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THE ECONOMIC IMPLICATIONS OF TIED AID AND LOCAL CONTENT REQUIREMENTS FOR CLIMATE FINANCE

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1. INTRODUCTION

Given the asymmetries in terms of responsibility, capability and vulnerability between countries, North-to-South financial transfers play a key role in the coordination of the global action against climate change. In the climate summits of Copenhagen (UNFCCC, 2009) and Cancun (UNFCCC, 2010), developed countries committed to mobilize financial resources to support climate action in developing countries. In this respect, two quantitative goals were set: USD 30 billion for the period 2010 – 2012 (i.e. the Fast-start Finance or FSF) and USD 100 billion per year by 2020 (ibid). Besides, the Paris Agreement points at raising ambition in terms of climate finance mobilization after 2025 (UNFCCC, 2015). The Organization for Economic Cooperation and Development (OECD) and the CPI have estimated that in the period 2013-2014 North-to-South climate finance reached USD 57 billion on average (OECD and CPI, 2015) [i].

It can be expected that international climate finance flows will continue to grow in the near future, so it is important to understand the economic consequences of these flows. The study of the geographic distribution of the economic impact of climate finance shows that, while the largest share of the impact is local, international trade deviates one part of the impact away from the recipient country (Román et al., 2018a, 2018b). This part constitutes the so-called spill-over effect[ii]. A sizeable share of the spill-over effect occurs in countries that are major contributors to climate finance (ibid). This is a very important feature of the climate finance flows that may affect donors' incentives. This paper focuses on the effect of spending conditions such as tied aid and local content requirements (LCR) on the size of these extra-benefits for the donor country.

In the 1990s, approximately 50% of foreign aid was "tied", meaning that recipients of aid had the explicit obligation of using the transferred resources in buying products (or contracting services) from the donor countries' companies (Wagner, 2003)[iii]. It has been claimed that this practice negatively affects aid effectiveness and efficiency (Osei, 2005), and the OECD has officially opposed this practice in several occasions[iv]. In 2007, tied aid was 24% of the total foreign aid[v]. However, the portion of actual tied aid is estimated to be much bigger, since technical cooperation and management components of most projects have been found to be *de facto* tied (Clay et al., 2009). In previous studies, the use of this practice by several donors such as Japan (Whitley, 2012), UK (Whitley et al., 2012), Germany (Whitley and Mohanty, 2013) and USA (Whitley and Mohanty, 2012) has been confirmed. This paper contributes to this research line by quantifying the economic effect of this practice.

LCR are provisions that regulate the extent to which certain projects must use local goods and/or services. It is explicitly prohibited under the World Trade Organization (WTO), but many member states have used them to protect local industries. For instance, in emerging economies, LCR have enabled the development of competitive renewable energy industries (Johnson, 2013; Kuntze and Moerenhout, 2012; Mathews, 2015; Pérez, 2013, 2013). This paper also complements this other research line with the quantification of the economic consequences of LCR.

The literature on climate finance has focused on aspects such as climate funds (Amin, 2015; Buchner et al., 2011, 2013, 2014, 2015; Fridahl and Linnér, 2015; Schalatek et al., 2015), finance needs (UNEP, 2014a, 2014b), climate agreements (Barrett, 2009; Barrett and Stavins, 2003; Benchekroun et al., 2011; Bowen et al., 2015; de Zeeuw, 2015; Marrouch and Ray Chaudhuri, 2011; Tian and Whalley, 2010), mobilization options (Buchholz and Peters, 2007; Buob and Stephan, 2013; Grasso, 2010; Heuson et al., 2012; Hof et al., 2011; Pickering et al., 2015; Pittel and Rübbelke, 2013; Rübbelke, 2011; Schenker and Stephan, 2014; Urpelainen, 2012a) or effectiveness (Bird and Brown, 2010; Chaum et al., 2011; Joffe et al., 2013; Michaelowa, 2012; Urpelainen, 2012b; Vandeweerd et al., 2012). To the best of our knowledge, no existing empirical research addresses the effects of spending conditions on the economic impacts of climate finance disbursements.

The two main research questions are the following: First, what is the effect of tied aid and LCR on the spill-overs captured by donor countries? Second, what locations and industries are more sensitive to these practices? The scope of this exercise is limited to the economic consequences of the phase of climate finance disbursement. The study of the economic implications of the previous phase of mobilization of climate finance is beyond the scope of this paper[vi]. The focus is on a group of donor and recipient countries, and on a set of 26 climate actions including the most relevant mitigation and adaptation solutions.

The article is structured in five sections. After this brief introduction, section 2 describes the methodology used to quantify the differences in spill-over effects arising from spending conditions. Section 3 presents the results, and finally, section 4 concludes.

2. METHODS AND DATA

The Leontief Input-Output (IO) model is able to capture direct and indirect impacts, and differentiates the part of the impact happening in a different place from where interventions take place (i.e. spill-over effects). Using this methodology, Beutel (2002) found that spill-over effects of European Structural Funds represented 20-30% of the total impact. However, the single-country IO framework used in that study was unable to show which countries were benefiting from these spill-overs.

A Global Multiregional Input-Output (GMRIO) framework is required for that purpose (Miller and Blair, 2009). GMRIO models are being increasingly used in the literature on global value chains (Johnson and Noguera, 2012; Koopman et al., 2012, 2014; Los et al., 2015), environmental footprints (Arto et al., 2012; Hoekstra and Mekonnen, 2012; Hoekstra and Wiedmann, 2014; Steen-Olsen et al., 2012; Wiedmann et al., 2013; Yu et al., 2013), and environmental consequences of international trade (Arto et al., 2014; Peters and Hertwich, 2008, Lenzen et al. 2007). Spill-overs, in particular, have been analysed in the study of the cross-border effects of trade (Arto et al., 2015). In the field of climate policy, the recent papers by Markandya et al. (2016) and Román et al. (2018b) track the domestic and cross-border effects (on employment and value added, respectively) associated to the energy transition in the EU in the former, and to climate finance disbursements in the latter. For this exercise, the World Input-Output Database (WIOD) is used. It provides multiregional IO tables (i.e. the WIOT) containing 35 sectors of 41 regions for the period 1995-2011 (Dietzenbacher et al., 2013; Timmer et al., 2012). Due to data availability constraints, the focus is on a particular set of countries. As donor countries, Germany, UK, Japan and USA are considered. These are four climate finance donors that may have tied climate aid in the past (Whitley, 2012; Whitley et al., 2012; Whitley and Mohanty, 2012, 2013), and together they represent nearly 60% of the climate finance pledged as for December 2017. As climate finance recipient countries, Brazil, China, Indonesia, India and Mexico are considered. These countries are five of the main climate finance recipient countries, accounting for 25% of the total funding approved as for December 2017[vii]. The year of study is 2011.

Data on climate finance disbursements is also required to characterize the demand shocks produced by climate finance in the recipient economy. Different types of climate actions entail different demand shocks. Different classifications of mitigation and adaptation measures from the literature are combined (Blazejczak et al., 2014; Buchner et al., 2013; OECD/IEA, 2014; Prowse and Snilstveit, 2010; REN21, 2014, p. 21) to obtain a set of measures representing the whole spectrum of climate action. Table A.1. in the Appendix contains a list with the 26 climate action types considered. For each of these types, the typical cost structure (i.e. distribution of the budget between the different economic sectors) is estimated using different sources of information.

Previous studies provide information about the cost structure of renewable energy technologies and energy efficiency measures (Lehr et al., 2008, 2012;Allan et al., 2008; Markaki et al., 2013). The cost structures of adaptation options are based on Priority Project Profile documents of National Adaptation Programmes of Action (NAPAs)[viii]. In order to connect this information with the GMRIO framework, cost structures are expressed in terms of industries following the NACE classification following the correspondence between commodities and industries detailed in Table A.2. in the Appendix.

In this model, demand shocks represent the new requirements of production for different industries that a particular climate action entails. We define $\mathbf{e}^a$ as the column vector of the demand shock, with elements e_j^a indicating the proportion of expenditure on a specific climate action *a* spent in sector *j*. We assume that this expenditure by sector is expressed at basic prices, i.e. excluding taxes and transport and trade margins.

Then the new demands are allocated to specific countries under three hypothetical scenarios regarding spending conditions: baseline, tied aid and LCR scenarios. To define the scenarios we depart from $\mathbf{f}^{st}$, the column vector of final demand in the WIOT, with elements f_j^{st} indicating the final demand in country *t* for products from industry *j* of country *s*. We calculate the fraction of the total final demand in country *t* for commodities imported from industry *j* from country *s* (when $s \neq t$) or produced domestically (when $s = t$) as $t_j^{st} = \frac{f_j^{st}}{\sum_s f_j^{st}}$. The column vector $\mathbf{t}^{st}$ indicates the trade structure of country *t* in the baseline scenario. This scenario, based on the actual flows of international trade as for 2011, is used as reference for comparison with the other two scenarios, and reflects the *status quo* of tied aid and LCR practices.

The tied aid scenario is based on the baseline scenario but substituting imports from third countries with imports from the donor country (the share of the demand satisfied with domestic production remains constant). This scenario represents a hypothetical situation in which the donor imposes as condition to be the supplier of all the goods and services that the recipient country has to import for the implementation of climate actions.

The LCR scenario consists in substituting all imports with domestic products. This would represent the extreme case in which recipient countries impose a 100% LCR as condition for hosting internationally funded climate actions[ix].

For the construction of these two scenarios, we substitute certain elements of the trade structure vector. We illustrate the procedure using an example with three countries, where 1 is the donor country, 2 is the recipient country and 3 is a third country. Then, in the baseline scenario $\mathbf{t}_B^{s2} = \begin{pmatrix} t^{12} \\ t^{22} \\ t^{32} \end{pmatrix}$, in the tied aid scenario

$\mathbf{t}_T^{s2} = \begin{pmatrix} t^{12} + t^{32} \\ t^{22} \\ 0 \end{pmatrix}$ and in the LCR scenario $\mathbf{t}_L^{s2} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$.

Next, we quantify total output requirements associated to this new demand considering both the demand and its production multiplier effect. The total output requirements are condensed in the Leontief inverse matrix calculated with information from the WIOT. To calculate the Leontief inverse we depart from $\mathbf{x}^r$, the column vector of gross output in country *r*, and $\mathbf{Z}^{rs}$, the matrix of intermediate inputs, with elements z_{ij}^{rs} indicating the sales of industry *i* of country *r* to industry *j* of country *s*. Then, we calculate the matrix of input coefficients as $\mathbf{A}^{rs} = \mathbf{Z}^{rs}\left(\hat{\mathbf{x}}^s\right)^{-1}$, where $\left(\hat{\mathbf{x}}^r\right)^{-1}$ is the inverse of the diagonal matrix of this vector. Then, the Leontief inverse matrix is obtained as $\mathbf{L} \equiv \left(\mathbf{I}\text{-}\mathbf{A}\right)^{-1}$, where $\mathbf{I}$ is an identity matrix of the appropriate dimension. $\mathbf{L}^{rs}$ contains the production multipliers of country *r* associated with the demand in country *s*.

In order to determine the contribution of each industry and country to the value-added embedded in these total output requirements, information from the WIOT is used to calculate value-added coefficients, which express the value-added per unit of output in each sector and country. The column vector of value-added coefficients is $\mathbf{v}^r = \left(\hat{\mathbf{x}}^r\right)^{-1}\mathbf{w}^r$, where $\mathbf{w}^r$ is a column vector of value-added with elements w_i^r indicating the value-added by industry *i* in country *r*.

With these elements we can calculate the value-added created in the donor country *r* as a consequence of the implementation of climate action *a* in the recipient country *t* as $\mathrm{W}^{rta} = \sum_s \mathbf{v}^{r\,\prime}\mathbf{L}^{rs}\mathbf{t}^{st} \otimes \mathbf{e}^a$, where $\otimes$ denotes the Hadamard product (i.e. the element by element multiplication).

To facilitate the interpretation and exposition of the results, we group the 26 climate actions into four groups depending on their purpose, i.e. renewable energy (RE), energy efficiency (EE), adaptation (A) and mitigation with adaptation (MA) (following IPCC, 2007 and Román et al., 2018b)[x]; and use group averages in the presentation of results. Table 1 shows the clustering, and Figure 1 illustrates the average cost structure of each group. Cost structures of all climate actions are given in Table A.3. in the Appendix.

Table 1. Grouping of climate actions

Figure 1. Average cost structure by climate action groups

The first group encompasses 14 mitigation actions related with the deployment of generation technologies based on RE sources, and the introduction of biofuels for transport. This group is characterized by a large share of expenses in manufacturing products (36% in machinery and equipment – M7, and 20% in plastic, mineral and metal products – M6). A second group gathers mitigation actions aimed at increasing EE in buildings, industries and in transport. Most of expenses in this group go to the construction sector (60%)[xi] . The next group, MA, comprises three types of adaptation actions that can also reduce emissions, and which require expenses mainly in other business activities (53%)[xii]. Finally, group A, contains other adaptation measures implying a rather equilibrated distribution of expenses among other business activities (35%), machinery (24%) and construction (23%)[xiii].

3. RESULTS AND DISCUSSION

First of all, results show that average spill-over effects across donors, recipient countries and climate actions are 1% in the LCR scenario, 2% in the baseline and 11% in the tied aid scenario. But depending on the climate action, recipient and donor, spill-overs could reach 10% in the LCR scenario, 17% in the baseline and 33% in the tied aid scenario. Figure 2 represents the spill-overs captured by each donor country depending on the recipient and climate action for the three scenarios.

Figure 2. Spill-overs by recipient country and climate action

The USA is the donor capturing the largest spill-overs in all scenarios (7% on average), followed by Japan (5%) and Germany (4%). The UK is the donor with the smallest spill-overs independently of the scenario (3%). Spill-overs differ depending on the country receiving the disbursement of climate finance. In the baseline and LCR scenarios, Germany and the UK capture similar spill-overs from all recipient countries (0% - 2%); Japan captures relatively large spill-overs from Indonesia (2% - 4%), and the USA captures large spill-overs from Mexico (8% - 14%)[xiv].

In the baseline and tied aid scenarios, RE measures generate the largest spill-overs in all donor countries. This is not the case in the LCR scenario, where EE measures generate larger spill-overs in most donors (with the exception of USA). MA measures produce the smallest spill-overs in all scenarios and donors.

When the donor ties its aid, it expands its market share in the recipient country and spill-overs are larger than those in the baseline scenario. Depending on the donor, the recipient and the group of climate action, the increase of spill-overs produced by tied aid ranges from 3 percentage points (pp) – like in the case of Germany when it finances energy efficiency in China – to 26 pp – Japanese finance in Mexico for renewable energy. The average increase is 9 pp. The tied aid specially increases spill-overs produced by disbursements in Mexico and Indonesia, which are the recipient countries producing the largest spill-overs for all donors in this scenario. Regarding the type of actions, spill-overs from RE actions are specially benefited from tied aid (13 pp larger on average).

The opposite happened with the LCR scenario, since it implies a reduction in the spill-overs due to the substitution of all imports with local products. However, LCR reduce spill-overs less than 1 pp in general, with the only exception of the USA, where spill-overs from disbursements in Mexico decrease up to 7pp.

The LCR scenario reduces the differences in the spill-overs obtained by different recipient countries (standard deviations are reduced 0.6 pp on average), whereas the tied aid scenario accentuates these differences (the increase of standard deviations is 3.4 pp on average). Similarly, the LCR scenario reduces the differences in the spill-overs obtained with different climate actions groups, whereas the tied aid scenario accentuates them (standard deviations changes are -0.3 pp and +3.2 pp, respectively).

Summarizing, results show that contrary to the limited effect of LCR, tying aid increases substantially spill-overs captured by every donor independently of the type of action and recipient country. However, the effects of tying aid practices is more significant in the case of certain recipients and climate actions, which coincide with those already producing relatively large spill-overs in the baseline scenario.

Next, we will detail which combinations of recipient country and climate action group are the most convenient to donors considering exclusively the size of spill-overs captured by them. That is, what would each donor finance if the objective would be to maximize the return of funds to their own country? The answer to this question varies depending on the scenario (see Table A.4. in the Appendix). For instance, in the case of Germany, the "best" (in terms of spill-overs maximization) combinations in the baseline scenario consist specially in RE measures in different recipient countries, producing an average spill-over of 2.5%. In the tied aid scenario, the best combinations include RE measures in Mexico and Indonesia, with an average spill-over of 20%. In the LCR scenario, best combinations include EE measures in Mexico and China, with an average spill-over of 1.2%. In short, the analysis of best combinations indicates that, for all donor countries analysed, the possibility to tie aid implies that two countries, i.e. Mexico and Indonesia appear amongst the best options. Regarding the type of climate action, RE measures appear in all cases (donors and scenarios), whereas EE and A measures are amongst the three best options only for some donors and scenarios. With LCR in place, EE measures appear more often amongst the best combinations, while MA measures do never appear amongst the three best options.

Finally, at the industry level, Figure A.1. in the Appendix shows the spill-over effects captured by each industry in each donor country and scenario (the average across climate actions and recipients). It can be observed that in all cases (for all donors) the most affected industry, both by tied aid and LCR, is machinery (M7).

Next, we discuss the results in the light of several macroeconomic indicators. The first indicator is the share of the final demand that is satisfied with domestic production (illustrated in Table 2), which represents the level of self-sufficiency of each recipient country for each type of product. A high level of self-sufficiency is typically associated to small spill-overs. This would be the case of the primary and services sectors, as indicated in the average column in Table 2. The low dependence from imports of these sectors explains that climate actions clustered in the MA group (with 80% of expenditures in these sectors) produce relatively small spill-overs. On the contrary, the recipient countries are in general highly dependent on imports of machinery and equipment (M7), industry where the domestic production satisfies only 64% of final demand on average. This might explain why the tied aid scenario increases specially spill-overs from climate actions related to the deployment of renewable energy and the construction of infrastructures for energy efficiency, with substantial requirements of machinery and equipment. The high dependence on imports of Indonesia and Mexico (as illustrated in the average row of Table 2) would also help to explain why the tied aid scenario produces specially large increases on spill-overs from these two countries.

Table 2. Share of domestic production in recipient countries

The second indicator is the trade share of donors in the final demand of each recipient country, which represents the level of penetration of donors' final goods on the markets of recipient countries (see Table 3). The larger the penetration rates of donors, the larger the spill-overs through trade of final goods. Table 3 shows that the USA is comparatively a prominent provider of many products for recipient countries. This is consistent with the USA being the recipient of the largest spill-overs in the baseline and tied aid scenarios. Note also that, in the case of the USA, the largest trade shares are in Mexico, and in the case of Japan, in Indonesia and China. This reflects the relevance of geographic proximity for trade linkages between countries. Besides, Table 3 also reflects that donors have the largest trade shares in manufacturing industries such as basic metals and non-metallic products (M6) and machinery (M7). This is line with the result of RE projects (where these sectors represent 56% of total expenses) producing the largest spill-overs in the baseline and tied aid scenarios.

Table 3. Trade shares in recipient countries by industry

But some of the sectors that, according to our results, capture relevant spill-overs have also low penetration rates (e.g. primary – P, chemicals – M5, and other business services – S1). An explanation for this might be found in a third indicator: the production multipliers represented in Table 4, which reflect the magnitude of total (direct plus indirect) effects on donors' industries, including the effects via the purchases of intermediate inputs by recipient countries' industries. These effects enable industries not directly involved in the supply of final products to participate in the associated economic benefits, according to their contribution to the value chain of industries directly involved. Values of production multipliers are high for the aforementioned sectors, where spill-overs are relevant despite the limited penetration of donors' final goods. This explains the sectoral results of the LCR scenario, where spill-overs are limited to impacts produced indirectly. This scenario results detrimental for the machinery industry of donor countries, being its impacts reduced from large direct impacts (via trade of final products) to more limited indirect impacts (via trade of intermediate inputs). However, spill-overs in this scenario are not negligible for some combinations of donors and recipient countries, like the USA-Mexico (6-10%), Japan-Indonesia (2-3%), USA-China and Japan-China (2% each). All these combinations are associated to high indirect effects (as shown in Table 4).

Table 4. Indirect effects on donor countries' industries

There are several practical implications that can be derived from this analysis. First, since dependency on imports determines the magnitude of the effect of tied aid, this practice may be specially effective for increasing the participation of donors in the economic stimulus generated by climate finance. This is, for instance, the case when disbursements are received by countries such as Mexico and Indonesia, which are highly dependent on imports, or when disbursements are used for climate actions associated to industries such as machinery or equipment, which are highly dependent on foreign products.

Second, it has been observed that the indirect channel for spill-overs through trade of intermediate goods is not affected by spending conditions imposed by either donors (tying aid) or recipients (LCR). Instead, it is associated with international competitiveness and participation in global value chains. This means that enhancing competitiveness is a way for donors to increase the capture of spill-overs that does not require tying aid, and that it is not affected by eventual LCR in recipient countries. This applies also to those recipient countries that, pursuing the enhancement of their competitive position on global markets, could limit indirect spill-overs.

4. CONCLUSIONS

Previous studies reveal the extension of the practice of tying aid to climate finance. Whitley and Mohanty (2012) estimate that approximately half of the American bilateral support to the private sector for climate action benefited American companies. Whitley and Mohanty (2013) report that 19% of Germany's private-oriented climate finance involved German technology. According to our estimates, tying aid would substantially increase donors' share of spill-overs: from 3 pp to 26 pp, with an average increase of 9 pp. The industry of machinery, very relevant for the deployment of renewable energy technologies, is specially sensitive to tying practices, with spill-overs increasing an average of one percentage point. With tied aid, penetration of products from donor countries would increase specially in sectors related to mitigation. Destinations that are dependent on international supplies are specially sensitive to the effect of tied aid. Tied aid accentuates the differences between alternative locations and actions regarding their potential to generate spill-overs for donors, creating an incentive to maintain the current concentration of disbursements (on mitigation projects in few countries) reported by OECD and CPI (2015).

A clear incentive for donors to choose bilateral channels for climate finance that facilitate tying aid has been detected. Multilateral funds seem to be less prone to be used by donors to promote their exports. This is in line with observations such as that by de Sépibus (2014), who documents that donors of climate finance are increasingly using "multi-bi-financing" channels at the expense of multilateral channels. Indeed, approximately 80% of FSF, and 56% of the public finance in 2013-2014 was channelled through bilateral aid institutions (OECD and CPI, 2015). This suggests that, if the international community is concerned with limiting the practice of tying climate aid, more attention should be paid to the climate finance architecture in future climate summits.

With regard to LCR, previous experience in emerging countries shows that LCR can facilitate the creation of competitive green industries domestically (Kuntze and Moerenhout, 2012; Mathews, 2015), and maximize the domestic impact of foreign financing. According to our results, LCR do not seem to have a relevant impact on donors' spill-overs, since donor countries participating in global value chains are still able to capture a share of the economic benefits of climate action in developing countries via international trade of intermediate inputs. Thus, the economic incentive of donors to claim against LCR is relatively low. Besides, LCR would contribute to correct the bias of climate finance towards mitigation actions since spill-overs indirectly captured from adaptation measures increase significantly with LCR.

LCR may also contribute to increase the impact of climate finance in the short run and to generate (green) industrial activity in the recipient country. However, given that LCR cannot avoid spill-overs from indirect effects via trade in intermediates, industrial development policies would have to pursue a specialization on high value-added tasks and an increased participation in global value chains.

Note that the employed methodology entails several limitations. First, those associated to IO model assumptions: constant returns to scale, linear production function, lack of substitution possibilities, homogeneity of input factors, underutilization of the economy and constancy of input coefficients over time. Second, the WIOD has its own weaknesses related to measurement issues regarding imports by use category, trade in services and intangibles, exports and imports for processing, among others (Timmer et al., 2015). Third, the scope of the study is restricted to a limited set of donor and recipient countries, which do not necessarily represent all countries involved in climate finance disbursements, although most findings and conclusions are general enough to apply to countries not included in the study. Finally, there is uncertainty about how different expenditures are allocated over the different sectors of the model, since the cost breakdown of climate actions can vary depending on the country and the specific purpose of the project. Despite these limitations, the approach used is robust enough to calculate the spill-over effects associated to international trade, and our findings are important to inform the international discussions on climate finance architecture.

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[i] This report does not reflect the pledges to the GCF. Pledges to the GCF reached USD 10.3 billion as of December 2016.

[ii] The use of the term "spill-over" that we make steams from the general definition of spatial spill-over which is defined as "non-zero cross-regional partial derivatives ($\partial x_i / \partial y_j \neq 0$), so changes in characteristics x of region i can exert an influence on activity y taking place in other regions j". (see LeSage and Pace, 2009). In our case y_j would be climate finance received by country j and x_i would be the impacts in terms of employment or value added in country $i \neq j$ (a 3rd country or the donor country).

[iii] This practice might respond to several factors such as the demand of donor country's constituencies for a percentage of "domestic return" from the resources devoted to international aid (Brakman and van Marrewijk, 1995; Martínez-Zarzoso et al., 2009; Schweinberger, 1990; Selbervik and Nygaard, 2006).

[iv] See OECD (2005), OECD/DAC (2014) and OECD (2008).

[v] Excluding technical cooperation and food support, with portions of tied aid of 30% and 50%, respectively.

[vi] Several previous analysis study the economic consequences of alternative instruments for mobilizing climate finance (Basu et al., 2011; IMF, 2011; Jones et al., 2013; Keen et al., 2012; Parker et al., 2010).

[vii] Another 25% of the approved funding went to Morocco, South Africa, Ukraine, Turkey, Egypt, Chile Vietnam and Bangladesh (www.climatefundsupdate.org).

[viii] See Román et al. (2018b) for a detailed explanation of the use of NAPAs for the estimation of climate actions' cost structure. The inventory of the submitted NAPAs is in https://unfccc.int/topics/resilience/workstreams/national-adaptation-programmes-of-action/napas-received

[ix] In the practice, LCR range from 15% to 100%, according to Qiu and Tao (2001). For illustrative purposes, we choose the most extreme case in order to offer an upper bound estimate of the effects of LCR. Any other percentage could be used for a more tailored analysis but the main results remain robust.

[x] Chapter 18 of IPCC (2007) deals with the complex inter-relationship between mitigation and adaptation. It points to agriculture and forestry like sectors where the opportunities of synergies are larger. Besides, capacity building is also considered to contribute to both objectives at the same time.

[xi] There are not expenses in other activities of S2; the 60% corresponds exclusively to expenses in construction services.

[xii] Accounting for the rest of services within S1, the percentage increases to 58%.

[xiii] Altogether, S1 (the group containing other business activities) represents 37% and S2 (the group containing construction) reaches 27%.

[xiv] Factors determining the size of spill-overs depending on the countries involved in climate finance disbursements are studied in Román et al. (2018a).