	0.0223	0.0149
	(0.0314)	(0.0222)
Colony	0.242*	0.184*
	(0.133)	(0.102)
RTA	0.0665	0.0569
	(0.0826)	(0.0597)
GATT	-0.0289	-0.0207
	(0.0756)	(0.0535)
Dist.	0.136**	0.0972**
	(0.0549)	(0.0380)
GDP pc ppp rec.	0.0863**	0.0662**
	(0.0431)	(0.0310)
GDP pc ppp don.	0.0914	0.107
	(0.146)	(0.102)
Intercept	-3.397***	-2.302***
	(0.685)	(0.480)
lnsig2u	-0.471***	-1.128***
	(0.0860)	(0.0962)
N	8684	8684
pseudo R^2	0.089	0.061
AIC	9311.6	9373.6
BIC	9389.4	9451.4

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Fig. A6. Probit margins plot for significant variables in table A12.

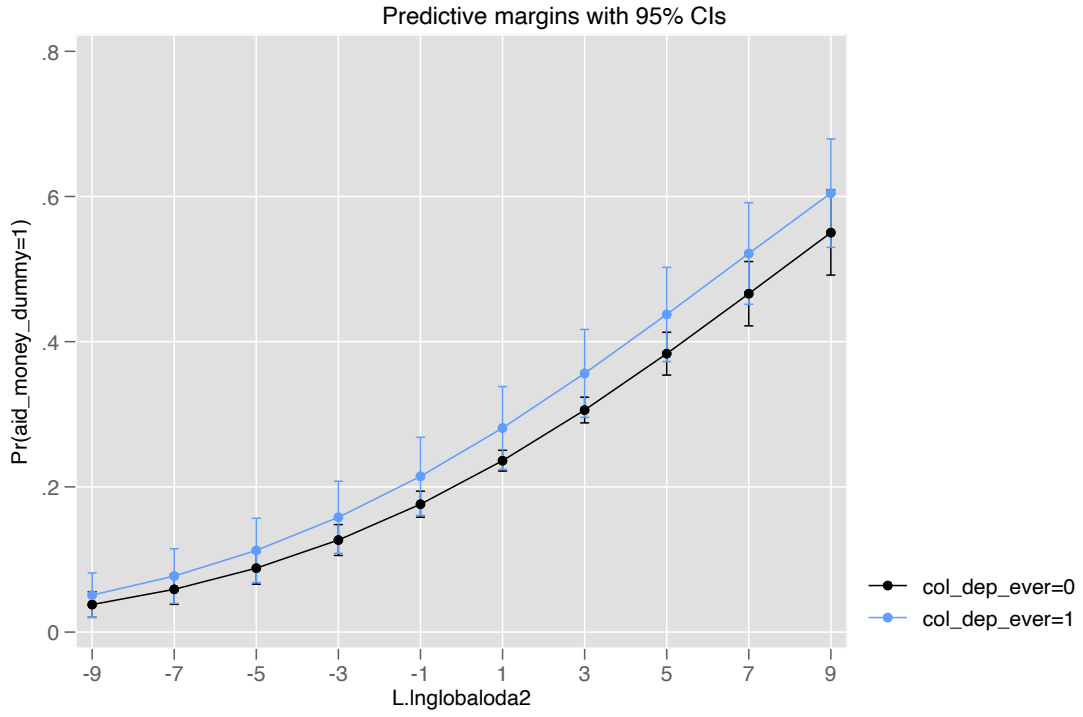


Fig. A7. Cloglog margins plot for significant variables in table A10.

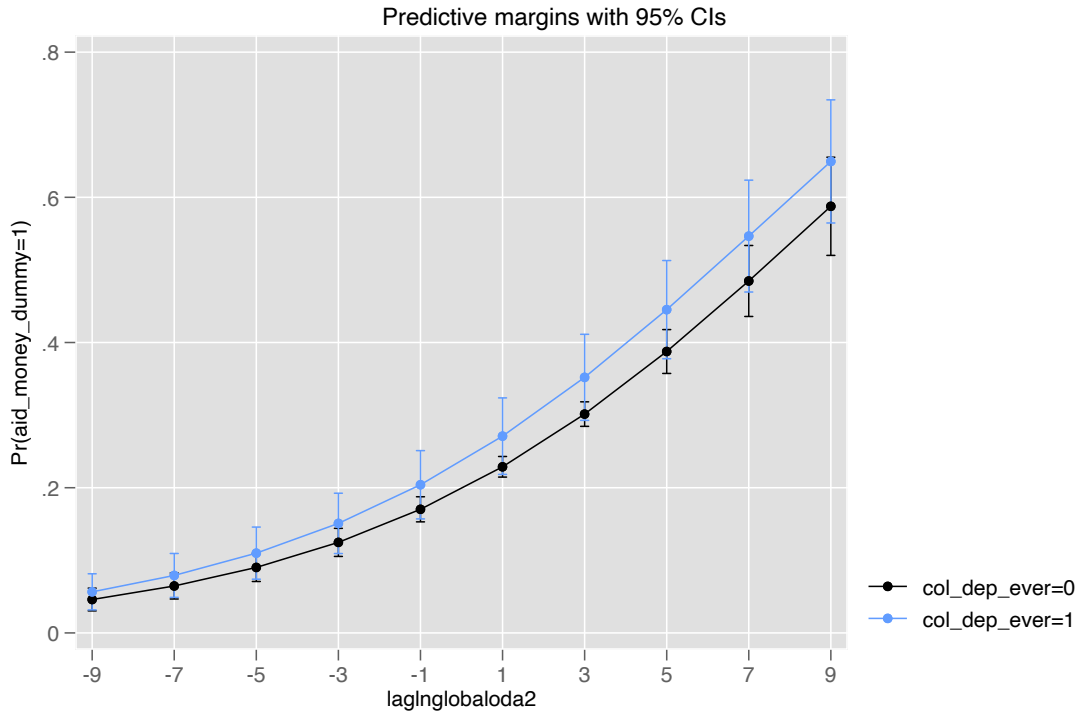


Table A13. Second stage estimations (allocation stage) Heckman– Coefficients OLS with production variables

	(1)	(2)	(3)	(4)	(5)	(6)
Market structure						
Centrality	3.125**			2.427		
	(1.570)			(1.504)		
HHI		5.929***			6.261***	
		(2.184)			(2.205)	
Market share			2.950***			2.952***
			(0.427)			(0.424)
Lithium prod	-0.864	-0.883	-0.973*	-0.823	-0.835	-0.928
	(0.577)	(0.583)	(0.574)	(0.570)	(0.574)	(0.566)
Rare earths prod	1.709*	1.823*	2.091**	1.596	1.683*	1.954**
	(1.030)	(1.033)	(1.016)	(1.003)	(1.001)	(0.984)
Cobalt prod	-0.524	-0.507	-0.408	-0.609	-0.598	-0.496
	(0.594)	(0.597)	(0.584)	(0.588)	(0.589)	(0.576)
Energy exports	-0.557*	-0.559*	-0.316	-0.575*	-0.578*	-0.333
	(0.338)	(0.338)	(0.322)	(0.334)	(0.333)	(0.318)
Energy imports	0.368	0.374	0.143	0.338	0.342	0.110
	(0.240)	(0.241)	(0.231)	(0.237)	(0.237)	(0.229)
Auction rec.	10.05**	10.86***	11.93***	9.800**	10.53***	11.59***
	(3.938)	(4.014)	(4.018)	(3.892)	(3.958)	(3.960)
FIT rec.	6.042	7.206*	8.243**	5.908	6.942*	7.960**
	(3.892)	(3.926)	(3.786)	(3.795)	(3.804)	(3.663)
Carbon tax rec.	2.238	5.170	4.607	2.321	5.153	4.503
	(7.788)	(7.428)	(7.190)	(7.598)	(7.209)	(7.016)
Tax credits rec.	-0.854	-0.417	-1.398	-0.577	-0.102	-1.122
	(3.348)	(3.332)	(3.286)	(3.318)	(3.297)	(3.251)
CO2 pc rec.	3.487*	4.305**	4.728***	3.551**	4.309**	4.705***
	(1.810)	(1.863)	(1.810)	(1.793)	(1.841)	(1.785)
% RE rec.	1.132*	1.545**	1.786***	1.095	1.478**	1.717**
	(0.677)	(0.698)	(0.687)	(0.678)	(0.700)	(0.683)
Vulnerability rec.	-4.232	-0.878	1.219	-6.040	-3.099	-1.035
	(19.05)	(18.55)	(18.39)	(19.07)	(18.56)	(18.38)
Reg. quality rec.	1.143	1.279	0.965	1.111	1.274	0.963
	(1.249)	(1.281)	(1.301)	(1.248)	(1.282)	(1.300)
Political stability rec.	-0.162	-0.128	-0.130	-0.322	-0.279	-0.276
	(0.622)	(0.631)	(0.654)	(0.630)	(0.636)	(0.653)
Colony	-12.80***	-15.01***	-16.37***	-15.05***	-16.96***	-18.21***
	(3.323)	(3.453)	(3.349)	(3.567)	(3.677)	(3.574)
RTA	3.079	3.192	3.253	2.387	2.469	2.564
	(2.887)	(2.895)	(2.864)	(2.787)	(2.783)	(2.754)
GATT	7.315**	7.383**	8.572***	7.379***	7.363**	8.555***
	(2.869)	(2.895)	(2.935)	(2.854)	(2.869)	(2.906)
Dist.	-3.633	-3.162	-2.240	-3.663	-3.248	-2.327
	(2.767)	(2.703)	(2.639)	(2.747)	(2.680)	(2.618)
GDP pc ppp rec.	-4.501	-6.064**	-6.565**	-4.501	-5.919**	-6.374**
	(2.848)	(2.999)	(2.991)	(2.820)	(2.957)	(2.946)
GDP pc ppp don.	11.90	6.608	1.323	10.73	5.809	0.712
	(21.97)	(21.00)	(21.10)	(21.86)	(20.91)	(20.99)
IMR	-24.12***	-28.91***	-29.30***	-98.99***	-111.7***	-111.4***
	(5.849)	(6.727)	(6.448)	(24.12)	(26.16)	(24.93)
Intercept	16.54	48.72	68.62	67.60	101.7	120.0*
	(76.42)	(71.63)	(73.24)	(74.99)	(70.68)	(72.15)
Year FE	Yes	Yes	Yes	Yes	Yes	YEs
Donor FE	Yes	Yes	Yes	Yes	Yes	YEs
Cluster Donor -recipient	Yes	Yes	Yes	Yes	Yes	YEs
	Probit	Probit	Probit	Cloglog	Cloglog	Cloglog
N	2339	2339	2339	2339	2339	2339
R^2	0.1160	0.1171	0.1431	0.1205	0.1223	0.1481

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Box 2. Instrumental variable in two steps

Based on the theories of credible commitment in political economy, effective policies may unlock additional ODA commitments (Morrissey, 2015; North and Weinsgast, 1989). Yet, one could expect this would not be the only mechanism at play and that also ODA and, in particular, aid conditionality may require the implementation or modification of certain types of domestic policies erected in recipient countries (Drazen and Isard, 2004; Fukuda-Parr et al. 2002). In this context, the relationship between ODA and renewable energy policies can be mutually reinforcing (Mawdsley, Savage, and Kim, 2014). The baseline results shown in Table 2, included as explanatory variables the first lags of the energy policy variables, i.e. FITs, Auctions, Tax credits and Carbon prices implemented in the recipient countries in order to avoid potential endogeneity problems derived from the aforementioned simultaneous relationships.

As an additional robustness exercise, we use an instrumental variable strategy in two steps. In the first step, we use a probit model and we instrument the categorical policy variables using three instrumental variables, i.e. the percentage of people with access to electricity in the recipient country, the amount of ODA received from multilateral partners (development banks) and the existence of a phase-out coal pledge in the recipient country. Details about these three variables can be found in the descriptive statistics table (See Table 1) .

We use the predictions in this first probit estimation as the regressors in the second stage. Our second stage, as in our baseline, will be determined by the use of a PPMLHDFE estimator (See Table A16 below). Different estimations correspond to different levels of FE included in the regressions. Our IV strategy allows us to exclude simultaneous variations in aid and the type of policy instruments implemented in recipient countries. The appendix below includes the first-step probit regressions (See Table A14) allowing to test for the relevance condition and a placebo test (See A15) in which the main regression is run replacing the endogenous variables with the instrument themselves to test the exclusion restriction.

Overall, the coefficients from the second step (PPMLHDFE) are closed to those in the baseline estimates. Yet, it is important to note the crucial role of the policy variables that is reinforced with an IV approach. The regression situates auctions as one of most important variables in determining the amount of ODA provided from donors to recipients together with the existence of regional trade agreements (RTAs). Results including the production of critical minerals can be found in the appendix (Tables A18 and A19).

Table A14. IV First step probit

	(1) Fit (-1)	(2) Auction (-1)	(3) Tax credits (-1)
Multilateral ODA (-2)	0.129**	0.664***	0.175***
	(0.0538)	(0.0612)	(0.0532)
Coal phase out	-0.300	-1.202***	1.138***
	(0.197)	(0.265)	(0.324)
Access to electricity (-2)	0.0736	4.513***	3.985***
	(0.193)	(0.350)	(0.447)
Reg. quality rec.	0.531***	-0.545***	-0.0671
	(0.0866)	(0.0922)	(0.0756)
Political stability rec.	-0.181***	-0.268***	-0.344***
	(0.0435)	(0.0541)	(0.0556)
Colony	-0.276	-1.153*	0.597
	(0.398)	(0.688)	(0.544)
RTA	-1.050***	0.913***	-0.570***
	(0.197)	(0.223)	(0.151)
GATT	-0.0956	7.959***	4.302***
	(0.213)	(0.299)	(0.307)
GDP pc ppp rec.	0.299*	3.922***	1.280***
	(0.168)	(0.211)	(0.236)
Intercept	-6.378***	-38.91***	-29.62***
	(0.781)	(1.529)	(1.860)
lnsig2u	2.909***	4.187***	3.591***
	(0.0865)	(0.0911)	(0.0888)
N	7714	7714	7714
pseudo R^2	0.47895	0.57664	0.6269
AIC	2877.6	4123.8	2854.4
BIC	2954.0	4200.3	2930.8
chi2	75.92	1342.8	370.0

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table A15. Placebo test with controls to test the exclusion restriction.

	(1)	(2)	(3)	(4)	(5)	(6)
Market structure						
Centrality	1.023***	1.295***				
	(0.212)	(0.195)				
HHI			0.255	-0.00320		
			(0.261)	(0.231)		
Market share					0.236***	0.322***
					(0.0339)	(0.0515)
Lithium imports	0.0840	-0.0103	0.0988*	-0.00544	0.109*	0.0217
	(0.0578)	(0.0471)	(0.0580)	(0.0532)	(0.0588)	(0.0534)
Rare earths imports	0.178***	0.0699**	0.192***	0.0904***	0.203***	0.104***
	(0.0391)	(0.0335)	(0.0387)	(0.0332)	(0.0375)	(0.0340)
Cobalt imports	0.142***	0.103***	0.152***	0.121***	0.159***	0.128***
	(0.0389)	(0.0318)	(0.0407)	(0.0390)	(0.0409)	(0.0374)
Energy exports	-0.0257	0.00113	-0.0145	0.0213	-0.00807	0.0454*
	(0.0345)	(0.0285)	(0.0332)	(0.0298)	(0.0309)	(0.0251)
Energy imports	0.0397*	-0.00671	0.0331	-0.0183	0.0295	-0.0361*
	(0.0220)	(0.0236)	(0.0204)	(0.0212)	(0.0205)	(0.0202)
Multilateral (-2)	0.158	0.166	0.332**	0.384***	0.401**	0.519***
	(0.156)	(0.126)	(0.168)	(0.148)	(0.171)	(0.161)
Coal phase out	-0.218	-0.258	-0.145	-0.174	-0.214	-0.211
	(0.327)	(0.237)	(0.326)	(0.253)	(0.342)	(0.257)
Access elec. (-2)	0.210	0.130	0.144	0.0906	0.238	0.151
	(0.356)	(0.301)	(0.320)	(0.279)	(0.315)	(0.278)
% RE rec.	0.0876	0.182	0.161	0.259**	0.181	0.269***
	(0.138)	(0.116)	(0.125)	(0.107)	(0.119)	(0.0997)
CO2 pc rec.	0.141	0.422*	0.358	0.614***	0.310	0.579***
	(0.285)	(0.242)	(0.260)	(0.223)	(0.255)	(0.216)
Vulnerability rec.	-2.400	-0.506	-1.245	0.289	-1.253	0.0277
	(2.577)	(1.485)	(2.622)	(1.743)	(2.599)	(1.603)
Reg. quality rec.	0.107	0.0897	0.176	0.150	0.184	0.155
	(0.132)	(0.0983)	(0.139)	(0.107)	(0.145)	(0.114)
Political stability rec.	0.0366	0.0331	0.0872	0.0783	0.101	0.112
	(0.119)	(0.121)	(0.127)	(0.128)	(0.126)	(0.127)
Colony	-0.284	-0.00581	-0.413	-0.419	-0.344	-0.482
	(0.295)	(0.359)	(0.301)	(0.380)	(0.316)	(0.389)
RTA	0.615**	0.362*	0.598**	0.391*	0.643**	0.473**
	(0.298)	(0.206)	(0.295)	(0.213)	(0.300)	(0.218)
GATT	0.829**	1.171***	0.952**	1.337***	1.037**	1.441***
	(0.417)	(0.378)	(0.425)	(0.428)	(0.429)	(0.420)
Dist.	-0.00433	-0.381*	0.0124	-0.330	0.0445	-0.240
	(0.242)	(0.220)	(0.258)	(0.274)	(0.271)	(0.282)
GDP pc ppp rec.	-0.450	-0.286	-0.459	-0.343	-0.407	-0.337
	(0.384)	(0.327)	(0.337)	(0.299)	(0.324)	(0.279)
GDP pc ppp don.	0.724*	1.954	0.822*	1.540	0.746*	2.125
	(0.425)	(2.927)	(0.427)	(2.848)	(0.426)	(2.847)
Intercept	-6.756**	-6.003	-5.752*	-3.755	-6.719**	-8.077
	(3.428)	(11.75)	(3.170)	(11.38)	(3.002)	(11.38)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Donor FE		Yes		Yes		Yes
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes
N	7439	7336	6564	6484	7439	7336
pseudo R^2	0.217	0.442	0.172	0.389	0.204	0.417
AIC	119376.3	84778.1	122127.2	89849.4	121343.7	88662.3
BIC	119521.5	84923.0	122269.7	89991.7	121489.0	88807.2
chi2	164.5	317.5	195.6	197.2	159.3	242.6

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Note: the estimations included here are those FE in which the coal is not absorbed as a FE. While the variable Multilateral is significant only in two models it is over 0.05

Table A16. IV estimations (second stage) - coefficients PPMLHDFE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.023***	1.201***	1.295***	1.205***	1.200***					
	(0.212)	(0.272)	(0.195)	(0.257)	(0.265)					
HHI						0.255	0.187	-0.00320	0.221	0.199
						(0.261)	(0.329)	(0.231)	(0.320)	(0.334)
Lithium imports	0.0840	0.108*	-0.0103	0.0344	0.00915	0.0988*	0.102*	-0.00544	0.00358	-0.0142
	(0.0578)	(0.0608)	(0.0471)	(0.0483)	(0.0499)	(0.0580)	(0.0621)	(0.0532)	(0.0523)	(0.0496)
Rare earths imports	0.178***	0.190***	0.0699**	0.0361	0.0295	0.192***	0.185***	0.0904***	0.0312	0.0230
	(0.0391)	(0.0421)	(0.0335)	(0.0389)	(0.0397)	(0.0387)	(0.0424)	(0.0332)	(0.0376)	(0.0380)
Cobalt imports	0.142***	0.145***	0.103***	0.0711**	0.0579*	0.152***	0.135***	0.121***	0.0591	0.0497
	(0.0389)	(0.0390)	(0.0318)	(0.0356)	(0.0321)	(0.0407)	(0.0397)	(0.0390)	(0.0377)	(0.0367)
Energy exports	-0.0257	-0.0355	0.00113	-0.00246	-0.0130	-0.0145	-0.0361	0.0213	-0.000153	-0.0118
	(0.0345)	(0.0389)	(0.0285)	(0.0336)	(0.0324)	(0.0332)	(0.0371)	(0.0298)	(0.0332)	(0.0298)
Energy imports	0.0397*	0.0735***	-0.00671	-0.00596	0.00570	0.0331	0.0755***	-0.0183	-0.00478	0.00879
	(0.0220)	(0.0268)	(0.0236)	(0.0331)	(0.0317)	(0.0204)	(0.0264)	(0.0212)	(0.0332)	(0.0283)
endogiv1	1.462	8.474***	1.587	7.771**	7.794**	4.392*	8.487***	5.187**	7.065***	7.295**
	(2.150)	(3.208)	(2.057)	(3.031)	(3.162)	(2.310)	(2.885)	(2.372)	(2.571)	(2.873)
endogiv2	-0.0764	-1.385*	-0.0854	-1.164	-1.216*	-0.490	-1.491**	-0.587	-1.106*	-1.212*
	(0.338)	(0.711)	(0.325)	(0.725)	(0.703)	(0.339)	(0.634)	(0.359)	(0.612)	(0.622)
endogiv3	0.112	1.333	0.100	1.088	1.146	0.510	1.517**	0.592*	1.088	1.239
	(0.334)	(0.819)	(0.323)	(0.837)	(0.809)	(0.335)	(0.763)	(0.352)	(0.750)	(0.754)
% RE rec.	0.0876	0.0989	0.182	0.0905	0.0808	0.161	0.136	0.259**	0.134	0.101
	(0.138)	(0.209)	(0.116)	(0.212)	(0.199)	(0.125)	(0.207)	(0.107)	(0.213)	(0.203)
CO2 pc rec.	0.141	-1.014	0.422*	-0.908	-0.946	0.358	-0.375	0.614***	-0.365	-0.305
	(0.285)	(0.626)	(0.242)	(0.619)	(0.623)	(0.260)	(0.552)	(0.223)	(0.551)	(0.534)
Vulnerability rec.	-2.400	2.413	-0.506	3.453	2.910	-1.245	-2.759	0.289	-1.917	-3.348
	(2.577)	(18.78)	(1.485)	(19.05)	(18.40)	(2.622)	(19.34)	(1.743)	(19.39)	(17.04)
Reg. quality rec.	-0.704	-5.085**	-0.792	-4.561**	-4.620**	-2.388*	-5.073***	-2.883**	-4.077**	-4.282**
	(1.333)	(2.071)	(1.274)	(1.988)	(2.052)	(1.409)	(1.839)	(1.451)	(1.669)	(1.820)
Political stability rec.	0.320	1.412**	0.332	1.244*	1.264*	0.927**	1.422**	1.064**	1.098*	1.181*
	(0.437)	(0.655)	(0.431)	(0.643)	(0.648)	(0.446)	(0.604)	(0.467)	(0.572)	(0.604)
Colony	-0.0350	-0.469	0.274	0.465	0.444	-0.0695	-0.722	-0.0155	0.320	0.222
	(0.392)	(0.814)	(0.427)	(0.839)	(0.838)	(0.410)	(0.853)	(0.471)	(0.863)	(0.910)
RTA	2.285	11.52***	2.162	9.974**	10.02**	5.949**	11.71***	6.710**	9.165***	9.521**
	(2.731)	(4.392)	(2.598)	(4.192)	(4.290)	(2.938)	(3.932)	(3.006)	(3.495)	(3.809)
GATT	1.093	4.979*	1.571	2.451	2.610	3.080**	5.106**	3.960**	2.262	2.231
	(1.509)	(2.639)	(1.521)	(3.043)	(2.784)	(1.552)	(2.244)	(1.667)	(2.510)	(2.465)

Dist.	-0.00433	0.157	-0.381*	-0.816***	-0.787***	0.0124	0.132	-0.330	-0.774***	-0.791***
	(0.242)	(0.326)	(0.220)	(0.275)	(0.278)	(0.258)	(0.318)	(0.274)	(0.268)	(0.268)
GDP pc ppp rec.	-0.732	0	-0.554	0	0	-0.503	0	-0.350	0	0
	(0.748)	(.)	(0.541)	(.)	(.)	(0.661)	(.)	(0.536)	(.)	(.)
GDP pc ppp don.	0.724*	0.999**	1.954	0	1.522	0.822*	1.003**	1.540	0	2.930*
	(0.425)	(0.480)	(2.927)	(.)	(2.846)	(0.427)	(0.482)	(2.848)	(.)	(1.644)
Intercept	2.926	37.91	3.760	50.77**	44.33*	18.30*	36.45	24.01	44.76**	34.08*
	(10.12)	(24.35)	(15.55)	(22.83)	(24.59)	(10.57)	(24.05)	(14.86)	(22.81)	(20.55)
Year FE	Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes			Yes		Yes
Recipient FE		Yes		Yes	Yes		Yes		Yes	Yes
Year-Donor FE				Yes					Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7439	7372	7336	6984	7277	6564	6562	6484	6218	6482
pseudo R^2	0.217	0.327	0.442	0.578	0.539	0.172	0.296	0.389	0.555	0.510
AIC	119376.3	102448.6	84778.1	63164.6	69967.9	122127.2	103845.7	89849.4	64538.7	71955.0
BIC	119521.5	102586.7	84923.0	63294.8	70105.8	122269.7	103981.5	89991.7	64666.6	72090.6
Wald chi2 (sig.)	164.5 (0.000)	135.3 (0.000)	317.5 (0.000)	84.83 (0.000)	97.85 (0.000)	195.6 (0.000)	115.6 (0.000)	197.2 (0.000)	58.70 (0.000)	50.94 (0.000)

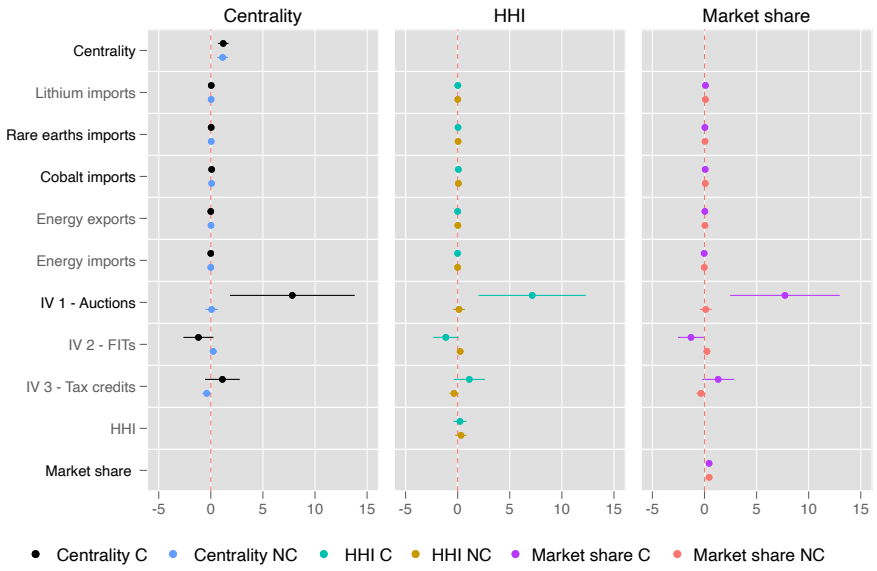
Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table 16 (cont). IV estimations (second stage) - coefficients PPMLHDFE

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.236***	0.308***	0.322***	0.445***	0.419***
	(0.0339)	(0.0417)	(0.0515)	(0.0616)	(0.0577)
Lithium imports	0.109*	0.138**	0.0217	0.0787	0.0425
	(0.0588)	(0.0627)	(0.0534)	(0.0533)	(0.0526)
Rare earths imports	0.203***	0.204***	0.104***	0.0375	0.0348
	(0.0375)	(0.0404)	(0.0340)	(0.0410)	(0.0417)
Cobalt imports	0.159***	0.147***	0.128***	0.0540*	0.0450
	(0.0409)	(0.0386)	(0.0374)	(0.0326)	(0.0320)
Energy exports	-0.00807	-0.0378	0.0454*	0.0349	0.0150
	(0.0309)	(0.0328)	(0.0251)	(0.0290)	(0.0271)
Energy imports	0.0295	0.0798***	-0.0361*	-0.0299	-0.00985
	(0.0205)	(0.0260)	(0.0202)	(0.0329)	(0.0294)
endogiv1	5.112**	8.968***	7.037***	7.725***	7.956***
	(2.312)	(2.875)	(2.620)	(2.647)	(2.616)
endogiv2	-0.544	-1.554**	-0.804**	-1.276**	-1.205*
	(0.336)	(0.646)	(0.392)	(0.635)	(0.636)
endogiv3	0.582*	1.613**	0.818**	1.292*	1.228
	(0.335)	(0.786)	(0.386)	(0.779)	(0.784)
% RE rec.	0.181	0.0907	0.269***	0.0631	0.0306
	(0.119)	(0.214)	(0.0997)	(0.228)	(0.226)
CO2 pc rec.	0.310	-0.381	0.579***	-0.460	-0.413
	(0.255)	(0.535)	(0.216)	(0.583)	(0.525)
Vulnerability rec.	-1.253	-1.353	0.0277	-2.852	-1.173
	(2.599)	(19.21)	(1.603)	(14.45)	(13.89)
Reg. quality rec.	-2.787**	-5.358***	-3.963**	-4.500***	-4.636***
	(1.404)	(1.842)	(1.598)	(1.736)	(1.695)
Political stability rec.	1.081**	1.513**	1.452***	1.304**	1.339**
	(0.443)	(0.610)	(0.509)	(0.602)	(0.578)
Colony	0.0937	-0.470	0.0479	0.281	0.489
	(0.432)	(0.873)	(0.469)	(0.767)	(0.923)
RTA	6.838**	12.39***	9.060***	10.22***	10.35***
	(2.951)	(3.877)	(3.338)	(3.619)	(3.538)
GATT	3.355**	5.162**	4.990***	2.587	2.287
	(1.537)	(2.200)	(1.801)	(2.508)	(2.407)
Dist.	0.0445	0.0818	-0.240	-0.693***	-0.712***
	(0.271)	(0.344)	(0.282)	(0.248)	(0.246)
GDP pc ppp rec.	-0.547	0	-0.339	0	0
	(0.645)	(.)	(0.504)	(.)	(.)
GDP pc ppp don.	0.746*	0.804*	2.125	0	3.283**
	(0.426)	(0.488)	(2.847)	(.)	(1.529)
Intercept	21.94**	41.40*	29.77*	47.04**	36.89**
	(10.76)	(22.65)	(15.54)	(18.72)	(15.95)
Year FE	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes
Recipient FE		Yes		Yes	Yes
Year-Donor FE				Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes	Yes
N	7439	7372	7336	6984	7277
pseudo R^2	0.204	0.342	0.417	0.603	0.558
AIC	121343.7	100190.9	88662.3	59521.7	66983.6
BIC	121489.0	100329.0	88807.2	59651.8	67121.4
Wald chi2 (sig.)	159.3 (0.000)	156.1 (0.000)	242.6 (0.000)	106.6 (0.000)	113.2 (0.000)

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Fig. A8. IV estimations summarizing the impact of the independent variables on the amount of RE ODA (elasticities)



Source: Own elaboration
Note: C means model with controls (coefficients as included in Table 5 and Table A16 in the appendix) and NC means model without controls (coefficients as included in Table A17). The graph represents the estimations derived from the regressions including year-donor FE and recipients FE. Values in the x-axe represents coefficients and can be interpreted as elasticities. Highlighted variables in the y-axe are statistically significant.

Table A17. IV estimations (second stage) without controls - coefficients PPMLHDFE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.232***	1.150***	1.531***	1.143***	1.129***					
	(0.198)	(0.269)	(0.168)	(0.264)	(0.266)					
HHI						-0.0957	0.264	-0.368	0.309	0.255
						(0.276)	(0.296)	(0.251)	(0.283)	(0.310)
Lithium imports	0.0633	0.0894	-0.0148	0.0244	0.00220	0.0784	0.0846	-0.0116	-0.00228	-0.0176
	(0.0514)	(0.0596)	(0.0443)	(0.0448)	(0.0474)	(0.0562)	(0.0598)	(0.0626)	(0.0482)	(0.0478)
Rare earths imports	0.163***	0.180***	0.0684**	0.0428	0.0421	0.182***	0.177***	0.0932***	0.0372	0.0350
	(0.0365)	(0.0409)	(0.0315)	(0.0373)	(0.0374)	(0.0372)	(0.0413)	(0.0356)	(0.0364)	(0.0359)
Cobalt imports	0.128***	0.133***	0.102***	0.0703*	0.0566*	0.147***	0.123***	0.133***	0.0575	0.0470
	(0.0391)	(0.0389)	(0.0308)	(0.0361)	(0.0330)	(0.0433)	(0.0402)	(0.0409)	(0.0384)	(0.0370)
Energy exports	-0.0241	-0.0332	0.0111	0.0177	0.00925	-0.0157	-0.0330	0.0262	0.0200	0.0110
	(0.0288)	(0.0366)	(0.0261)	(0.0347)	(0.0317)	(0.0285)	(0.0354)	(0.0265)	(0.0335)	(0.0300)
Energy imports	0.0361	0.0615**	-0.00780	-0.000351	0.00775	0.0368*	0.0638**	-0.0111	-0.000751	0.00971
	(0.0223)	(0.0265)	(0.0198)	(0.0324)	(0.0308)	(0.0214)	(0.0263)	(0.0207)	(0.0323)	(0.0280)
IV1 - Auctions	-0.0284	0.209	0.00266	0.0737	0.0574	0.216	0.254	0.238*	0.126	0.171
	(0.159)	(0.352)	(0.117)	(0.301)	(0.295)	(0.154)	(0.336)	(0.129)	(0.289)	(0.316)
IV2 – Fits	0.131	0.269**	0.159**	0.227	0.188	0.148	0.284**	0.187**	0.240	0.296*
	(0.0857)	(0.135)	(0.0678)	(0.166)	(0.168)	(0.0900)	(0.137)	(0.0793)	(0.162)	(0.180)
IV3 – Tax credits	-0.147	-0.496***	-0.180*	-0.385*	-0.349	-0.198	-0.458**	-0.258**	-0.338	-0.328
	(0.123)	(0.183)	(0.0958)	(0.215)	(0.225)	(0.135)	(0.192)	(0.117)	(0.226)	(0.255)
Intercept	-1.462	-1.417	-0.732	-0.244	-0.294	1.100	0.810	1.857**	2.099*	2.283*
	(1.068)	(1.812)	(0.865)	(1.331)	(1.292)	(0.928)	(1.709)	(0.818)	(1.147)	(1.185)
Year FE	Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes			Yes		Yes
Recipient FE		Yes		Yes	Yes		Yes		Yes	Yes
Year-Donor FE				Yes					Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
N	7714	7647	7611	7237	7552	6737	6735	6657	6375	6655
pseudo R^2	0.200	0.317	0.424	0.564	0.525	0.125	0.286	0.333	0.541	0.496
AIC	123260.3	104911.9	88373.2	65976.3	72713.6	129945.0	106042.8	98789.0	67012.2	74614.4
BIC	123329.8	104981.3	88442.5	66045.2	72782.9	130013.1	106111.0	98857.0	67079.8	74682.4
chi2	121.0	82.48	193.6	35.03	34.98	79.26	65.43	62.82	13.75	17.65

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table A17 (cont). IV estimations (second stage) without controls - coefficients PPMLHDFE

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.176***	0.306***	0.188***	0.447***	0.412***
	(0.0278)	(0.0418)	(0.0378)	(0.0608)	(0.0568)
Lithium imports	0.0886	0.123*	0.00415	0.0745	0.0439
	(0.0580)	(0.0632)	(0.0662)	(0.0506)	(0.0516)
Rare earths imports	0.193***	0.199***	0.111***	0.0463	0.0503
	(0.0382)	(0.0405)	(0.0373)	(0.0384)	(0.0382)
Cobalt imports	0.157***	0.139***	0.144***	0.0587*	0.0493
	(0.0445)	(0.0379)	(0.0436)	(0.0327)	(0.0331)
Energy exports	-0.00971	-0.0348	0.0366	0.0459	0.0329
	(0.0285)	(0.0311)	(0.0260)	(0.0285)	(0.0269)
Energy imports	0.0345	0.0714***	-0.0185	-0.0212	-0.00852
	(0.0217)	(0.0261)	(0.0222)	(0.0322)	(0.0290)
IV1 - Auctions	0.284*	0.171	0.339**	0.125	0.211
	(0.157)	(0.353)	(0.135)	(0.290)	(0.330)
IV2 – Fits	0.175*	0.259	0.229***	0.237	0.367*
	(0.0909)	(0.160)	(0.0831)	(0.157)	(0.194)
IV3 – Tax credits	-0.246*	-0.395*	-0.336***	-0.339	-0.407
	(0.141)	(0.225)	(0.127)	(0.226)	(0.277)
Intercept	1.248	0.651	2.099**	2.205**	2.309**
	(0.918)	(1.757)	(0.817)	(1.061)	(1.071)
Year FE	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes
Recipient FE		Yes		Yes	Yes
Year-Donor FE				Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes	
N	7714	7647	7611	7237	7552
pseudo R^2	0.144	0.333	0.332	0.589	0.543
AIC	131799.9	102516.3	102460.7	62080.7	69986.0
BIC	131869.4	102585.8	102530.1	62149.6	70055.3
chi2	98.24	134.8	91.25	74.43	70.56

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table A18. IV estimations (second stage) - coefficients PPMLHDFE with production

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.105***	1.150***	1.326***	1.179***	1.187***					
	(0.231)	(0.256)	(0.218)	(0.247)	(0.260)					
HHI						0.226	0.254	0.0217	0.257	0.242
						(0.244)	(0.324)	(0.213)	(0.318)	(0.327)
Lithium prod	-0.0647	0.111*	-0.0521	0.115***	0.111*	-0.0800	0.155**	-0.0706	0.160***	0.154**
	(0.0579)	(0.0603)	(0.0431)	(0.0426)	(0.0583)	(0.0608)	(0.0619)	(0.0446)	(0.0459)	(0.0603)
Rare earths prod	0.0557	0.145	0.0744**	0.158	0.149	0.0836	0.150	0.111***	0.163*	0.156*
	(0.0556)	(0.109)	(0.0372)	(0.104)	(0.110)	(0.0570)	(0.0924)	(0.0393)	(0.0878)	(0.0931)
Cobalt prod	-0.00258	-0.109	0.00194	-0.107*	-0.104	0.0195	-0.0886	0.0306	-0.0911	-0.0832
	(0.0407)	(0.0676)	(0.0261)	(0.0624)	(0.0689)	(0.0445)	(0.0622)	(0.0299)	(0.0598)	(0.0639)
Energy exports	-0.0262	-0.0462	0.0106	-0.00139	-0.00705	-0.0165	-0.0473	0.0270	0.00257	-0.00701
	(0.0344)	(0.0351)	(0.0311)	(0.0325)	(0.0319)	(0.0349)	(0.0346)	(0.0333)	(0.0324)	(0.0303)
Energy imports	0.0533**	0.0856***	-0.0105	-0.00219	0.00212	0.0466**	0.0887***	-0.0213	-0.00305	0.00512
	(0.0211)	(0.0262)	(0.0236)	(0.0315)	(0.0298)	(0.0203)	(0.0259)	(0.0224)	(0.0319)	(0.0281)
endogiv1	0.913	5.874*	1.448	5.582	5.551	4.170*	6.193*	5.204**	5.440	5.792*
	(2.311)	(3.470)	(2.099)	(3.579)	(3.511)	(2.384)	(3.315)	(2.391)	(3.319)	(3.366)
endogiv2	0.0101	-0.815	-0.0782	-0.693	-0.725	-0.463	-1.016	-0.614*	-0.768	-0.911
	(0.354)	(0.783)	(0.331)	(0.831)	(0.800)	(0.345)	(0.773)	(0.362)	(0.806)	(0.790)
endogiv3	0.0237	0.767	0.102	0.626	0.663	0.484	1.046	0.633*	0.761	0.924
	(0.349)	(0.898)	(0.327)	(0.954)	(0.918)	(0.342)	(0.903)	(0.356)	(0.949)	(0.924)
% RE rec.	0.116	0.0645	0.154	0.0591	0.0589	0.184	0.118	0.231**	0.124	0.107
	(0.139)	(0.205)	(0.120)	(0.215)	(0.203)	(0.124)	(0.203)	(0.109)	(0.214)	(0.200)
CO2 pc rec.	0.253	-1.056*	0.346	-1.040*	-1.066*	0.438	-0.468	0.526**	-0.532	-0.460
	(0.284)	(0.636)	(0.254)	(0.629)	(0.643)	(0.270)	(0.554)	(0.226)	(0.535)	(0.558)
Vulnerability rec.	-2.347	2.533	-1.189	4.183	2.766	-1.284	-3.843	-0.326	-2.574	-3.787
	(2.471)	(18.11)	(1.548)	(18.69)	(18.06)	(2.538)	(18.16)	(1.687)	(18.55)	(18.09)
Reg. quality rec.	-0.384	-3.483	-0.723	-3.252	-3.270	-2.290	-3.659*	-2.937**	-3.115	-3.397
	(1.419)	(2.240)	(1.299)	(2.306)	(2.266)	(1.437)	(2.112)	(1.459)	(2.119)	(2.143)
Political stability rec.	0.186	0.890	0.300	0.828	0.834	0.859*	0.966	1.073**	0.800	0.896
	(0.469)	(0.713)	(0.438)	(0.750)	(0.726)	(0.461)	(0.692)	(0.469)	(0.715)	(0.706)
Colony	-0.0745	-0.197	0.275	0.772	0.736	-0.0815	-0.522	0.0851	0.547	0.424
	(0.400)	(0.851)	(0.434)	(0.893)	(0.892)	(0.414)	(0.913)	(0.449)	(0.944)	(0.933)
RTA	1.518	7.955*	2.060	6.962	6.970	5.646*	8.627*	6.851**	6.951	7.501
	(2.908)	(4.762)	(2.641)	(4.951)	(4.811)	(2.984)	(4.588)	(3.010)	(4.615)	(4.625)
GATT	1.038	2.880	1.589	0.419	0.577	3.316**	3.295	4.144**	0.778	1.008

	(1.581)	(2.811)	(1.547)	(3.328)	(3.080)	(1.565)	(2.689)	(1.671)	(3.158)	(3.008)
Dist.	-0.0363	0.0353	-0.320	-0.770***	-0.740***	-0.0128	0.0465	-0.278	-0.727***	-0.745***
	(0.236)	(0.307)	(0.223)	(0.256)	(0.259)	(0.255)	(0.302)	(0.267)	(0.251)	(0.257)
GDP pc ppp rec.	-0.741	0	-0.483	0	0	-0.453	0	-0.242	0	0
	(0.723)	(.)	(0.589)	(.)	(.)	(0.620)	(.)	(0.532)	(.)	(.)
GDP pc ppp don.	0.467	0.567	1.271	0	1.213	0.511	0.578	0.642	0	0.856
	(0.369)	(0.421)	(2.829)	(.)	(2.839)	(0.363)	(0.422)	(2.700)	(.)	(2.769)
Intercept	1.445	28.29	4.529	40.48*	34.17	18.41*	27.00	26.46*	36.04	33.87
	(10.90)	(23.18)	(15.18)	(22.99)	(23.99)	(10.88)	(23.98)	(13.95)	(23.80)	(25.37)
Year FE	Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes			Yes		Yes
Recipient FE		Yes		Yes	Yes		Yes		Yes	Yes
Year-Donor FE				Yes					Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
N	7439	7372	7336	6984	7277	6564	6562	6484	6218	6482
pseudo R^2	0.183	0.301	0.433	0.579	0.540	0.132	0.271	0.379	0.557	0.517
AIC	124652.2	106314.2	86198.3	63015.8	69711.8	127947.5	107415.9	91262.7	64242.0	70946.1
BIC	124797.4	106452.3	86343.2	63145.9	69849.7	128090.1	107551.7	91405.1	64370.0	71081.6
chi2	91.43	125.9	298.8	97.66	97.12	100.1	93.92	168.6	97.78	76.75

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table A18 (cont). IV estimations (second stage) - coefficients PPMLHDFE with production

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.284***	0.330***	0.417***	0.421***	0.421***
	(0.0367)	(0.0577)	(0.0612)	(0.0609)	(0.0609)
Lithium prod	0.162**	-0.0792*	0.178***	0.155**	0.155**
	(0.0665)	(0.0449)	(0.0555)	(0.0615)	(0.0615)
Rare earths prod	0.149*	0.118***	0.171**	0.164**	0.164**
	(0.0868)	(0.0401)	(0.0794)	(0.0751)	(0.0751)
Cobalt prod	-0.109*	0.0452	-0.0762	-0.0986	-0.0986
	(0.0643)	(0.0309)	(0.0485)	(0.0613)	(0.0613)
Energy exports	-0.0512	0.0510*	0.0169	0.0172	0.0172
	(0.0313)	(0.0288)	(0.0269)	(0.0268)	(0.0268)
Energy imports	0.0986***	-0.0368*	-0.00992	-0.00908	-0.00908
	(0.0261)	(0.0211)	(0.0279)	(0.0280)	(0.0280)
endogiv1	6.492**	7.026***	6.503**	5.645*	5.645*
	(3.249)	(2.672)	(2.835)	(3.260)	(3.260)
endogiv2	-1.066	-0.830**	-0.905	-0.747	-0.747
	(0.781)	(0.399)	(0.704)	(0.814)	(0.814)
endogiv3	1.123	0.865**	0.924	0.741	0.741
	(0.921)	(0.396)	(0.849)	(0.956)	(0.956)
% RE rec.	0.0795	0.246**	0.0295	0.0330	0.0330
	(0.211)	(0.101)	(0.225)	(0.225)	(0.225)
CO2 pc rec.	-0.431	0.507**	-0.574	-0.567	-0.567
	(0.542)	(0.213)	(0.527)	(0.559)	(0.559)
Vulnerability rec.	-2.806	-0.261	-2.376	-2.367	-2.367
	(18.03)	(1.541)	(13.76)	(14.91)	(14.91)
Reg. quality rec.	-3.857*	-3.999**	-3.759**	-3.268	-3.268
	(2.089)	(1.627)	(1.839)	(2.097)	(2.097)
Political stability rec.	1.017	1.456***	1.063*	0.895	0.895
	(0.692)	(0.518)	(0.617)	(0.703)	(0.703)
Colony	-0.294	0.161	0.687	0.740	0.740
	(0.927)	(0.441)	(0.956)	(0.956)	(0.956)
RTA	9.064**	9.183***	8.398**	7.214	7.214
	(4.543)	(3.391)	(3.869)	(4.549)	(4.549)
GATT	3.332	5.144***	1.043	0.487	0.487
	(2.669)	(1.814)	(2.645)	(3.044)	(3.044)
Dist.	-0.0328	-0.183	-0.719***	-0.724***	-0.724***
	(0.343)	(0.267)	(0.237)	(0.241)	(0.241)
GDP pc ppp rec.	0	-0.222	0	0	0
	(.)	(0.511)	(.)	(.)	(.)
GDP pc ppp don.	0.413	1.483	2.489	1.449	1.449
	(0.432)	(2.633)	(1.721)	(2.469)	(2.469)
Intercept	30.86	31.33**	31.91**	31.65	31.65
	(22.75)	(14.72)	(16.12)	(22.80)	(22.80)
Year FE	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes
Recipient FE		Yes		Yes	Yes
Year-Donor FE				Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes	
N	7372	7336	7277	7277	7277
pseudo R^2	0.316	0.408	0.562	0.566	0.566
AIC	104131.7	89989.9	66409.0	65817.8	65817.8
BIC	104269.9	90134.9	66546.9	65955.7	65955.7
chi2	133.7	207.1	168.8	156.1	156.1

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Table A19. IV estimations (second stage) without controls - coefficients PPMLHDFE with production

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Market structure										
Centrality	1.273***	1.107***	1.524***	1.111***	1.121***					
	(0.195)	(0.255)	(0.173)	(0.251)	(0.256)					
HHI						-0.108	0.277	-0.359	0.299	0.281
						(0.266)	(0.295)	(0.235)	(0.281)	(0.291)
Lithium prod	-0.0716	0.0950	-0.0797*	0.103***	0.0938	-0.127	0.135**	-0.136**	0.147***	0.133**
	(0.0689)	(0.0591)	(0.0432)	(0.0390)	(0.0572)	(0.0804)	(0.0628)	(0.0619)	(0.0442)	(0.0600)
Rare earths prod	0.0376	0.129	0.0700**	0.150	0.142	0.0897	0.161*	0.121**	0.181*	0.177*
	(0.0565)	(0.115)	(0.0346)	(0.117)	(0.121)	(0.0602)	(0.0961)	(0.0506)	(0.0981)	(0.102)
Cobalt prod	0.00904	-0.147**	0.0109	-0.152**	-0.149**	0.0401	-0.130**	0.0536	-0.139***	-0.131**
	(0.0527)	(0.0649)	(0.0390)	(0.0597)	(0.0662)	(0.0552)	(0.0561)	(0.0479)	(0.0528)	(0.0580)
Energy exports	-0.0224	-0.0440	0.0209	0.0152	0.0129	-0.0140	-0.0452	0.0353	0.0197	0.0128
	(0.0281)	(0.0325)	(0.0278)	(0.0325)	(0.0304)	(0.0288)	(0.0323)	(0.0295)	(0.0318)	(0.0293)
Energy imports	0.0480**	0.0790***	-0.0130	0.00482	0.00476	0.0441**	0.0824***	-0.0189	0.00238	0.00848
	(0.0199)	(0.0259)	(0.0197)	(0.0313)	(0.0289)	(0.0195)	(0.0255)	(0.0203)	(0.0314)	(0.0276)
endogiv1	-0.00456	0.0740	-0.0268	-0.0634	-0.0781	0.167	0.122	0.168	0.00181	-0.0279
	(0.168)	(0.341)	(0.123)	(0.293)	(0.284)	(0.158)	(0.317)	(0.138)	(0.273)	(0.273)
endogiv2	0.164**	0.290**	0.157**	0.188	0.180	0.173**	0.294**	0.177**	0.206	0.183
	(0.0824)	(0.146)	(0.0644)	(0.168)	(0.169)	(0.0837)	(0.150)	(0.0726)	(0.170)	(0.173)
endogiv3	-0.159	-0.437**	-0.147	-0.247	-0.243	-0.188	-0.399**	-0.206*	-0.215	-0.197
	(0.121)	(0.193)	(0.0978)	(0.213)	(0.216)	(0.131)	(0.203)	(0.115)	(0.228)	(0.233)
Intercept	-1.200	-1.408	-0.583	-0.165	-0.369	1.122	0.640	1.878**	1.983*	1.735
	(1.147)	(1.738)	(0.895)	(1.300)	(1.258)	(1.079)	(1.581)	(0.951)	(1.055)	(1.074)
Year FE	Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes			Yes		Yes
Recipient FE		Yes		Yes	Yes		Yes		Yes	Yes
Year-Donor FE				Yes					Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	
N	7714	7647	7611	7237	7552	6737	6735	6657	6375	6655
pseudo R^2	0.169	0.298	0.417	0.568	0.530	0.092	0.267	0.326	0.546	0.507
AIC	127942.7	107935.9	89478.9	65311.6	71936.2	134787.6	108888.2	99687.0	66250.6	72939.0
BIC	128012.2	108005.3	89548.2	65380.5	72005.5	134855.8	108956.4	99755.0	66318.2	73007.0
chi2	64.50	79.91	166.2	66.69	52.21	40.77	56.59	56.12	40.35	30.60

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

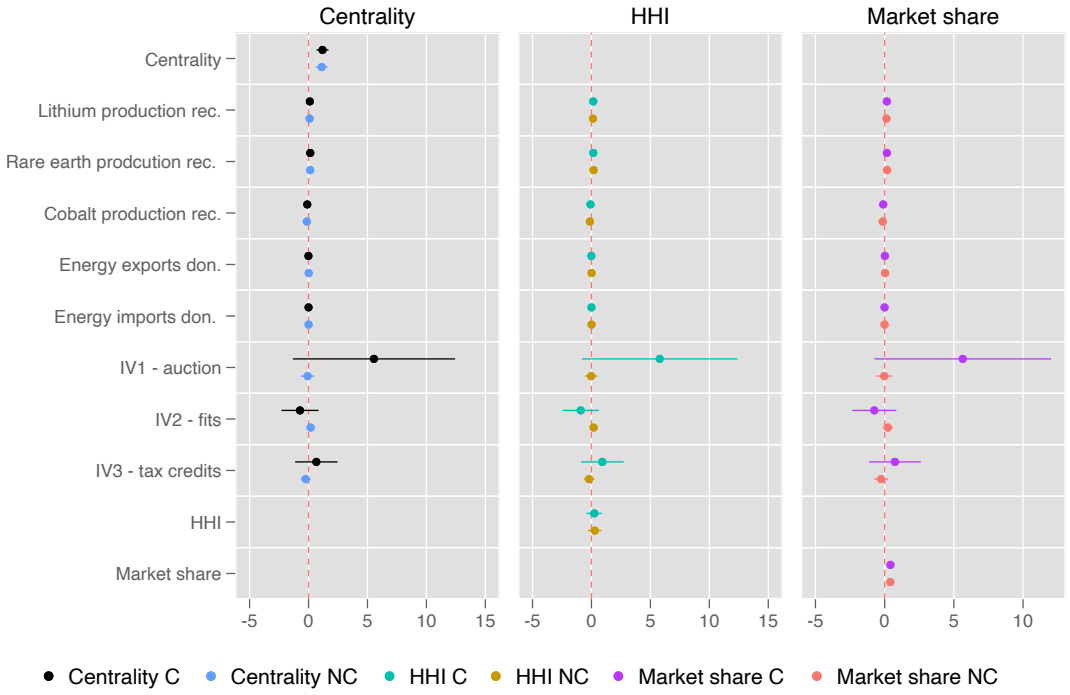
Table A19 (cont). IV estimations (second stage) without controls - coefficients PPMLHDFE with production

	(11)	(12)	(13)	(14)	(15)
Market structure					
Market share	0.169***	0.278***	0.197***	0.444***	0.411***
	(0.0252)	(0.0341)	(0.0393)	(0.0659)	(0.0575)
Lithium prod	-0.143*	0.147**	-0.157**	0.159***	0.136**
	(0.0852)	(0.0663)	(0.0692)	(0.0451)	(0.0624)
Rare earths prod	0.107	0.164*	0.141**	0.189**	0.179**
	(0.0653)	(0.0915)	(0.0587)	(0.0819)	(0.0842)
Cobalt prod	0.0505	-0.154***	0.0734	-0.147***	-0.142**
	(0.0555)	(0.0572)	(0.0498)	(0.0503)	(0.0562)
Energy exports	-0.00804	-0.0486*	0.0485*	0.0460	0.0335
	(0.0278)	(0.0285)	(0.0278)	(0.0281)	(0.0254)
Energy imports	0.0422**	0.0947***	-0.0278	-0.0187	-0.00429
	(0.0199)	(0.0262)	(0.0220)	(0.0307)	(0.0276)
endogiv1	0.207	0.00955	0.245*	-0.0399	-0.0290
	(0.153)	(0.339)	(0.143)	(0.269)	(0.286)
endogiv2	0.195**	0.255	0.210***	0.206	0.233
	(0.0844)	(0.168)	(0.0757)	(0.160)	(0.192)
endogiv3	-0.225*	-0.321	-0.267**	-0.234	-0.253
	(0.136)	(0.228)	(0.124)	(0.224)	(0.257)
Intercept	1.164	0.426	2.056**	1.817*	1.641*
	(1.041)	(1.728)	(0.956)	(0.994)	(0.969)
Year FE	Yes	Yes	Yes		Yes
Donor FE			Yes		Yes
Recipient FE		Yes		Yes	Yes
Year-Donor FE				Yes	
Donor-recipient cluster	Yes	Yes	Yes	Yes	
N	7714	7647	7611	7237	7552
pseudo R^2	0.111	0.312	0.328	0.596	0.556
AIC	136896.5	105744.9	103116.0	61121.9	68070.9
BIC	136966.0	105814.3	103185.4	61190.7	68140.2
chi2	77.97	104.8	78.65	88.37	88.58

Standard errors in parentheses * p<.10, ** p<.05, *** p<.01

Fig. A9. IV estimations summarizing the impact of the independent variables on the amount of RE ODA (elasticities) including production of critical minerals.

(a) All independent variables



(b) Zoom in – critical minerals and energy variables

