Foreign aid, green cities and buildings.

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Abstract

This paper attempts, first, to assess foreign aid effectiveness in fostering green city procedures in developing countries. For this purpose, we rely on the following aid effectiveness criteria: national ownership; harmonization; alignment and mutual accountability; and results management. Our analysis shows that some programmes are effective and scalable. Secondly, using a GMM model, we try to link CO_2 emissions from residential buildings as well as commercial and public services to foreign aid for renewable energy sources. Our results show that the effect of foreign aid is significant with a negative impact on CO_2 emissions. The relationship is linear but also quadratic, indicating that there is a threshold before foreign aid can be effective in reducing CO_2 emissions. Efforts of the international community for climate change mitigation through the promotion of green city procedures should be supported to reach appreciable levels so that foreign aid will help to promote green cities procedures and green building in developing countries.

Keywords: climate change; climate finance; foreign aid; green cities and buildings; carbon emissions
JEL classification: F64; O18; Q28; Q56

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Acronyms

AFD	Agence Française de Développement
BCCRF	Bangladesh Climate Change Resilience Fund
BCCTF	Bangladesh Climate Change Trust Fund
CIF	Climate Investment Fund
CTF	Clean Technology Fund
CRS	Creditor Reporting System (of the OECD)
GEF	Global Environment Facility
GHG	greenhouse gases
GMM	generalized moment method
IFC	International Financial Corporation
ODA	official development aid
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
SCF	Strategic Climate Fund
SREP	Scaling-up Renewable Energy Programme
WDI	world development indicators
SPCR	Strategic Programme for Climate Resilience

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Introduction

For more than a decade, global warming and climate change have challenged United Nations and the international community. Indeed, scientists have noticed changes in the atmospheric concentration of greenhouse gases (GHG) and aerosols, in the percentage of covered land area (in particular due to urbanization) and solar radiation. The two main responses to climate change are (i) mitigation of climate change and (ii) adapting to these changes. In order to support these two solutions, the United Nations initiated a global agreement on climate change. Around the world, many measures have been undertaken to encourage changes in energy consumption habits and especially changes in the relationship with the environment. In the developed countries, there has been a redefinition of life's standards. One can hear about concepts like sustainable development, green industry, eco-tourism, green cities... In the developing world, however, countries face a more difficult challenge related to those concepts. Indeed, they must address issues of economic development that sometimes clash with ecological principles. Urbanization is among those issues.

According to the United Nations, by 2050 the number of people living in urban areas is expected to reach 6.4 billion out of a total population of 9.2 billion. Most of this urban growth will occur in the developing region of Asia, Africa and Latin America. Because cities in a global economy are centres of consumption, their ecological footprints extend far beyond their geographical boundaries. Indeed, cities are major contributors to climate change, producing more than 60 per cent of all carbon dioxide and significant amounts of other greenhouse gas emissions, mainly through energy generation, vehicles, industry and biomass use. How we plan, design, build and retrofit our cities will affect the world's natural resource consumption and the health and quality of life. This is a particular burden for developing countries which face the dual challenges of rapid urban growth and limited economic resources. For this reason, expertise and financial resources are being directed to developing countries to support them in transforming their cities into green ones. Understanding how cities in developing countries have rebuilt outmoded infrastructure, restored urban ecosystems and instituted innovative environmental policies can serve as blueprints for the greening of other developing countries' cities (Cohen and Robbins 2011).

To the best of our knowledge no studies have been conducted on the topic of foreign aid and green cities, although some authors have been interested in the impact of official development aid (ODA) on the environment in developing countries.[1] Our study aims to fill this gap by reviewing evaluation reports on foreign aid programmes and green city procedures. In doing so, we address the following questions:

- What evidence exists on the effectiveness of foreign aid with regard to procedures for green cities in the developing world?
- What kinds of foreign aid practices have the potential to work towards the achievement of green cities? How innovative and promising are these programmes, initiatives and practices?

[1] See, for instance, Arvin, Dabir-Alai and Lew (2006); Auer (2006); Hicks et al. (2008); Kretschmer, Hubler Nunnenkamp (2011); and Hynes and Wang (2012).

- What types of foreign aid (practices) that have worked in small-scale foreign aid interventions can be scaled up, and what needs to be done to deliver foreign aid on a bigger scale?
- What aid experiences have been transferred and could be successfully duplicated across countries?

To answer these questions, we review some reports on green cities in order to assess how effective foreign aid practices are. Subsequently, we conduct an empirical analysis by trying to establish a link between foreign aid and CO_2 emissions in cities.

Our regressions show that ODA for renewable energy sources helps reduce city CO_2 emissions. An important feature is the fact that this relationship is not only linear but also quadratic, implying that there is a threshold beyond which foreign aid will be effective in reducing CO_2 emissions. Our findings are robust to several tests. More specifically, foreign aid for renewable sources is more significant in reducing CO_2 emissions in cities than in other sectors like transport, manufacturing industries and lastly electricity and heat production.

The rest of the paper is organized as follows. Section 1 is devoted to the literature review in which we attempt to answer the four questions raised in the introduction. In Section 2, we use the generalized moment method (GMM) model to assess the impact of ODA on CO_2 emissions in the cities of recipient countries. Lastly, the conclusion summarizes our findings and raises some policy recommendations.

1 Literature review: foreign aid effectiveness and green city procedures

1.1 Aid effectiveness

Foreign aid and its effectiveness for recipient countries has been the subject of several studies. Talking about aid effectiveness is to talk about assessing the practices and policies of bilateral and multilateral donors, analysing existing programmes, and monitoring donor innovations.

In the 2005 Paris Declaration on Aid Effectiveness, developed and developing countries agreed on five key commitments to improve aid effectiveness: support for *national ownership* of the development process, promotion of *donor harmonization*, *alignment* of donor systems with national systems, *management for results* and *mutual accountability* between donor and recipient. Support to national ownership refers to the extent to which developing countries exercise leadership over their climate change policies and strategies. Harmonization fosters donors to implement shared arrangements and simplified procedures, with the goal of reducing the transactions costs imposed by donors on recipient governments. Aid alignment with country policies and systems implies the use of the relevant country's public financial management systems, use of country procurement systems, avoiding parallel project implementation units, aid predictability, untying aid, and coordinating technical assistance with national development strategies. Finally, accountability means that foreign aid should be administered in both a transparent and accountable manner (Bird and Glennie 2011). Both donor and partner-country governments should be accountable—to their respective publics and to each other—for the use of

resources and management to achieve development results. But the Accra Agenda in 2008, a step towards 2010 Paris Declaration Targets, showed that progress had been mixed. More specifically, it was stressed that the fourth principle, namely management for results and mutual accountability between donor and recipient, should be reinforced to improve its applicability by emphasizing results and performance monitoring frameworks.

Since then, several economists have used the new AidData database to assess whether these principles were respected, and whether donors improved their aid policies. Knack, Rogers and Eubank (2011) have constructed an overall aid quality index. This index includes a more comprehensive set of performance indicators, combining existing indicators with new ones that reflect the content of the Paris Declaration in a more comprehensive and representative way. They include four sub-indices on *aid selectivity*, *alignment*, *harmonization*, and *specialization*. The four dimensions of aid quality used in their study emerge from the aid effectiveness literature and from international agreements. More specifically, aid selectivity refers to the notion that aid has greater development impact where it is needed the most—that is, where there are large numbers of poor people—and where policy and institutional environment is favourable for growth and development. With regard to specialization, Knack and Rahman (2007) show that a proliferation of donors and projects undermines the capacity of recipient governments to manage aid and their relations with donors. Again, donors' reluctance to specialize also reduces their average level of expertise in the countries and sectors in which they operate, which may reduce aid's effectiveness even in beneficiary countries that are not faced with a proliferation of donors and projects. Another study by Easterly and Williamson (2011) attempts to monitor the best and worst aid practices among bilateral, multilateral, and UN agencies. For this purpose, the authors create aid practice measures based on aid transparency, specialization, selectivity, ineffective aid channels, and overhead costs. Their results show that, on average, performance of all agencies with regard to transparency, fragmentation, and selectivity is still very poor. They also find that best practice trends modestly improve transparency but there is no evidence of improvements in specialization, fragmentation, and selectivity.

In the remainder of this section, we try to answer the four questions raised in the introduction. We rely on the four criteria of the Paris Declaration on aid effectiveness to judge which foreign aid practices do work with respect to green city procedures, indeed those criteria are more relevant for climate finance.

1.2 What evidence exists on the effectiveness of foreign aid with regard to green city procedures in the developing world?

To answer this question, we present some examples of foreign aid in the context of green cities. There are different aspects of urbanization that are funded by donors and implemented in a way that encourages compliance with ecological standards. When we talk about urbanization, we consider five fields: (i) urban design and public policy, with an emphasis on buildings and infrastructure; (ii) transportation systems; (iii) pollution and waste treatment; (iv) energy supply and finally (v) water supply and sewage. In the following, we highlight some examples of projects undertaken in each of these urban fields.

Urban design and public policy, emphasis on green buildings and infrastructure

Four hundred million homes are predicted to be built globally by 2020, most of them in the emerging market countries. Buildings consume a significant amount of energy for heating/cooling and lighting purposes. Therefore, improving energy performance of new building stock will significantly reduce national consumption. The 'green buildings' concept aims to improve energy efficiency, rationalizing water consumption and mitigating environmental hazards. How foreign aid was used for green buildings in the developing countries is exemplified by the case of Indonesia. It is one of the world's largest greenhouse gas emitters with its building sector accounting for more than a quarter of total energy use in 2004, and this is expected to almost double to nearly 40 per cent in the next two decades. In response, International Financial Corporation (IFC) undertook measures to help the government develop a 'green buildings' code. This cooperation indicates that details of the code have been developed in close consultation with the government as well as private sector stakeholders. Although the code also considers climate change adaptation practices in building designs, its specificity is to establish energy and water efficiency requirements for large commercial and residential buildings through a simple code that can be readily and effectively implemented, and is easy to monitor.

Transportation system

Transportation is an important issue in a city without which no economic activity is possible. Developing countries suffer from a lack of transportation networks, and urbanization programmes by development agencies try to address this issue, keeping in mind ecological constraints. Thus, projects related to the development of public transport services such as trains, trams, trans-urban buses, are favoured. One of the illustrations of foreign aid for green urban transport is the Global Environment Facility (GEF). It is an operative entity of the UNFCCC (United Nations Framework Convention on Climate Change) to promote climate change mitigation. It finances sustainable development by addressing related environmental issues. More specifically, this multilateral fund has been devoted to urban transport projects since 1999, also providing technical assistance on financed projects. To be funded, projects must be undertaken in an eligible country, i.e., UNFCCC member, and be consistent with the eligible country's national priorities and programmes. Projects should also be in compliance with the GEF's climate change focal strategy and should endeavour to deliver tangible global environmental benefits.

Pollution and waste treatment

In this section, we present a project on the reduction of industrial pollution funded by Agence Française de Développement (AFD) in Egypt. In cooperation with other donors, it awarded €142 million to the National Bank of Egypt in the form of 'green credit' lines. The aim of these green credit lines is to foster industries to use clean technology and thus reduce pollution. Relevant industries were granted a 20 per cent debt abatement, once they reached a specified reduction level in pollution. Results were significant, and approved projects reduced annual sulphur dioxide emissions by 22,700 tons and particulate matter (i.e., dust) emissions by 104,000 tons. To better appreciate the magnitude of these pollution reduction efforts, the volumes correspond to 15 per cent and 31 per cent, respectively, of France's industrial emissions, energy excluded. An assessment of potential reductions in pollution that could be generated by the programme reported an annual drop of 650,000 tons CO_2, i.e., the emissions of about 250,000 cars.

Energy supply

An interesting example of foreign aid related primarily to energy supply but also to transport is the Clean Technology Fund (CTF). It is one of the two Climate Investment Funds (CIF) which is an interim source of finance created in 2008 by the World Bank in cooperation with multilateral development banks. The CFT helps developing countries to fill funding gaps for initiatives on energy projects with a climate change mitigation component. Funding is allocated through coordination with development institutions and harmonized policy support. To be eligible for funding, countries must be eligible for ODA and have an active multilateral development banks programme. The activities must build on existing country-owned strategies or action plans and demonstrate how it complements these. Other criteria are its high potential for mitigating greenhouse gases, cost effectiveness and development impact.

Water supply and sewage

Lastly, water supply and sewage are also important issues in cities, and they must be addressed in an ecological way. An illustration of foreign aid intervention is the Olandes Sewage Treatment Plant. The World Bank financed the US$4.69 million project designed to clean up domestic waste water from Marikina and Quezon City and help reduce pollution in Marikina River in Manila (Philippines). This project was established to reduce the pollution in Metro Manila waterways and the Manila Bay, as well as reduce health hazards caused by human exposure to sewage by expanding the septage-management approach of the city's metropolitan waterworks and sewerage system.

1.3 What could work?

There are only a few papers or reports on procedures for green cities. And there are no assessment reports on the effectiveness of foreign aid for green cities. So to address the question of 'what could work?', we first summarize the results on green city procedures and, second, by utilizing assessment reports of programmes financing climate change mitigation, attempt to determine how well these fit in with the financing of green city procedures.

One of the assessments on green cities in developing countries is a research project conducted by the Economist Intelligence Unit that focuses on 17 cities in Latin America. This report is based on the Latin American green city index, which measures environmental performance in the following eight categories: (i) energy and CO_2, (ii) land use and buildings, (iii) transport, (iv) waste treatment, (v) water, (vi) sanitation, (vii) air quality and (viii) environmental governance, with equal weight given to each. Of these 17 cities,[2] Curitiba (Brazil) seems to perform well above the others, perhaps because of its long history in dealing with environmental issues. On average, nine of the 17 cities are classified well above the average in 'energy and CO_2' and 'land use and buildings'. In fact, these cities provide hydropower as the source for electricity supply, which has a low impact on CO_2 emissions. They also have partial or total eco-building standards. With respect to 'transport', most cities have bus rapid transit systems similar to Curitiba's, which contributes to a reduction in CO_2 emissions by promoting the use of less

[2] The 17 cities are: Belo Horizonte, Bogota, Brasilia, Buenos Aires, Curitiba, Guadalajara, Lima, Medellin, Mexico City, Monterrey, Montevideo, Porto Alegre, Puebla, Quito, Rio de Janeiro, Santiago, Sao Paulo.

polluting means of transport. The official score for waste treatment, on average, is 96 per cent but this does not take into account the waste generated by the informal settlements. The figure for water is the same, but it also overlooks informal settlements: usage, on average, is 264 litres per capita per day (compared to the European average of 288 litres). The same rate applies to sanitation: almost 94 per cent have access to sanitation. But only five cities meet the three World Health Organization criteria with respect to the 'quality of air': sulphur dioxide level (20 micrograms), nitrogen dioxide level (40 micrograms), particulate matter level (50 micrograms). Last but not least, with respect to 'governance', all cities have environmental department. These departments include stakeholders in decisions on projects with a high environmental component. But there are problems of overlapping jurisdiction and some cities may lack expertise in the implementation of their own policies. This can prevent effective governance.

Thus, to the best of our knowledge, there are no reports assessing the effectiveness of ODA for green cities. However, some programmes of development assistance allocated to the general issue of climate change mitigation in certain Asian countries have been analysed, and can serve as a basis for answering the question of 'what could work'. We examine the results of those studies and show how similar aid practices could work in the case of green cities.

Bird (2011) shows that the Memorandum of Understanding for Nepal signed by the government and fourteen development partners in 2009 is not sufficient. Although this memorandum lists the principles to guide development partners' support on climate change and provides the basis for donors to act in a coordinated and consistent manner, it does not open the window to subsequent donor action or funds for a climate finance framework. Donors can ignore Nepal's national climate change policy, which is in defiance with the ownership principle. Bangladesh, Cambodia, Indonesia, Philippines and Vietnam, on the other hand, have national climate change plans, and Thornton (2011) evaluates the effectiveness of aid in those five countries, comparing the results under the criteria of ownership, alignment, harmonization, results measurement and accountability. Generally, implementation of climate change mitigation programmes in these five countries highlights some flaws, such as the lack of donor confidence in government entities, and a lack of capability on the part of the government entity, which leads to poor harmonization and alignment. There is also an imprecise definition of the role of government agencies during project implementation. This is counter to the principle of respect of ownership. Lastly, in terms of accountability, most of the studied countries use internal mechanisms based on government and bureaucratic requirements. Bangladesh, where civil society is involved in discussions, is the exception. However, Indonesia and Bangladesh seem to exhibit better results than Cambodia, Philippines and Vietnam. Therefore, in the following section we review some of the foreign aid procedures relating to climate change mitigation that have been implemented in those countries. They could serve as replicable examples of what foreign aid can do for green cities.

Hedger (2011) assesses foreign aid effectiveness in the climate change mitigation framework in Bangladesh. Bangladesh is of particular interest because the country represents a special case of environmental vulnerability to climate hazards irrespective of climate change. The country's commitment to defining a national policy for climate change mitigation is underscored by the two funds that have been created to address the issue: the Bangladesh Climate Change Resilience Fund (BCCRF) and the Bangladesh Climate Change Trust Fund (BCCTF). BCCRF, the first fund, is aimed at supporting the country's national strategy for climate change mitigation and ensuring coordination, donor harmonization, flexible fund management and transparency in order

to eliminate overlaps. One of its interesting specificities is that governance is assured by the government of Bangladesh ministries, development partners and the World Bank Country Director as an observer. More specifically, the World Bank serves as the secretariat during the initial three years whilst government capacity is built up. In addition, there are two multi-donor programmes on climate change: the World Bank's Strategic Programme for Climate Resilience and the comprehensive Disaster Management Programme. However, this proliferation of programmes and funds runs contrary to the principles of harmonization and alignment in the aid effectiveness agenda.

Another country which could serve as an example for foreign aid effectiveness in climate change mitigation is Indonesia. In their study of Indonesia, Brown and Peskett (2011) pinpoint an interesting feature: the emphasis on harmonization and alignment. Indeed, Indonesia Climate Change Trust Fund, a government agency, is trying to harmonize financial management by pooling international funding into one money pot, and aligning it with national processes and procedures.

To summarize, as these case studies of Bangladesh and Indonesia show, there are some flaws including the proliferation of programmes and funds. A good practice, therefore, could be the creation of one common fund to which multiple donors would inject money. Such a fund could be used to finance projects that are part of a beneficiary country's national climate change plan, or it could be adapted to green cities. The fund could be managed by a multilateral agency like the World Bank or UNDP, both of which have the capabilities and enjoy the confidence of other bilateral agencies. The premise that a multilateral agency would need to manage the fund for some time, could be set the needed time for the government agency (which can be, for example, the ministry of urbanism) to build capacity. Indeed, the relevant agency may have experience in foreign aid management, but lacks expertise in the specificity of aid to green cities. After the 2-3 year period needed for building capability, responsibility for the fund could be transferred to the government agency, with donors keeping an eye on its management. This would eliminate the mistrust of donors and lack of credibility of the government agency. This could also partially resolve the problem of effective urban environmental governance, since the scheme could be replicated at the city level. The principle of accountability would thus be respected.

The government agency which would manage this fund would have to be transparent with all donors, by providing them with all necessary information on fund management. Donors would be involved in decisions regarding the use of the fund. This implies that the government would, once again, offer its green city strategy to donor scrutiny. Donors would have the opportunity to analyse the use and allocation of funds. This would generate mutual accountability, because of reciprocal supervision among the different parties. Such a foreign aid configuration also meets the other criteria of aid effectiveness. Indeed, funding amounts from donors would be used in their entirety to finance national strategies and policies for green cities (ownership). This approach also would reduce duplication and project overlap. In addition, because each donor has participated in setting up the specified green city fund, each donor would have the right to take part in discussions on financing projects, and tensions concerning funding other development projects would disappear. Such a scheme would foster control over costs and thus improve efficiency, this satisfying the principles of harmonization and alignment.

1.4 What is scalable?

In this section, we focus on a specific aid programme related to green cities. Indeed, there are some pilot projects regarding green city procedures that are effective and can be scaled up. One example is the scaling-up renewable energy programme (SREP) in low-income countries (SREP). SREP is a targeted SCF-CIF programme aimed at fostering renewable energy use projects in low-income countries. This is done at several levels: transformation of the renewable market by obtaining government support for market creation, private sector implementation, and productive energy use. Since SREP is country-led and builds on national policies and the activities of other existing energy initiatives, it complies with the criteria on ownership and alignment. SREP operates in a small number of low-income pilot countries (Ethiopia, Honduras, Kenya, Maldives, Mali, Nepal and Tanzania).

SREP allocated US$40 million to Nepal to supply one million households, through increased energy capacity, with electricity or the option of cleaner fuel. In Mali, SREP funded US$40 million for the expansion of solar mini-hydro and bio-fuel technologies. SREP is also working to build capacity and project management skills for the long-term transformation of Mali's renewable energy sector. This programme, as noted in the assessment of the two pilot countries, gives good results, indicating that it can be scaled up. Again, because it is funded by a multilateral source, problems related to the lack of harmonization and mismanagement can be avoided. As was noted above, the examples of Indonesia and Malaysia show that the creation of a common fund allows several donors to pool their money for a mutual goal. The management of such a fund would then be supervised by a multilateral agency. This boosts donor confidence in the management capability of the beneficiary country. Again, the principles with respect to management for results as well as for mutual accountability are ensured. Any aid programme with similar characteristics can be scaled up. If such a scheme has proven to be successful, it can be replicated for green city projects in developing countries. Then, to avoid overlap with the common fund scheme presented in the previous section, projects would simply need to be coordinated.

1.5 What is transferable?

In this section, we try to analyse if some aid projects and practices meet the main principles for aid effectiveness and green city criteria to justify their transferability across countries. We have already shown how SREP and other programmes encompassing these features are scalable, and thus transferable to green city procedures. Therefore, examples of initiatives by multilateral funds that can be replicated include the Clean Technology Fund (CTF) and the Global Environment Facility (GEF), both of which meet the standards of aid effectiveness in the context of climate change. The harmonization principle is apparent in the fact that these initiatives are funded by several development banks, which prevents duplication of project and promotes efficiency in the use of aid for climate change mitigation. In addition, the principles of national ownership and alignment are achieved by the fact that these funds must be earmarked to a project that is part of a country's climate change strategy. Because these funds also provide technical assistance, they contribute to capacity building. Again, the eligibility criterion imposed by these agencies on the specific projects they want to finance reinforces aid effectiveness. With respect of CTF, for example, the cost-effectiveness criterion ensures that project costs will be controlled. Also, given that one of the GEF regulations stipulates that projects must be proposed and developed by one of

the ten GEF-member agencies means that GEF will take responsibility for its achievement. This can promote transparency and accountability. Principles of development impact and GHG mitigation ensure that projects in renewable energy or green transportation will be supported if they also contribute to the development of a city. Finally, estimates of potential GHG reductions and development impact could encourage project proponents to undertake the initiative and to commit to achieving significant results. This means that such a carefully-analysed project has a high probability of success, especially as it has been double checked by CTF or GEF. Needless to say, coordination with the common fund scheme presented in Section 3 is necessary in order to avoid overlapping projects.

Another interesting foreign aid practice is the distribution of 'green credit lines'. This credit line project was funded by the Agence Française de Développement (AFD) to promote less polluting industries in Egypt. It also meets most of the qualifications on aid effectiveness. When funding is arranged through several development agencies, like the AFD, via a development bank, it helps to avoid project duplication. Moreover, the fact that this fund is allocated through a development bank shows that there is national ownership of a policy supporting green industries. Indeed, the National Bank of Egypt decides, in accordance with AFD, whether or not to grant credit and what criteria are applicable. The green credit lines procedures complies with the accountability principle, as AFD works in partnership with banks to identify possible investments, selects the sectors with the highest potential and defines an action plan that aims to reduce the country's investment obstacles. Loans granted to customers provide them with incentives (maturity, rate) to invest. AFD also helps partner banks set up or strengthen internal environmental and social risk management mechanisms. There is also a capacity-building element, since AFD works closely with the National Bank of Egypt. This procedure could be replicated in building or other development projects with an ecological dimension.

2 Empirical analysis

This section of the study provides empirical evidence of the effectiveness of foreign aid on green city procedures. We concentrate on green buildings because variables on other green-city characteristics are not available.

Although the literature review above does suggest that some ODA schemes tend to promote green cities, there are, to the best of our knowledge, no empirical studies on the impact of foreign aid on green cities. Sylwester (2008) addresses the issue of foreign aid and urbanization, but he doesn't encompass in its study green urbanization. Some authors, however, have examined the impact of foreign aid on the environment. For instance, Arvin, Dabir-Alai and Lew (2006) show that, depending on the level of external debt within a developing country, aid can have a negative impact on pollution. This result holds particularly for the upper-income countries (newly industrialized countries), as they are in a transitory phase of development. However, the picture is different for lower-income countries, where more aid fosters less pollution. But these results are biased by the fact that the authors do not take other variables into account which could affect the relationship between aid and environment. Moreover, they overlook country heterogeneity. Kretschmer, Hubler and Nunnenkamp (2011) try to counter these shortcomings by adding other explanatory variables to their regression like the level of development, investment ratio, industry share, import ratio and foreign direct investment in a GMM panel regression. They are especially

interested in studying the relationship of foreign aid and carbon as well as energy intensities. In particular, they are concerned about the composition of aid and distinguish between aid for industry and aid for energy. The results show that foreign aid reduces energy intensity, especially when the variable aid for energy is included in the regression. However, aid does not have a significant impact on carbon emissions even when the variable aid for industry is included in the regression.

2.1 The model

In this empirical analysis, we are particularly interested in the impact of foreign aid on green city procedures. Our idea is to link CO_2 emissions in developing country cities with its first lag, foreign aid for renewable energy sources and other control variables likely to explain it. The ordinary least square fixed effects model gives some biased estimators because of the inclusion of the lagged dependant variable. Nickell (1981) pinpoints the observation that the bias is serious for a sample with a short time period. However, the lagged dependent variable bias becomes less serious as the time period increases. In our study, the time span is ten years (from 2002 to 2011). However, the average number of years available per country ranges between 4 and 10, because our sample is unbalanced.

The preferred technique to deal with this bias is the generalized moments method (GMM), which can provide solutions to simultaneity bias, reverse causality and omitted variables. Moreover, Kretschmer, Hubler and Nunnenkamp (2011) use the GMM estimator to deal with the possible endogeneity of aid when they assess the impact of aid on energy and emission intensities. There are two types of GMM estimators for dynamic panel: the first difference GMM estimator and the system GMM estimator. The first estimator consists of taking the first difference of the estimated equation for each period in order to eliminate the country-specific effects. Then the explanatory variables of the first difference equation will be instrumented by their lagged level values. The second estimator combines the equation in first difference with level equations in which variables are instrumented by their first differences. Blundell and Bond (1998) show that this GMM system estimator is more efficient than the one in first difference. Indeed, the first difference GMM estimator gives biased results in a small sample when the chosen instruments are weak. We therefore choose the GMM system estimator for our estimations, as the period of study is short. Our model is as follow:

$$\ln(CO2)_{it} = \alpha \ln(CO2)_{it-1} + \beta \ln(aid\_renewgdp)_{it-1} + \lambda X_{it} + u_i + v_t + e_{it}$$

with $CO2_{it}$, CO_2 emissions from residential buildings and commercial and public services for country i at year t;

aid_renewgdp is net ODA for renewable energy sources divided by GDP for country i at year t-1;

X_{it} is a vector of control variables in logarithm;

u_i are the country-specific fixed effects, v_t are the year-specific fixed effects and e_{it} is the error term.

We choose CO_2 emissions from residential buildings as well as commercial and public services as a proxy for green buildings. Indeed, this variable measures all emissions from fuel combustion

in households as well as in other activities that generally take place in cities, expressed in million metric tons. Variables related to CO_2 emissions in world development indicators usually measure emissions originating from the burning of fossil fuels and/or the manufacture of cement. Therefore emission measures are gauged only according to fuel consumption. CO_2 emissions from residential buildings as well as commercial and public services are also measured as a per cent of total fuel combustion. Other values measured as a share of total fuel combustion in this database are CO_2 emissions: from electricity and heat production, from transport, from manufacturing industries and construction, and lastly CO_2 emissions from other sectors excluding residential buildings or commercial and public services.[3] Of those five sub-categories, the first one related to residential buildings as well as commercial and public services, seems to be the best for capturing CO_2 emissions of buildings in cities. This is not surprising given that most residential buildings as well as commercial and public services are located in cities. This, therefore, can be used as an acceptable proxy for green buildings in developing country cities. This variable represents on average 10 per cent as the share of total fuel combustion in the countries in our sample (as given in Appendix Table 1). Because CO_2 emissions are defined in relation to fuel consumption, we considered using oil price to control for the use of other energy sources when oil price increases. But this caution is not necessary because oil prices change over the years but not across countries, therefore this effect will be captured by the year-specific fixed effect.

As explanatory variables, we use *aid_renewgdp* (defined as net ODA for renewable energy sources) divided by GDP. The most appropriate variable related to foreign aid would have been aid for green cities or building projects. However, such a variable is not available. Therefore, we believe that foreign aid for renewable energy sources is an adequate proxy to measure foreign aid to promote green buildings. Indeed, the use of energy from renewal sources decreases CO_2 emissions from fuel combustion because energy from renewable sources may be potential, alternative sources. Next, we add other control variables. We assume that the size of an urban population (*urbpop*) can negatively affect CO_2 emissions in residential buildings as well as commercial and public services. As the size of the city population affects CO_2 emissions because activities increase, so does energy use. We assume a positive relationship between the two. We also include electricity production from renewable sources (*renewable*) in the regression to control for the presence of a country policy fostering renewable energy source projects. Indeed, our case studies of Bangladesh and Indonesia show that these two countries had the political willingness to address climate change. Therefore, we think that such a variable can have a negative impact on CO_2 emissions from residential buildings as well as commercial and public services. The more a country uses electricity from renewable sources, the less its CO_2 emissions will be. We also consider GDP per capita to control for the country's level of development. GDP per capita reflects higher general productivity, which can be associated with lower energy intensity. Again, the more advanced the level of a country's development, the stronger its incentive to seek less emission-intensive energy sources. However, previous studies showed that foreign aid had a negative impact on pollution for newly industrialized countries, because of their transitory phase of development. So the sign is not pre-defined.

[3] This variable contains the emissions from commercial/institutional activities, residential, agriculture/forestry, fishing and other emissions not specified elsewhere.

Lastly, the literature on aid shows the importance of the role of institutions and policies. For instance, Burnside and Dollar (2000) and Boone (1996) in their regressions introduce variables of political-economic environment and an index of political participation and civil liberties, respectively. In particular Burnside and Dollar use aid (as a share of GNP) as well as aid interacted with their policy variable in a standard growth regression. Furthermore, Hansen and Tarp (2001) introduce a quadratic term of aid in the regression, showing that there is a threshold beyond which aid has no more positive effect on growth. In our regression, we introduce a quadratic term of *aid* to take into account such an effect of ODA. We also include the quality of government index (*qog*) as institutional variable. It is a composite index, which takes into account corruption, bureaucracy quality, and law and order. It is often used to measure the quality of governance.

2.2 The data

A summary of data statistics is given in Appendix Table 1 Most of the variables are extracted from the world development indicators (WDI). However, the data related to foreign aid for renewable energy sources are taken from OECD's Creditor Reporting System (CRS). Aid effectiveness analyses are generally based on aid disbursements rather than aid commitments, as commitments do not imply actual resource flows to the recipient country, or actual flows can be delayed (Michaelowa and Weber 2007; Dreher, Nunnenkamp and Thiele 2008). Thus, foreign aid disbursements are our choice here. Lastly, the index 'quality of government' is obtained from the quality of government dataset. Our analysis covers the period 2002 to 2011, for which data are available. However, we would have liked to cover the period 1992–2011 to reflect the adoption of Agenda 21, the programme according to which local city authorities are committed to implementing sustainable development that encompasses the concept of environment and green cities. Although our timescope covers only the last ten years, we believe it is sufficient to gauge whether or not foreign aid earmarked to this purpose was effective. The correlation matrix is displayed in Appendix Table 2. Our panel covers 144 countries for which the relevant data are available and which are classified by the World Bank as low-income, lower middle-income and upper middle-income countries. Even though small, low-income countries and least developed countries make only a scant contribution to global emissions, we examine the full sample of developing countries in order to study how foreign aid earmarked to renewable energy sources has affected the CO_2 emissions of developing country cities.

2.3 Results

Although our preferred method of analysis is GMM, we carried out an OLS regression with fixed effects,[4] to serve as a reference. The only significant variable in the OLS regression is the lagged dependent variable. Concerning GMM system (regression 2), the coefficient of the lagged dependant variable is significant and positive. CO_2 emissions in developing country cities are strongly path dependent. We test the significance of the one, two, three, four and five-lag of foreign aid for renewable energy sources. The only significant lagged variable was the one-period lag of foreign aid for renewable energy sources. It has a negative impact on CO_2 emissions. This means that foreign aid allocated to renewable energy sources contributes to the reduction of CO_2

[4] We conducted the Haussmann test which suggested fixed effects instead of random effects.

emissions in cities. This relationship is not only linear, indeed the quadratic term of foreign aid for renewable energy sources also has a negative significant impact on the CO_2 emissions of the cities. The interpretation could be that foreign aid for renewable sources contributes to the reduction of CO_2 emissions, but only from a certain threshold. Indeed, a 10 per cent increase as a share of GDP in foreign aid for renewable energy sources decreases CO_2 emissions by 4.59 per cent after a certain threshold is reached. Electricity production through renewable sources (excluding hydroelectric) is not significant. Urban population, however, has a positive impact on CO_2 emissions as expected, meaning that larger urban populations increase city CO_2 emissions. In regression 3 we introduce the variable 'quality of governance' to take into account foreign aid management, but it was not significant. We did the same for education and for road sector energy consumption; but neither were significant.

Robustness checks

To check for the robustness of our results, we ran the same GMM system regressions using the CO_2 emissions from residential buildings as well as commercial and public services as a share of

Table 1: Regressions for the impact of foreign aid for renewable energy sources on CO_2 emissions in the cities of developing countries

Econometric method	OLS	GMM				
	CO_2 emissions from residential, commercial buildings and public services					CO_2 emissions from other sectors[1/]
	(million metric tons)			(% of total fuel combustion)		(million metric tons)
Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
L.dependent variable	0.586	0.774	0.737	0.808	0.675	3.796
	(14.28)**	(5.63)***	(3.52)***	(4.02)***	(2.49)**	(4.31)***
L.aid_renewgdp	-0.008	-0.459	-0.503	-0.034	-0.017	-11.787
	(0.11)	(1.96)**	(0.81)	(1.75)*	(0.50)	(0.92)
L.(aid_renewgdp)^2	-0.000	-0.009	-0.009	-0.001	-0.000	-0.260
	(0.09)	(1.94)*	(0.82)	(1.79)*	(0.48)	(1.02)
renewable	0.551	0.440	6.949	0.073	0.346	-2.724
	(0.60)	(0.44)	(0.71)	(1.26)	(0.63)	(2.43)**
gdpc	0.192	0.101	0.344	-0.009	0.005	6.572
	(1.56)	(0.61)	(0.54)	(0.89)	(0.22)	(1.94)*
urbpop	-0.130	0.198	0.259	0.006	0.004	
	(0.55)	(1.82)*	(0.71)	(0.69)	(0.30)	
qog			1.063		0.040	
			(0.27)		(0.16)	
industry						-9.481
						(1.46)
investment						2.183
						(0.44)
constant	0.835	-9.396	-13.714	-0.427	-0.338	-170.048
	(0.24)	(2.49)**	(1.24)	(1.82)*	(0.76)	(1.09)
No. of observations	500	500	324	501	324	219
AR(2)		0.6	0.95	0.23	0.5	0.34
Hansen test		0.32	0.42	0.56	0.33	0.44
R2	0.35					

Note: [1/] excludes residential, commercial buildings and public services; t_statistics in parentheses; L. indicates the lagged variable; *, **, ***, significant respectively at 10, 5 and 1%.

Source: Computed by author; see text.

total fuel combustion as our definition of CO_2 emissions in cities. The attempt was to gauge how robust our results are when we consider the relative importance of cities' CO_2 emissions in a country. Regressions 4 and 5 give the results, which are consistent with our previous findings. Indeed, an increase in foreign aid for renewable energy sources decreases city CO_2 emissions by 0.3 per cent of total fuel combustion. Thus, either the absolute term of CO_2 emissions or the share in the total fuel combustion is negatively, and significantly affected by foreign aid for renewable energy sources. In summary, our results show that foreign aid allocated to renewable energy sources has an impact on the CO_2 emissions of cities, and contributes to greener cities in developing countries. Again, we wanted to check how foreign aid for renewable sources affected the CO_2 emissions from other sectors (residential buildings as well as commercial and public services excluded). For this purpose, we included some variables to control for such economic activities as industry and investment, variables that are also used in Kretshmer et al. (2011) to assess carbon intensity of foreign aid. Our results show that foreign aid for renewable sources is not significant either in linear or quadratic terms. However, electricity production from renewable sources as a share of GDP is significant, and contributes in CO_2 reductions in other sectors of the economy. Other estimations are conducted with CO_2 emissions sub-categories mentioned in Section 2.1. However, apart from the lag dependent variable, no other variable is significant. This is consistent with sectors like manufacture, transport and lastly electricity and heat production, and means simply that foreign aid for renewable energy sources does not contribute significantly to CO_2 emissions in those sectors. To sum up, we can say that these robustness checks do not invalidate our findings. Foreign aid for promoting renewable sources does play a role in CO_2 reductions in residential buildings as well as commercial and public services and therefore contributes in greener cities.

3 Conclusion

This paper has analysed how foreign aid contributes to greener cities. For this purpose, a review of the literature provided an understanding of the importance of development assistance for promoting green cities in developing countries. Cities produce more than 60 per cent of all carbon dioxide and significant amounts of other greenhouse gas emissions, yet at the same time are powerful engines for development. Thus, evaluation of foreign aid effectiveness with regard to green city procedures is to ensure that ODA for urbanization is steered in an ecological direction. In this regard, it is important to know whether ODA for green cities is effective. To understand this concept of aid effectiveness, we rely on the criteria and principles presented in the literature. These principles have used in several articles related to aid effectiveness, and are subject to an international agreement (Paris Declaration on Aid Effectiveness). We are also interested in the criteria governing climate finance effectiveness. Finally in our assessment of foreign aid with regard to green cities, we apply standards which are relevant both for the effectiveness of aid and climate finance. These include national ownership, harmonization, alignment and mutual accountability and results management.

Next, to draw our analysis and to answer the questions raised at the beginning of the paper, we rely on reports from development agencies, and articles related to foreign aid effectiveness. Based on our chosen criteria on the effectiveness of aid, several foreign aid initiatives were noteworthy and this helped us define how best practices could be replicated in the context of

green cities. In particular, common funds managed by multilateral agencies in conjunction with a government agency could fulfil all requirements for aid effectiveness.

The second part of our study was intended to establish an empirical relationship between foreign aid and green city procedures. As variables, we chose CO_2 emissions from residential buildings as well as commercial and public services for capturing green city procedures, and foreign aid for renewable energy sources for capturing foreign aid in green city procedures. Our results show that there is a threshold before ODA begins to have an influence on CO_2 emissions in cities. Once this threshold is reached, foreign aid will have a significant negative impact on CO_2 emissions reduction. Our results are robust to different definitions of CO_2 emissions from residential buildings and commercial and public services, whether defined as a share of total fuel consumption or in million metric tons. Again, other categories of CO_2 emissions like manufacturing industries, transport and electricity and heat production (all defined as a share of total fuel consumption) are not significantly affected by foreign aid for renewable energy sources. These results mean that much remains to be done if foreign aid is to have a significant impact on CO_2 emissions in those sectors. The variable 'quality of governance' used as a proxy of aid management is not significant.

To sum up, this paper shows clearly that efforts made by the international community to promote green city procedures are effective and have the potential to become even more effective. Indeed many programmes designed for this purpose meet the criteria of aid effectiveness. Furthermore, our empirical analysis shows that the variables with the strongest effect on CO_2 emissions in the cities are the lagged dependent variables, urban population and foreign aid for renewable energy sources. This means that more efforts should be made to encourage energy production from renewable sources.

Lastly, we have to acknowledge that our study has some shortages. Indeed, apart from CO_2 emissions, we were unable to capture and measure the other aspects of green cities. Such an analysis could be made on a micro-level basis, with data provided through an investigation.

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Appendix Table 1: Descriptive statistics and data sources[s2]

Variable	Variable	Source	No of obs	Mean	Std. dev.	Min.	Max.
CO_2 emissions from: – residential buildings as well as commercial and public services (% of total fuel combustion)	CO2p	WDI	811	10.20988	7.326328	.01	39.72126
– residential buildings as well as commercial and public services (million metric tons)	CO2m	WDI	811	12.46466	42.23917	.10636681	438.8
– other sectors, excluding residential buildings as well as commercial and public services (million metric tons)	CO2_sectors	WDI	733	5.381265	9.283367	-1.960784	73.30961
Urban population	urbpop	WDI	1,287	1.68e+07	5.87e+07	4464.119	6.59e+08
GDP per capita constant (2000 US$)	gdpc	WDI	1,225	1993.392	2054.71	83.09156	13139.27
Quality of government	qog	Quality of government	658	0.4178909	0.1172867	0.0833333	0.7777778
Foreign aid for renewable energy sources/GDP constant (2000 US$)	aid_renewgdp	OECD CRS	908	1.21e-09	3.73e-09	-1.77e-10	5.27e-08
Industry, value added (% of GDP)	industry	WDI	1,225	29.94134	13.35383	4.835888	99.9125613
Gross fixed capital formation (% of GDP)	investment	WDI	1,194	22.67825	7.917055	2.000441	62.50872
Electricity production from renewable sources, excluding hydroelectric (share of total)	renewable	WDI	825	0.0196539	0.0517913	0	0.3033863

Source: See text

Appendix Table 2: Correlation matrix

	CO2m	CO2p	CO2_sectors	aid_renewgdp	gdpc	renewable_source	urbpop	qog	investment	industry
CO2m	1.0000									
	807									
CO2p	0.0523	1.0000								
	0.1376									
	807	807								
CO2_sectors	-0.0932*	-0.1237*	1.0000							
	0.0125	0.0009								
	717	717	733							
aid_renewgdp	-0.1011*	0.1893*	0.3049*	1.0000						
	0.0147	0.0000	0.0000							
	582	582	519	908						
gdpc	0.0147	-0.2517*	-0.1243*	-0.0636*	1.0000					
	0.6799	0.0000	0.0009	0.0718						
	787	787	717	802	1225					
renewable_source	-0.0682*	-0.1298*	-0.1099*	-0.0318	0.0646*	1.0000				
	0.0527	0.0002	0.0029	0.4374	0.0669					
	807	807	733	597	805	825				
urbpop	0.8726*	-0.0935*	-0.0874*	-0.0827*	0.0030	-0.0186	1.0000			
	0.0000	0.0082	0.0185	0.0193	0.9158	0.5958				
	798	798	725	800	1216	816	1287			
qog	0.1442*	-0.1587*	-0.0087	-0.0790*	0.4042*	0.0493	0.1658*	1.0000		
	0.0007	0.0002	0.8382	0.0935	0.0000	0.2471	0.0000			
	553	553	553	452	637	553	658	658		
investment	0.3073*	0.0486	-0.1332*	0.1206*	0.0992*	-0.1377*	0.2106*	0.3224*	1.0000	
	0.0000	0.1833	0.0005	0.0006	0.0011	0.0001	0.0000	0.0000		
	751	751	684	811	1076	769	1083	598	1194	
industry	0.1392*	0.0123	-0.1293*	-0.1747*	0.0709*	-0.1192*	0.1465*	-0.0413	0.1241*	1.0000
	0.0001	0.7357	0.0007	0.0000	0.0184	0.0009	0.0000	0.3112	0.0000	
	753	753	690	820	1106	771	1117	603	1160	1225

Note: * Significant at 10% level.
Source: See text.