

Mobilising Private Adaptation Finance: Lessons Learned From the Green Climate Fund

P. P. Stoll

Independent Consultant

W. P. Pauw (✉ w.p.pauw@gmail.com)

Frankfurt School of Finance & Management, Germany

Farah Tohme

Leibniz Institute for Financial Research SAFE: Leibniz-Institut für Finanzmarktforschung SAFE

<https://orcid.org/0000-0002-0272-1958>

C. Grüning

Frankfurt School of Finance & Management, Germany

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Abstract

The mobilisation of private sector engagement is considered to be critical to address the adaptation challenge, but literature demonstrates that it has proven difficult. In the context of international climate finance, the focus has been on mobilising private finance for adaptation, and in addressing barriers that prevent investments from materialising. In contrast, this article identifies options to engage the private sector in adaptation beyond finance and focuses on market imperfections instead of barriers. This moves the focus away from simply mobilising more private adaptation finance towards identifying market forces that innovate, engage and direct investments towards adaptation.

The Green Climate Fund (GCF) and its portfolio of 67 adaptation projects serve as a case study. We demonstrate that 79 per cent of the GCF projects engage the private sector in ways that go beyond co-finance or project development, thus indicating the important broader role of the private sector in adaptation. Furthermore, our ordinal regression demonstrates that addressing the market imperfections of positive externalities, imperfect capital markets, and incomplete and/or asymmetric information all have a significant positive effect on private sector engagement in the GCF's adaptation portfolio.

Both findings indicate that there is a big potential for the GCF - and other climate finance providers - to increase private sector engagement in adaptation. However, the mobilisation of private sector engagement in adaptation is a means to this end, not an end in itself. The main aim should be to adapt society as a whole in an efficient manner, including the most vulnerable people.

1. Introduction

The adaptation challenge grows in the face of ongoing climate change. Adaptation costs are estimated at US\$ 140–300 billion per year by 2030 in developing countries alone (UNEP, 2021). The public sector has long considered adaptation to be a public response to climate change, but in the context of the UN climate negotiations it is increasingly stimulating the private sector to invest in adaptation. This shift in focus from public towards private finance in adaptation is rational. Adaptation literature often defines the private sector as ranging from large international and domestic corporations to micro, small, and medium-sized enterprises (MSMEs) and smallholder farmers, thus including private sector actors in the financial sector as well as in the real economy (see Druce et al., 2016; Fayolle et al., 2019). A country cannot be resilient if its private sector is not resilient. In Africa, for example, the private sector provides almost 67 per cent of the continent's investment, 75 per cent of its economic output and 90 per cent of its formal and informal employment (AfDB, 2011). It is also in the self-interest of private actors to adapt its own operations and assets to climate change and to invest in new business opportunities to achieve business sustainability (Druce et al., 2016; Averchenkova et al., 2016).

However, literature demonstrates that mobilising private investments in adaptation is challenging (Pauw et al., 2016; Micale, et al, 2018; World Economic Forum, 2020; Bisaro & Hinkel, 2018; Steckel et al, 2017, Khan, et al., 2020). Literature had already discussed a 'seemingly endless' list of barriers to adaptation in

general (Biesbroek et al., 2013; 1119) and later also started to discuss barriers that specifically prevent private investments in adaptation from materialising (see e.g. PCIR, 2012; Antwi-Agyei, 2013; Biagini & Miller, 2013; Trabacchi & Mazza, 2015; Vivid Economics, 2015; Hallmeyer and Tonkonogy, 2018), including financial, institutional, technological and information barriers. As Pauw et al (in press) explain, the focus on these barriers has major limitations: they are descriptive rather than explanatory, sometimes mix cause and effect, and tend to focus on eliminating obstacles, rather than adapting efficiently.

This article takes a different approach. First, successful private sector engagement in adaptation goes beyond financing. It therefore identifies different private sector actors' roles in the planning, implementing, financing and supporting of adaptation efforts. Our assumption is that this could help to clarify and increase the opportunities for private investments towards urgently needed adaptation.

Second, instead of looking at barriers, this article assumes that addressing market imperfections would facilitate to attract more private sector engagement in adaptation. Market imperfections create distortions in the risk/return profiles of investments and can result in under-investment (Cohen & Winn, 2007). Three particularly relevant observed market imperfections inhibiting adaptation-related activities are: positive externalities, incomplete or asymmetric information; and imperfect financial markets (Druce et al. 2016; Pauw et al., in press).

This article examines whether addressing the three market imperfections results in higher level of private sector engagement in adaptation. As a case study, it uses the 67 adaptation project proposals that have been approved by the Board of the Green Climate Fund (GCF) to date. The GCF is the largest multilateral climate fund and has a clear mandate to shift and mobilise finance managed by the private sector to increase its impact into low-emission and climate-resilient investments in developing countries.

This paper is structured as follows. The next section explains the GCF efforts engage the private sector in its activities, and how a focus on market imperfections could increase such engagement. Section 3 explains our method, including an ordinal regression analysis. Section 4 provides our results. Finally, Sect. 5 concludes and provides recommendations to the GCF and the broader climate finance community.

2. The Gcf, Private Sector Engagement And Market Imperfections

2.1 Mobilizing private adaptation finance through public support

The Copenhagen Accord that was negotiated at the UNFCCC climate summit in 2009 was a watershed in terms of climate finance. First, it introduced a quantitative target on climate finance: US\$ 100 billion annually by 2020 to support developing countries with climate change mitigation and adaptation. Second, the private sector was supposed to become one of the sources of these annual US\$ 100 billion.

Ever since, there has been a strong focus on mobilising finance from the private sector for adaptation and mitigation (Pauw et al, 2016).

The GCF was created to channel a large part of the US\$ 100 billion and became operational in 2014. In line with the Copenhagen Accord and later decisions taken at the UN climate negotiations, crowding-in and maximization of private sector participation is central to its strategic priorities (Zamarioli et al., 2020). In order to shift towards and mobilize private sector finance, the GCF has set up the Private Sector Facility (PSF), a dedicated division designed to fund and mobilise private sector activities (GCF Decision B.04/08). Private finance is all financial resources that flow into projects/programs from entities that are more than 50 per cent owned and/or controlled by private shareholders (GCF/B.24/17).

GCF partners also play a key role in mobilising private sector finance. Project proposals are developed by Accredited Entities (AEs) that meet the GCF's standards such as fiduciary responsibilities, as well as environmental and social safeguards. They can be private or public, national, regional or international and direct access entities (DAEs). AEs can act as the direct implementer of funding proposals or contract an Executing Entities (EEs) to be responsible for project implementation on their behalf. However, while the GCF has already successfully shown how it manages to mobilize private finance in its mitigation project portfolio, it has not exhibited the same success in mobilizing private finance for adaptation. For example, mitigation projects generally mobilize more private co-finance than adaptation projects, and adaptation projects have attracted almost no co-financing from private sources (Grüning et al., 2020). Furthermore, only two of the 67 GCF adaptation projects are developed by 'private' AEs, as compared to 23 out of 52 mitigation projects.

In addition to the binary private versus public classification used by the GCF (dependent on the AE that originated the project), we derived three further 'levels' of private sector engagement that fall within this spectrum, based on literature (Agrawala et al, 2011; Barkó, et al., 2018; Fayolle, et al., 2019; IFC, 2012; Trabacchi & Stadelmann, 2013). After an initial assessment of the GCF adaptation projects, we developed and further defined criteria to classify the GCF projects among a total of five private sector engagement levels (see Table 1).

Complementary to the binary GCF classification (level I with no private sector engagement, and level V as fully private project), we see private sector actors as implementing partners (Level II), as actors being 'mobilized' during a project (Level III) and as a possible co-financiers (level IV, see Table 1). This derivation of engagement levels was based on two underlying motivations. On the one hand, our more detailed spectrum of the roles can help the GCF and other climate finance providers to better understand how to engage the private sector in adaptation and mobilize more private sector finance over time. For example, a private sector actor that 'only' serves as an executing entity now, might provide co-finance or apply for accreditation in the future. On the other hand, in a broader whole-of-society perspective, the private sector needs to adapt to climate change in order for a society to become adapted. More clarity on levels on roles and level of any private sector engagement in adaptation can contribute to that, not just finance.

2.2 Addressing market imperfections to stimulate private sector engagement in adaptation

Druce et al (2016) and Pauw et al. (in press) hypothesize that private sector engagement in adaptation can be increased by addressing three market imperfections: Positive externalities of adaptation projects, incomplete/asymmetric information, and imperfect financial markets.

Positive externalities occur when private investments generate public goods. These are benefits to society that do not necessarily generate additional cash flows and hence are not captured by the financial return of an investment. As the societal benefits and other externalities are not part of the routine financial metrics, they are rarely documented, recorded, or even quantified, meaning that financial returns on the investment do not reflect the full value of undertaking the activity (Druce, et al., 2016). Addressing positive externalities from a private sector perspective means quantitatively leveraging them in a way that effectively improves the risk-return characteristics of an adaptation investment, making it more attractive from an economic view through either innovative ways of generating additional revenues or effectively de-risking the endeavour. In the past, adaptation projects have successfully addressed positive externalities by leveraging them as an additional source of financing: Flooding systems doubling in function as transport possibilities can charge small tolls; modest water tariffs by local beneficiaries of water supply projects can finance operation and maintenance requirements; tax incentives, grants, and vouchers are direct examples of support mechanisms that can be made available to recompense and incentivize the private sector (Ahenkan et al, 2018).

Incomplete/asymmetric information occurs when critical information is unavailable, inaccessible, or distributed unevenly among different actors (see Akerlof, 1970). In adaptation, this market imperfection occurs when actors, be it investors, farmers, or businesses, are unaware of the risks and impacts that climate change exacerbates, as well as the measures available to mitigate these risks (Fayolle, et al., 2019). Unavailability, inaccessibility, or uneven distribution of information among relevant actors disempowers them from making adaptation decisions and investing accordingly, in particular in developing economies (Antwi-Agyei, 2013; Stenek et al., 2013). The public sector can help to address this market imperfection. For example, our assessment of GCF projects shows that the market imperfection is, for instance, addressed through workshops held with affected stakeholders; broadcasting relevant information via television, radio or cell phone; networking events; pilot projects serving as showcases for possible replications; and the continuous collection of and access to climate relevant data and models.

Imperfect financial markets can limit adaptation in many ways. For example, adaptation investments may require long-term debt because climate risks often materialize on longer time-horizons. However, the market has short-term maturity preferences (Biagini & Miller, 2013) and developing countries in particular often lack a liquid, long-term financial market (Kempa & Moslener, 2017). Inefficient allocation and availability of capital as well as inadequate risk transfers lead to the development of unfavourable business climates. This limits opportunities and availability of resources for financing adaptation projects, especially given their already challenging risk-return characteristics (Trabacchi & Stadelmann, 2013; Fayolle, et al., 2019). Strengthening and supporting financial institutions in the development of adequate products to finance adaptation projects based on their specific needs would help to alleviate this market imperfection. In terms of debt, for example, this includes adapting framework conditions of

loans but also comprises offerings such as guarantees mechanisms, policy insurance, and local currency solutions (Brown, 2011).

This article will test the expectations of Druce et al (2016) and Pauw et al. (in press) that addressing these market imperfections can increase private sector engagement in adaptation. In this research, 'increasing' means that projects that address market imperfections score higher on the five-level ordinal scale. A focus on market imperfections should not be confused with arguing in favour of an 'adaptation market' or with laissez-faire economics. Although there are positive experiences with cost-benefit analysis of adaptation measures (e.g. Zhou et al., 2013; UNFCCC, 2011) and value-for-money assessments (Savage, 2015), it is unfeasible to commodify and trade adaptation, partly also because it is multifaceted and locally contextualized (Persson, 2011). In addition, there are many adaptation-related areas where market principles should not play a dominant role. Governments also have purely distributional goals, such as immediate disaster response, as well as legal obligations for protection (e.g. against coastal flooding, see Bisaro & Hinkel, 2018). The development of markets should aim to contribute to the overall welfare of society, including the most vulnerable – it is not an end in itself. In that sense, focus on market imperfections is a call for a larger role of public actors (Pauw et al., in press)

3. Method

We examine if market imperfections are addressed in the funding proposals of all 67 adaptation projects that are approved by the GCF Board, inclusive of its 27th meeting in November 2020. Cross-cutting GCF projects were excluded from the analysis, as it would not always be possible to identify whether a private sector actor has been mobilized for the mitigation or adaptation share of the project.

We first identified the level of private sector engagement of each project proposal using the criteria introduced in Table 1. This analytical criteria-based approach draws on existing methodology in climate finance literature and (multi-)criteria scoring systems that allow for comparisons and ranking (Grafakos, et al., 2019) (Lee, et al., 2014). To source the right information, all proposals were read in their entirety with a particular focus on the main project activities (section C.3: "Project / Programme Description") and stakeholders. In addition, a key word search was conducted to make sure all parts of the funding proposal were considered that might relate to private sector engagement. Searched words included "private", "businesses", "compan[y/ies]", "bank[able]", "value chain", and "entrepreneur".

Second, we assessed if a given project addresses any of the three market imperfections (see Sect. 2.2) through a set of criteria (see Table 2) which yields a "1" or "0" for each market imperfection and project using manual content analysis.

Intercoder subjectivity was mitigated by using two coders that evaluated all 67 reports independently. Intercoder reliability was substantial, with 83 per cent agreement on the private sector engagement levels and an average Cohen's kappa of 0.63 for the three market imperfections. Discrepancies have been discussed between and settled by the two coders.

In addition, we collected project and country specific parameters for each project. Project-specific parameters are whether an accredited entity is domestic or regional/international (AE_type), project size (p_size), funding type (f_type)(grant vs. non-grant, loans, guarantees), time elapsed since the first GCF board approval (t_elapsed) and project duration (t). Country-specific parameters were used to record macroeconomic and climate aspects. For each project country of implementation, the World Bank's Ease of Doing Business (DB), the Human Development Index (HDI), and the Climate Risk Index (CR) scores of the respective approval year were taken into consideration. All variables are listed in Table 3).

An ordinal project-level regression model was used to evaluate the hypothesis. This is appropriate because the private sector engagement level is an ordinal, i.e. non-continuous variable with an arbitrary scale where only the relative ordering between values is relevant (Betancourt, 2019; Shi, et al., 2015; Mase, et al., 2017). We used private sector engagement as dependent variable and the project and country specific parameters mentioned above as independent variables. Technically, the data are nested, i.e. there are projects that come from the same country. Therefore, a multilevel regression would be more appropriate. Against the background of the limited sample size however, we implemented a project-level model only using Stata 16.1.

To also assess the relationship between variables and optimize our method, we performed a correlation analysis and found no critical correlations between our independent variables. In addition, we calculated variance inflation factors (VIF) for all variables. The low VIFs (mean of 1.51), all significantly below the threshold of 10, further support our method and selection of variables. We also examined if our findings are robust against varying model specifications. As the sample only included two level-V projects and they both addressed all market imperfections, a sanity check was conducted to identify whether these level-V projects distorted the analysis. We omitted these two projects from the sample and re-ran the regression. This regression had a slightly lower pseudo R^2 of 0.42, still indicating a very good fit, as well as strong statistical significance of the coefficients that will be further elaborated upon in the results section.

4. Results

The results show a mixed distribution of GCF adaptation projects across all five levels of our private sector engagement spectrum (see Table 4). Descriptive evidence suggests that our assumption on private sector engagement was correct. Engagement is both larger, in terms of number of projects, and more diverse, in terms of levels, than expected based on the GCF definition (see Grüning et al., 2020). Sixteen per cent of the GCF adaptation projects engages the private sector in a way that is reflected by the GCF's current indicators (as co-finance and private sector-led projects). An additional 79 per cent of the projects include level II and level III engagement of the private sector (see Tables 1 and 4).

As private sector engagement increases, so does the share of projects per engagement level that addresses market imperfections (see Fig. 1).

Table 5 reports the results of the ordinal regression analysis. With a McFadden pseudo R^2 of 0.445, the overall model fit is very good, a McFadden's pseudo R^2 between 0.2 and 0.4 is already considered to represent an excellent fit (Domencich & McFadden, 1975).

4.1 Addressing market imperfections increases private sector engagement in GCF projects

The addressal of market imperfections has a positive and statistically significant effect on private-sector engagement in the GCF's adaptation portfolio. Marginal effects calculated as part of the analysis support this and indicate that each market imperfection addressed increases the likelihood of a project scoring in the top three levels and decreases the likelihood of scoring in the bottom to levels of private sector engagement (see Table 6). The latter can be explained by the fact that there is no private sector engagement in level I and that private sector engagement is limited to implementation of project activities under level II.

With more than 95 per cent confidence, the findings indicate that addressing the barrier of **positive externalities** increases private sector engagement in the GCF's adaptation projects. Finding ways of creating stable revenue streams to offset costs and achieve bankability appears key to engaging the private sector. The marginal effects indicate that addressing positive externalities increases the likeliness of a GCF project being in level IV by more than 10 per cent and decreases the likeliness of being in the lowest two levels by 4.1 and 17.5 per cent respectively (see Table 6).

Asymmetric and incomplete information has the strongest impact on private sector engagement in adaptation with a 99 per cent of statistical significance. It is also the most widely addressed market imperfection (see Fig. 1): Sixty-six per cent of the project proposals including activities such as advisory offerings, business model improvements and information services developed specifically for private sector actors. Addressing the incomplete/asymmetric information can reduce the uncertainty of an investment decision by providing understanding of risk mitigants and create awareness of opportunities in the first place. In the GCF sample, this has an effect of dramatically decreasing the likeliness of a project being in level I (by 7.6 per cent) or level II (by 42.2 per cent) and increasing the likeliness of being reaching level III by almost than a third.

At a confidence level of 99 per cent, addressing **imperfect financial markets**, i.e. improving access to finance, indicates a high potential impact in mobilizing the private sector. Addressing the issue of imperfect financial markets empirically heightens likelihood of engaging at level IV by almost a fifth. However, only 22 per cent of the GCF adaptation projects exhibited mechanisms to address this market imperfection. AEs and financing partners of GCF projects generally do not face financing constraints and are, to a large extent, able to provide different financing solutions. The access to finance by an actor of the local private sector is thus not an issue on the GCF level but rather on a beneficiary or project level (e.g. MSMEs or farmers). Channelling capital down to the beneficiary level poses its own challenges (regulatory, financial, even social) making it a more complex action to perform by an AE, possibly compromising bankability in the process.

4.2 Project-specific parameters

Among the project-specific parameters, all beside the temporal variables showed statistical significance. At a 90 per cent significance level, the p_size coefficient indicates a slight but positive relationship to private sector engagement. The marginal effects, however, show that while there is statistical significance, the impact is negligible.

A strong (99 per cent confidence) positive relation was found between the level of private sector engagement and the existence of a GCF loan component in projects (f_type). In five projects, the AE used loans to finance (a part of) a project, hinting that a project component offers revenue generation and a retrievability of funds. The marginal effect also supports this, indicating that loan components lever private engagement sector in levels IV and V – the levels in which finance from the public actors starts flowing into adaptation projects. While half of the entities that have submitted adaptation proposals have an accreditation of using non-grant instruments and providing the impactful products, 93 per cent of adaptation-only funding remains in the form of grants (WRI, 2018). Using non-grant instruments thus is not a question of availability but relates to financial feasibility. From an AE perspective, the bankability (related to positive externalities) seems to be a larger hurdle than the available access to finance (related to imperfect capital markets).

With 95 per cent statistical significance, the findings showed a negative connection between projects accredited by national, direct access entities (DAEs) and private sector engagement. The marginal effects show that DAEs seem to decrease the likelihood of projects scoring in the higher three levels of private sector engagement. This is an important outcome, as the GCF in its Updated Strategic Plan both aims to catalyse private sector investments in adaptation and to significantly increase funding channelled through DAEs (GCF, 2020). Few DAEs are accredited to use loans in their projects (REF: GCF Monitor 4) and they might have less experiences with and lower capacity to mobilise private sector engagement, explaining why fewer projects have scored higher on the spectrum. These findings would indicate the importance of encouraging DAEs to engage the private sector more.

The coefficients concerning temporal aspects have no statistical significance, indicating that the level of private sector engagement has not significantly increased over time despite GCF efforts (such as the PSF) ($t_elapsed$). Similarly, the duration (t) parameter also lacks statistical significance, providing no evidence for private sector engagement to vary depending on the length of a project.

4.3 Country specific parameters

Only the *Ease of Doing Business* coefficient (DB) was statistically significant (90 per cent) and exhibited a negative relation. Projects in countries with a better business climate scored lower on our private sector engagement scale. The nature of the GCF and its priorities to focus on the most vulnerable developing countries might offer an explanation for these outcomes. The GCF prioritizes funding towards Least Developed Countries (LDCs), Small Island Developing States (SIDS), and African States, nations that predominately perform below average on the Ease of Doing Business ranking (GCF, 2016). The selectivity

and mission of the GCF to focus on more fragile nations potentially demotivates some private sector actors to engage in the GCFs activities. In addition, some of these countries also hold the position that adaptation should be financed through grants by developed countries, rather than through mobilized private sector investments (Pauw, 2015) or loans that need to be repaid (see e.g. the GCF Board's discussion on project FP114 (GCF Board, 2019). The findings indicate that the GCF is not a representative tool for analysing private adaptation efforts globally, but rather a niche with a specific focus on regions that have particular challenges in attracting private finance. Likewise, the results indicate that when indiscriminatory of the type of private sector actor (smallholder farmers to multinationals), private sector engagement in adaptation is possible regardless of the business environment.

4.4 Limitations

Three limitations to this research should be mentioned. First, as a new fund, the GCF has not completed any adaptation projects yet. Results are therefore based on project proposals rather than implemented action. Although plans could be adjusted when being implemented, we nevertheless expect the results to be robust, as the projects are proposed by entities that went through careful accreditation processes.

Second, this article analysed ways in which GCF projects address market imperfections. The options do so are limited for this multilateral fund. For example, the GCF cannot directly apply instruments such as regulatory reform or impose policies. In that sense, the potential of the public sector to engage the private sector in adaptation is probably larger than our analysis demonstrates. In addition, the geographic focus of the GCF - developing countries, with a prioritization towards LDCs, SIDS and African states – also mean that the results of this article might not equally in other geographic contexts.

Finally, the GCF is a 'continuously learning institution' that is still developing and updating policies to improve its work (see IEU, 2019). It is also still expanding its project portfolio. In that sense, if this analysis were to be repeated over time, we cannot rule out that it could yield different results. At the same time, we do believe our analysis is solid, despite the limited sample size. For example, the significance of the outcomes did not change when we tried the case where the market imperfections for the two project of level V are not addressed.

5. Conclusion And Discussion

The mobilisation of private sector engagement is seen as critical to address the adaptation challenge, but so far it appears very difficult. This article shines a new light on private sector engagement in adaptation projects, by focusing on market imperfections and by using the GCF's adaptation project portfolio as a case study.

We demonstrate that focusing on private sector led projects and private sector finance for adaptation alone does not adequately explain the extent to which the private sector already engages in adaptation.

Private co-financing and private sector led projects, as this explains private sector engagement in only 16 per cent of all the GCF's adaptation projects. In an additional 80 per cent of the projects, the private sector

has a role as an implementing partner or as an actor that is actively incentivised to support the project implementation through subsequent activities or opportunities.

Looking at private sector engagement in a more granular way is important for two reasons. First, it can help the GCF to better understand how to engage the private sector in adaptation. Growing experience with private sector engagement will lead to a better mutual understanding of public-private value creation. This is important, because it currently appears low (see Zamarioli et al., 2020). Over time, it might increasingly stimulate the mobilization of private sector finance. For example, a private sector actor that 'only' serves as an executing entity now, might learn more about risks and returns in the field of adaptation, develop its own business model and potentially provide co-finance or apply for accreditation in the future. Second, in a broader whole-of-society perspective, the private sector needs to adapt to climate change in order for a society to become adapted. Any private sector engagement in adaptation can contribute to that, not just finance and not just engagement in the context of the GCF. A private sector actor might learn about adaptation in the context of a GCF project and replicate or scale up elsewhere.

In order to mobilize more private sector engagement and to have more impact, the GCF and other climate finance providers should thus move beyond the binary classification of private versus public projects and to aim to mobilize co-finance. Instead, they should work with their relevant partners in developing countries to mobilize private sector engagement in a tailor-made way.

The second important conclusion of this article is that it is key to address market imperfections in order to mobilize private sector engagement in adaptation. The GCF has limited options to address market imperfections directly by modifying the market environment, for example through policy and regulatory reform. The GCF is better suited to address the consequences of market imperfections, for example through compensation and concessional approaches (see Pauw et al., in press; Druce et al., 2016). While it was out of the scope of this paper to identify what the most effective ways are to address market imperfections, the GFC data does provide a clear connection between the engagement of the private sector and instruments (such as matching grant funds, technical assistance programmes, risk sharing facilities) that are directly related to the three market imperfections analysed in this paper.

In addressing market imperfections, the GCF and other climate finance providers should take into account that they also have distributional responsibilities, including reducing the vulnerability of the most marginalised. While private-sector engagement might be stimulated by addressing market imperfections, policy objectives such as equity (just allocation of resources) or affordability of essential goods such as water (see Osberghaus et al., 2010) can also create market imperfections. The main aim should be to efficiently adapt society as a whole, including the most vulnerable people. The mobilisation of private sector engagement in adaptation is a means to this end, not an end in itself.

Figure: Mobilising Private Adaptation Finance: Lessons Learning from the Green Climate Fund

Tables: Mobilising Private Adaptation Finance: Lessons Learning from the Green Climate Fund

Table 1

Criteria used to assess the level of private sector engagement in GCF adaptation projects.

I	No Private Sector engagement	Purely public project.
II	Private sector as implementing partner	Private sector involvement only as a paid planning or implementing entity. No contribution/investment by private sector or long-term engagement.
III	Mobilisation of private sector engagement	Development of programs/projects specifically for private sector engagement. Efforts primarily go from the creation of new programs/committees/units, over to staffing, and capacity building (for example through workshops, feasibility studies) with the clear goal to incentivize private sector engagement.
IV	Private sector as co-financier/contributor	Active private sector participation with own resources (financial and/or non-financial): business case/ bankability and contribution. Includes Public-private partnerships (PPPs)
V	GCF Private Sector project	Strict private sector definition of the GCF: All financial resources that are provided for the implementation of a Funded Activity from entities that are more than 50 per cent owned and/or controlled by private shareholders (GCF, 2019).

Table 2

Framework used to assess market imperfection are addressed in GCF adaptation projects.

<p>Positive externalities (Pos_Ext)</p>	<p>Project specific instruments/mechanisms are derived to address the positive externalities created by the project to improve the risk-return profile for the private sector actor. Identifying or developing an additional source of funding or risk mitigation creates an incentive for a private sector actor to engage in positive externality creating activities.</p>	<p>Examples: Grants (FP113, Kenya; FP059, Grenada), tariffs (FP043, Morocco), tolls, fees (FP075, Tajikistan) to raise funds from the externalities that would otherwise not exist. Tax incentives, supply-demand match making mechanisms, and vouchers also count.</p>
<p>Incomplete/asymmetric information (As_Info)</p>	<p>The project integrates actions that contribute to private sector actors' knowledge and understanding of climate change impacts and adaptation measures and strategies. In order to meet the requirements, these activities must be (i) targeted at the private sector; and (ii) be continuous or otherwise intensive.</p>	<p>Examples: Climate forecast service (FP002, Malawi), value chain and business advisory (FP011, Gambia; SAP003, Senegal), comprehensive training leading to income diversification (FP072, Zambia). Actions like one-time workshops or the dissemination of flyers would not be sufficient to count towards addressing incomplete/asymmetric information.</p>
<p>Incomplete financial markets (Inc_fin_M)</p>	<p>The project offers services that improve or facilitate the access to finance for private sector actors. This can be achieved by financial institutions through innovative products addressing specific private sector needs, funding schemes, or other activities that provide a source of capital that were not available or feasible before.</p>	<p>Examples: Cooperation with (micro-) finance institutions for special loans, revolving financing facilities, community trust schemes (FP069, Bangladesh; FP108, Pakistan; SAP011, Gambia).</p>

Table 3

Description of the independent variables used for the analysis of GCF adaptation projects (N = 67)

Parameter	Type	Description	Source	Min	Max	Mean
Private sector engagement	<i>Ordinal</i>	Level of private sector engagement, dependent variable	Own assessment based on Table 1	1	5	2.72
Pos_Ext	<i>Dummy</i>	'1' if been addressed in GCF project, '0' otherwise (see Table 2)	Own assessment based on data from funding proposal	0	1	0.462
As_Info	<i>Dummy</i>	'1' if been addressed in GCF project, '0' otherwise (see Table 2)	Own assessment based on data from funding proposal	0	1	0.656
Inc_fin_M	<i>Dummy</i>	'1' if been addressed in GCF project, '0' otherwise (see Table 2)	Own assessment based on data from funding proposal	0	1	0.223
p_size	<i>Continuous</i>	Sum of GCF financing and any co-financing (in US\$ millions)	Calculation based on data from funding proposal	2.20	405,1	55.62
f_type	<i>Dummy</i>	'0' if the given project contains only grant financing, '0' otherwise	Own assessment based on data from funding proposal	0	1	0.074
AE_type	<i>Dummy</i>	'1' if the accrediting entity is national i.e. a DAE, '0' otherwise	Data from funding proposal	0	1	0.149
t_elapsed	<i>Continuous</i>	Time elapsed since board approval of the first GCF adaption project (t = 0)	Calculation based on data from funding proposal	0	5.08	2.665
T	<i>Continuous</i>	Length of the project in years	Data from funding proposal	4	26	7.253
HDI	<i>Continuous</i>	Index of life expectancy, gross nat. income and years of education	United Nations Development Programme	0.422	0.852	0.628
DB	<i>Continuous</i>	Index of the business friendliness of a country's regulatory environment	World Bank Group	40.41	82.80	56.38

Parameter	Type	Description	Source	Min	Max	Mean
CR	<i>Continuous</i>	Index analysing to what extent countries have been affected by weather-related loss events	Developed by NGO Germanwatch e.V.	-13.4	11.8	-2.03

Table 4
Number of projects for each private sector engagement level (N = 67).

Source: authors

Private Sector Engagement Level	Number of Projects
I	3
II	26
III	27
IV	9
V	2
Total	67

Table 5

The table reports coefficients, standard errors and significances for an ordinal regression analysis on private sector engagement. Significant coefficients at the *** 99%, ** 95%, and * 90% confidence levels.

Source: Authors.

		Number of Observations		=	67
		LR Chi² (11)		=	74.41
		Prob > Chi²		=	0.0000
		Pseudo R²		=	0.445
Parameter	Coefficient	Std. Err.	z	[95% conf. interval]	
Pos_Ext	2.004**	0.829	2.42	0.379	3.630
As_Info	3.782***	0.949	3.99	1.922	5.64
Inc_fin_M	2.910***	0.822	3.54	1.299	4.520
p_size	0.009*	0.005	1.95	0.000	0.019
f_type	2.935***	1.105	2.66	0.770	5.100
AE_type	-1.867**	0.819	-2.28	-3.553	-0.321
t_elapsed	-0.013	0.198	-0.006	-0.400	0.375
T	-0.033	0.071	-0.47	-0.172	0.105
DB	-0.089*	0.051	-1.76	-0.189	0.010
HDI	-0.198	3.790	-0.05	-7.627	7.231
CR	0.108	0.079	1.36	-0.048	-0.261

Table 6

Average marginal effects for significant variables. The values indicate, assuming all other variables are held equal, the impact a variable has on the likeliness of a project belonging to a respective private sector engagement level.

Engagement Level	I	II	III	IV	V
Pos_Ext	-0.041	-0.175	0.086	0.104	0.026
As_Info	-0.076	-0.422	0.326	0.140	0.031
Inc_fin_M	-0.043	-0.239	0.027	0.190	0.066
p_size	-0.000	-0.001	0.000	0.000	0.000
f_type	-0.041	-0.216	-0.002	0.151	0.108
AE_type	0.081	0.098	-0.069	-0.083	-0.027
DB	0.003	0.006	-0.003	-0.004	-0.002

Declarations

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Conflicts of interest/Competing interests

The authors whose names are listed immediately below certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

Availability of data and material

The data that support the findings of this study are available from the corresponding author, WPP, upon request.

Code availability

The Stata code that supports the findings of this study are available from the corresponding author, WPP, upon request.

References

AfDB, 2011. *African Development Report 11: The Role of the Private Sector in Africa's Economic Development*, Abidjan: African Development Bank.

Agrawala, S., Carraro, M., Kingsmill, N., Lanzi, E., Mullan, M., & Prudent-Richard, G. (2011). Private sector engagement in adaptation to climate change: approaches to managing climate risks.

Ahenkan, A., Osei, J., & Owusu, E. H. (2018). Mainstreaming Green Economy: An Assessment of Private Sector Led Initiatives in Climate Change Adaptation in Ghana. *Journal of Sustainable Development*, 11(2), 77-87.

Akerlof, G. (1970). The market for lemons: Quality uncertainty and the market mechanism. *The Quarterly Journal of Economics*, 89, 488-500.

Antwi-Agyei, P., Dougill, A. J., & Stringer, L. C. (2013). Barriers to climate change adaptation in sub-Saharan Africa: evidence from northeast Ghana & systematic literature review.

Averchenkova, A. et al., 2016. Multinational and large national corporations and climate adaptation: are we asking the right questions? A review of current knowledge and a new research perspective. *WIREs Climate Change*, 7(4), pp. 517-536.

Barkó, T., Cremers, M. & Renneboog, L., 2018. Shareholder engagement on environmental, social, and governance performance. *Tilburg University*.

Betancourt, M. (2019, May). *Ordinal regression*. Betanalpha.
https://betanalpha.github.io/assets/case_studies/ordinal_regression.html

Biagini, B., & Miller, A. (2013). Engaging the private sector in adaptation to climate change in developing countries: importance, status, and challenges. *Climate and Development*, 5(3), 242-252.

Biesbroek, G. R., Klostermann, J. E., Termeer, C. J., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change*, 13(5), 1119-1129.

Bisaro, A., & Hinkel, J. (2018). Mobilizing private finance for coastal adaptation: A literature review. *Wiley Interdisciplinary Reviews: Climate Change*, 9(3), e514.

Brown, J. (2011). Leveraging private investment: the role of public sector climate finance. Background Note. Overseas Development Institute

Cohen, B. & Winn, M. I., 2007. *Market imperfections, opportunity and sustainable entrepreneurship*. *Journal of Business Venturing*, 22(1), pp. 29-49.

Domencich, T. A., & McFadden, D. (1975). *Urban travel demand-a behavioral analysis* (No. Monograph).

Druce, L., Moslener, U., Gruening, C., Pauw, W. P., & Connell, R. (2016). Demystifying adaptation finance for the private sector.

Vivid Economics (2015). Building an evidence base on private sector engagement in financing climate change adaptation. *London: Vivid Economics*.

Fayolle, V., Fouvet, C., Soundarajan, V., Nath, V., Acharya, S., Gupta, N., & Petrarulo, L. (2019). Engaging the private sector in financing adaptation to climate change: Learning from practice. *Action on Climate Today, Learning Paper, February*.

Grafakos, S., Trigg, K., Landauer, M., Chelleri, L., & Dhakal, S. (2019). Analytical framework to evaluate the level of integration of climate adaptation and mitigation in cities. *Climatic change*, 154(1), 87-106.

GCF and UNEP, 2017. *FP011 Funding Proposal*. [Online]
<https://www.greenclimate.fund/document/large-scale-ecosystem-based-adaptation-gambia-river-basin-developing-climate-resilient>

GCF Board, 2019. *GCF/B.23/24: Report of the twenty-third meeting of the Board*. [Online]
<https://www.greenclimate.fund/document/gcf-b23-24>

GCF, 2016. *Initial Strategic Plan for the GCF*, Incheon : Green Climate Fund.

GCF. (2019). *Policy on co-financing*. <https://www.greenclimate.fund/sites/default/files/document/policy-cofinancing.pdf>

GCF. (2020). *Decisions, policies, and frameworks as agreed by the Board of the Green Climate Fund from B.01 to B.24*. <https://www.greenclimate.fund/sites/default/files/document/gcf-handbook.pdf>

Green Climate Fund Dashboard. (2020). *Portfolio dashboard*.<https://www.greenclimate.fund/projects/dashboard>

GCF. (2018, July). *The GCF's approach to adaptation: Analysis and implications for the fund*. World Resources Institute. <https://www.greenclimate.fund/sites/default/files/document/gcf-b21-inf03-add01.pdf>

Gruening, C., Pauw, W. P., & Zamarioli, L. (2020). Mobilising public and private co-finance. *GCF Monitor*, (1). Frankfurt School of Finance and Management

Hallmeyer K, Tonkonogy B. 2018. "Designing Technical Assistance Activities for Adaptation and Resilience Companies." Climate Policy Initiative. Available at: <https://climatepolicyinitiative.org/wp-content/uploads/2018/05/Designing-Technical-Assistance-Activities-for-Adaptation-and-Resilience-Companies.pdf>

Independent Evaluation Unit (IEU). (2019). Forward-Looking Performance Review of The Green Climate Fund (FPR) Evaluation Report No. 3, Green Climate Fund, Songdo, South Korea

International Finance Cooperation. (2012). Private investment in inclusive green growth and climate-related activities: Key messages from the literature and bibliography.

- Kempa, K., & Moslener, U. (2017). Climate policy with the chequebook—An economic analysis of climate investment support. *Economics of Energy & Environmental Policy*, 6(1), 111-130.
- Khan, M., Robinson, S. A., Weikmans, R., Cipler, D., & Roberts, J. T. (2020). Twenty-five years of adaptation finance through a climate justice lens. *Climatic Change*, 161(2), 251-269.
- Lee, D. R., Edmeades, S., De Nys, E., McDonald, A., & Janssen, W. (2014). Developing local adaptation strategies for climate change in agriculture: A priority-setting approach with application to Latin America. *Global Environmental Change*, 29, 78-91.
- Mase, A. S., Gramig, B. M., & Prokopy, L. S. (2017). Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern US crop farmers. *Clim Risk Manag* 15: 8–17.
- Micale, V., Tonkonogy, B., & Mazza, F. (2018). Understanding and increasing finance for climate adaptation in developing countries. *Climate Policy Initiative*.
- Pauw, P., 2014. Not a panacea: private-sector engagement in adaptation and adaptation finance in developing countries. *Climate Policy*, 15(5).
- Pauw, W. P., Klein, R. J., Vellinga, P., & Biermann, F. (2016). Private finance for adaptation: do private realities meet public ambitions? *Climatic Change*, 134(4), 489-503.
- Pauw, W.P., Kempa, L., Moslener, U., Gruening, C. & Çevik, C. (in press). A focus on market imperfections can help governments to mobilise private investments in adaptation. *Climate & Development*
- PCIR. (2012). Barriers to Effective Climate Change Adaptation, Productivity Commission Inquiry Report, 59.
- Persson, Å. (2011). Institutionalising climate adaptation finance under the UNFCCC and beyond: Could an adaptation “market” emerge. *Stockholm: Stockholm Environment Institute*.
- Osberghaus, D., Dannenberg, A., Menzel, T., & Sturm, B. (2010). The role of the government in adaptation to climate change. *Environment and Planning C: Government and Policy*, 28(5), 834-850.
- Savage, M. (2015). Evidence paper on VFM of investments in climate resilient development. Oxford Consulting Partners for Evidence on Demand. http://dx.doi.org/10.12774/eod_hd.august2015.savagem
- Shi, L., Chu, E., & Debats, J. (2015). Explaining progress in climate adaptation planning across 156 US municipalities. *Journal of the American Planning Association*, 81(3), 191-202.
- Steckel, J. C. et al., 2017. From climate finance toward. 8:e437. doi: 10.1002/wcc.437.
- Stenek, V., Amado, J. C., & Greenall, D. (2013). Enabling environment for private sector adaptation: An index assessment framework.

Trabacchi, C., & Mazza, F. (2015). Emerging solutions to drive private investment in climate resilience. Climate Policy Initiative

Trabacchi, C., & Stadelmann, M. (2013). Making adaptation a private sector business: Insights from the pilot program for climate resilience in Nepal. *Venice: Climate Policy Initiative.*

UNFCCC. (2011). Assessing the costs and benefits of adaptation options: an overview of approaches. *The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change, 52.*

UNEP (2021). Adaptation Gap Report 2020. UNEP, Nairobi

Vivid Economics (2015). Building an Evidence Base on Private Sector Engagement in Financing Climate Change Adaptation, Report prepared for EBRD

World Economic Forum. (2020). *Global risks report 2020* (15th ed.). Marsh & McLennan, Zurich Insurance Group.

Zamarioli, L., Pauw, W.P. & Gruening, C. (2020). Country Ownership as the Means for Paradigm Shift: The Case of the Green Climate Fund. Sustainability. <https://doi.org/10.3390/su12145714>

Zhou, Q., Panduro, T. E., Thorsen, B. J., & Arnbjerg-Nielsen, K. (2013). Adaption to extreme rainfall with open urban drainage system: An integrated hydrological cost-benefit analysis. *Environmental management, 51*(3), 586-601.

Figures

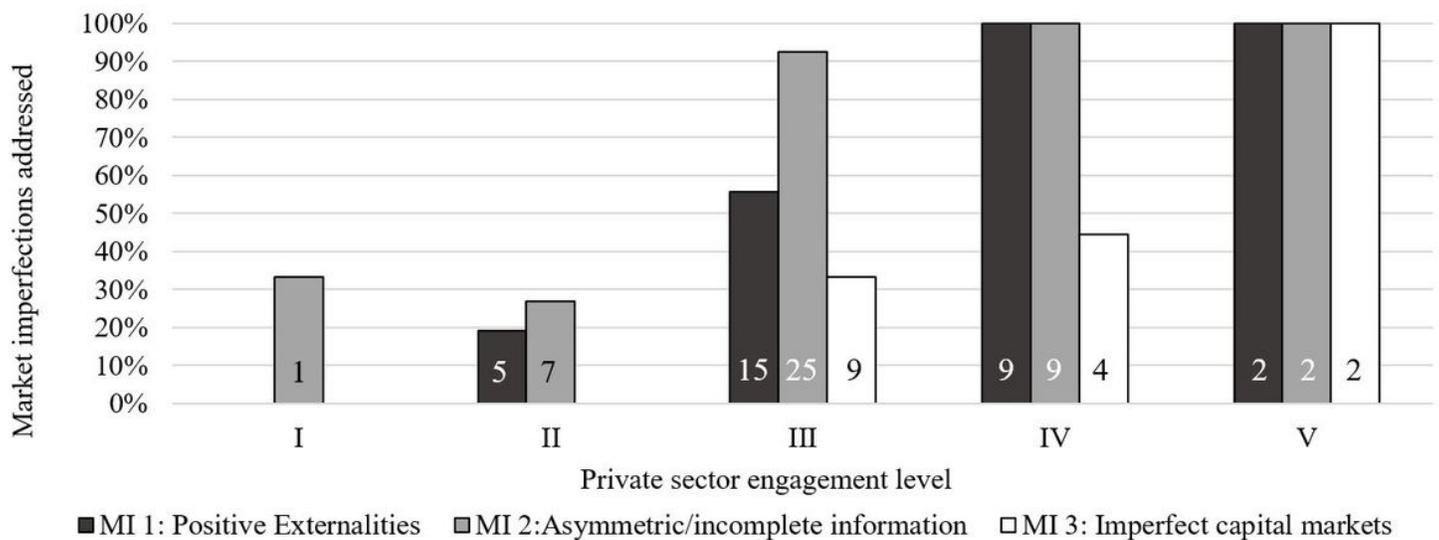


Figure 1

Mobilising Private Adaptation Finance: Lessons Learning from the Green Climate Fund. Private sector engagement and addressed market imperfections (N = 67).