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PARIS SCHOOL OF ECONOMICS
ECOLE D'ÉCONOMIE DE PARIS

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PARIS SCHOOL OF ECONOMICS

Doctoral thesis

A thesis submitted and publicly defended on July 23rd 2020 in fulfillment of the requirements for the degree of Doctor of Philosophy in Economics

by Ingy HELMY

Three Essays on Institutional Investors Participation in Infrastructure Projects

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"Be willing to embrace wonder, to experience unexpected discovery, and to go in unknown directions. A posture of ignorance compels you to keep learning. Never become so enamored of your own smarts that you stop signing up for life's hard classes. Keep your conclusions light and your curiosity ferocious. Keep groping in the darkness with ravenous desire to know more. "

– Melissa Harris-Perry

To my mother, Hoda.
For sharing all my joys and sorrows, my trials, failures and achievements; and for her unconditional love, advice and support.

Acknowledgements

These are the last lines I write in this dissertation and it actually turned out to be a lot more emotional than what I expected. Reaching this moment is the result of a four year adventure that was challenging, demanding but at the same time extremely exciting and empowering. I was fortunate to have the best of both worlds: being in academia but also in the professional sphere as my PhD was funded by Infra Gestion, a consulting firm working on infrastructure investments. I would like to focus in this section on thanking all the people that helped me, believed in me and supported me along this journey. I will first start with the people in academia sphere before moving to the professional and personal sphere.

First, I would like to thank my PhD advisors, Carine Staropoli and Frédéric Marty for offering me this opportunity. They guided me along the past four years. I am thankful for all their valuable comments and their in-depth review of my dissertation. I am particularly grateful for their patience with my continuous stress and my long emails. They always had the right words to reassure me and they believed in me through it all. I feel fortunate and grateful to have had them as my PhD supervisors.

I would like to thank Béatrice Boulu-Reshef who was member in my thesis committee and also my co-author. I am grateful for all her valuable comments, suggestions and comments. I am also grateful for her advice, availability and her patience when I was doubting (something that happened quite often). I will always remember our skype calls, late messages and long working sessions.

I would also like to take this opportunity to thank Paola Valbonesi, Stéphane Straub, Laure Athias, Stéphane Robin and Jean-Bernard Chatelain for accepting to be part of my PhD jury. It is an honor to have my work read and discussed by these distinguished scholars. I would particularly like to thank Stéphae Straub and Paola Valbonesi for their valuable comments and constructive criticism during the pre-defense of the thesis.

I am thankful for Marian Moszoro, my co-author. I am particularly grateful for his in-depth review and comments as well as his continuous availability. I would also like to thank Stéphane Saussier for all the comments and suggestions on my work. I am also particularly grateful for the funding allocated for the experiment in this dissertation, by the *Chaire PPP* presided by Stéphane.

These past four years would not have been the same without Infra Gestion. I am sincerely grateful that they offered me this opportunity to pursue my PhD This journey would not have been the same without: Jean-Ghislain Lepic, Pierre Rolland and Romain Barbier. I am thankful for Jean-Ghislain Lepic for believing in me since day one. I am thankful for Pierre Rolland for his continuous support throughout the past four years and for his understanding and patience. He always had a solution for every problem. I am sincerely grateful for having him as a manager. I also would like to thank Romain Barbier for pushing my limits, believing in me and for teaching me what a PPP is. My gratitude also goes to the amazing Infra Gestion team who supported me and were very understanding of how stressful a PhD can get, and with who I had the chance to collaborate on different projects. I would like to thank Hervé Gakpe, Sébastien David, Raphael Vaquette, Paul Mazengat, Florian Duvocelle, Yasmine El Alami, Samuel Larue, Ibrahim Ait-Daoud, Zakary Bekai, Elisa Ouakil. I sincerly believe that I owe Infra Gestion part of who I am today. The past four years with all the challenges, stress and doubt allowed me to grow so much on the personal and the professional level. I am thankful for the opportunity they gave me to work on exciting infrastructure projects. The past four years with them will remain engraved in my memory.

The PhD journey was of course made easier by my dearest friends, and I am grateful to them for their love and support. I am particularly grateful for having Nourhane El Agamawy in my life. She was always a shoulder to lean on, she was always understanding, patient and loving. I would like to thank her with all my heart for always pushing me forward and believing in me.

Last, but for sure not least, I would like to thank my family, the most precious

thing I have, for always supporting my decisions. I am tremendously grateful for their unconditional love. I would particularly like to thank my brother Amr for his continuous support and for all the precious moments we shared throughout our lives. I would also like to express my gratitude for my mother Hoda, I owe all what I am today to her. I am fortunate to have her as my mother and hope I can always make her proud.

Foreword

This PhD. dissertation, entitled "Three Essays on Institutional Investors Participation in Infrastructure Projects", consists of three chapters. The objective of this dissertation is to investigate the question of how to make a better match between infrastructure investments and institutional investors. The General Introduction describes the different research questions addressed in these chapters, as well as the connections that can be established between them. The General Conclusion summarizes the results and their implications for public policies and future work. Nevertheless, each chapter can be read separately. This implies the presence of redundant information across chapters, notably concerning the related literature and the institutional context.

Abstract

Three Essays on Institutional Investors Participation in Infrastructure Projects

Despite a theoretical perfect match between institutional investors and infrastructure investments, allocations to infrastructure have been slow and small. This dissertation investigates using empirical methods the question of how to make a better match between infrastructure investments and institutional investors. The dissertation contributes to the literature on private participation in infrastructure and shifts the debate from private participation in infrastructure as a public policy matter to what is needed to be done from an investment standpoint to unlock the full potential of institutional investors in infrastructure. First, the relation between infrastructure project risks and projects' attractiveness for institutional investors is investigated. The results highlight that higher macroeconomic, regulatory and political risk can hinder investment by institutional investors. Furthermore, a different risk appetite among direct institutional investors, asset managers and infrastructure funds is found. Second, the role of financial multilateral support in crowding-in institutional investors' capital into infrastructure is analyzed in developed and developing countries. The results suggest a positive effect in developed countries and a crowding-out effect in developing countries. Finally, an exit and bail-out options mechanism to overcome *ex-ante* fear of investment in infrastructure is proposed and tested in the lab. Concurrent exit and bail-out options were found to increase partnership formation, cooperative behavior and partnership sustainability compared to situations without exit or unilateral exit from the government only.

Keywords: Infrastructure Investments, Institutional Investors, Infrastructure Financing Gap, Public-Private Partnerships, Multilateral Banks, Exit and Bail-out Options, Direct & Indirect Investment, Infrastructure Funds.

Contents

List of Abbreviations

AB	**A**vailability **B**ased
ECU	**E**xperimental **C**urrency **U**nit
EDHEC	**E**cole des **H**autes **E**tudes **C**ommerciales du Nord
ESG	**E**nvironmental **S**ocial **R**isks
II	**I**nstitutional **I**nvestors
LEEP	**L**aboratoire d'**E**conomie **E**xpérimentale de **P**aris
MDB	**M**ultilateral **D**evelopment **B**ank
MENA	**M**iddle **E**ast & **N**orth **A**frica
MLS	**M**ultilateral **S**upport
MCPP	**M**anaged for **C**o-Lending **P**ortfolio and **P**rogram
PD	**P**risonner's **D**ilemma
PE	**P**rivate **E**quity
PF	**P**roject **F**inance
PPI	**P**rivate **P**articipation in **I**nfrastructure
PPP	**P**ublic **P**rivate **P**artnership
PSM	**P**ropensity **S**core **M**atching
OECD	**O**rganisation for **E**conomic **C**o-operation and **D**evelopment
SPE	**S**ubgame **P**erfect **E**quilibrium
SPV	**S**pecial **P**urpose **V**ehicle
SVO	**S**ocial **V**alue **O**rientation
SWF	**S**overeign **W**ealth **F**und

Résumé

La question de savoir comment accroître davantage la participation du secteur privé dans les infrastructures figure en tête des priorités des décideurs publiques. Les sources de financement traditionnelles, sont confrontées à de fortes contraintes qui les empêchent de répondre aux besoins croissants de financement des infrastructures. Les investisseurs institutionnels, i.e. les fonds de pension, les compagnies d'assurance et les fonds souverains, avec plus de 100 milliards de dollars sous gestion (OECD, 2018), sont généralement cités comme une source alternative pour le financement à long terme des infrastructures (Della Croce et al., 2013; Inderst et al., 2014). Dans le même temps, compte tenu de l'environnement de rendement faible, les investisseurs institutionnels ont commencé à considérer l'infrastructure comme une opportunité d'investissement convaincante qui leur permet de réaliser une meilleure diversification de leur allocation d'actifs (Blanc-Brude, 2013).

Au cours des dernières années, l'opportunité de favoriser l'augmentation de la participation des investisseurs institutionnels dans le financement des infrastructures a été largement débattue. Des efforts sont déployés à l'échelle mondiale pour faire de l'infrastructure une classe d'actifs à part entière pour attirer davantage d'investisseurs.

Malgré une adéquation théorique parfaite entre les investisseurs institutionnels et les investissements dans les infrastructures, les contributions ont été lentes et modestes (OECD, 2018). En fait, certains obstacles existent et pourraient entraver la participation des investisseurs institutionnels. L'adéquation théorique potentielle est une chose, mais la question pratique de "comment investir" reste à l'étude.

La question de la participation des investisseurs institutionnels est encore très

peu étudiée, principalement en raison du manque de données. Le but de cette thèse est d'explorer des solutions potentielles qui permettraient d'accroître l'implication des investisseurs institutionnels dans le financement des infrastructures. En effet, la plupart des recherches actuelles sur la participation privée dans les infrastructures sont axées sur la participation du secteur privé dans son ensemble et sont principalement basées sur la base de données de la Banque Mondiale sur la participation privée dans les infrastructures (PPI) dans les pays en voie de développement (Basılio, 2017; Mansaray, 2018; Ruhashyankiko et al., 2006).

Dans le cadre de cette thèse, nous utilisons un nouvel ensemble de données fourni par IJglobal sur les transactions de financement de projet entre 2000 et 2018 dans les pays développés et en voie de développement. Nous analysons tous les sponsors de projets et les fournisseurs de dette par transaction pour construire deux variables importantes : la présence d'un investisseur institutionnel et la présence d'un gestionnaire d'actifs ou d'un fonds d'infrastructure. Cette dernière est particulièrement pertinente, car les investisseurs institutionnels peuvent accéder aux investissements dans les infrastructures par le biais du canal d'investissement indirect, c'est-à-dire par l'intermédiaire d'un gestionnaire d'actifs ou d'un fonds.

Résumé des Chapitres

L'objectif de cette thèse est d'étudier à l'aide de méthodes empiriques les modalités de favoriser une plus forte participation des investisseurs institutionnels dans les projets d'infrastructure. Pour ce faire, nous abordons le problème sous trois angles différents :

1. **Comprendre les stratégies d'investissement** : Comment les risques liés aux projets d'infrastructure influent-ils sur l'attrait du projet pour la participation des investisseurs institutionnels?

2. **Comprendre le rôle des institutions multilatérales** : Le soutien des institutions multilatérales favorise-t-il la participation des investisseurs institutionnels?

3. **Réduire la crainte *ex-ante* de l'investissement** : Comment un mécanisme de sortie de l'investisseur en cours du contrat peut-il-aider à rassurer les investisseurs en amont des transactions?

Chapitre 1: La Participation des Investisseurs Institutionnels dans les Infrastructures : Analyse des Opérations de Financement de Projet

Accroître la participation des investisseurs institutionnels dans le financement des infrastructures figure parmi les priorités des décideurs publiques du monde entier. Toutefois, les projets d'infrastructure comportent des risques inhérents qui peuvent entraver la participation de ce type d'investisseurs (Inderst et al., 2014). Le but de ce chapitre est de comprendre les risques liés aux différents projets d'infrastructure,[1] et comments ils affectent l'attractivité des projets pour les investisseurs institutionnels. Pour ce faire, nous utilisons des régressions logistiques sur un nouvel ensemble de données pour les opérations de financement de projet à la clôture financière entre 2000 et 2018 fournies par IJglobal.

Dans cette étude, nous nous intéressons aux investissements réalisés par les investisseurs institutionnels par la voie directe ainsi qu'aux contributions apportées par les gestionnaires d'actifs et les fonds d'infrastructure. Dans cette étude, nous considérons que l'investissement direct est l'investissement effectué par des investisseurs institutionnels, alors que l'investissement indirect est l'investissement effectué par des gestionnaires d'actifs et des fonds dans lesquels les investisseurs institutionnels investissent (Blanc-Brude, 2013; Inderst et al., 2014).

[1] Risque macroéconomique; risque politique; risque juridique et réglementaire et risques propres au projet (risque de construction, risque de demande).

Ce chapitre contribue à la litérature sur l'investissement privé dans les infrastructures d'une double manière. Tout d'abord, ce chapitre est basé sur un nouvel ensemble de données sur les opérations de financement de projet. La plupart des recherches actuelles sur la participation privée dans les infrastructures utilisent les données de la base de données de la Banque Mondiale pour étudier les liens entre la participation privée dans les infrastructures en général et les contextes institutionnels (Basılio, 2017; Moszoro et al., 2015; Ruhashyankiko et al., 2006). Deuxièmement, cette étude est la première qui se focalise sur la participation des investisseurs institutionnels.

Nos résultats indiquent que, pour la voie de l'investissement direct, la réduction des risques macroéconomiques, politiques et réglementaires est essentielle pour accroître l'attrait d'un projet. Pour les gestionnaires d'actifs et les fonds d'infrastructure, seul un faible risque réglementaire est statistiquement significatif, ce qui suggère que ces deux familles d'investisseurs ne partagent pas le même appétit pour le risque. Nous constatons également que les projets sans risque de demande sont plus attrayants.

Ces résultats mettent en lumière l'importance des risques liés aux infrastructures pour les investisseurs institutionnels. Ces derniers sont soumis à des régimes réglementaires différents et peuvent donc être limités dans la possibilité de prendre certains risques. Pour attirer davantage d'investisseurs institutionnels, il est essentiel d'identifier, d'isoler et de regrouper les risques qui ont de l'importance de manière à les attribuer au parti qui est mieux à même de les prendre en charge. En outre, l'investissement direct exige des connaissances et des capacités spécifiques qui limitent l'investissement direct pour les investisseurs institutionnels essentiellement. Les produits d'investissement actuels ne répondent pas entièrement aux attentes des investisseurs (Blanc-Brude et al., 2016). Il est donc primordial de concevoir des véhicules de financement en adéquation avec les objectifs à long terme des investisseurs institutionnels.

De plus, notre étude est la première étude empirique sur les investissements en

infrastructure qui adopte l'idée avancée par Blanc-Brude (2013) sur l'importance de considérer les modalités contractuels sous-jacents des projets plutôt que d'adopter une classification sectorielle. Les décideurs devraient intégrer la distinction entre le développement des infrastructures d'une point de vue de politiques publiques et l'investissement en infrastructure d'un point de vue purement financier. Du point de vue des politiques publiques, le développement des infrastructures est axé sur la classification et les besoins sectoriels. Toutefois, ce qui dicte les rendements et la performance des projets, ce sont les contrats. La classification sectorielle ou industrielle fournit très peu d'informations sur la nature des flux financiers. Par exemple, un investisseur serait exposé à des risques de nature différente pour des projets dans le même secteur selon les modalités soujacentes relatives au risque d'exploitation.

Chapitre 2: Le Rôle des Institutions Multilatérales: Un Catalyseur de La participation des Investisseurs Institutionnels dans Les Projets d'Infrastructure ?

Le soutien des institutions multilatérales peut prendre de multiples formes afin de faciliter le flux des capitaux privés vers les projets d'infrastructure. Il peut prendre la forme de garanties (Pereira Dos Santos et al., 2018), de soutien financier par l'investissement ou de soutien non financier comme le soutien consultatif aux transactions (Humphrey, 2018). Le soutien financier sous forme d'investissement est censé réduire la perception globale du risque d'un projet et peut signaler la solvabilité des investisseurs privés, agissant comme catalyseur pour accroître la participation des investisseurs institutionnels dans le secteur des infrastructures (Basılio, 2014; Inderst et al., 2014).

Notre étude tente de comprendre le rôle du soutien financier multilatéral en tant que catalysateur de la participation des investisseurs institutionnels, des gestionnaires d'actifs et des fonds d'infrastructure dans les opérations de financement de projet d'infrastructure. Nous explorons ensuite les différences entre les pays

développés et les pays en voie de développement. La difficulté d'étudier cette question réside dans le fait que le soutien multilatéral n'est pas une décision prise au hasard. Il est déterminé par plusieurs facteurs (Basılio, 2014) tels que l'intérêt des donateurs ou les besoins des bénéficiaires (McKinlay et al., 1977). Dans les études observationnelles, les méthodes quasi-expérimentales peuvent être utilisées pour s'attaquer au manque de randomisation (White et al., 2014). Ainsi, nous utilisons une méthode quasi-expérimentale sur un nouvel ensemble de données de transactions de financement de projet à la clôture financière entre 2000 et 2018 fournies par IJglobal. Comme l'absence de soutien multilatéral ne peut être directement observable dans les projets sans soutien multilatéral, nous estimons d'abord la probabilité que les projets reçoivent un soutien multilatéral au moyen d'une régression logistique. Ensuite, nous utilisons la méthode d'appariement des scores de propension pour former un contrefactuel fiable pour la comparaison. Une fois qu'un contrefactuel fiable est construit, nous étudions les effets du soutien multilatéral sur la participation des investisseurs institutionnels.

Notre étude contribue à la litérature sur la participation privée dans les infrastructures (Basılio, 2017; Moszoro et al., 2015; Ruhashyankiko et al., 2006) ainsi qu'à la litérature sur l'impact du soutien multilatéral sur la mobilisation d'investissements privés (Basılio, 2014; Bird et al., 2007, 2008; Clemens, 2002) d'une double manière. Tout d'abord, l'étude est basée sur un ensemble de données inédit d'opérations de financement de projet. Le fait de se concentrer sur le financement des projets nous permet d'avoir un groupe homogène de projets dans le secteur des infrastructures. En outre, l'étude se base sur des données mondiales sur les pays développés et en voie de développement. La litérature existante utilise habituellement des bases de données qui regroupent des projets concentrés principalement dans les pays en voie de développement. Deuxièmement, à notre connaissance, il s'agit de la première étude qui se focalise principalement sur le rôle du soutien financier multilatéral pour attirer les investisseurs institutionnels.

Nos résultats indiquent que, pour les pays développés, un effet catalyseur ou

une additionnalité financière peut être observé. Le soutien financier multilatéral visant à renforcer la confiance dans les projets et les marchés a réussi à mobiliser les investisseurs institutionnels ainsi que les gestionnaires d'actifs et les fonds entre 2000 et 2018. Toutefois, pour les pays en voie de développement, la situation est très différente. Nous ne constatons aucun effet sur la participation des gestionnaires d'actifs et des fonds d'infrastructure, et nous observons un effet d'éviction sur les investisseurs institutionnels directs.

Les résultats soulignent les défis auxquels sont confrontés les pays en voie de développement. Les situations d'éviction des investisseurs institutionnels due peut-être à des conditions de prêt plus compétitifs par les institutions multilatérales pourraient être évitées si les prêts multilatéraux sont basés sur le principe d'*additionnalité*. Les organismes multilatéraux devraient optimiser leurs ressources limitées et les utiliser lorsqu'il n'y a pas d'autres sources de capitaux disponibles ou sous forme de capital-risque pour encourager d'autres investisseurs.

Chapitre 3: Investissement en Infrastructures et Comportements Opportunistes

Les contrats de PPP peuvent faire l'objet de comportements opportunistes (Williamson, 1974). Le risque d'un comportement opportuniste de part et d'autre; le gouvernement en plafonnant les profits et en expropriant (Spiller, 2013); l'investisseur en deviant des termes contractuels (Hart et al., 2008), a été un puissant dissuasif pour de nombreux projets de partenariats public-privé (PPP) potentiellement réussis au mieux et une cause de rupture de contrat au pire. Le risque de déviation par la contrepartie conduit à des clauses contractuelles rigides qui à leur tour peuvent conduire à la non clôture ou à la rupture du contrat (Athias et al., 2018).

Pour diminuer l'aversion *ex-ante* aux comportements opportunistes, une solution potentielle est de permettre au gouvernement ou à l'investisseur de résilier le

contrat sous certaines conditions spécifiques (Moszoro, 2013). Ce chapitre examine les micro-mécanismes comportementaux sous-jacents et contribue à expliquer pourquoi cela peut aider à surmonter la peur *ex-ante* d'entrer dans le partenariat public-privé.

Un modèle de PPP utilisant un jeu infiniment répété du dilemme du prisonnier entre le gouvernement et un investisseur nous permet de saisir les éléments essentiels de l'interaction susmentionnée. Les prédictions théoriques sont testées dans le laboratoire à l'aide de techniques expérimentales. Les impacts de l'introduction de l'option de sortie sur la décision d'entrer dans le partenariat ainsi que le comportement coopératif au sein du partenariat sont documentés.

Ce chapitre contribue à la litérature sur les PPP en modélisant l'impact des options de sortie sur les interactions entre les entités publiques et privées, aux niveaux de la signature et de l'exécution des contrats. En outre, le chapitre apporte trois contributions à la littérature expérimentale sur les jeux infiniment répétés du dilemme du prisonnier avec une possibilité de séparation volontaire (Arend et al., 2005; Fujiwara-Greve et al., 2009, 2011; Lee, 2018; Mengel, 2018; Wilson et al., 2017). Pour commencer, il s'agit de la première étude qui explore la participation volontaire à des jeux de dilemme du prisonnier en présence d'une possibilité de séparation volontaire. Deuxièmement, il permet d'étendre nos connaissances sur le comportement coopératif dans les jeux présentant simultanément la participation et la séparation volontaire.

Nos résultats suggèrent que les options de sortie simultanées augmentent la formation de partenariats par rapport aux situations sans sortie ou sortie unilatérale. En outre, nous observons un comportement plus coopératif et une plus grande durabilité des partenariats dans le cas où l'option de sortie est accordée simultanément à l'investisseur et au gouvernement.

General Introduction

Infrastructure Financing Gap

From a public policy perspective, Infrastructure corresponds to the basic physical and organizational structures and facilities required to perform a series of industrial functions such as transportation, power supply, water supply ...etc.

A lack of infrastructure supply comes at an enormous economic and social cost. The links between infrastructure development, economic growth and poverty alleviation are well established. There is an extensive theoretical and empirical evidence on the links between infrastructure and development outcomes.[2]

However, the global level of current investment has not been enough to avoid significant gaps and investment needs are only growing steeper. In fact, there is a growing gap between the acute need for new and modernized infrastructure, maintenance and renovation measures and the actual levels of investment and current expenditure in highly developed industrialized nations, high-growth emerging economies and developing countries alike (Weber et al., 2010). The global investment amounts needed for new investments and operating & maintenance costs far exceeds the financing available through traditional sources. Low and middle income economies are facing major challenges in financing new infrastructure. But, high income countries are also facing challenges in undertaking modernisation and maintenance measures for existing infrastructure to meet current requirements including environmental and social standards.

[2]See Straub (2008) for a comprehensive survey on the theoretical and empirical literature on the links between infrastructure and development outcomes.

Estimating accurate infrastructure financing needs is rather complex. Various methodologies using different approaches have been used to estimate global investment needs. Rozenberg et al. (2019) give an exhaustive survey of the main methods used in the literature to quantify infrastructure investment needs. Among these methods, we can cite two major families: "topdown" benchmarking using a variety of benchmarks such as historical evolution or differences with high-income countries (Fay et al., 2003; Ruiz-Nuñez et al., 2015) and "bottom-up" approaches based on the costing of specific goals such as sustainable development goals (Bhattacharyay, 2010; Hutton et al., 2016).

For instance, Bhattacharyay (2012) estimates infrastructure investment needs for 32 developing economies in Asia. The estimated amount is of USD 8.2 trillion over the course of 2011 to 2020. This breaks down to an annual USD 776 billion worth of national investments estimated in a top-down approach and an annual USD 29 billion worth for regional infrastructure estimated with a bottom-up approach. Another example of "topdown" benchmarking is the estimate provided by the Global infrastructure outlook.[3] The infrastructure gap between 2017 and 2040 is estimated to around 15 trillion USD. This result is derived from the difference between the global needed investments of around 94 trillion USD and investment current trends of around 79 trillion USD.[4]

A major critique of the methodologies used in the literature advanced by Rozenberg et al. (2019) is the fact that the above mentioned methods are focused on providing a single quantified estimate that is rather non informative. The authors argue that single estimates do not give a complete picture and that there is a need to shift the debate on spending in a more efficient way for the right objectives based on a systematic approach. The question should not be based only on how much more

[3] https://outlook.gihub.org/

[4] The forecasts are based on the assumption that countries continue to invest in line with current trends, with growth occurring only in response to changes in each country's economic and demographic fundamentals. The investment needs are calculated according to investments that would occur if countries were to match the performance of their best performing peers, after controlling for differences in the characteristics of each country.

we need to spend but rather on why and for which objectives. The author argues that investment needs depend not only on individual country goals but also on the efficiency by which they pursue these goals. Shifting the debate on spending better in a more efficient way can help reduce the amount of investments needed.

The question of estimating accurately the amount of investment needed is beyond the scope of this thesis. Agreeing with or challenging the traditional estimates of investment needs does not attenuate the ugly truth: 950 million individuals are without electricity[5], 780 million people do not have access to an improved water source[6], 2.5 billion people lack access to improved sanitation[7]. Furthermore, an uncounted number of individuals miss work and education opportunities due to the absence of transport services or live far away from basic social infrastructure facilities such as schools and hospitals. Not to mention, all the required investments needed to address climate change risks, renovation, operation and maintenance of existing infrastructure worldwide.

To answer global needs of infrastructure, a distinction needs to be made between funding and financing infrastructure (Fay et al., 2018). Financing infrastructure is about finding who puts the needed investment costs upfront. Funding infrastructure focuses on how cash-flows of the project are generated to pay the financier. For instance, a project can be funded by user fees or by availability payments from the public sector or a mix of both.

Challenges Facing Traditional Financing Sources

Historically, the public sector was responsible for infrastructure investment and provision given the inherent public good nature of infrastructure assets and services. Recently, strong budgetary and fiscal constraints are preventing it from investing

[5]International Energy Agency.
[6]World Health Organization.
[7]U.S. Census Bureau.

the necessary amounts needed to close the infrastructure gap. A substantial downward trend in public investment[8] is observed globally, although considerable differences in the underlying causes exist in terms of political, economic, financial and legal conditions between developed and developing countries.

Facing growing infrastructure needs and limited resources, national policies have sought to increase private sector participation in the financing and implementation of infrastructure projects. Over recent years, the volume of private investments in infrastructure has risen across most regions (Figure 2).

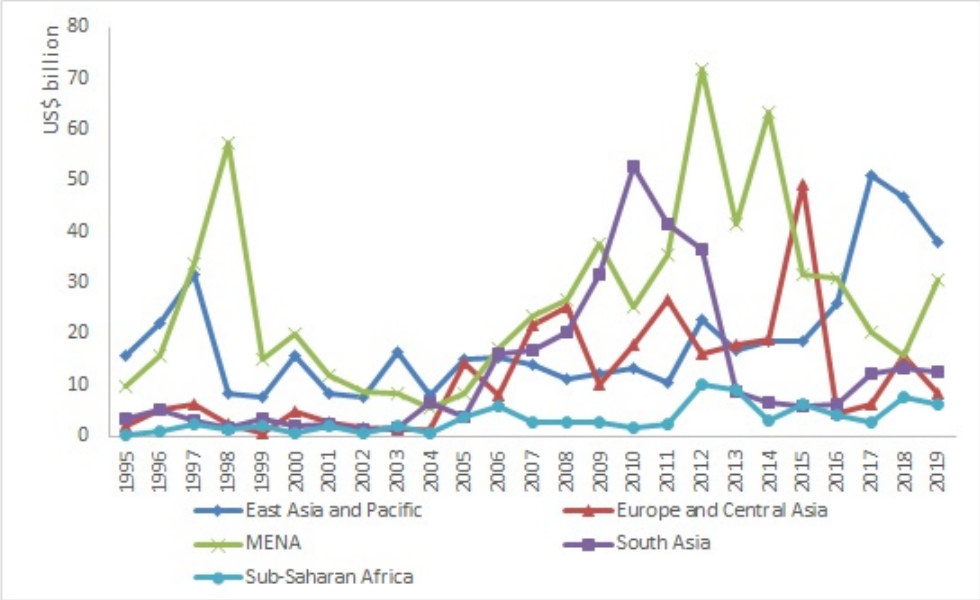

Figure 2. Investment commitments to infrastructure projects with private participation by region, 1995-2019

Source: Private Participation in Infrastructure Project Database 2020

Private participation in infrastructure may take various forms ranging from long term concession agreements to full privatisation. In recent years, Public Private Partnerships (PPP) with its variants, have become the primary form of private participation in infrastructure.

PPP are, in general, long term cooperation agreements between the public and private sector for the provision of infrastructure assets and services. Typically, the

[8] As an example, the study Infrastructure 2030 OECD published in 2006, shows that between 1970 and 2002 government spending on infrastructure went from 2.6% of GNP between 1991-1997 to 2.2% of GNP for the period 1997-2002. Another study by the OECD shows that the level of investment is around 0.9% of GNP for the period 2002-2011.

private sector is responsible for design, built, finance, operation and maintenance. The possibility of risk transfer from the public sector to the private sector is at the heart of the PPP model and the main reason for its recent expansion (Engel et al., 2011).

Traditionally, the main actors involved in private infrastructure financing are often organizations that are connected with the project development or operations in some way (construction companies, equipment suppliers, operating companies or host governments) and the lenders are banks (Gemson et al., 2012).

However, after the 2008 financial crisis, structural weaknesses in the banking sector are leading to bad deleveraging, in the form of restrained growth causing a growing mismatch between the amount and time horizon of available capital and the demand for long term finance of infrastructure projects (Della Croce et al., 2014). Increases in prudential requirements, most notably BASEL III is negatively affecting the ability of banks to provide long term capital for infrastructure financing. This is especially exacerbated in regions seen as risky, where such investments would require a higher risk weighting and therefore require greater capital reserves (Gatzert et al., 2016).

Constraints on traditional public and private financing sources for long-term infrastructure financing are pushing policy makers to seek alternative sources of capital. Crowding in more private capital especially the large pool of private savings looking for long-term investment has been gaining momentum over recent years (Della Croce et al., 2013).

Infrastructure Investments and Institutional Investors

With more than USD 100 trillion under management (OECD, 2018), institutional investors with long term horizon, such as insurance companies, pension funds, mutual funds and sovereign wealth funds are frequently cited as an alternative source of financing to bridge the infrastructure financing gap. The main driver besides the

large amount of assets under management is the common long term horizon between infrastructure assets and the investors' liabilities that usually span multiple decades. Furthermore, infrastructure investments has the potential to yield great diversification opportunities compared to traditional assets in a particularly low interest rate environment driven by the quest for higher yields.

Institutional investors are not related to neither the development nor operations of infrastructure assets. Their participation in infrastructure is for pure investment purposes. Policymakers, governments and multilateral banks have thus been working on creating infrastructure as an asset class.

Investment in infrastructure can take many forms. Figure 3 gives an overview of the main financing instruments (Equity or Debt), investment strategies (Public/ Listed or Private/ Unlisted), and investment channels (Direct or Indirect).

For the public or listed investment strategy, investment in infrastructure can be made through two routes: Direct or Indirect, and through two investment instruments: Debt or Equity (Inderst et al., 2014). For direct investment, the investment is through the capital markets in the form of investment in infrastructure stocks for the equity instrument and in bonds for the Debt instrument. The indirect investment route consists of investing in shares of listed funds that invest in the above mentioned instruments.

For the private or unlisted investment strategy, investment in infrastructure can be made through two routes: Direct or Indirect, and through two investment instruments: Debt or Equity. For direct investment using equity or debt, the investment is made directly in the project equity or through loans to infrastructure projects. Indirect investment consists of investing in unlisted funds that invest in infrastructure projects through equity or debt.

Investors wishing to invest in infrastructure are attracted by what is called the "infrastructure investment narrative" (Blanc-Brude, 2013). The infrastructure's value proposition resides in the following characteristics:

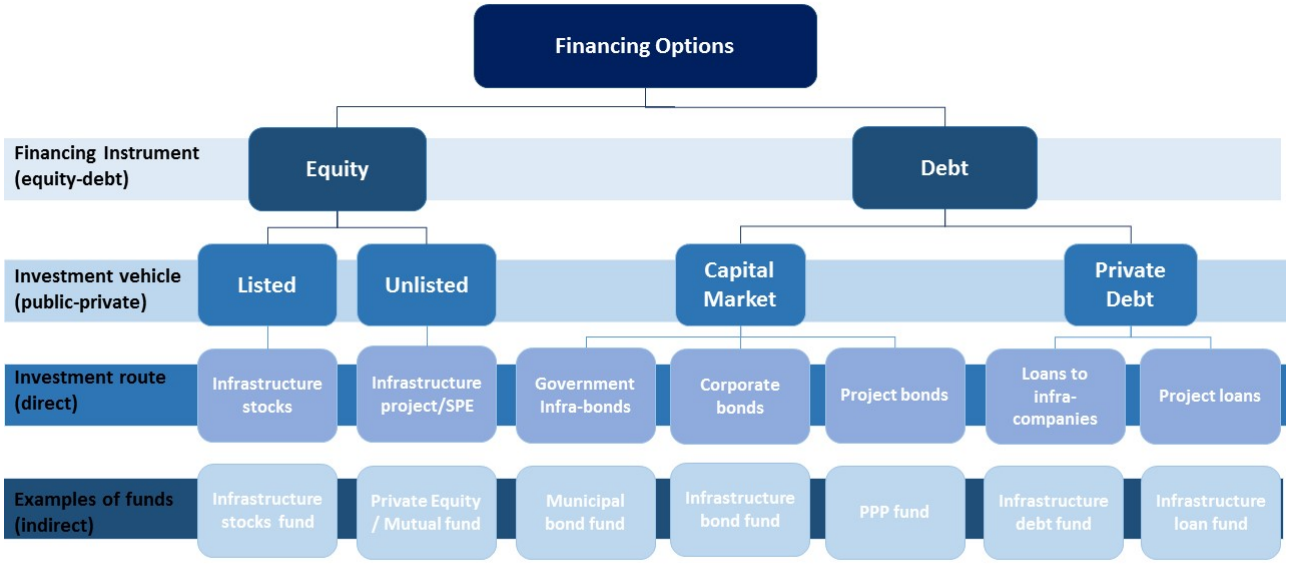

Figure 3. Infrastructure Financing and Investment Options

Source: Inderst et al. (2014)

- Quasi-monopolistic nature: implying stable demand and low price elasticity of demand;
- Inflation hedging: revenues are usually linked to inflation;
- Attractive risk-adjusted returns;
- Low business risk: implying stable cash flows and low return volatility;
- Low correlation with the business cycle: potential improvement of portfolio diversification.

However, the literature on listed infrastructure shows that direct and indirect listed infrastructure investment does not deliver the "infrastructure investment narrative" (Ammar et al., 2015; Bianchi et al., 2017; Blanc-Brude et al., 2017; Rödel et al., 2012). A potential different listed infrastructure class is possible but today does not exist. A debate in the literature on what allows investors to access infrastructure attractive characteristics is ongoing.

However, a recent consensus was reached on the definition of infrastructure from an investment standpoint. Unlisted equity or private debt is the investment route that can allow investors to access the "infrastructure investment narrative". These transactions are mostly based on Project Finance techniques. Blanc-Brude (2014) suggests that project finance debt and equity instruments embody many of the infrastructure investment narrative. Furthermore, over the past 15 years most investable infrastructure projects were created using project finance for an amount of USD 3.3 trillion (Blanc-Brude, 2014). Moreover, project finance has an uncontroversial definition since the Basel-2 Capital Accord : *"Project Finance (PF) is a method of funding in which investors look primarily to the revenues generated by a single project, both as the source of repayment and as security for the exposure. In such transactions, investors are usually paid solely or almost exclusively out of the money generated by the contracts for the facility's output, such as the electricity sold by a power plant. The borrower is usually a Special Purpose Vehicle (SPV) that is not permitted to perform any function other than developing, owning, and operating the installation. The consequence is that repayment depends primarily on the project's cash flow and on the collateral value of the project's assets."*

Focusing on project finance transactions allows capturing the bulk of private infrastructure investment. In a project finance transaction, the creditors share much of the project risk and financing is obtained mainly on the strength of the project cash flows. The lenders receive their interest and principal payments from the cash flows of the project and the assets of the project are used as collateral to secure the loan (Esty, 2014; Kleimeier et al., 2001). Since the lenders do not have recourse to the cash flows or the assets of the sponsor, such type of financing is called limited or non-recourse financing (Finnerty, 2007).

It is also important to understand the different types of infrastructure projects and stages of investments (Figure 4). Infrastructure investments can be made in two main categories: Economic infrastructure and Social infrastructure (Inderst et al., 2014). Economic infrastructure is mainly sectors where a potential collection of fees is possible. Social infrastructure includes schools, hospitals and prison for example.

Irrespective of the sector, we can differentiate investments by the project's maturity and the timing of the investment. Primary financing is investment that happens at the financial close of the project, it is the first investment in the project. In that case, investors can choose to invest in Greenfield or Brownfield projects. A greenfield project is an asset constructed at a specific site for the first time. It follows that there is no available track record for the demand for the project's output nor an available asset-specific experience as well as a risk for delays and completion. This may cause a higher degree of uncertainty on the costs as well as on the revenues side jeopardizing in consequence the profitability of the project. In contrast, a brownfield project is an existing asset whether operational or has a predecessor of some sort at the same site. Secondary stage investments are investments that results of the refinancing of projects. It implies that the construction phase and the uncertainty about the projects' cash flows are usually over.

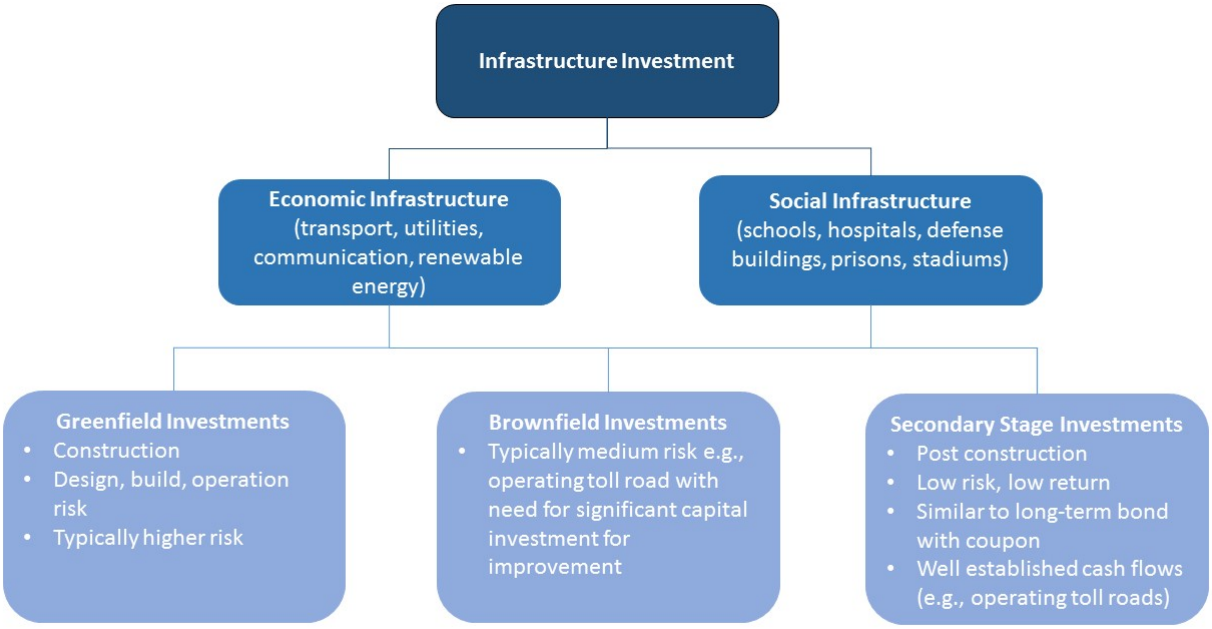

Figure 4. Infrastructure Investment Types

Source: Inderst et al. (2014)

Risks and Barriers to Institutional Investors Participation in Infrastructure

Despite the perfect theoretical match between institutional investors' long term capital and infrastructure investments, available data suggests that infrastructure assets constitute a fraction of institutional investors' portfolios: The OECD 2018 Survey of Large Pension Funds and Public Pension Reserve Funds of funds managing more than USD 10 trillion in assets finds that they have only about 1% of their assets directly invested in infrastructure (OECD, 2018).

Most institutional investors have very little experience in managing infrastructure assets and in managing risks that are inherent to infrastructure projects. From an investment standpoint, infrastructure projects have inherent risks, including but not limited to[9]:

- Construction risks for greenfield projects;
- Operational, demand and market risks;
- Financial and interest rate risks (e.g., Forex, leverage, refinancing);
- Legal and Regulatory risks (e.g., changing regulations, corruption, rule of law); and
- Political risks (e.g., absence of political commitment, expropriation risks).

The investment decision of institutional investors should be driven by diversification opportunities based on well assessed risks. In fact, the primary objective of institutional investors is to pay liabilities such as pensions, annuities and insurance. In that sense, their investments are not a public policy matter but results from a strict assessment of risk and return. Thus, they should not be coerced to invest in infrastructure by policymakers. Investment in infrastructure is not an easy task and institutional investors are only able to take on certain types of risk. The key

[9]See Weber et al. (2016) for an exhaustive presentation of infrastructure project risks.

to the successful involvement of institutional investors is well designed investment products structured with the risk return profile that they need.

Direct investment by institutional investors requires specific knowledge and important capabilities to source, execute infrastructure transactions and to manage and monitor projects throughout their life cycle. Internalizing the investment activity can be very challenging for smaller investors and is limited to bigger and sophisticated ones. It also raises major issues related to the difficulty of creating well diversified portfolios of a reasonable size (Blanc-Brude, 2013). The natural preferred way of for institutional investors to access infrastructure investments should be delegation to an asset manager or investment in infrastructure funds (Blanc-Brude et al., 2016). The market allowing access to infrastructure through infrastructure funds is growing and the number of asset managers active in infrastructure investments is large. Figure 5 shows the number of funds and amount of capital raised worldwide since 2012.

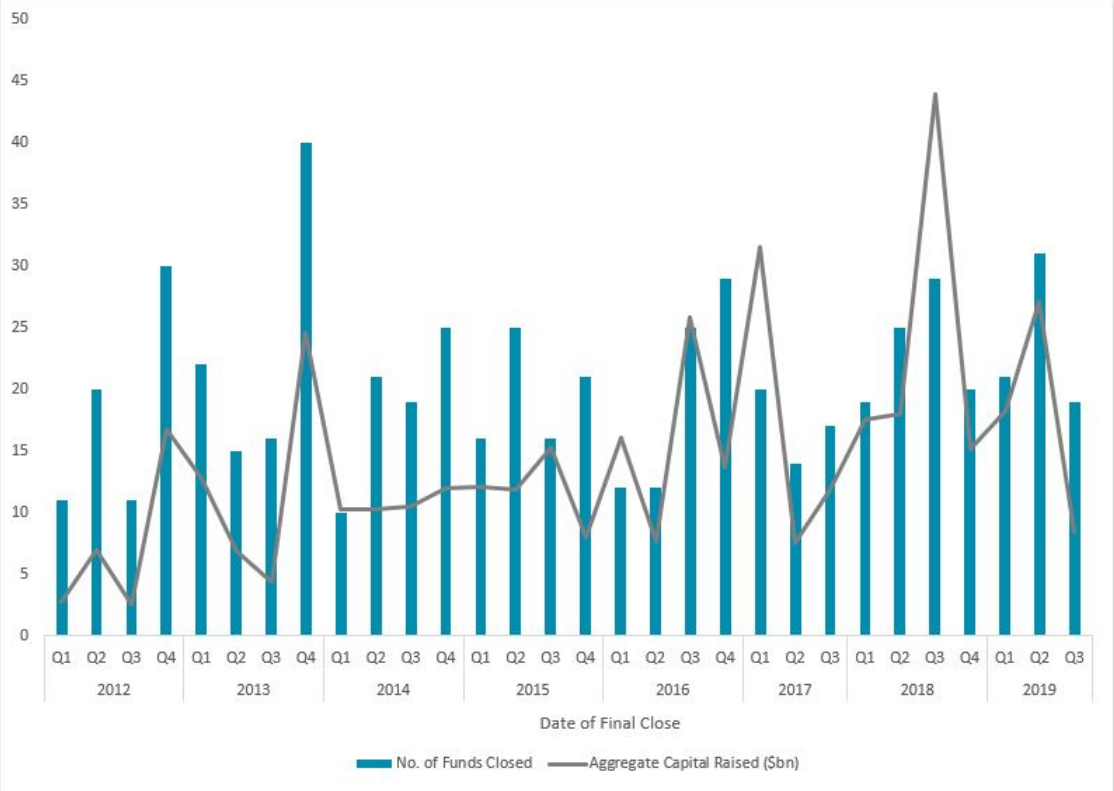

Figure 5. Global Quarterly Unlisted Infrastructure Fundraising, Q1 2012 - Q3 2019

Source: Preqin 2020

However, a survey of institutional investors made by Blanc-Brude et al. (2016) shows that 80% of institutional investors surveyed think that available infrastructure investment products are "outdated and not adding value". Most available infrastructure funds are too expensive (fees) and not designed to achieve long term investment goals. In fact, most available funds are closed-ended Private Equity (PE) like funds that focuses on certain geographical areas or industrial sectors[10] Their investment strategies focus on exiting investments after few years. This investment strategy is neither aligned with the long term " infrastructure narrative" explained earlier nor match long term objectives that institutional investors seek through accessing infrastructure (Blanc-Brude, 2013). This makes the structuring of investment vehicles adapted for direct and indirect investment a key consideration.

Another major challenge in transforming infrastructure to an investable asset class is the lack of documentation and available data on risk metrics and valuations. Blanc-Brude et al. (2016) insists on the necessity of having infrastructure investment benchmarks based on a global database of cash flows and investment characteristics. Current benchmarks are mostly relative to a market or a macroeconomic index. This step can help crowding-in institutional investors' capital for two reasons:

1. **Better delegated investment products**: benchmarks would reduce information asymmetries between institutional investors and asset managers with regard to risk metrics and valuation. Proper benchmarks would allow investors to understand what can be achievable and thus allow the creation of adapted investment products for long term investment strategies. It would also allow good asset managers to signal what they can deliver;

2. **Facilitate direct investment**: benchmarks would allow investors who wish to access infrastructure through the direct route, to understand what to expect, what can be achieved and which factors exposure drive risk and returns.

[10]The survey also highlights the consensus between institutional investors on the limited role of industrial sectors in infrastructure investments. Performance is driven by underlying contractual arrangements (Presence of regulation, demand risk...etc.) and not by industrial sectors per se.

Besides the above mentioned barriers, not all institutional investors are subject to the same regulatory funding and solvency regimes. Some institutional investors are required by regulatory oversight or their governing documents to make only high credit quality investments. Such investors might not be willing, or will be prohibited from investing, in higher credit risk investments. Even when institutional investors are willing to consider investments in infrastructure, weaknesses in the enabling environment and the lack of good projects can still be a major problem. At times, the constraint is the lack of suitable, profitable infrastructure projects to invest in.

Recent advances aiming to solve some of the market failures for infrastructure investments have been introduced in recent years. EDHEC infrastructure led by Frédéric Blanc-Brude in cooperation with The Global infrastructure Hub and Natixis have been working since 2013 on the creation of infrastructure benchmarks. In 2019, the first standardized benchmarks for equity and debt infrastructure investments based on geographical areas and infrastrucure business models were published[11].

Furthermore, multilateral banks wishing to attract institutional investors put in place different initiatives such as credit enhancement, political risk guarantees, co-investment platforms. They also help governments in project design and enhancement of regulatory frameworks. The purpose is to help overcome certain hurdles and attenuate risks present in infrastructure investments. For example, co-investment platforms can help attract direct institutional investors by providing an innovative model in which institutional investors can finance infrastructure projects while the heavy tasks of project origination,due diligence, structuring and monitoring remain with the multilateral agency. It can also help overcome problems related to overly concentrated portfolios.[12]

[11] For benchmarks and detailed methodology: https://edhec.infrastructure.institute/

[12] An example of this model is the International Finance Corporation's Managed Co-Lending Portfolio Program (MCPP) for Infrastructure. IFC and each investor sign an agreement. Investors are then offered the opportunity to co-lend in every new loan that IFC originates that fits the investor's criteria. Portfolio concentration limits can be established to ensure that the portfolio is not overly concentrated in any sector, region or country.

Summary of Chapters

The objective of this PhD dissertation is to investigate using empirical methods the question of how to make a better match between infrastructure investments and institutional investors. To do so, we address the problem through three different angles:

1. **Understanding institutional investors' strategies**: How infrastructure project risks impact project's attractiveness for institutional investors' participation?

2. **Understanding the role of Multilateral support**: Does Multilateral support crowd-in institutional investors' participation?

3. **Reducing ex-ante fear of investment**: How can an exit/bail-out option mechanism help overcome double-sided opportunistic behavior in infrastructure investments?

As explained in the introduction, infrastructure investments have inherent risks (Inderst et al., 2014; Weber et al., 2016). The first chapter studies how different project risks affect project attractiveness for institutional investors as well as for infrastructure funds using a novel data set of global infrastructure deals between 2000 and 2018. The data is provided by IJGlobal. The second chapter investigates the role of financial multilateral support in crowding in institutional investors' capital using quasi-experimental methods. The third chapter attempts to propose a solution to overcome ex ante fear of investment in infrastructure: options for the investor and the government to exit the project under specific condition. This chapter uses an experimental design to investigate the underlying micro-mechanisms and reasons of potential efficacy of such mechanism.

The remainder of this dissertation is organized as follows. First, we provide a concise summary of each chapter. The first chapter investigates the impact of different infrastructure risks on project attractiveness for institutional investors. The

second chapter studies the role of financial multilateral support in crowding institutional investors' capital. The third chapter focuses on exit and bail-out options as a mechanism to overcome ex ante fear of investment. A final section concludes, and highlights the main contributions of this dissertation, the limits of our works, and the avenues for future research.

Chapter 1: Institutional Investors' Participation in Infrastructure: Evidence from Project Finance Transactions

Increasing institutional investors' participation in infrastructure financing is on the top agenda of policymakers around the globe. However, infrastructure projects have inherent risks that can hinder crowding in capital from institutional investors (Inderst et al., 2014). The purpose of this chapter is to understand how different infrastructure projects risks[13] affect project attractiveness for institutional investors' participation. To do so, we use logistic regressions on a novel data set for project finance deals[14] at financial close between 2000 and 2018 provided by IJGlobal.

The definition proposed by the World Bank for institutional investors (Saha Deblina, 2017)[15] groups two different types of investors that do not share the same purpose. Institutional investors' main responsibility is to pay back their liabilities, these investors include pension funds, insurance companies and sovereign wealth funds (Blanc-Brude, 2017). Asset managers and funds' main activity is investment and generating profitable returns. Institutional investors can internalize the investment

[13] Macroeconomic risk; Political risk; Legal and Regulatory risk and Project specific risks (construction risk, demand risk).

[14] Focusing on project finance transactions enables us to capture the bulk of private infrastructure investment. In a project finance transaction, the creditors share much of the project risk and financing is obtained mainly on the strength of the project cash flows. The lenders receive their interest and principal payments from the cash flows of the project and the assets of the project are used as collateral to secure the loan (Esty, 2014; Kleimeier et al., 2001) Since the lenders do not have recourse to the cash flows or the assets of the sponsor, such type of financing is called as limited or non-recourse financing (Finnerty, 2007)).

[15] "entities that pool money from various sources to invest in different asset classes, with the intent of generating profitable returns on their investment. All entities that are primarily in the business of making financial investments in the form of equity or debt, without being involved in the construction, operation or management of the infrastructure project e.g. pension funds, private-equity funds, hedge funds, mutual funds, insurance companies."

activity by investing directly in infrastructure. They can also delegate this activity to asset managers and infrastructure funds, in that case they access infrastructure through the indirect route (Blanc-Brude, 2017; Blanc-Brude et al., 2016; Inderst et al., 2014).

In this study, we are interested in the investments made by institutional investors through the direct route as well as the investments made by asset managers and infrastructure funds. We consider that direct investment is investment made by institutional investors, while indirect investment is the investment made by asset managers and funds (in which institutional investors invest) (Blanc-Brude, 2013; Inderst et al., 2014).

This chapter contributes to the literature on private investment in infrastructure and uses a novel data set on project finance deals. Most current research on private participation in infrastructure uses data from the World Bank Private Participation in Infrastructure (PPI) database to study the links between private participation in infrastructure at large and institutional contexts and country risks (Basılio, 2017; Moszoro et al., 2015; Ruhashyankiko et al., 2006). This database raises two concerns. First, it does not allow differentiation by financing sources as it includes infrastructure projects that are financed through various financing methods i.e. project and corporate finance that do not have the same risk profile.[16] A recent consensus has been reached in the literature that project finance transactions is the investment method that allows investor to access diversification opportunities of infrastructure (Bianchi et al., 2017; Blanc-Brude, 2013; Blanc-Brude et al., 2017). Second, most institutional investors' allocation is based in developed countries, the PPI database collects data on projects solely in developing countries limiting the possibility to better understand investment dynamics of institutional investors. Moreover, this chapter moves the debate from private participation in infrastructure at large to institutional

[16]Project finance minimizes risk to the sponsoring company, as compared to traditional corporate finance, because the lender relies only on the project revenues to repay the loan and cannot pursue the sponsoring company's assets in the case of default.

investors' participation in specific. Attracting institutional investors' capital is pivotal for future infrastructure financing in developed and developing countries.

A similar work by Gemson et al. (2012) studies the determinants of private equity (PE) firms investments in project finance infrastructure transactions. The authors used project finance deals from the Global Project Finance database provided by Venture Xpert on 2821 infrastructure projects that were announced during 1990–2009. It was found that projects with PE investment were larger when compared to projects that did not have PE investment, indicating that that PE investment helped in successfully financing larger projects.[17] Their analysis also indicated that PE investment in infrastructure is more frequently seen in developed countries and in countries with lower country risk. PE firms/funds are one type of vehicles in which institutional investors can invest to access infrastructure. However, a debate is ongoing on the adequacy of private equity funds with long term allocation objectives of institutional investors. PE investments in infrastructure tend to have short tenor, PE funds aim to exit investments after few years (Blanc-Brude, 2013; Blanc-Brude et al., 2016; Lopez-de-Silanes et al., 2015). Our study is larger in scope as it focuses on direct investment made by institutional investors as well as investments made by asset managers and infrastructure funds including PE firms.

Our results indicate that for the direct investment route lower macroeconomic, political and regulatory risk are vital factors in increasing a project's attractiveness. For asset managers and infrastructure funds only lower regulatory risk is statistically significant, suggesting that these two families of investors do no share the same risk appetite. Furthermore, we find no indication of higher attractiveness for brownfield projects compared to greenfield projects. We also find that projects without demand risk i.e. Availability payment are more attractive for both investment routes.

[17] Appendix A shows results for comparison between projects with and without institutional investors. We find similar results indicating that institutional investors are not replacing existing investors, but are rather bringing additional resources to help fund larger projects.

Chapter 2: The Role of Multilateral Support in Crowding in Institutional Investors' Participation in Infrastructure Projects

Multilateral support can take multiple forms in order to facilitate the flow of private capital to infrastructure projects. It can be in the form of guarantees (Pereira Dos Santos et al., 2018), financial support through investment or non-financial support such as transaction advisory support (Humphrey, 2018). Financial support in the form of investment is believed to reduce the overall risk perception of a project and can signal creditworthiness for private investors, acting as catalyst for increasing institutional investors' participation in infrastructure (Basılio, 2014; Inderst et al., 2014).

Our study attempts to understand the role of financial multilateral support in the form of investment in crowding-in capital flows from institutional investors, asset managers and infrastructure funds to infrastructure project finance transactions. We then explore differences between developed and developing countries. The difficulty in studying this question resides in the fact that multilateral support is not a random decision. It is determined by multiple factors (Basılio, 2014) such as donor interest or recipient need (McKinlay et al., 1977). In observational studies, quasi-experimental designs can be used to tackle lack of randomization (White et al., 2014). Thus, we use a quasi-experimental design on a novel data set of project finance transactions at financial close between 2000-2018 provided by IJGlobal. As the effect of not having multilateral support can not be directly observable in projects without multilateral support, we first estimate projects' probability to receive multilateral support through a regression analysis. Then, we use propensity score matching to form a reliable counterfactual for comparison. Once a reliable counterfactual is constructed, we study the effects of multilateral support on crowding in capital from institutional investors as per the World Bank definition. We then look at effects on attracting direct institutional investors (i.e. Sovereign Wealth Funds (SWF), insurance companies and pension funds) and indirect institutional investors (i.e. asset

managers and infrastructure funds).

Our study contributes to the literature on private participation in infrastructure (Basılio, 2017; Fay et al., 2018; Gemson et al., 2012; Mansaray, 2018; Moszoro et al., 2015; Ruhashyankiko et al., 2006) as well as the literature on the role of multilateral support in attracting private investment (Bird et al., 2007, 2009; Clemens, 2002; Humphrey, 2018) in a twofold manner. First, the study is based on a novel dataset of project finance deals. Focusing on project finance deals allows us to have a homogeneous group of projects within the infrastructure sector. Furthermore, the chapter focuses on global data on developed and developing countries for the infrastructure sector. Existing literature usually uses databases that group projects that varies dramatically in their financing method i.e. corporate and project finance,[18] and that are mostly based in developing countries. Second, to our knowledge, this is the first chapter trying to shed the light on the role of financial multilateral support on attracting institutional investors in particular into infrastructure. The question of institutional investors' participation is still very much under-researched mainly due to lack of data on infrastructure projects and institutional investors allocations.

Our results indicate that for developed countries a catalytic effect or financial additionality can be observed. Multilateral financial support aiming to build confidence in projects and markets succeeded in crowding-in institutional investors as well as asset managers and infrastructure funds between 2000 and 2018. However, For developing countries, the picture is quite different. We find no effect on crowding-in capital from asset managers and infrastructure funds and a crowding-out effect on direct institutional investors.

[18] Project finance minimizes risk to the sponsoring company, as compared to traditional corporate finance, because the lender relies only on the project revenue to repay the loan and cannot pursue the sponsoring company's assets in the case of default.

Chapter 3: Overcoming Double-Sided Opportunism in Infrastructure Investment

Investment in infrastructure is socially desirable, capital-intense, long-term, and risky. Private participation in infrastructure is made difficult by "serious contractual difficulties" (Williamson, 1985), which have their source in bounded rationality. Due to substantial sunk assets, long-term payback, informational asymmetries, and unaligned goals, PPP contracts may be prone to opportunistic behavior. The risk of opportunistic behavior on either side—the government by capping profit and expropriating (Spiller, 2013); the investor by curbing investment (Hart et al., 2008)—has been, however, a powerful deterrent to many potentially successful PPP projects at best and a cause to contract breach at worst. Governmental opportunism and private opportunism backload themselves: the risk of deviation by the counter-party leads to *ex-ante* rigid contractual terms which in turn lead to contract non-closure or breach (Athias et al., 2018).[19]

To lessen the *ex-ante* aversion to opportunistic behavior, a potential solution is over-the-counter exit and bail-out options analogous to put and call options on the investor's present value of capital outlays (Moszoro, 2013). In other words, allowing the government or the investor to terminate the contract and exit the partnership under specific conditions. This chapter investigates the behavioral micro-mechanisms that underlie such exit and bail-out options and thus contributes to explaining why they may help overcome the *ex-ante* fear of entering the partnership. A model of public-private partnerships using an infinitely repeated prisoner's dilemma game between the government and an investor captures the essential elements of the above-mentioned interaction. The theoretical predictions are tested experimentally:

[19]There are many examples of PPP projects in Latin America and Europe that were canceled, renegotiated, or terminated by either the government or the investors in the wake of opportunism. In Poland in 2009-2017, out of 506 projects started, 328 (i.e., 64 percent) were void, and another 12 (i.e., 2.4 percent) were never completed.See https://www.ppp.gov.pl/Aktualnosci/Documents/2018_03_18_analiza_rynku_PPP_2017.pdf (accessed May 2018). On a sample of more than 1,000 concession contracts signed in Latin American countries between the mid-1980s and 2000, Guasch (2004) found that 78% of transportation contracts and 92% of water and sewage contracts were renegotiated.

the impacts of introducing the possibility to terminate the partnership on the decision to enter the partnership as well as the cooperative behavior within the partnership are documented.

This chapter contributes to the literature on PPPs with modelling the impact of exit and bail-out options on the interactions of public and private entities, at the entry and contract fulfilment levels. It also contributes to the literature on opportunism in PPPs by offering a potential solution to overcome double sided-opportunism in such interactions (Liu et al., 2016, 2017; Moszoro, 2013; Moszoro et al., 2012; Ruhashyankiko et al., 2006). Furthermore, the chapter makes three contributions to the experimental literature on infinitely repeated prisoner's dilemma (PD) games with voluntarily separation (Arend et al., 2005; Fujiwara-Greve et al., 2009, 2011; Lee, 2018; Mengel, 2018; Wilson et al., 2017). To start with, it is the first study that explores voluntary participation in PD games with voluntary separation. Second, it allows to extend our knowledge on cooperative behavior in the presence of voluntary separation as it adds voluntary participation, which had not been explored in this literature. Third, it compares partnership formation and cooperation rates for no exit options to one-sided exit options to double-sided exit options treatments. One-sided exit options are relevant to the PPP setting described in this chapter, as usually only the government is allowed to unilaterally breach contracts for reasons such as public interest.

Our results suggest that concurrent exit and bail-out options increase partnership formation compared to situations without exit or unilateral exit. Furthermore, we observe higher cooperative behavior and higher partnership sustainability.

Table 1. Summary of chapters

Chapter	Methodology (and Data)	Main results
• Chapter 1. Institutional Investors' Participation in Infrastructure: Evidence from Project Finance Transactions • Research Question: How infrastructure project risks impact project's attractiveness for institutional investors' participation?	• Econometric analysis (Logistic regressions) • Global Project Finance deals between 2000 and 2018 at financial close • 6371 project finance deals across 130 countries • Source: IJGlobal database, World Bank data, Institutional Investors presence variable coded by the author	• Project maturity is not a determinant factor in projects' attractiveness for institutional investors. • Availability based projects seem to be more attractive for direct institutional investors. • Macroeconomic, regulatory and political risks reduce projects' attractiveness for direct institutional investors. • Only regulatory risk seems to play an important role for indirect institutional investors.
• Chapter 2.The Role of Multilateral Support in Crowding in Institutional Investors Participation in Infrastructure Projects • Research Question: Does Multilateral support crowd-in institutional investors' participation?	• Econometric analysis (Logit estimation, OLS, Propensity Score Matching) • Global Project Finance deals between 2000 and 2018 at financial close • 6371 project finance deals across 130 countries • Source: IJGlobal database, World Bank data, Institutional Investors presence variable coded by the author	• For the global sample, the results suggest no effect of multilateral support on crowding-in institutional investors' capital. • For developed countries, multilateral financial support have a catalytic effect both on direct and indirect institutional investors' participation. • For developing countries, no effect is found for asset managers and infrastructure funds and a crowding out effect for direct institutional investors.
• Chapter 3. Overcoming Double-Sided Opportunism in Infrastructure Investment • Research Question:How can an exit/bail-out option mechanism help overcome double-sided opportunistic behavior in infrastructure investments?	• Behavioral & Experimental Economics • Infinitely repeated prisoner's dilemma game with voluntary participation and termination options • 3084 observations based on 238 subjects	• Compared to unilateral exit, concurrent exit and bail-out options are found to reduce *ex ante* entry barriers. • Cooperation rate and partnership sustainability are significantly higher in the treatment with concurrent exit and bail-out option compared to the baseline treatment and and and the treatment where only the government can terminate the partnership.

Chapter 1

Institutional Investors' Participation in Infrastructure: Evidence from Project Finance Transactions

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1.1 Introduction

The public sector facing strong budgetary and fiscal constraints preventing it from investing the necessary amounts needed, is urged to find solutions to increase the private sector participation in infrastructure provision. Since the 1990s, national policies have sought to increase private sector participation in the financing and implementation of infrastructure projects. Traditionally, the main private actors in infrastructure investment alongside the public sector are project sponsors that are often organizations connected with the project development or operations in some way (construction companies, equipment suppliers, operating companies or host governments) and the lenders are banks. However, after the financial crisis, structural weaknesses in the banking sector are leading to bad deleveraging, in the form of restrained growth causing a growing mismatch between the amount and time horizon of available capital and the demand for long term finance of infrastructure projects. New banking regulations are negatively affecting the ability of banks to

provide long term infrastructure financing (Della Croce et al., 2014; Feyen et al., 2013).

With more than USD 100 trillion under management, institutional investors with long term horizon, such as insurance companies, pension funds, mutual funds and sovereign wealth funds are frequently cited as an alternative source of financing for infrastructure. The main driver besides the large amount of assets under management is the common long term horizon between infrastructure assets and the investors' liabilities that usually span multiple decades. Furthermore, infrastructure investments has the potential to yield great diversification opportunities compared to traditional assets in a particularly low interest rate environment driven by the quest for higher yields (Della Croce et al., 2013). Despite the perfect theoretical match, available data suggests that infrastructure assets constitute a fraction of institutional investors' portfolios: The OECD 2018 Survey of Large Pension Funds and Public Pension Reserve Funds of funds managing more than USD 10 trillion in assets finds that they have only about 1% of their assets directly invested in infrastructure (OECD, 2018).

Increasing institutional investors' participation in infrastructure financing is on the top agenda of policymakers around the globe. However, infrastructure projects have inherent risks that can hinder crowding in capital from institutional investors (Inderst et al., 2014). The purpose of this paper is to understand how different infrastructure projects risks[1] affect project attractiveness for institutional investors' participation. To do so, we use logistic regressions on a novel data set for project finance deals[2] at financial close between 2000 and 2018 provided by IJGlobal.

[1]Macroeconomic risk; Political risk; Legal and Regulatory risk and Project specific risks (construction risk, demand risk).

[2]Focusing on project finance transactions enables us to capture the bulk of private infrastructure investment. In a project finance transaction, the creditors share much of the project risk and financing is obtained mainly on the strength of the project cash flows. The lenders receive their interest and principal payments from the cash flows of the project and the assets of the project are used as collateral to secure the loan (Esty, 2014; Kleimeier et al., 2001). Since the lenders do not have recourse to the cash flows or the assets of the sponsor, such type of financing is called as limited or non-recourse financing (Finnerty, 2007)).

The definition proposed by the World Bank for institutional investors (Saha Deblina, 2017)[3] groups two different types of investors that do not share the same purpose. Institutional investors' main responsibility is to pay back their liabilities, these investors include pension funds, insurance companies and sovereign wealth funds (Blanc-Brude, 2017). Asset managers and funds' main activity is investment and generating profitable returns. Institutional investors can internalize the investment activity by investing directly in infrastructure. They can also delegate this activity to asset managers and infrastructure funds, in that case they access infrastructure through the indirect route (Blanc-Brude, 2017; Blanc-Brude et al., 2016; Inderst et al., 2014).

In this study, we are interested in the investments made by institutional investors through the direct route as well as the contributions made by asset managers and infrastructure funds. We consider that direct investment is investment made by institutional investors, while indirect investment is the investment made by asset managers and funds (in which institutional investors invest) (Blanc-Brude, 2013; Inderst et al., 2014).

This paper contributes to the literature on private investment in infrastructure. This paper is based on a novel data set on project finance deals. Most current research on private participation in infrastructure uses data from the World Bank Private Participation in Infrastructure (PPI) database to study the links between private participation in infrastructure at large and institutional contexts and country risks (Basılio, 2017; Moszoro et al., 2015; Ruhashyankiko et al., 2006). This database raises two conerns. First, it does not allow differentiation by financing sources as it includes infrastructure projects that are financed through various financing methods

[3] "entities that pool money from various sources to invest in different asset classes, with the intent of generating profitable returns on their investment. All entities that are primarily in the business of making financial investments in the form of equity or debt, without being involved in the construction, operation or management of the infrastructure project (e.g., pension funds, private-equity funds, hedge funds, mutual funds, insurance companies, etc.)".

i.e. project and corporate finance that do not have the same risk profile.[4] A recent consensus has been reached in the literature that project finance transactions is the best investment method that allows investor to access diversification opportunities of infrastructure (Bianchi et al., 2017; Blanc-Brude, 2013; Blanc-Brude et al., 2017). Second, most institutional investors' allocation is based in developed countries, the PPI database collects data on projects only in developing countries limiting the possibility to better understand investment dynamics of institutional investors. Moreover, this paper moves the debate from private participation in infrastructure at large to institutional investors' participation in specific. Attracting institutional investors' capital is pivotal for future infrastructure financing in developed and developing countries.

A similar work by Gemson et al. (2012) studies the determinants of private equity (PE) firms investments in project finance infrastructure transactions. The authors used project finance deals from the Global Project Finance database provided by Venture Xpert on 2821 infrastructure projects that were announced during 1990–2009. It was found that projects with PE investment were larger when compared to projects that did not have PE investment, indicating that that PE investment helped in successfully financing larger projects.[5] Their analysis also indicated that PE investment in infrastructure is more frequently seen in developed countries and in countries with lower country risk. PE firms/funds are one type of vehicles in which institutional investors can invest to access infrastructure. However, a debate is ongoing on the adequacy of private equity funds with long term allocation objectives of institutional investors. PE investments in infrastructure tend to have short tenor, PE funds aim to exit investments after few years (Blanc-Brude, 2013; Blanc-Brude et al., 2016; Lopez-de-Silanes et al., 2015). Our study is larger in scope as it focuses on

[4]Project finance greatly minimizes risk to the sponsoring company, as compared to traditional corporate finance, because the lender relies only on the project revenue to repay the loan and cannot pursue the sponsoring company's assets in the case of default.

[5]Appendix A shows results for comparison between projects with and without institutional investors. We find similar results indicating that institutional investors are not replacing existing investors, but are rather bringing additional resources to help fund larger projects.

direct investment made by institutional investors as well as investments made by asset managers and infrastructure funds including PE firms.

Our results indicate that for the direct investment route lower macroeconomic, political and regulatory risk are vital factors in increasing a project's attractiveness. For asset managers and infrastructure funds only lower regulatory risk is statistically significant, suggesting that these two families of investors do no share the same risk appetite. Furthermore, we find no indication of higher attractiveness for brownfield projects compared to greenfield projects. We also find that projects without demand risk i.e. Availability payment are more attractive for both investment routes.

These results shed the light on the relevant importance of infrastructure risks for institutional investors. Institutional investors are subject to different regulatory regimes and can thus be limited in the possibility of taking certain risks. Identifying, isolating and packaging risks that matter in a way that allocate them to the party that can best bears them is the key for attracting more institutional investors capital. This study can help policymakers design better infrastructure financing vehicles and instruments.

The remainder of this article is organized as follows: section 1.2 derives the propositions tested based on the existing literature, section 2.3 provides details about the data and empirical strategy used, section 3.6 presents the results and chapter 3.7 concludes.

1.2 Related Literature and Testable Hypothesis

The question of institutional investors' participation in infrastructure had not been studied empirically in the literature. This is mainly due to the lack of data on institutional investors participation. Most available data on infrastructure investments focus on private participation at large. The scarcity of data is a problem we faced,

urging us to identify for 6371 projects the presence or not of an institutional investor among debt providers or project sponsors.

The question of explaining the determinants of private investment and the dynamics between investment and risk is at heart of economic and financial literature.

1.2.1 Related Literature

On the theoretical side, Estache et al. (2015) sheds the light on the importance of understanding a country's institutional weaknesses in order to determine the best financing mix between private and public resources. Furthermore, the literature points at multiple key determinants for choosing or attracting private investment such as investment efficiency , productivity differential (Grout, 2003; Moszoro, 2018a) bundling (Hart, 2003; Iossa et al., 2016), risk allocation (Engel et al., 2013), contracting flexibility and regulation (Iossa et al., 2016) as well as the effects of corruption, political stability, bureaucracy and regulatory quality (Moszoro et al., 2012; Williamson, 1979).

On the empirical side, the question of the determinants of foreign direct investment (FDI) has been the focus of many studies (Asiedu, 2002; Bevan et al., 2004; Blonigen, 2005; Chakrabarti, 2001). However, the empirical literature related to private participation in infrastructure is scarce but not non existing (Basılio, 2017; Ruhashyankiko et al., 2006). The empirical evidence on determinants of private participation in infrastructure uses in most cases the World Bank PPI database with cross country panel regression approaches to look at the importance of different country indicators and country risks in attracting private investment in infrastructure.

The overall country risk level affects its capacity to attract private investment in infrastructure through different indicators. Through an empirical analysis of the relationship between private participation in infrastructure and country risk, Araya et al. (2013) finds that a difference of one standard deviation in a country's sovereign

risk score is associated with a 27 percent increase in the probability of having a private participation in infrastructure commitment. The authors use the World Bank PPI database for infrastructure projects in developing countries.

Basılio (2017) performs an empirical analysis using fractional response models to explore the determinants of the degree of private participation in public private partnerships in developing and emerging economies. The author uses data from the World Bank's PPI database for the period spanning 2000 to 2014. The results suggest the importance of favourable fiscal conditions. Furthermore, the results suggested that private involvement is higher in countries with underdeveloped financial markets. Ruhashyankiko et al. (2006) using data from the World Bank PPI database conduct an empirical analysis of the cross-country and cross-industry determinants of public-private partnership (PPP) arrangements. The results suggest that PPPs i.e private participation in infrastructure tend to be more common in countries where governments suffer from heavy debt burdens and where aggregate demand and market size are large. Furthermore, the results suggest that macroeconomic stability is essential for PPPs.

Generally, most of the studies investigating private investment in infrastructure focus on countries' attractiveness (Basılio, 2017; Mansaray, 2018; Ruhashyankiko et al., 2006). These analysis are conducted on a country level basis using variables such as number of sponsors per country, number of projects per country or volume of investments per country. However, very little interest is given to project characteristics or the type of private partners involved in the transactions. In fact, private investors participating in infrastructure projects do not have the same incentives for investment nor seek the same results.

To our knowledge, only one study focused on a specific type of investors in infrastructure. Gemson et al. (2012) using project finance data between 1990 and 2009 from Global project finance database, finds that a country's overall risk proxied by the international country risk guide (ICRG) score reduced the probability of private equity investors' participation in infrastructure. The author also finds that project

structures that give more responsibility to the private sector (Build- Own- Operate schemes for instance) tends to attract more private equity investors.

The literature on private participation in infrastructure at large helps us to identify major risks that matter for investors in general. We build on that literature by focusing on a specific type of investors: institutional investors. This paper differs from the paper mentioned above in multiple ways. First, a novel data set of over 6000 global project finance deals is used allowing us to study projects that are financed through a similar financing structure. The World Bank PPI database groups projects that differs dramatically in the financing methods used ans is only focused on developing countries. Second, to our knowledge, this is the first paper to focus on institutional investors' participation in infrastructure.

1.2.2 Infrastructure Investment Risks

From an institutional investor's perspective, assessing an investment's return and potential risks is key for making an informed investment decision. Infrastructure projects have a number of inherent risks that need to be well identified, quantified in order to be efficiently mitigated. Infrastructure assets and transactions are very heterogeneous and institutional investors historically have little experience in investing and managing infrastructure projects and more specifically risks that are inherent to the assets.

Different methods of categorizing infrastructure risks can be found in the literature (Akintoye et al., 2001; Boussabaine, 2013; Weber et al., 2016; Yescombe, 2007). In this paper, we focused on infrastructure risks for institutional investors presented by Inderst et al. (2014) and organized them into two main categories: General risks and Project specific risks. We then derive hypothesis on how these risks can affect projects' attractiveness for institutional investors.

General Risks

General risks are common risks that exist independently of the project or asset type and are usually difficult to influence by project participants. These risks are largely related to the project surrounding environment or country. Investment in infrastructure especially in developing countries faces three main risk families: macroeconomic risks, political risks and legal & regulatory risks.

Macroeconomic Risk

In project finance transactions where the project company i.e. special purpose vehicle (SPV) assumes almost the entire risks and returns of an infrastructure project, a stable macroeconomic environment is a key consideration for the project investors, due to the important impact that these risks can have on the profitability and returns of the project.

Macroeconomic stability or efficient mitigation of macroeconomic risks are necessary to ensure project's profitability. Macroeconomic stability is defined by Fischer (1993) as a situation where "inflation is low and predictable, real interest rates are appropriate ...the real exchange rate is competitive and predictable". Inflation is considered a core indicator for an economy's health. Furthermore, various studies in the literature have shown that inflation has a significant negative effect on investment and growth (Aizenman et al., 1993; Bernoth et al., 2014). In addition to that, exchange rate risks can be threatening for project's revenues, in cases where the financing provided is in a different currency than that of the project's revenue. For instance, projects where the collection of fares is made in local currencies (toll roads, water, ...etc.).

The literature on private participation in infrastructure identifies macroeconomic stability as an essential factor for higher private participation in infrastructure. Using OLS and Zero Inflated Poisson regression on the World Bank PPI database for projects between 1990 and 2003, Ruhashyankiko et al. (2006) find that macroeconomic stability is a key determinant of PPPs (measured by number of PPP projects

in a given country). They find a negative relationship between the number of PPPs and inflation. Mansaray (2018) studies countries' attractiveness for private participation in infrastructure using the World Bank's PPI database for the period between 1980 and 2014 through Zero-Inflated Negative Binomial and Cragg's Double Hurdle models. The author finds strong supporting evidence for the importance of macroeconomic stability for private participation in infrastructure, measured by number of sponsors, number of projects and amounts of investments.

Hypothesis 1 *Infrastructure projects in countries with a lower macroeconomic risk are more likely to attract institutional investors' participation.*

Legal and Regulatory Risk

In the literature, the importance of the legal and regulatory system for the availability of external finance has already been emphasized (Daude et al., 2007; Pistor et al., 2000). The importance of the institutional and regulatory framework has been identified in multiple studies as a key determinant for private investment in infrastructure. Pargal (2003) uses compiled data on private and public sector investment in water, power, telecoms, railroads and roads sectors between 1980 and 1998 for nine countries in Latin America to assess the importance of the regulatory framework as a determinant of private sector investment in infrastructure. The results suggest that the legislation that aims to increase regulatory certainty and minimize the perceived risk of expropriation through the establishment of independent regulatory bodies is a critical determinant of the volume of private investment flows.

Moszoro et al. (2015) using a toy model on data from the World Bank PPI database find that overall private participation in infrastructure financing increases with freedom of corruption, rule of law, quality of regulations and decreases with the length of court disputes. Kirkpatrick et al. (2006) using the World Bank database for projects between 1984 and 2002 for the transport, energy, telecoms and water sectors find that foreign direct investment in infrastructure responded positively to an effective domestic regulatory in the hosting country of the project.

The legal and regulatory quality can be assessed through different angles. We focus on the main aspects that seem crucial for infrastructure investments. First of all, regulatory quality which translates in local and national governments' capacity to foster private participation through formulation and implementation of sound policies (Levy et al., 1994). Next in line, is the efficiency and time taken by the judicial system. It is always said that *Delayed justice is injustice*. In fact, investors need to have confidence in the judicial system and be sure that their rights are protected and that justice can me made in a timely manner in case of disputes. Furthermore, Djankov et al. (2002) constructed an index of procedural formalism of dispute resolution for 109 countries. The index is then used to understand the relationship between procedural formalism and the quality of institutions. The results suggest that procedural formalism is associated with more corruption, less consistency, less honesty, less fairness in judicial decisions as well as an inferior access to justice.

Hypothesis 2 *Infrastructure projects in countries with lower legal and regulatory risk are more likely to attract institutional investors' participation.*

Political Risk

Heavy initial investments and the long life span of infrastructure projects make them extremely sensitive to political risk. Private investment in infrastructure is thus related to political stability of the environment in which the project is planned to operate. The occurrence of political conflicts whether translated by change of governments or more severely by violence, terrorism and wars can constitute a great hinder for attracting private investors in infrastructure and more specifically institutional investors.

The empirical evidence on the importance of political stability for private investment in infrastructure has been put forward in the literature. Mansaray (2018) finds a positive relation between political stability and private participation in infrastructure using the number of private investors in countries per year as a measure.

It should also be noted that some political events can constitute *Force Majeure* events that can result in the total loss of the project's capital. *Force Majeure* risks cannot always be mitigated through insurance. A strong risk assessment and an efficient allocation of risks between the different parties involved is necessary.

Hypothesis 3 *Infrastructure projects in countries with political stability are more likely to attract institutional investors' participation.*

Project Specific Risks

Project specific risks are by definition related to the project or asset. In this paper, we focus on two main risks: construction and demand risk.

Construction Risk

From an investment standpoint, besides the nature of the infrastructure, we can differentiate investments by project's maturity: greenfield or brownfield. Investors can choose to invest in *Greenfield* or *Brownfield projects*. A greenfield project is an asset constructed at a specific site for the first time. It follows that there is no available track record for the demand for the project's output nor an available asset-specific experience as well as a risk for delays and completion. This may cause a higher degree of uncertainty on the costs as well as on the revenues side jeopardizing in consequence the profitability of the project. In contrast, a brownfield project is an existing asset whether operational or has a predecessor of some sort at the same site.

An *a priori* view is that institutional investors have a stronger preferences for brownfield projects given their lower perceived risk. However, a closer look into the literature on the sources of failure of infrastructure projects show that construction risk is not the main cause of failure (Blanc-Brude et al., 2013b). In addition to that, (Blanc-Brude et al., 2013b) conduct an empirical analysis on the determinants of credit spreads and yield to maturity in project finance term loans. They show that construction risk is not the main driver of the cost of debt in infrastructure projects. Furthermore, they also show that institutional investors need construction risk to

build diversified portfolios. In fact, the completion of the construction phase in infrastructure projects leads to a rather predictable shift in risks across mainly project specific and macro level risk factors. Focusing only on brownfield projects would let investors miss substantial diversification benefits that can be obtained through including greenfield projects in their portfolios. The authors also showed that construction risks are almost entirely idiosyncratic and can be thus, in principle, diversified.

EDHEC infrastructure conducted two surveys on investors' preferences and their willingness to invest in infrastructure project finance deals (Blanc-Brude, 2017; Blanc-Brude et al., 2016), the results show that there is no greenfield premia demanded for infrastructure equity. They argue that this is due to the fact that equity investors are mostly protected from construction risk and that cost overruns related to construction risk are on average equal to zero (Blanc-Brude et al., 2013a). They also state that construction risk is project specific and is not necessarily larger compared to other risks in the project's life cycle such as traffic or demand risk. Construction risk is not expected to be a systematic hinder for attracting institutional investors.

Hypothesis 4 *Brownfield infrastructure projects are not more likely to attract institutional investors' participation compared to Greenfield projects.*

Demand Risk

Most empirical studies on infrastructure investments and private participation in infrastructure give a considerable attention to industrial sectors with almost no mention of underlying contractual arrangements nor business models. However, infrastructure investments are characterized by their lack of liquidity, long term life span and huge sunk costs in relationship-specific assets. The underlying contractual arrangements are what matters for investors' returns rather than the physical asset itself. The sector and the physical investments needed only dictate the necessity of having long term contracts which in turn dictates the business model as well as the

risks and returns of the infrastructure project. Taking the example of a road infrastructure, the risk profile of a toll road project is completely different compared to an availability payment road for which the project company bears no traffic risk. It is thus necessary to distinguish between infrastructure development from a public policy perspective based on industrial needs and infrastructure investments where the underlying contractual arrangements are what dictates the investment risk profile (Blanc-Brude et al., 2016).

The idea of not categorizing infrastructure investments by industrial sectors but rather by contractual arrangements was first put forward by Blanc-Brude (2014). The author defines three *"Business Models"* for infrastructure projects depending on the nature of the project company's revenues :

- **Contracted or Availability-based infrastructure:** revenues have been pre-agreed with counter-party over a pre-agreed period of time.
- **Merchant Infrastructure:** revenues are generated by collecting fees or tolls from users and are exposed to demand risk.
- **Regulated Infrastructure:** user fees and capital programs constrained by a regulatory body. It is the case of natural monopolies for example.

In the survey conducted by Blanc-Brude (2017) on investors' preferences for infrastructure, investors demand higher internal rate of return (IRR) for merchant infrastructure compared to contracted and regulated infrastructure. The author also highlights the fact that for a same IRR, investors have a lower probability to invest in merchant infrastructure compared to the other two types.

Hypothesis 5 *Contracted or Availability-based infrastructure projects are more likely to attract institutional investors' participation.*

1.3 Data and Empirical Strategy

1.3.1 Data Description

Project level data used in this paper has been obtained from IJglobal project finance database. It is the largest database provider for project finance transactions in the industry and it is the same data provider for the World Bank Private Participation in Infrastructure database (PPI database). The database provides details on global infrastructure deals at different development stage. It has more than 25 thousand transactions. Project information available includes sector, sub-sector, contract duration, cost, gearing ratio, contract type, date of financial closure, country, region, sponsors, debt providers, asset maturity and transaction type.

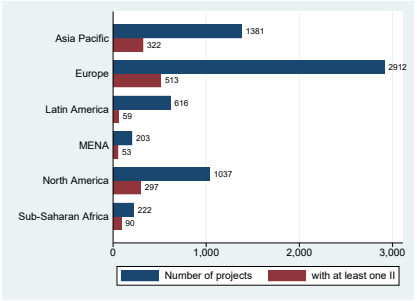
Our study focuses on primary finance[6] projects at financial closure, financed through project finance spanning the period from 2000 to 2018. The infrastructure sectors covered are social & defense, power, transport, renewable energy, telecoms and water. The sample consists of a total of 6371 projects over the period 2000 to 2018 across 130 countries spanning all income levels.

The sample consists of 1334 projects with at least one institutional investors' contribution in the form of direct or indirect investment. Increasing the granularity, the data presents 604 projects with at least one direct institutional investor through debt or equity. For indirect investment, the data consists of 931 projects having at least one asset manager or infrastructure fund (institutional investor's presence through indirect investment) through debt or equity.[7]

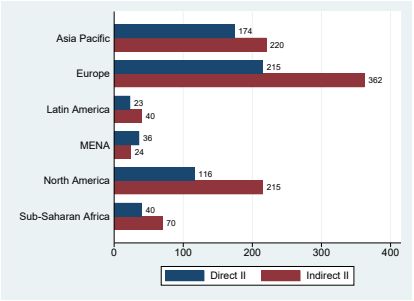
Looking at the regional distribution of projects, we find that most infrastructure

[6]Primary financing is investment that happens at the financial close of the project, it is the first investment in the project.Secondary stage investments are investments that results of the refinancing of projects. It implies that the construction phase and the uncertainty about the projects' cash flows are usually over. These investments are usually of lower risk and of lower return. Our study is focused on primary financing.

[7]Some information for certain projects are missing. Our final sample counts 5100 projects across 130 countries with 1292 projects having at least one institutional investor, 586 with at least one direct investor, 901 with at least one indirect investor.



(a) Distribution of projects and projects with II



(b) Distribution of projects with direct and indirect II

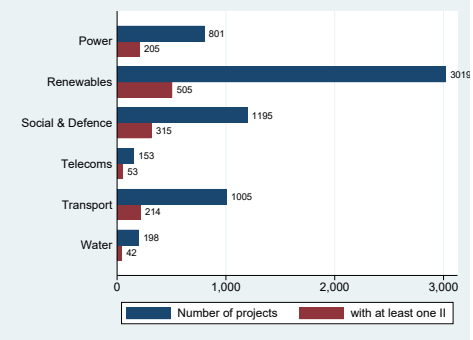
Figure 1.1. Regional Distribution of infrastructure Project finance transactions and Institutional investors participation (2000 - 2018)

project finance deals are found in Europe, followed by Asia Pacific and North America. Furthermore, the same pattern exists in terms of the absolute number of project finance deals with at least one institutional investor. In fact, the United Kingdom, Canada and Australia are pioneers in public private partnerships that are mostly financed through project finance. Furthermore, these three countries are pioneers in attracting institutional investors' participation in infrastructure. Taking a closer look to project with institutional investors, we find a higher number for project with asset managers and infrastructure funds than projects with direct institutional investors.

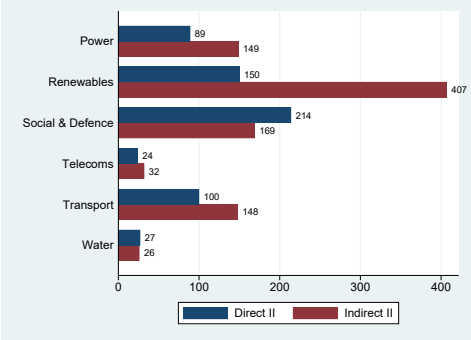
Looking at the distribution of projects across sectors, we observe that half of the projects are in the renewable energy sector. Furthermore, we find that asset managers and infrastructure funds are present across all sector with a strong presence on renewable energy deals. Again, projects with investment from asset managers/ infrastructure funds are higher in number across all sectors except for Social & Defense. This could be explained by different risk appetites between direct institutional investors, asset managers and infrastructure funds. Social & Defense projects usually do not present any demand risk.

Looking at the distribution of projects across countries' income levels[8], we instantly see the challenges facing developing countries. In fact, most project finance deals in general and those mobilising institutional investors in particular are concentrated in high income economies.

[8]For income levels, we use the World Bank classification.

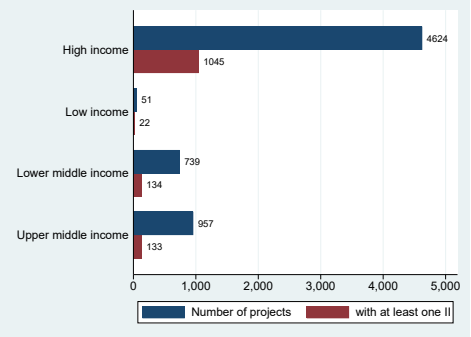


(a) Distribution of projects and projects with II

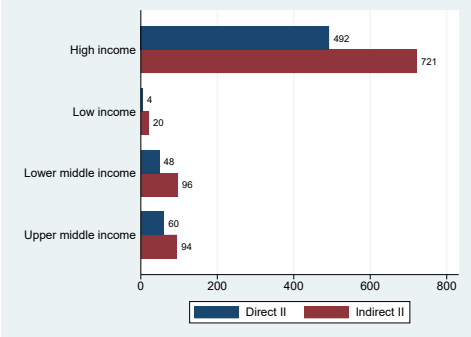


(b) Distribution of projects with direct and indirect II

Figure 1.2. Sectoral Distribution of infrastructure Project finance transactions and Institutional investors participation (2000 - 2018)



(a) Distribution of projects and projects with II



(b) Distribution of projects with direct and indirect II

Figure 1.3. Income level Distribution of infrastructure Project finance transactions and Institutional investors participation (2000 - 2018)

1.3.2 Variables Description

A description of the explanatory and dependent variables is presented in this section.

Dependent Variable - Presence of an Institutional Investor as a Sponsor or Debt provider

To measure the attractiveness of a project for an institutional investor, we focus on the presence or not of an institutional investor in the projects' sponsors or debt providers. This variable is a dummy variable equal to 1 if there is at least one investor. We do not use the number of investors as very few project present multiple institutional investors at the same time.

However, this variable does not take into account the heterogeneity of investors, it groups asset managers and infrastructure funds along with direct institutional

investors. To account for that, we increase the granularity of the analysis to study projects' attractiveness for direct investors and indirect investors : we distinguish direct investors i.e. pension funds, sovereign wealth fund or insurance company from indirect investors i.e. asset managers and infrastructure funds.

To derive these variables, we characterized the type of all the sponsors and debt providers of the 6371 projects of the overall sample.[9] We then categorized investors by type of investors and identified the presence of institutional investors for the direct investment channel, and the presence of asset managers, and infrastructure funds for the indirect investment channel.

Substantive Predictors

As outlined in section 1.2, we identified multiple risks that can reduce a project's attractiveness for institutional investors including general risks and project specific risks. General risks include: (i) macroeconomic risk, (ii) political risk, (iii) regulatory and legal risk. Project specific risks include: (i) construction risk and (ii) demand risk.

General Risks

Macroeconomic Risk

These risks are measured in this study by the following variables:

- Exchange rate volatility: we define exchange rate as the rate at which a country's currency is exchanged for one US dollar. We calculate the standard deviation of the percentage change in the exchange rate over 5 years prior to the financial close year.

[9] More than 2600 sponsors analysed and 1000 debt providers using Inframation database and public information available online.

- Inflation volatility: Most of the studies on the topic measure price stability by using the inflation rate. The latter is the annual percentage change in a country's consumer price index (CPI). We measure volatility over 5 years period prior to the financial close year.[10]

Political Risk

This risk is measured by the political stability and Absence of Violence index provided by the World Bank. This variable measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. It allocates higher values to more stable countries.

Legal and Regulatory Risk

These risks are measured by the following variables:[11]

- Regulatory Quality: this variable provided by the World Bank is an index from 0 to 100 that allocates higher values to countries with better regulatory quality. It captures the perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

- Time required to enforce contracts: this variable provided by the World Bank is the number of calendar days from the filing of the lawsuit in court until the final determination and, in appropriate cases, payment.

Project specific Risks

Construction Risk

This risk is captured by a dummy variable that indicates whether a project is Greenfield or Brownfield.

[10]For investment decision, long term stability is key. Thus, we decided to use volatility over 5 years for the exchange rate and inflation instead of 1 year periods.

[11]Other variables could have also been used such as control of corruption or rule of law. However, Table 1.2 shows the correlation between variables. The correlation between regulatory quality, control of corruption and rule of law exceed 0.9. Thus, we only use regulatory quality to eliminate any risk of multicollinearity.

Demand Risk

Revenue risk can be influenced by institutional investors' participation in the project through for instance requiring revenue guarantees. This could raise endogeneity concerns, if all risk categories are included in the regression. Although it is true that for projects with demand risk, investors could influence the guarantees demanded for investing. However, their influence do not interfere on whether a project is an availability based or not.

For that reason, risk is captured in this study by a dummy variable that is equal to 1 if a project is an *Availability based* project. We manage to construct this variable for 5230 projects using publicly available data online, the World Bank PPI database for developing countries projects and the database Inframation.

This allows us to understand if projects with no demand risk are more attractive to institutional investors.

Other variables

Other variables are used in our study:

- Project's Sector: This is a categorical variable. Sectors include: Water, Renewables, Power, Social & Defense, Transport and Telecoms.
- PPP: this is a dummy variable equal to 1 if a project is a PPP according to IJGlobal definition.[12]
- Financial close year: This is the year where the project reached financial close.
- Region: this is a categorical variable that indicated the hosting region of the projet.

[12]For a project to be classified as a PPP, it must contain the following attributes: (1) Procurement conducted by a public-sector procuring authority or other government body. (2) Private partner that is at least majority-owned by the private sector. (3) Some element of commercial debt financing. (4) Responsibility for arranging financing to lie with the private partner. (4) Little or no responsibility for the public partner to service debt. (5) Usually a concession period.

- MDB support: this variable is a dummy variable that indicates multilateral agencies financial support in the form of investment in equity or in debt.[13]

1.3.3 Empirical Strategy

We explore how different project risks affect project's attractiveness for institutional investors' participation. Our data allow us only to observe the presence or not of an institutional investor, an asset manager or an infrastructure fund. The adapted model to understand the relationship between different project risks and institutional investors' decision to participate in infrastructure projects, is a logit model. We estimate the following regression:

$$\begin{aligned} Y_i = \alpha + \beta_1 InflationVol_i + \beta_2 Forex_i + \beta_2 Political_i + \beta_3 RegQuality_i \\ + \beta_4 Contractenforcementdays_i + \beta_5 Greenfield_i + \beta_6 AB_i + \gamma X_i + \epsilon_i \quad (1.1) \end{aligned}$$

where Y_i is the dependent variable representing a dummy variable equals to 1 if an institutional investor is present in the project i. $InflationVol$ is a measure of inflation volatility over the 5 years prior to the poject's financial close, $Forex$ is a measure of exchange rate volatility over the 5 years prior to the project's financial close, $Greenfield$ is a dummy variable equals to 1 if the project is greenfield and 0 otherwise, AB is a dummy variable that is equal to 1 if a project is an Availability payment project. $Contractenforcementdays$ is the logarithm of the number of calendar days from the filing of a lawsuit in court until the final determination. $Political$ is

[13] We followed the World Bank PPI database definition for multilateral support. Thus, we don't track non-financial support from multilateral agencies, such as transaction advisory support. To construct this variable, we analyzed sponsors and debt providers for all 6372 projects and identified multilateral and bilateral development agencies.

a variable measuring the political stability of the host country and *RegQuality* measures the quality of the regulatory framework. We also include a dummy variable for multilateral financial support as well as a dummy variable of whether a project is a PPP. We run the regression with sector fixed effects, time fixed effects and region fixed effects in order to absorb any characteristics that we failed to capture.

The broad definition of institutional investors groups direct institutional investors alongside asset managers and infrastructure funds, two different families of investors. Thus, we estimate the above mentioned regression for direct institutional investors (pension funds, insurance companies and sovereign wealth funds) and for indirect institutional investors (asset managers and infrastructure funds) separately.

1.4 Empirical Results and Discussion

All the regressions were performed using the statistical software STATA 15. It is important to note that correlation was expected among the observations within each country for the same year. We cluster standard errors by country relaxing thus the independence assumption and requiring observations to be not correlated between clusters.

1.4.1 Project's Attractiveness for Institutional Investors

Table 2.16 shows the result for the regression for the broad definition of institutional investors.

For macroeconomic risk, we find that higher inflation and exchange rate volatility have a negative effect on the probability of an institutional investor's participation in infrastructure project finance deals. However, they are not statistically significant, thus hypothesis 1 is not supported. Two main characteristics of infrastructure investments make macroeconomic variables key in the risk analysis: huge upfront costs and long term contracts. Given that projects cash-flows cover the repayment of investors, not identifying and mitigating macroeconomic risks can have a huge

impact on project cash-flows and thus on the investors' returns. This is particularly true for projects where the project company bears demand risk or where cash-flows are not linked to inflation or when cash-flows are paid in local currencies without any exchange rate guarantees. Some hedging and mitigating mechanisms exist to reduce and limit exchange rate risks. It is usually hedged through a derivative contract, a swap, a future or a forward contract. These contracts are widely available in the over the counter market for frequently traded liquid currencies but are much less likely to be available for certain currencies in developing countries.

Interest rate risk can also have a considerable impact on project's profitability in case of inefficient mitigation. For instance, loans are usually negotiated with variable interest rates consisting of two components: the reference interest rate and the interest margin. The former is dependant on the currency of the loan for example three or six months Euribor for Euro or Libor for US dollars. The interest margin may be in most cases fixed. However, the reference interest rate varies according to capital markets development. Thus, the project can be exposed to additional costs if interest payments increase affecting project cash-flows in consequence. The variables related to macroeconomic risk might not be statistically significant as investors can mitigate macroeconomic risks through various methods. Furthermore, as explained earlier, the broad definition of institutional investors group two families of investors who might not have the same risk appetite nor experience with macroeconomic risks in project finance deals.

Political stability has a positive effect on the probability of a project receiving investment from an institutional investors' participation. This result is statistically significant only when we include sector and year fixed effects, meaning that within year and within sector political stability is a key variable. In politically unstable environments, renegotiations of contracts or breach of contracts may have a negative effect on the profitability and continuity of projects (Hart, 2003). Violence through wars or terrorism affect directly the projects' revenues in case of deterioration or complete destruction of the assets.

For regulatory risk, we find that higher regulatory quality has a positive effect on the probability of institutional investor's participation in project finance deals. This result is statistically significant and consistent when we include year and region fixed effects. Furthermore, we find that longer contract enforcement days affect negatively the probability of institutional investors' participation in infrastructure project finance deals. This result is in line with the literature on the importance of sound regulatory frameworks for private participation in infrastructure (Basılio, 2017; Moszoro et al., 2015; Ruhashyankiko et al., 2006). Infrastructure projects and project finance transactions are based on contractual arrangements. These arrangements are usually long term contracts that define rights and obligations of the various parties involved as well as risk allocation among them. A weak regulatory and legal system can threaten the viability and sustainability of such contractual relationships. In fact, countries and local governments can impact a project through legislation, expropriation, the failure to obtain necessary authorizations or even through breach of contracts (Weber et al., 2016). Poor legal and regulatory systems along with high corruption levels can hinder investment. This is particularly true for developing countries. However, regulatory and legal risk is also relevant in developed countries, typically, change in tax, environment or investment regulations can create a risk for investment in infrastructure. A relatively recent example of the effect of a regulatory change on the profitability of infrastructure projects, is the case of Norway. In fact, in 2012 a consortium of foreign institutional investors bought the Norwegian national gas network, Gasled. Few months after the transaction, Norway decided to change the regulations governing its gas network, resulting in 90% reduction in the tariffs allowed to be charged by the company.

For construction risk, we find that a greenfield project impacts negatively the probability of institutional investor's participation in infrastructure project finance deals. However, this result is not statistically significant supporting hypothesis 4.

For demand risk, we find that availability based projects increase the probability

of institutional investors' participation in infrastructure deals. This result is statistically significant and robust to inclusion of sector, year and region fixed effects. This result is in line with Blanc-Brude (2018), who highlights the fact that for a same internal rate of return (IRR), investors have a lower probability to invest in merchant infrastructure compared to infrastructure with contracted revenues i.e. Availability based.

Furthermore, we find that multilateral support increase the probability of institutional investors' participation. We also find that a PPP project reduces the probability of institutional investors' participation. These result are statistically significant and robust to inclusion of sector, year and region fixed effects.

1.4.2 Projects' Attractiveness for Direct *versus* Indirect Investment Channel

As explained earlier, the broad definition of institutional investors include institutional investors per say: pension funds, sovereign wealth funds and insurance companies, alongside asset managers and infrastructure funds. Institutional investors can also access infrastructure through an asset manager or an infrastructure fund. In this section, direct institutional investors are institutional investors per say. Indirect institutional investors are asset managers and infrastructure infrastructure funds.

These two families of investors are not homogeneous nor in their risk appetite nor in their investment capabilities. Investment in infrastructure requires thorough due diligence and stringent risk assessment. On one hand, direct institutional investors differ in size and do not always have the required capabilities. Investment is not their main historical activity. Investing directly in infrastructure needs high specific knowledge and is usually possible for very big institutional investors. Furthermore, building a direct portfolio of infrastructure assets is a long term goal that can take at least 15 years and have on average 20 or 25 investments (Blanc-Brude,

2017). Moreover, this portfolio is unlikely to be well diversified as it usually presents concentrated exposure to few large projects.

On the other hand, asset managers and infrastructure funds' main activity is investment, they have specialized teams for due diligence & monitoring of projects. Asset managers and infrastructure funds are expected to be more comfortable in investing in higher risk environments and in riskier projects, given that they can invest in multiple projects with exposure to different risks in order to achieve diversification purposes.

Appendix A shows comparison for projects with direct institutional investors versus projects with investment from asset managers or infrastructure funds. Table 12 shows that for the period 2000-2018, projects with direct investment are bigger in size and have a higher number of investors than projects with indirect investment. However, this result is different for the first sub-period 2000-2008. We observe no significant difference in the size of projects with direct investment compared to projects with indirect investment along with a significantly higher number of investors for projects with direct investment.

Table 1.4 shows the regression results for direct institutional investors i.e. pension funds, insurance companies and sovereign wealth funds.

The signs are similar to the signs found in the first regression with the broad definition for institutional investors.

For project specific risks, we find that direct and indirect institutional investors do not have a systematic preference for brownfield projects. We find that projects with no demand risk i.e. Availability based projects increase projects' attractiveness for direct institutional investors. This result is statistically significant and robust to inclusion to year, region and sector fixed effects. For asset managers and infrastructure funds, we find a positive effect that is only statistically significant when region fixed effects are not included. Furthermore, multilateral support is found to increase project' attractiveness for direct and indirect investment by institutional investors. However, we find that PPP projects reduces the probability of a direct institutional

investors' participation in a deal.

For General risks, we find evidence for the importance of sound regulatory frameworks, political stability and low macroeconomic risks for attracting direct institutional investors. This result is robust for inclusion of year, sector and region fixed effects. For asset managers and infrastructure funds, we only a statistical significant result for the importance of regulatory quality.

These results suggest that asset managers and infrastructure funds might be willing to take higher risks compared to direct institutional investors.

1.5 Conclusion and Policy Recommendations

Infrastructure projects are by their nature prone to specific risks and imply long term commitment. Institutional investors' participation in infrastructure is driven by potential diversification opportunities based on well assessed risks. This study investigated infrastructure project attractiveness for institutional investors given several major risks: macroeconomic risk, legal and regulatory risk, political risk, construction risk and revenue risk.

The study is based on a new data set of 6371 infrastructure project finance deals at financial close between 2000 and 2018. To measure project's attractiveness for an institutional investor, we look at the presence or not of an institutional investor in the transaction's sponsors or debt providers. To assess projects' attractiveness, we first consider a broad definition of institutional investors following the definition proposed by the World Bank. This definition groups institutional investors (pension funds, insurance companies and sovereign wealth funds) as well as asset managers and infrastructure funds. We then separate these two groups and we study direct investment done by institutional investors directly (direct investment) and the investment decision done by asset managers and funds that are mandated by institutional investors (indirect investment).

Looking at the broad definition of institutional investors including asset managers and funds provided by the World Bank (Saha Deblina, 2017), we find strong evidence that projects with lower political and regulatory risk have a higher probability in attracting institutional investors. Furthermore, we find that multilateral support and absence of revenue risk increases project's attractiveness.

However, when we separate direct investment made by institutional investors from indirect investment made by asset managers and infrastructure funds mandated by institutional investors, we find slightly different results. On the one hand, for the strict definition of institutional investors including only pension funds, insurance companies and sovereign wealth funds, we find that higher macroeconomic, political and regulatory risk reduces projects' attractiveness. For asset managers and infrastructure funds, higher risks reduces projects' attractiveness but regulatory risk is the only statistically significant. The difference between direct institutional investors and asset managers resides in the fact that investing in infrastructure needs high specific knowledge and specialized teams. Direct institutional investors who prefer to internally manage their portfolios might forgo diversification for a more concentrated exposure to few large projects with low risks (Blanc-Brude, 2017). On the other hand, asset managers and infrastructure funds have specialized teams that can achieve diversification across multiple projects, suggesting that they can be more comfortable taking more risk.

Our results also suggest that availability based projects i.e. without demand risk, are more attractive for direct institutional investors. This result sheds the light on the importance of distinguishing between infrastructure development for public policy motives based on industrial needs and infrastructure investments where the underlying contractual arrangements are what dictates the investment risks and returns (Blanc-Brude, 2018; Blanc-Brude et al., 2016). In fact, the underlying contractual arrangements are what matters for investors' returns rather than the physical asset itself. Furthermore, we find that project's maturity i.e. greenfield versus brownfield has no incident on project's attractiveness for institutional investors.

This study sheds the light on the challenges facing developing countries, in need of large amounts of investment for infrastructure. Institutional investors are subject to different regulatory regimes and can thus be limited in the possibility of taking certain risks. The key to attracting more institutional investors is isolating and packaging risks in a way that allocate them to the party that can best bears them. There is a need for well designed infrastructure financing vehicles and instruments.

This study presents some limitations and should be considered as a starting point for further investigations on institutional investors participation in infrastructure. First, our database did not include amounts of investment committed by different investors preventing us from exploring differences in investment volumes with more sophisticated statistical techniques. Second, other project risks could have been included but unfortunately due to data limitation, it was not possible. Among these risks, it would be interesting to explore the effect of Environmental, Social and Governance (ESG) risks on infrastructure projects' attractiveness for institutional investors. Third, we did not explore co-investment strategies between direct institutional investors investing alongside asset managers and infrastructure funds. Furthermore, we focus on primary financing project finance deals, it would be interesting to expand this study to cover institutional investors' participation in secondary stage investments i.e. refinancing transactions occurring after the construction and ramp-up phase are over.

Table 1.1. Descriptive statistics

	Obs	Mean	Std. Dev.	Min	Max
Project size	6235	309,424	606,485	0,960	14250
Number of sponsors	6371	1,910	1,490	0	18
Number of debt providers	6371	2,854	3,040	0	34
Number of investors	6371	4,765	3,689	0	41
FCyear	6371	2011,359	4,040	2000	2018
Risk (revenue)	5230	2,053	0,973	1	4
Population (log)	6371	7,805	0,602	4,460	9,141
Gdpcapita (log)	6371	12.074	0.728	4.149	13.251
Inflation volatility	6369	1,300	1,292	4,35E-15	21,179
Exchange rate volatility	6 371	0.053	0	0	0.540
Political Stability	6 369	0,182	0,765	-2,810	1,615
Regulatory Quality	6 369	0,978	0,766	-1,934	2,260
Rule of Law	6 369	0,953	0,848	-1,863	2,100
Control of Corruption	6 369	0,889	0,934	-1,443	2,446
Contract Enforcement days (log)	6 369	2,739	0,185	2,079	3,233

Table 1.2. Correlation matrix

	Acronym	Risk	LPOP	LGDPC	Inflv	Xchgv	Psa	RQ	RoL	CoC	LCEd
Risk (revenue)	Risk	1									
Population (log)	LPOP	0,1271	1								
Gdpcapita (log)	LGDPC	-0,0316	0,464	1							
Inflation volatility	Inflv	0,1967	0,0549	-0,161	1						
Exchange rate volatility	Xchgv	0,0492	0,0603	-0,073	0,2037	1					
Political Stability	Psa	-0,3147	-0,4536	0,1998	-0,3724	-0,1047	1				
Regulatory Quality	RQ	-0,3572	-0,3215	0,2712	-0,5159	-0,1968	0,782	1			
Rule of Law	RoL	-0,3542	-0,2059	0,332	-0,4846	-0,1996	0,781	0,943	1		
Control of Corruption	CoC	-0,3622	-0,2925	0,2589	-0,4708	-0,1913	0,7948	0,9464	0,9727	1	
Contract Enforcement days (log)	LCEd	0,2517	0,297	-0,1936	0,2317	-0,0214	-0,4593	-0,5385	-0,4681	-0,497	1

Note: the "L" in front of the acronyms means "log".

Table 1.3. Determinants of Institutional Investors' participation in infrastructure Project finance transactions obtained from IJGlobal database for the period between 2000 and 2018. Clustered standard errors by Country are presented in brackets. * , ** , *** denote significant estimate at 1%, 5% and 10% respectively.

Dependent Variable: II's participation	(M1)	(M2)	(M3)
Macroeconomic Risk			
Inflation	-0.002	-0.031	-0.041
	(0.031)	(0.034)	(0.046)
Exchange Rate volatility	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Political Risk			
Political Stability	0.092	0.125*	0.038
	(0.070)	(0.073)	(0.091)
Legal & Regulatory Risk			
Regulatory Quality	0.303***	0.289***	0.570***
	(0.083)	(0.086)	(0.119)
Contract enforcement days (log)	-0.595***	-0.743***	-0.099
	(0.226)	(0.233)	(0.282)
Construction Risk			
Greenfield	-0.009	-0.061	-0.050
	(0.095)	(0.099)	(0.110)
Demand Risk			
Availability based	0.468***	0.377***	0.324**
	(0.125)	(0.130)	(0.154)
Other project characteristics			
MDB support	0.501***	0.528***	0.532***
	(0.084)	(0.869)	(0.102)
PPP	-0.496***	-0.477***	-0.424***
	(0.123)	(0.128)	(0.147)
Year FE	NO	YES	YES
Sector FE	YES	YES	YES
Region FE	NO	NO	YES
Observations	5101	5072	4592

Table 1.4. Determinants of Direct Institutional Investors' participation in infrastructure Project finance transactions obtained from IJGlobal database for the period between 2000 and 2018. Clustered standard errors by Country are presented in brackets. * , ** , *** denote significant estimate at 1%, 5% and 10% respectively.

Dependent Variable: Direct II's participation	(M1)	(M2)
Macroeconomic Risk		
Inflation	-0.137**	-0.160*
	(0.058)	(0.084)
Exchange Rate volatility	-0.002*	-0.002*
	(0.001)	(0.001)
Political Risk		
Political Stability	0.181*	0.131*
	(0.103)	(0.134)
Legal & Regulatory Risk		
Regulatory Quality	0.001	0.358**
	(0.118)	(0.162)
Contract enforcement days (log)	-1.814***	-1.314***
	(0.325)	(0.408)
Construction Risk		
Greenfield	0.045	0.001
	(0.128)	(0.139)
Demand Risk		
Availability based	0.300*	0.363*
	(0.173)	(0.215)
Other project characteristics		
MDB support	0.749***	0.712***
	(0.113)	(0.136)
PPP	-0.378**	-0.426**
	(0.165)	(0.188)
Year FE	YES	YES
Sector FE	YES	YES
Region	NO	YES
Observations	5018	3850

Table 1.5. Determinants of Indirect Institutional Investors' participation in infrastructure Project finance transactions obtained from IJGlobal database for the period between 2000 and 2018. Clustered standard errors by Country are presented in brackets. * , ** , *** denote significant estimate at 1%, 5% and 10% respectively.

Dependent Variable: Indirect II's participation	(M1)	(M2)
Macroeconomic Risk		
Inflation	-0.005	-0.008
	(0.037)	(0.050)
Exchange Rate volatility	-0.0004	-0.0004
	(0.001)	(0.001)
Political Risk		
Political Stability	0.035	0.146
	(0.084)	(0.104)
Legal & Regulatory Risk		
Regulatory Quality	0.460***	0.857**
	(0.099)	(0.140)
Contract enforcement days (log)	-0.328	-0.436
	(0.267)	(0.319)
Construction Risk		
Greenfield	0.101	0.131
	(0.116)	(0.128)
Demand Risk		
Availability based	0.319**	0.145
	(0.149)	(0.172)
Other project characteristics		
MDB support	0.518***	0.533***
	(0.096)	(0.112)
PPP	-0.308**	-0.193
	(0.147)	(0.164)
Year FE	YES	YES
Sector FE	YES	YES
Region FE	NO	YES
Observations	5031	4412

Chapter 2

The Role of Multilateral Support in Crowding-in Institutional Investors' Participation in Infrastructure Projects

2.1 Introduction

Worldwide, there is a growing gap between the needs for new infrastructure, maintenance and modernisation of infrastructure, and the actual investment levels in developed, emerging and developing economies alike.[1] The public sector, historically responsible for infrastructure provision, is faced with strong budgetary and fiscal constraints hindering it from reaching the required level of investments.

To answer global needs of infrastructure, a distinction needs to be made between funding and financing infrastructure. Financing infrastructure is about finding who puts the needed investment costs upfront. Funding infrastructure focuses on how cash-flows of the project are generated to pay the financier (Fay et al., 2018). For instance, a project can be funded by user fees or by availability payments from the public sector or a mix of both depending on multiple factors including the sector and market size.

[1] See Rozenberg et al. (2019) for an analysis of infrastructure needs around the world.

Large financing needs in infrastructure has led multilateral agencies to place infrastructure development and financing high on their agenda. To increase the finance available for infrastructure, development partners have been working on mobilizing the private sector. Since the 2008 financial crisis, multilateral agencies such as the World Bank, Asian Development Bank and African Development Bank have been focusing on developing infrastructure as an asset class to attract institutional investors. With more than USD 100 trillion under management, institutional investors with long term horizon, such as insurance companies, pension funds, mutual funds and sovereign wealth funds are frequently cited as an alternative source of financing for infrastructure.

The definition proposed by the World Bank for institutional investors (Saha Deblina, 2017) groups two different types of investors that do not share the same objectives: institutional investors, asset managers and infrastructure funds. Institutional investors' main responsibility is to pay back their liabilities, these investors include pension funds, insurance companies and sovereign wealth funds (Blanc-Brude, 2017). However, asset managers and infrastructure funds' main activity is investment and generating profitable returns. Institutional investors can internalize the investment activity by investing directly in infrastructure. They can also delegate this activity to asset managers and infrastructure funds, in that case they access infrastructure through the indirect route (Inderst et al., 2014).

Multilateral support can take multiple forms in order to facilitate the flow of private capital to infrastructure projects. It can be in the form of guarantees (Pereira Dos Santos et al., 2018), financial support through investment or non-financial support such as transaction advisory support (Humphrey, 2018). Financial support in the form of investment is believed to reduce the overall risk perception of a project and can signal creditworthiness for private investors, acting as catalyst for increasing institutional investors' participation in infrastructure (Basılio, 2014; Inderst et al., 2014).

Our study attempts to understand the role of financial multilateral support in

the form of investment in crowding-in capital flows from institutional investors, asset managers and infrastructure funds to infrastructure project finance transactions. We then explore differences between developed and developing countries. The difficulty in studying this question resides in the fact that multilateral support is not a random decision. It is determined by multiple factors (Basılio, 2014) such as donor interest or recipient need (McKinlay et al., 1977). In observational studies, quasi-experimental designs can be used to tackle lack of randomization (White et al., 2014). Thus, we use a quasi-experimental design on a novel data set of project finance transactions at financial close between 2000-2018 provided by IJGlobal. As the effect of not having multilateral support can not be directly observable in projects without multilateral support, we first estimate projects' probability to receive multilateral support through a regression analysis. Then, we use propensity score matching to form a reliable counterfactual for comparison. Once a reliable counterfactual is constructed, we study the effects of multilateral support on crowding in capital from institutional investors as per the World Bank definition. We then look at effects on attracting direct institutional investors (i.e. Sovereign Wealth Funds (SWF), insurance companies and pension funds) and indirect institutional investors (i.e. asset managers and infrastructure funds).

Our study contributes to the literature on private participation in infrastructure as well as the literature on the role of multilateral support in attracting private investment in a twofold manner. First, the study is based on a novel dataset of project finance deals. Focusing on project finance deals allows us to have a homogeneous group of projects within the infrastructure sector. Furthermore, the paper focuses on global data on developed and developing countries for the infrastructure sector. Existing literature usually uses databases that group projects that varies dramatically in their financing method i.e. corporate and project finance, [2] and are mostly based in developing countries. Second, to our knowledge, this is the first paper

[2]Project finance greatly minimizes risk to the sponsoring company, as compared to traditional corporate finance, because the lender relies only on the project revenue to repay the loan and cannot pursue the sponsoring company's assets in the case of default.

trying to shed the light on the role of financial multilateral support on attracting institutional investors in particular into infrastructure. The question of institutional investors' participation is still very much under-researched mainly due to lack of data on infrastructure projects and institutional investors allocations.

Our results indicate that for developed countries a catalytic effect or financial *additionality* can be observed. Multilateral financial support aiming to building confidence in projects and markets succeeded in crowding-in institutional investors as well as asset managers and infrastructure funds between 2000 and 2018. However, for developing countries, the picture is quite different. We find no effect on crowding-in capital from asset managers and infrastructure funds and a crowding-out effect on direct institutional investors.

The remainder of this paper is organized as follows. section 2.2 presents a review of literature on multilateral support and infrastructure financing. section 2.3 provides details about the data. In section 2.4, we present the methodology. section 2.5 presents the results for the global sample. In section 2.6, we present sub-group analysis for developed and developing countries. chapter 3.7 concludes.

2.2 Multilateral Support, Infrastructure and Institutional Investors

The role of multilateral agencies in overcoming financial market failures has been studied in the literature.[3] Multilateral support can have a major role on private investment acting as a catalyst to encourage more investment. It can also act as a substitute for private capital (Basılio, 2014) for countries or projects that do not have access to private capital markets (Bird et al., 2007).

However, empirical studies have failed to find any strong evidence for the catalyst role of multilateral support. For instance, Bird et al. (2009) using treatment effect

[3]See (Lindbaek et al., 1998) and (Stiglitz, 1998) for a taxonomy of potential interventions for financial market failures.

models on data from 68 middle income countries, find no effect of IMF support on other capital flows. The authors also highlight that results may not be generalized across countries and across capital sources. Furthermore, a study done by Clemens (2002) concludes that there is neither a substitution nor a catalytic effect was found for private international lending. The author used data on IBRD lending to 137 developing countries to study the effect of lagged IBRD flows on subsequent private flow between 1985 and 1999.

Furthermore, several authors studied the determinants for aid flows in general (not only for infrastructure projects). McKinlay et al. (1977) introduced the idea of explaining aid allocation decisions by two distinct models: *donor interest* and *recipient need*. These models opposes two views. For donor interest models, the main driver of aid allocation is strategic based on political or commercial concerns (Gates et al., 2004; Gelb, 2010). For recipient need models, aid flows are driven by humanitarian needs of the recipient countries (Harrigan et al., 2006, 2011; Kilby, 2006). Some authors argue that it is best to use hybrid models that groups donor interest and recipient need (Berthélemy, 2006; Dollar et al., 2006). A new strand of the literature sheds the light on the importance of incorporating the demand side of lending (Humphrey et al., 2013; Knack et al., 2012). These studies put forward the idea that the decision of aid is not solely based on the lender and that it needs to incorporate the preferences of the borrower or recipient.

For infrastructure investments, the studies on the determinants of multilateral support are scarce. Basılio (2014) uses limited dependent variable models on data from the World Bank's private participation in infrastructure (PPI) database from 1990 to 2007. She finds that financial multilateral support to infrastructure is more likely in projects found in countries with underdeveloped financial markets and legal frameworks. Her results also suggest that interventions are more likely in projects in poorer and more populous countries. She finds no evidence for the importance of political risk. Marcelo Gordillo et al. (2016) estimate a multi-effect probit model to calculate the probability of a project to receive multilateral support. They

use data from the World Bank's PPI database between 1990 and 2010. Their results suggest that the probability is higher for bigger projects in poorer and less populous countries.

Few empirical studies looked at the role of multilateral financial support in crowding in private investment in infrastructure projects. Once again, these studies are mainly based on the World Bank's PPI database. This database groups different types of infrastructure finance types and is not limited to project finance. Basılio (2017) finds a negative effect of multilateral support on the degree of private participation in infrastructure projects. She measures the degree as the percentage of private capital flowing to a certain infrastructure project. Her results suggest that multilateral support substitutes private capital. Our study differs from Basılio (2017)'s study. First, her study focuses on the degree of private participation as a whole and is not focused on a specific of investor. In fact, the multilateral support effect on private participation might not be the same by investor type. Furthermore, the PPI database does not solely focus on project finance transactions but include a multitude of financial arrangements and is only focused on the developing world.

Gemson et al. (2012) studies the determinants of private equity funds' participation in global infrastructure project finance transactions. The author uses logistic regressions on project finance deals from the Global Project Finance database between 1990 and 2009. She finds a negative impact for multilateral support on the probability of receiving a private equity investment from such funds. This study focuses on a very specific type of investors: private equity funds. PE firms/funds are one type of vehicles in which institutional investors can invest to access infrastructure. However, a debate is ongoing on the adequacy of private equity funds with long term allocation objectives of institutional investors. PE investments in infrastructure tend to have short tenor, PE funds aim to exit investments after few years (Blanc-Brude, 2013; Blanc-Brude et al., 2016; Lopez-de-Silanes et al., 2015). Our study is larger in scope as it focuses on direct investment made by institutional investors as well as investments made by asset managers and infrastructure funds

including PE firms. Furthermore, our study differs from the above mentioned results in the method used. We use a quasi experimental design to try to quantify the effect of multilateral support on attracting institutional investors.

2.3 Data

Project level data used in this paper has been obtained from IJglobal project finance database. It is the largest database provider for project finance transactions and it is the same data provider as for the World Bank Private Participation in Infrastructure database (PPI database). The database provides details on global infrastructure deals at different development stage. It has more than 25 thousand transactions. The sample chosen for this study included primary finance projects at financial closure, financed through project finance spanning the period from 2000 to 2018. The infrastructure sectors covered are social & defense, power, transport, renewable energy, telecoms and water.

The sample consists of a total of 6371 projects over the period 2000 to 2018 across 130 countries spanning all income levels. Table 2.1 gives a summary of the distribution of project finance transactions according to the country's income level. 72% of project finance deals are in high income countries.

1334 projects have at least one institutional investors' contribution in the form of direct or indirect investment.[4] Increasing the granularity, the data presents 604 projects with at least one direct institutional investor, 211 with equity investments and 433 with debt investments. For indirect investment, the data consists of 931 projects having at least one asset manager or infrastructure fund, with 614 projects having indirect equity contributions and 391 projects having indirect debt contributions.

[4]Each project can attract multiple investors. The sum of projects per investment channel will thus exceeds 1334 projects.

Table 2.1. Income Level Distribution of infrastructure Project finance transactions and number of projects with Institutional investors' participation (2000 - 2018)

Income level	Number of Projects	II	Direct II	Indirect II
High income	4624	1045	492	721
Upper middle income	957	133	60	94
Lower middle income	739	134	48	96
Low income	51	22	4	20
Total	6371	1334	604	931

2.3.1 Multilateral Support and Institutional Investors' Participation

The outcome variable that we analyze in this paper is the rate of projects with at least one institutional investor at project's financial close between 2000 and 2018. The purpose is to try to understand whether multilateral support has an effect in crowding in private finance by institutional investors.

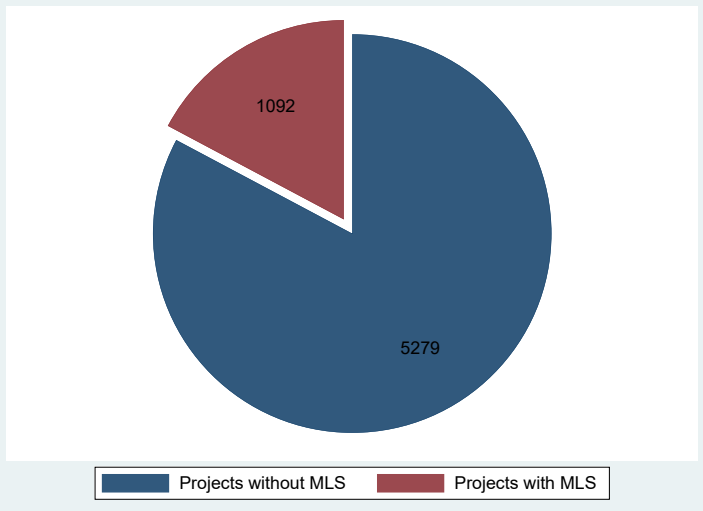
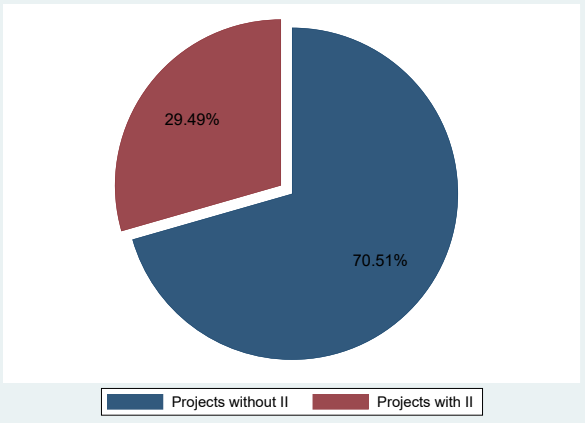


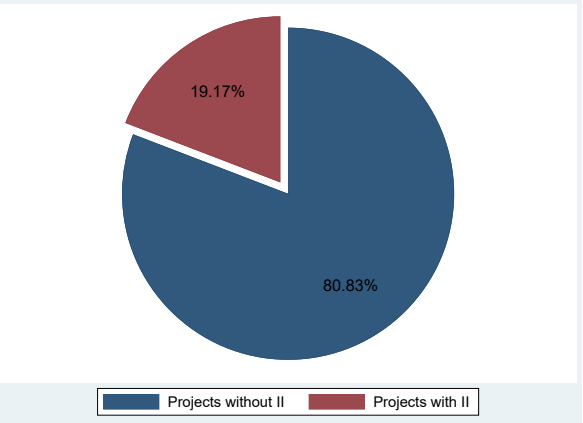
Figure 2.1. Infrastructure Project Finance Deals with and without multilateral support (MLS) 2000-2018.

In the full IJglobal data set of primary financing transactions reaching financial close between 2000 and 2018, there are 6371 transactions. 1092 transactions have a financial multilateral support in the form of debt or equity (Figure 2.1). Projects with multilateral support represent approximately 17% of total project finance deals studied. However, 538 projects out of the 1092 deals with multilateral support are in middle and low income countries.

If we take a closer look at the number of projects with multilateral support that has at least one institutional investor, we find that that 29.49% of projects with multilateral support have an institutional investor's contribution compared to only 19.17% in projects without multilateral support (Figure 2.2).



(a) Projects with MLS



(b) Projects without MLS

Figure 2.2. Institutional investors' participation in projects with and without multilateral support 2000-2018.

A naive comparison of these percentages could lead us to overestimate the actual effect of multilateral support on crowding in institutional investors in infrastructure. For the IJ global data set, it would lead us to conclude that multilateral support increased by 54% institutional investors' participation in infrastructure deals between 2000 and 2018.

However, the effect of not having multilateral support can not be directly observable in projects without multilateral support. In order to eliminate any bias and correctly understand the impact of multilateral support on crowding in institutional investors in infrastructure, we need to construct a proper comparison group for projects with multilateral support. The aim of this paper to thus construct a counterfactual group for projects with multilateral support to be able to quantify the effect of multilateral support on institutional investors participation.

2.4 Methodology

We follow the method used by (Marcelo Gordillo et al., 2016) in studying the effect of multilateral support on cancellation rates of infrastructure public private partnerships.

The purpose is to reduce the bias in quantifying the effect of multilateral support on crowding in institutional investment. In fact, in randomized controlled trials, there is a randomly assigned intervention or policy that is randomly assigned to individuals and divide them to a treated group and a control group or an untreated group. As the intervention is randomized, each individual had exactly the same likelihood of falling in the treated or in the control group. Thus, both groups can be considered identical in terms of their characteristics. An unbiased assessment of the effect of the intervention can be done by comparing both groups.

However, this randomization can not be made in observational studies. The observed interventions are usually not randomly assigned. Our case is a great example. In fact, multilateral support for an infrastructure project is not random. Multiple factors can drive the decision of multilateral agencies to support specific projects. Some can be focused on specific sectors, geographic reasons or business models (Basılio, 2014; Marcelo Gordillo et al., 2016). For these reasons, we can not consider that projects have the same probability of receiving multilateral support. Moreover, a naive comparison between projects with and without multilateral support will lead to biased conclusions.

A possible way of correcting for the absence of randomization is to use quasi-experimental designs. Quasi-experimental designs are cases where the intervention to be studied is assigned by means of self selection (the individuals choose treatment or control groups) or by administrator selection (policymakers, officials..etc.) (White et al., 2014). The essence of quasi-experimental designs is to identify a comparison group that is as identical as possible to the treatment group.

Different methods can be used to identify the control group. Among them, we

can mention regression discontinuity design and propensity score matching. Comparing the treatment and control group give an idea about the net effect of the treatment or intervention of interest.

In our case, the treatment or intervention is the multilateral support and the outcome studied is the percentage of projects with institutional investors' participation. To construct the counterfactual, we first define a metric according to which we compare projects with and without multilateral support. In order to do that, we estimate and calculate the probability for each project to receive multilateral support. Second, we identify a group of projects without multilateral support but with identical probability to receive it using propensity score matching (PSM). Lastly, once the control group is identified we compare the rate of institutional investors' participation in the treatment and control groups.

2.4.1 Comparison Metric

In order to identify a comparison group, we first need to define the metric on which these projects are chosen. The metric depends on observed characteristics. Perfect matching would suggest that each project in the treatment group is matched with a control project identical on all observable characteristics. The larger number of characteristics, the harder the matching process becomes. In that case, it is advised to calculate a propensity score. It is defined as the likelihood of the project to be in the treatment group given observable characteristics.

To calculate the propensity score, we use a logit regressions to estimate the probability for a project to receive multilateral support (receive=1, not receive=0). It is advisable that the characteristics used to estimate the probability be as exhaustive as possible. However, (Caliendo et al., 2008) advise to only include variables that are not influenced by the treatment. For that reason, we use different model specifications and compare their results.

First, we estimate a logit model to calculate the probability of a project to receive multilateral support focusing only on exogenous variables. We use the following substantive predictors, summary statistics of these variables are shown in Table 2.8:

- **Maturity**: it is a dummy variable that takes the value of 1 if the project is a greenfield project. A greenfield project is an asset constructed at a specific site for the first time. It follows that there is no available track record for the demand for the project's output nor an available asset-specific experience as well as a risk for delays and completion.In contrast, a brownfield project is an existing asset whether operational or has a predecessor of some sort at the same site.

- **Political Risk**: this is a rating provided by the International Country Risk Guide (ICRG). It assesses the political stability of the host country of the project. It assigns a number of risk points for the following variables: government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability and bureaucracy quality. The higher the points, the lower is the risk.

- **Economic Risk**: this is a rating provided by ICRG. It assesses the economic strengths and weaknesses of the host country. It assigns risk points for the following variables: GDP per head, real GDP growth, annual inflation rate, budget balance as percentage of GDP and current account as percentage of GDP. The higher the points, the lower is the risk.

- **Financial Risk**: this is a rating provided by ICRG. It assesses the solvency of the host country. It assigns risk points for the following variables: foreign debt as percentage of GDP, foreign debt service as a percentage of exports of goods and services, current account as a percentage of exports of goods and services, net international liquidity as months of import cover and exchange rate stability. The higher the points, the lower is the risk.

- **Financial close year**: is a continuous variable between 2000 and 2018. It is the year of the financial close of the project.
- Regions and sectors dummies.

We then run two other specifications with one including the value of the transaction and the other with the number of debt providers and project sponsors.

We include clustered standard errors by countries to correct biases in the parameter estimates. We thus relax the independence assumption only requiring observations to be independent between countries but correlated within clusters (countries). This results from the fact that projects in the same country are subject to the same macro level policies and environment and can thus be highly correlated.

2.4.2 Propensity Score Matching

The probability estimated from the logit model is used as the propensity score for each project to receive multilateral support. The higher the difference in the propensity score, the further is the project in terms of comparison. Essama-Nssah (2006) suggests that weights are assigned to projects without treatment according to the following rule: weights are assigned based on the distance between the treated unit and the comparison unit, the farther away the lower is the weight.

Multiple methods exist for matching such as the Nearest neighbour , caliper and radius matching or Kernel matching method. For our study, we use Kernel matching. In fact, this method has the advantage of being a non-parametric approach. It is more adapted to smaller samples as it uses information from all projects in order to construct the counterfactual group (Caliendo et al., 2008).

The weight given to the comparison project is in proportion to the closeness of

the propensity scores between treated and control projects (Sianesi, 2001). The proportion is defined as:

$$w_{ij} = \frac{K\left(\frac{p_i - p_j}{h}\right)}{\sum_{j \in d=0} K\left(\frac{p_i - p_j}{h}\right)} \tag{2.1}$$

K(.) is a Kernel weighting function, p is the propensity score, h is a smoothing parameter, and i, j denote projects with and without treatment respectively.

2.4.3 Propensity Score Matching and Subgroup Analysis

After looking at the overall sample effect of multilateral support on attracting institutional investors. We look at the differences between the developed and developing countries. Using data from the overall sample to calculate the propensity score and then use it to infer treatment effects within subgroups can be biased. In fact, the estimated propensity score might balance the observable characteristics for the overall sample but not within subgroups of the sample. A possible solution is to re-estimate the propensity score using only data from the subgroup of interest. However, this solution might have larger variance as the size of the subgroup sample is smaller than the overall sample (Dong et al., 2020).

We use both methods to infer subgroup effects in the developing and developed countries.

2.5 Global Sample Results

This section presents the results for the global sample for developed and developing countries. A naive comparison between projects with and without multilateral support show that 30% of projects with multilateral support succeeded in attracting at least one institutional investor per project versus only 20% of projects had at least one institutional investor per project when multilateral support was absent. A naive conclusion would thus be that the effect of multilateral support is around

a 10% increase in the number of projects with institutional investors' participation. However, this comparison is biased as projects with and without multilateral support do not have the same probability to receive multilateral support nor have the same characteristics. Table 2.10 show the comparison of the unmatched samples on observable characteristics and how different the projects with and without multilateral support are. For instance, the probability to receive multilateral support before matching is 33% for the projects that actually received multilateral support versus only 14% for projects in the comparison group.

The first step in order to understand the effect of multilateral support on attracting institutional investors in infrastructure in an unbiased manner, is to estimate the probability for a project to receive multilateral support. Using this probability, we a construct a control group that did not have multilateral support but has the same probability to receive it according to observable characteristics. In order to do so, a logit model is estimated, then propensity score matching is used to create a control group.

2.5.1 Method 1: No project Size Controls

The variables used to estimate the probability of receiving multilateral support should be variables that are unaffected by participation of multilateral banks or by the anticipation of their participation (Caliendo et al., 2008). We start by estimating a logit model of the probability of receiving multilateral support without controlling for project size (Table 2.9, Model 1A).

$$Y_i = \alpha + \beta_2 PRisk_i + \beta_3 ERisk_i + \beta_4 FRisk_i + \beta_5 Greenfield_i + \gamma X_i + \epsilon_i \qquad (2.2)$$

Y_i is the dependent variable: a dummy variable for multilateral financial support. $PRisk_i$ is political risk, $ERisk_i$ is economic risk and $FRisk_i$ is financial risk. $Greenfield_i$ is a dummy variable if a project is greenfield. We also include sector and

region dummies and financial close year of the project. Other controls are added in subsection 2.5.2 and subsection 2.5.3.

In fact, project size can be influenced to a certain extent by the participation of multilateral agencies. For instance, project design or its conformity to social and environmental safeguards can have an impact on investment costs. We find that higher political and economic risk [5] are associated with a higher probability of participation from multilateral banks but this result is statistically insignificant. We also find that countries with lower financial risk attract more multilateral support. Financial risk measures mainly the solvency of the host country of the project. Furthermore, we find no statistical difference between the probability of a greenfield project and a brownfield project to receive multilateral support. We also find that the Sub-Saharan region has a higher probability of receiving multilateral support compared to all other regions.

Using the World Bank definition for institutional investors,[6] we find that among projects that received multilateral support 30.01% of projects succeeded in attracting at least one institutional investor versus only 20.43%. If we focus only on direct institutional investors,[7] we find that 16.55% of projects with multilateral support succeeded in attracting one direct institutional investor versus only 11.36% of projects without multilateral support. For indirect institutional investors (i.e. Asset managers and infrastructure funds), we find that 21.05% of projects with multilateral support succeeded in attracting at least one indirect investor versus only 12.85% of projects without multilateral support. Table 2.13, Table 2.14 and Table 2.15 show that these results are statistically significant.[8]

For these results to be relevant, two things should be verified: common support

[5] A higher risk score is associated with more stable environments.

[6] The broad definition of institutional investors group pension funds, insurance companies, SWF as well as asset managers and infrastructure funds.

[7] Pension funds, insurance companies and SWF.

[8] These results are consistent with OLS regression of Institutional investor's participation. See Appendix B.

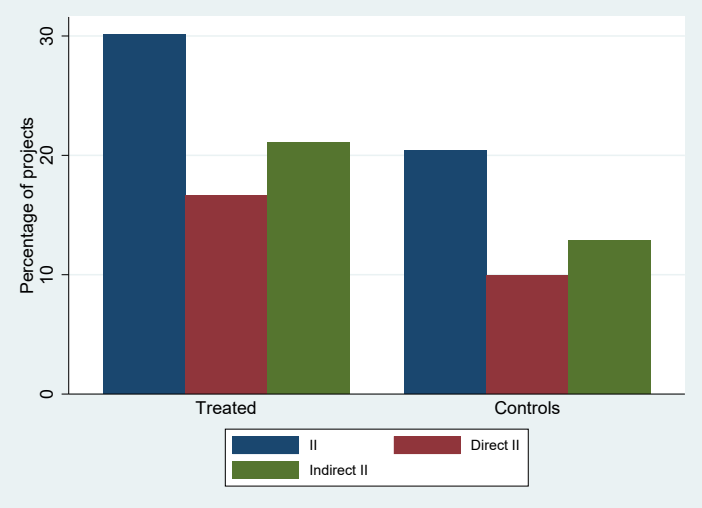


Figure 2.3. Global sample: Average treatment effects on institutional investors' participation in infrastructure deals. Matching method: Kernel. Method 1: No controls for project size in PSM.

between the treatment and control group and balancing across observable characteristics among both groups. Ensuring the common support guarantees that any combination of characteristics observed in the treatment group can also be found in the control group (Caliendo et al., 2008). Table 2.11 shows that the common support condition is respected and that we use all 5904 projects and no projects are discarded. Looking at the balancing across observable characteristics among the treatment and control group, Table 2.10 shows that the treatment and control group show no difference on regional and sectorial aspects, risk score, project maturity, nor financial close year.

Method 1 allows us to use only exogenous variables that are not affected by participation nor by its anticipation. However, neglecting project size and the number of investors might lead us to overestimate the effect of multilateral support.

2.5.2 Method 2: Controlling for Project Size

A major problem with the above mentioned results is that projects in the treatment group and in the control group are not of same size nor have the same number of debt providers nor project sponsors (Table 2.10). In fact, we find that projects that received multilateral support are on average around 536 million USD compared to

only 326 million USD from projects without multilateral support and this difference is statistically significant (Table 2.10). Furthermore, we notice that the number of debt providers and number of sponsors are higher in projects with multilateral support (Table 2.10). This higher number of investors can be attributed to the larger size of projects in the treatment group.

Not controlling for project size can be problematic as it might overestimate the effect of multilateral support on attracting institutional investors. In fact, multilateral agencies have criteria for participation in infrastructure projects that are related to project sizes. For instance the European Bank for Reconstruction and Development participate in projects with loans of at least of 25 million euros and they can take only up to 50% of investment costs. Project size affect thus the decision of multilateral to participate in projects. However, investment costs can also be affected by multilateral participation as discussed earlier. A potential endogeneity problem might arise from including project size in the estimation of a project's probability to receive multilateral support.

Nevertheless, we estimate a logit model for the probability of an infrastructure project to receive multilateral support while controlling for project size. Table 2.9, Model (1B) shows that including project size doesn't affect nor the signs nor the magnitudes of coefficients nor the significance of the variables compared to the case where we didn't control for project size. Furthermore, the purpose of the first step regression is to obtain balance across the observable characteristics and not to correctly predict the probability of receiving multilateral support (Caliendo et al., 2008).

When we control for project size, we find that the effect of multilateral support is lower than in the case where we do not control for project size but is still positive. For the broad definition of institutional investors, we find that around 30% of projects with multilateral support succeeded in attracting at least one institutional investor versus only 22.64% of projects without multilateral support (Table 2.13). The effect is positive but around 3% lower than in the case where we don't control

for project size. For direct institutional investors, we observe the same trend, a positive effect but of a lower magnitude. We find that the effect of multilateral support is of 5.18% increase in the number of projects that succeeded to attract direct institutional investors (Table 2.14) compared to the control group. For indirect investors, we find that this percentage is of a 6.68% increase compared to the control group.[9]

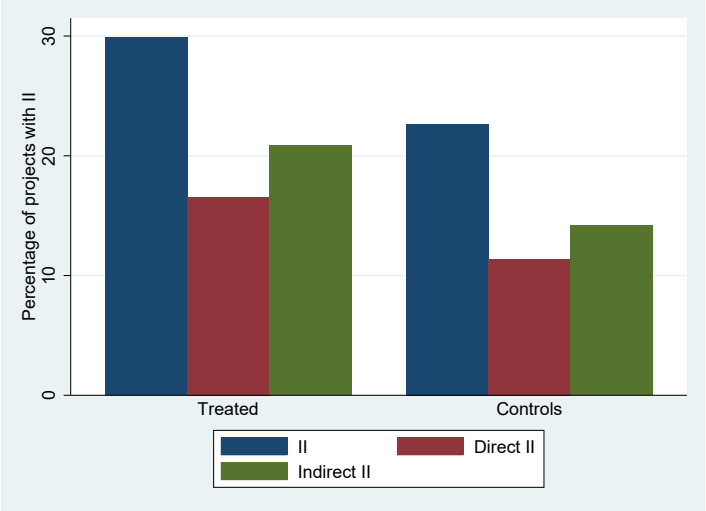


Figure 2.4. Global sample: Average treatment effects on institutional investors' participation in infrastructure deals. Matching method: Kernel. Method 2: Controlling for project size in PSM.

Looking at the common support for the propensity score, Table 2.12 shows that no projects were discarded. For the balancing across observable characteristics, balance is achieved across all variables including project size.

The results are lower in magnitude compared to the case where we do not control for project size but remain positive. However, besides the endogeneity problem that might arise from including project size, we find that controlling for project size doesn't allow to balance the number of debt providers and the number of sponsors across the treatment and control group. In fact, Table 2.10 shows that for method 2, there is no statistical difference in project size across the treatment and control group. However, it shows that on average projects that received multilateral support had 1.5 more debt investors and 0.6 more project sponsors compared to the control group. These differences are statistically significant.

[9]These results are consistent with OLS regression of Institutional investor's participation. See Appendix B.

Not controlling for the number of investors (i.e. number of debt providers and project sponsors) can be problematic. In fact, the higher the number of investors the lower is project risk. This phenomena is called syndication. The most common motive for syndication is risk sharing (Lockett et al., 2001). The number of investors in a consortium can affect the probability of an institutional investor to participate in a project. Once again, the effect that we found using method 1 and method 2 can be overestimated. The difference in the percentage of projects with multilateral support that actually received institutional investors' participation might not be solely attributed to multilateral support.

Method 2 raises concerns with regard to the endogeneity of project size and whether it is impacted by multilateral support. Furthermore, this method does not allow us to control for the number of investors i.e. project sponsors and debt providers. Not controlling for the number of investors neglects an important dynamic in infrastructure investments: syndication. In fact, the higher the number of investors, the lower is project risk. Thus, this method might lead to an overestimation of the effect of multilateral support.

2.5.3 Method 3: Controlling for the Number of Investors

To overcome the endogeneity problem arising from including project size as well as the potential bias from the unbalance between the number of investors across the treatment and control groups, we control for the number of debt providers and the number of investors. Controlling for the number of investors instead of project size allow us to balance the treatment and control group for the project size as well as the number of investors (Table 2.10). Furthermore, including the number of debt providers and the number of sponsors do not influence the magnitude nor the signs of the different variables already included in the regression (Table 2.9, Model 3A).

Controlling for the number of investors allows us to actually disentangle the actual effect of multilateral support and do not overestimate the effect of multilateral

support. It allows us to see for two comparable projects with the same characteristics, size, and same number of debt providers and project sponsors, whether having a multilateral agency among investors actually make a difference in attracting institutional investors.

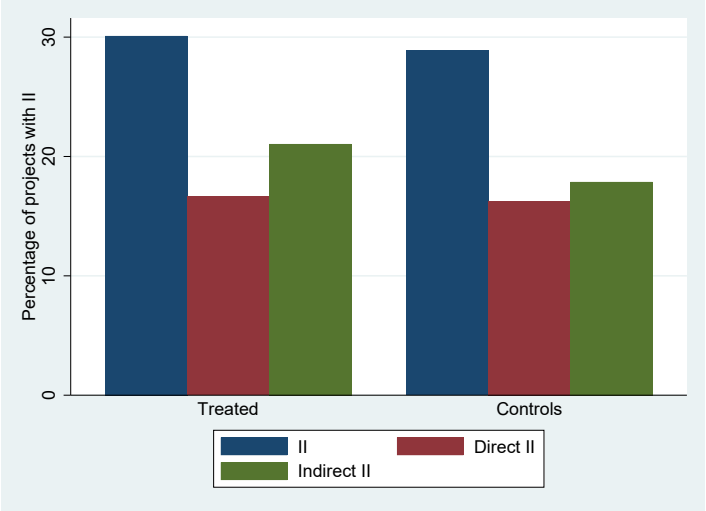


Figure 2.5. Global sample: Average treatment effects on institutional investors' participation in infrastructure deals. Matching method: Kernel. Method 3: Controlling for debt providers and project sponsors in PSM.

For the broad definition of institutional investors, we find that after controlling for the number of investors, multilateral support has a positive impact on attracting institutional investors but this effect is statistically insignificant (Table 2.13).

For direct institutional investors, the effect is also statistically insignificant. For indirect institutional investors, we find a positive effect of around 3.18% increase in the number of projects with multilateral support that succeeded in attracting at least one asset manager or an infrastructure fund.

These results suggest that for direct institutional investors, when we control for the number of debt providers and the number of sponsors for comparable project sizes, multilateral support has no effect on attracting this type of investors. It is rather the number of investors in the consortium that matters more than whether one of the investors is a multilateral agency. The results also suggest that for asset managers and infrastructure funds, the presence of multilateral support has an

impact on attracting this type of investors.[10]

Method 3 reconciles the need to control for project size and syndication behavior among investors. In our opinion, this is the most reliable method among the three explored as it allows for balancing of covariates including project size and the number of investors.

2.6 Subgroup Analysis: Developed *versus* Developing countries

In the previous section, we looked at the effect of multilateral support on attracting institutional investors using the global sample without differentiating between developed and developing countries. We believe that the role of multilateral support is not the same across developed and developing countries. Furthermore, institutional investors' participation in infrastructure is not homogeneous between developed and developing countries.

To identify developed countries, we follow the World Bank income level classification for countries. Developed countries are countries that fall in the high income category. Developing countries are countries in the middle and low income categories.

As explained earlier, the propensity score is the probability of a project to receive multilateral support given the covariates. Using data from the overall sample to calculate the propensity score and then use it to infer treatment effects within subgroups can be biased. In fact, the estimated propensity score might balance the observable characteristics for the overall sample but not within subgroups of the sample. A possible solution is to re-estimate the propensity score using only data from the subgroup of interest. However, this solution might have larger variance

[10]These results are consistent with OLS regression of Institutional investor's participation. See Appendix B.

as the size of the subgroup sample is smaller than the overall sample (Dong et al., 2020).

The overall sample propensity score didn't yield good balancing across the treatment group and control group withing developed and developing subgroups (Table 2.27 and Table 2.29). We present below the results obtained from a re-estimation of the propensity score over the subgroups.[11] We also compare these results to the results obtained from the use of the overall propensity score.

2.6.1 Developed Countries

Our sample for developed countries consists of 4234 transactions out of which 512 deals have financial multilateral support.

We estimate the probability of a project to receive multilateral support in developed countries using the three methods presented for the overall sample: no controls for project size, controlling for project size and controlling for the number of investors. Table 2.16 shows the results of the regressions (2A, 2B, 2C). The results are different in certain aspects compared to the overall sample results. In fact, we find that a higher probability to receive multilateral support in developed countries is linked to higher economic risk. Economic risk assigns risk points to GDP per head, real GDP growth, annual inflation rate, budget balance as percentage of GDP and current account as percentage of GDP. The higher the points, the lower is the risk. Furthermore, we find that the solvency of the host country captured by a low financial risk increases the probability of participation of multilateral agencies in infrastructure. There is no preference between greenfield and brownfield projects. Countries in the Northern American region have lower probability to receive multilateral support compared to developed countries in other regions. Once again, the signs and magnitude of coefficients do not change when we control by the number of investors nor by project size.

[11] ll projects are on common support. Table 2.21, Table 2.20, Table 2.26 and Table 2.25 show common support tables.

For the broad definition of institutional investors, we find a positive effect of multilateral support on attracting institutional investors.[12] This effect is lower and statistically insignificant when we control for the number of investors. Controlling for the number of investors, we find that 38.28% of projects with multilateral support has at least one institutional investor versus only 35.72% in the control group (Table 2.2).

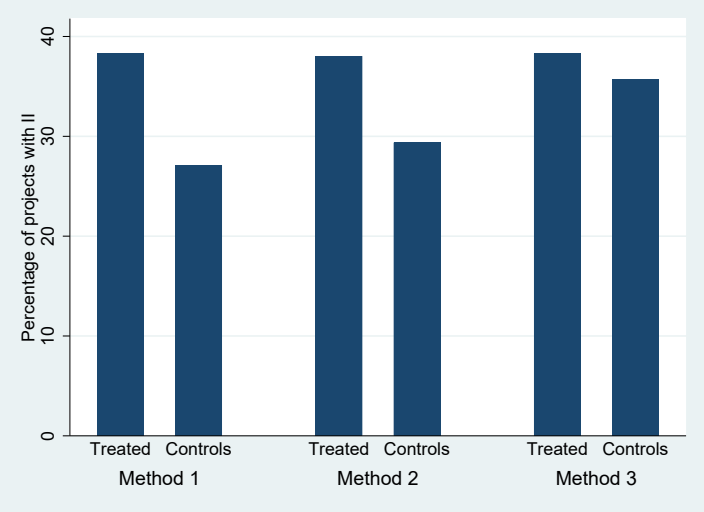


Figure 2.6. Developed countries - Sub group propensity score: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and Method 3 controls for the number of debt providers and the number of sponsors in a transaction.

Table 2.2. Developed countries - Sub group propensity score: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
II	Unmatched	0.3828	0.2241	0.1587	0.0201	7.9	0.000
	ATT-Method 1	0.3828	0.2712	0.1116	0.0252	5.49	0.000
	ATT-Method 2	0.3804	0.2937	0.0867	0.0259	3.34	0.000
	ATT-Method 3	0.3828	0.3572	0.0256	0.0276	0.93	0.176

When we look at the results obtained from the overall sample propensity score matching, we find a positive effect of multilateral support on attracting institutional investors. This effect is also the lowest when we control for the number of investors. However, the difference is statistically significant and is around 4.43% between the

[12] Balance is achieved across the treatment and control group (Table 2.28).

treatment and control group. Once again, the problem of this method is that covariates are not balanced across the treatment and control group (Table 2.27).

For direct institutional investors, the subgroup propensity score results suggest a positive and statistically significant effect of the presence of multilateral support (Table 2.3). Projects with multilateral support had on average 11.38% more projects with a direct institutional investor. Once again, the effect becomes smaller when we control for the project size (9.16% increase) and smallest when we control for the number of investors (4.05% increase). The results from the overall sample propensity score are comparable to these results but slightly higher (Table 2.18).

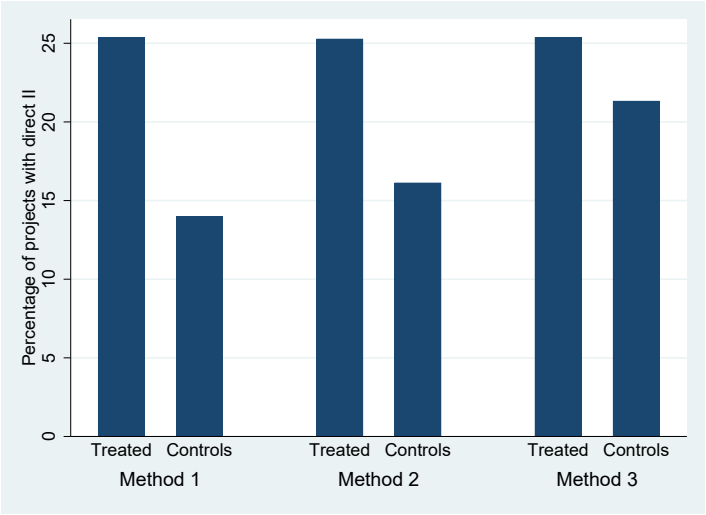


Figure 2.7. Developed countries - Sub group propensity score: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

Table 2.3. Developed countries - Sub group propensity score: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
II	Unmatched	0.2539	0.0951	0.1588	0.0148	10.73	0.000
	ATT-Method 1	0.2539	0.1401	0.11138	0.0214	5.432	0.000
	ATT-Method 2	0.2529	0.1614	0.0916	0.0218	4.20	0.000
	ATT-Method 3	0.2539	0.2134	0.0405	0.0228	1.78	0.037

For indirect institutional investors, the subgroup propensity score results suggest a positive and statistically significant effect of the presence of multilateral support

Table 2.4. Projects with multilateral support had on average 8.90% more projects with an indirect institutional investor. The effect becomes smaller when we control for the project size (7.63% increase) and smallest when we control for the number of investors (3.94% increase). The results from the overall sample propensity score are comparable to these results but slightly higher (Table 2.19).

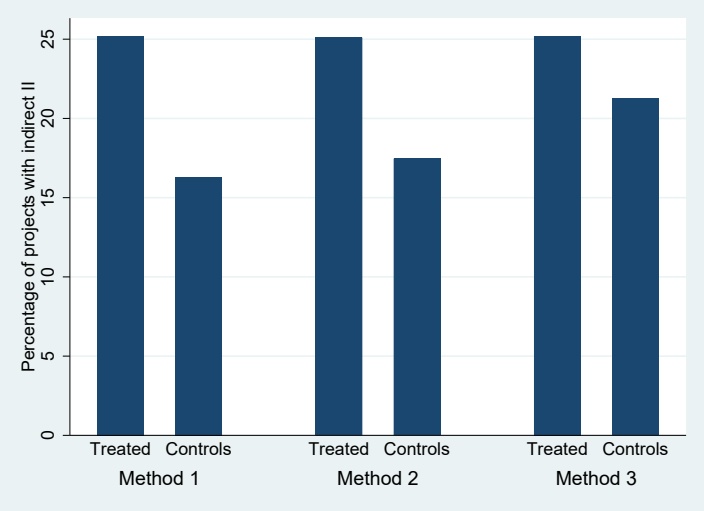


Figure 2.8. Developed countries - Sub group propensity score: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

Table 2.4. Developed countries - Sub group propensity score: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Indirect II	Unmatched	0.2520	0.1569	0.0950	0.0176	5.41	0.000
	ATT-Method 1	0.2520	0.1629	0.0890	0.0224	3.97	0.000
	ATT-Method 2	0.2510	0.1747	0.0763	0.0230	3.32	0.000
	ATT-Method 3	0.2520	0.2126	0.0394	0.0244	1.62	0.052

2.6.2 Developing Countries

Our sample for developing countries consists of 1668 transactions out of which 538 deals have financial multilateral support.

We estimate the probability of a project to receive multilateral support in developing countries using the three methods presented for the overall sample: no controls for project size, controlling for project size and controlling for the number of investors. Table 2.16 shows the results of the regressions (3A, 3B, 3C). The results are different in certain aspects compared to the overall sample results and developed countries results. We find that a higher probability to receive multilateral support in developing countries is linked to higher economic, political and financial risk. However, only political risk is statistically significant. There is no preference between greenfield and brownfield projects. Once again, the signs and magnitude of coefficients do not change when we control by the number of investors nor by project size.

For the broad definition of institutional investors, we find a positive effect of multilateral support on attracting institutional investors when no project size controls are included but also when project controls are. However, this effect becomes negative and statistically insignificant when we control for the number of investors (Table 2.5).[13] The results are similar when we use the overall sample propensity score matching (Table 2.22).[14]

Table 2.5. Developing countries - Sub group propensity score: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
II	Unmatched	0.2230	0.1434	0.0797	0.0195	4.08	0.000
	ATT-Method 1	0.2230	0.1511	0.0720	0.0240	3.00	0.000
	ATT-Method 2	0.2206	0.1643	0.0563	0.0244	2.31	0.010
	ATT-Method 3	0.2230	0.2402	-0.0171	0.0255	-0.67	0.251

For method 2: the unmatched mean for the treated is 0.2206 and 0.1448 for the controls.

[13] Balance is achieved across covariates (Table 2.30).

[14] This method does not achieve balance across covariates (Table 2.29).

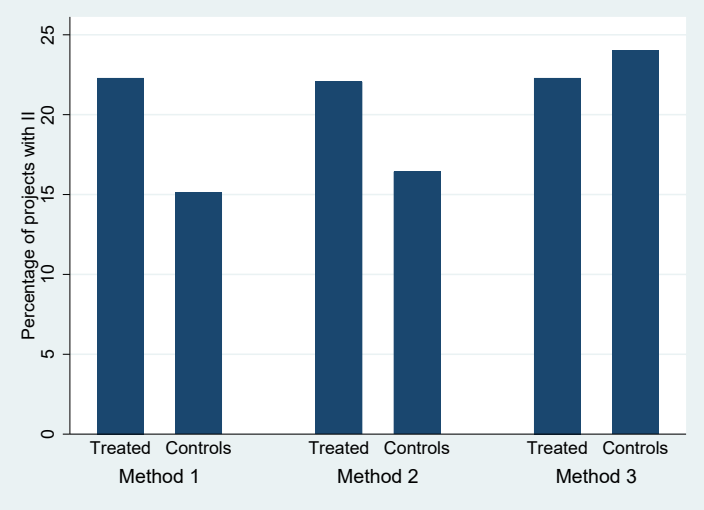


Figure 2.9. Developing countries - Sub group propensity score: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

For direct institutional investors, the subgroup propensity score results suggest no statistically significant effect of the presence of multilateral support with and without controls for project size (Table 2.6). When we control for the number of investors, we find that projects with multilateral support (8.36%) attracted less institutional investors compared to the control group (13.11%). The results from the overall sample propensity score are comparable to these results (Table 2.23). This result suggests that multilateral agencies might have a crowding out effect on direct institutional investors as they can offer better pricing for loans. Multilateral agencies in that case enter projects as a substitute for other type of investors.[15]

Table 2.6. Developing countries - Sub group propensity score: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Direct II	Unmatched	0.0836	0.0575	0.0261	0.0130	2.01	0.022
	ATT-Method 1	0.0836	0.0672	0.0165	0.0159	1.03	0.151
	ATT-Method 2	0.0822	0.0760	0.0062	0.0162	0.38	0.351
	ATT-Method 3	0.0836	0.1311	-0.0474	0.0170	-2.8	0.002

For method 2: the unmatched mean for the treated is 0.0822 and 0.0579 for the controls.

[15]This result is in line with the literature in the relationship between international finance institutions and private capital markets (Lindbaek et al., 1998)), (Bird et al., 2007), (Stiglitz, 1998), (Basılio, 2017)

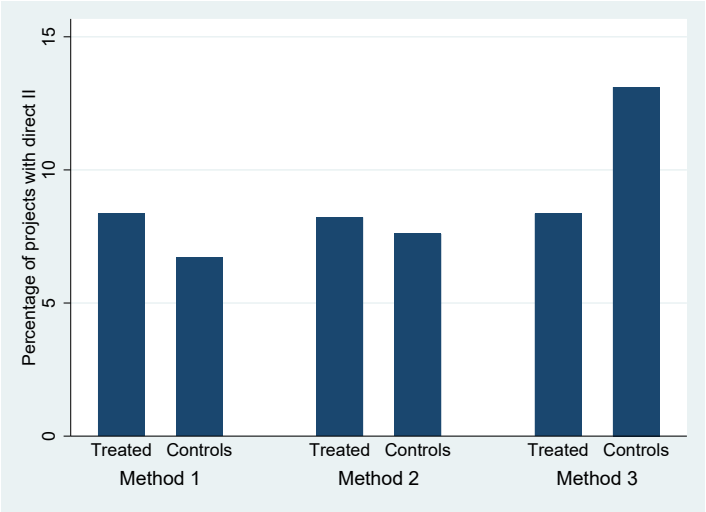


Figure 2.10. Developing countries - Sub group propensity score: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

For indirect institutional investors, the subgroup propensity score results suggest a positive and statistically significant effect of the presence of multilateral support Table 2.7. Projects with multilateral support had on average 7.24% more projects with an indirect institutional investor. The effect becomes smaller when we control for the project size (6.09% increase) and smallest when we control for the number of investors (1.75% increase). The difference is insignificant when we control for the number of investors. The results from the overall sample propensity score are similar to these results (Table 2.24).

The fact that the effect of multilateral support fades away when we control for the number of investors in certain cases suggests that syndication and sharing risk across investors play an important role in the investment decisions.

Table 2.7. Developing countries - Sub group propensity score: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Indirect II	Unmatched	0.1710	0.0991	0.0719	0.0171	4.21	0.000
	ATT-Method 1	0.1710	0.0986	0.0724	0.0211	3.42	0.000
	ATT-Method 2	0.1682	0.1073	0.0609	0.0215	2.84	0.002
	ATT-Method 3	0.1710	0.1535	0.0175	0.0224	0.78	0.217

For method 2: the unmatched mean for the treated is 0.1682 and 0.1005 for the controls.

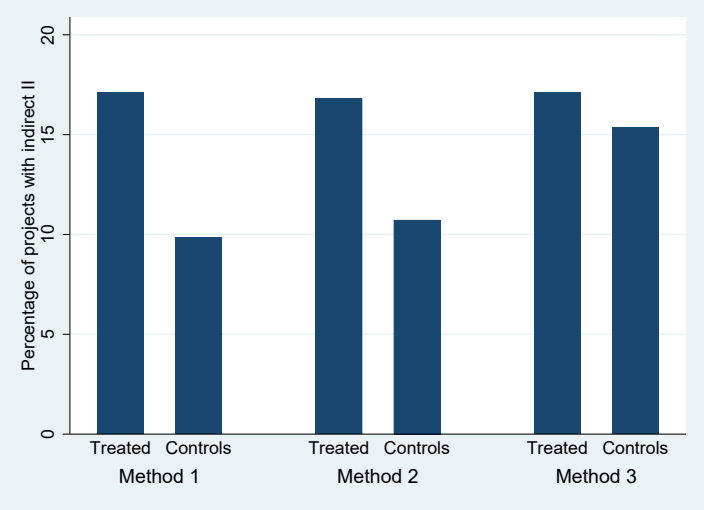


Figure 2.11. Developing countries - Sub group propensity score: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

2.7 Conclusion and Policy Implications

This study attempts to understand the effect of multilateral financial support in crowding in capital from institutional investors into infrastructure projects. We overcome the lack of randomization of multilateral support by using a quasi-experimental design where we first estimate the probability for receiving multilateral support then we use propensity matching score to construct a counterfactual for projects with multilateral support. The idea is to construct a control group that has the same probability of receiving multilateral support but did not receive it. We then compared the percentage of projects with institutional investors among projects with multilateral support to the percentage of projects with institutional investors but without multilateral support.

Using data on 6371 project finance deals between 2000 and 2018 from IJGlobal database, our results suggest that for the global sample, a positive effect of multilateral support on crowding in institutional investors' capital when controls for project size and the number of debt providers and project sponsors are not included. A

closer look at the investment channel, the results are consistent for direct institutional investors[16] and indirect institutional investors[17]. However, when we construct a counterfactual group that is similar to projects with multilateral support on all aspects (Region, sector, risk, maturity, size, number of debt providers and number of project sponsors), the results differ. We find no effect for multilateral support on attracting direct institutional investors. This result suggests that multilateral support does not have a catalytic effect on direct institutional investors' capital inflows. However, it highlights the importance of syndication among investors. For projects with similar characteristics and the same number of investors and debt providers, having a multilateral agency among investors does not attract a higher level of institutional investors compared to projects without financial multilateral support.

Taking a closer look at sub-group effects between developed and developing countries, we find drastically different results. For developed countries, multilateral financial support have a catalytic effect both on direct and indirect institutional investors' participation. This result suggests that syndication with a multilateral investor succeeded in crowding in capital from institutional investors in high income level economies. For middle and low income countries a positive effect is found when we do not control for project size nor the number of investors. However, once we control for the number of investors i.e number of debt providers and number of sponsors the effect fades. For indirect institutional investors, there is no catalytic effect of a presence of multilateral support among investors on attracting asset managers and infrastructure funds. For direct institutional investors, we find that projects with multilateral support have a lower percentage of projects that succeeded in attracting institutional investors compared to projects without multilateral support. This result highlights a potential crowding out effect. This could be due to better loan pricing by multilateral banks on certain deals. In fact, institutional investors need to focus on maximizing shareholder value, while multilateral

[16] Direct institutional investors include pension funds, sovereign wealth funds and insurance companies.

[17] This category includes asset managers and infrastructure funds.

agencies might have some flexibility with pricing given their development mandate. Furthermore, multilateral development banks usually have a lower cost of financing given that they have the sovereign backing of their member countries.

Our results indicate that for developed countries a catalytic effect can be observed. Multilateral financial support aiming to building confidence in projects and markets succeeded in crowding-in institutional investors as well as asset managers and infrastructure funds between 2000 and 2018. However, for developing countries, the picture is quite different. We find no effect on crowding-in capital from asset managers and infrastructure funds and a crowding-out effect on direct institutional investors.

The results shed the light on the challenges facing developing countries. Situations of crowding-out institutional investors due maybe to better loan prices by multilaterals could be avoided if multilateral lending is based on the principle of *additionality*. On the one hand, multilateral development banks usually have a lower cost of financing given the sovereign backing of their member countries, and some flexibility with pricing given their development mandate. On the other hand, institutional investors need to focus on maximizing shareholder value. Potential solutions such as co-lending platforms or investment vehicles aimed at attracting more investment from institutional investors should be designed to avoid situations of crowding-out potential investors. Multilateral agencies should leverage their limited resources and use it when no other sources of capital are available or otherwise as risk capital to encourage other investors. The main motive should be *additionality* and focus on avoiding situations of substitution.

Potential limitations of our work reside in the discretion used in the method to estimate the probability of a project to receive multilateral support. Including other project characteristics that we could not control for might alter the results. In addition to that, our data did not have information on investments committed by institutional investors and we only considered financial multilateral support.

A possible extension of our work is to test whether the results are similar if

we consider amounts of investments committed by institutional investors. Furthermore, other types of multilateral support such as guarantees or non financial support might have a positive impact on mobilizing institutional investors' capital into infrastructure.

Table 2.8. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
MLS	6371	0.171	0.376	0	1
Transaction Value	6235	309.424	606.485	0.96	14250
Debt providers	6371	2.854	3.041	0	34
Project sponsors	6371	1.910	1.490	1	18
Greenfield	5938	0.845	0.361	0	1
Political Risk	6338	76.158	12.337	38.625	131.821
Economic Risk	6336	37.313	6.234	23.75	78.791
Financial Risk	6337	39.143	6.579	2.44	83.75
Financial Close Year	6371	2011.359	4.040	2000	2018
Renewables	6371	0.473	0.499	0	1
Social and Defense	6371	0.187	0.390	0	1
Telecoms	6371	0.240	0.153	0	1
Transport	6371	0.157	0.364	0	1
Water	6371	0.031	0.173	0	1
Europe	6371	0.457	0.498	0	1
Latin America	6371	0.096	0.295	0	1
MENA	6371	0.031	0.175	0	1
North America	6371	0.457	0.369	0	1
Sub-Saharan Africa	6371	0.096	0.183	0	1

Table 2.9. Determinants of multilateral support (MLS) in infrastructure project finance transactions using global data. The table reports the estimation results of the logit regression for the presence of MLS in the project. Clustered standard errors by country are presented between brackets. The 1%, 5%, and 10% significance levels are represented by ***, **, and *, respectively. The omitted category of reference for the sector is Power. The omitted category of reference for the Region is sub-Saharan Africa. For specification (1B), we include project size. For specification (1C) we include the number of debt providers and project sponsors.

MLS	(1A)	(1B)	(1C)
Political Risk	-0.008	-0.003	-0.015
	(0.014)	(0.014)	(0.014)
Economic Risk	-0.014	-0.032	-0.014
	(0.038)	(0.039)	(0.042)
Financial Risk	0.092***	0.104***	0.103***
	(0.028)	(0.030)	(0.033)
Project size		0.001***	
		(0.001)	
Number of debt providers			0.181***
			(0.040)
Number of sponsors			0.207***
			(0.035)
Greenfield	-0.033	-0.051	-0.049
	(0.164)	(0.159)	(0.154)
Financial Close Year	0.041*	0.035	0.045*
	(0.024)	(0.024)	(0.024)
Sector			
Renewables	-0.517***	-0.203	-0.075
	(0.187)	(0.192)	(0.196)
Social & Defence	-1.027***	-0.764***	-0.516**
	(0.213)	(0.207)	(0.202)
Telecoms	-0.024	-0.017	-0.006
	(0.233)	(0.234)	(0.252)
Transport	-0.100	-0.119	-0.084
	(0.172)	(0.158)	(0.186)
Water	-0.815***	-0.537*	-0.310***
	(0.313)	(0.305)	(0.349)
Region			
Asia Pacific	-2.236***	-2.391***	-2.234***
	(0.478)	(0.511)	(0.515)
Europe	-1.745***	-1.878***	-1.655***
	(0.306)	(0.344)	(0.366)
Latin America	-0.859***	-0.853***	-0.618*
	(0.276)	(0.311)	(0.353)
MENA	-0.623*	-0.791*	-0.967*
	(0.367)	(0.446)	(0.495)
North America	-2.827***	-2.992***	-2.841***
	(0.449)	(0.491)	(0.531)
N	5904	5783	5904
Clusters	116	115	116

Table 2.10. Balance tests of means for the overall sample before and after PSM. Matching method: Kernel. Balance tests are presented only for method 3 when balance is achieved for these covariates also using method 1 and 2.

Variable	Sample	Treated	Control	%bias	t	p-value
Probability MLS	Unmatched	0.3259	0.1487	103	34.96	0.000
	Matched- method1	0.3060	0.3013	2.9	0.56	0.567
	Matched- method2	0.3259	0.3211	2.8	0.54	0.590
	Matched- method3	0.3633	0.3583	2.6	0.48	0.63
Project size	Unmatched	536.27	272.19	37.5	12.59	0.000
	Matched- method1	**536.27**	**326.49**	**29.8**	**6.47**	**0.000**
	Matched- method2	536.27	506.84	4.2	0.57	0.571
	Matched- method3	536.27	515.83	2.9	0.57	0.571
Number of debt providers	Unmatched	4.6727	2.5842	63.2	20.4	0.000
	Matched- method1	**4.6724**	**2.6584**	**61.1**	**13.69**	**0.000**
	Matched- method2	**4.6727**	**3.1038**	**47.5**	**9.84**	**0.000**
	Matched- method3	4.6724	4.8549	-5.5	-0.91	0.361
Number of sponsors	Unmatched	2.5244	1.8356	40	13.47	0.000
	Matched- method1	**2.5352**	**1.8809**	**37.9**	**8.55**	**0.000**
	Matched- method2	**2.5244**	**1.9906**	**31**	**6.82**	**0.000**
	Matched- method3	2.5352	2.4564	4.6	0.87	0.385
Political risk	Unmatched	73.558	76.507	-19.2	-6.87	0.000
	Matched- method3	73.583	73.372	1.4	0.28	0.783
Economic risk	Unmatched	38.67	37.044	19.4	7.43	0.000
	Matched- method3	38.688	38.575	1.3	0.25	0.801
Financial risk	Unmatched	42.019	38.645	39.6	14.9	0.000
	Matched- method3	42.048	41.734	3.7	0.7	0.484
Greenfield	Unmatched	0.83828	0.84614	-2.2	-0.63	0.525
	Matched- method3	0.8381	0.82968	2.3	0.52	0.605
Sector (Renewables=1)	Unmatched	0.3923	0.4544	-12.6	-3.66	0.000
	Matched- method3	0.3933	0.3850	1.7	0.39	0.698
Sector (Social and Defense=1)	Unmatched	0.1081	0.2226	-31.2	-8.4	0.000
	Matched- method3	0.1076	0.1062	0.4	0.1	0.921
Sector (Telecoms=1)	Unmatched	0.0373	0.0209	9.8	3.15	0.002
	Matched- method3	0.0371	0.0345	1.6	0.32	0.746
Sector (Transport=1)	Unmatched	0.2268	0.1579	17.5	5.38	0.000
	Matched- method3	0.2267	0.2478	-5.4	-1.14	0.255
Sector (Water=1)	Unmatched	0.0421	0.0306	6.1	1.89	0.058
	Matched- method3	0.0419	0.0428	-0.5	-0.1	0.917
Region (Asia Pacific=1)	Unmatched	0.2287	0.2191	2.3	0.68	0.497
	Matched- method3	0.2286	0.2195	2.2	0.5	0.618
Region (Europe=1)	Unmatched	0.3081	0.4821	-36.1	-10.32	0.000
	Matched- method3	0.3086	0.3178	-1.9	-0.45	0.649
Region (Latin America=1)	Unmatched	0.2163	0.0775	40	13.6	0.000
	Matched- method3	0.2152	0.2325	-5	-0.95	0.344
Region (MENA=1)	Unmatched	0.0880	0.0220	29.3	10.79	0.000
	Matched- method3	0.0876	0.0803	3.2	0.6	0.548
Region (North America=1)	Unmatched	0.0459	0.1821	-43.9	-11.05	0.000
	Matched- method3	0.0457	0.0480	-0.7	-0.25	0.802
Financial close year	Unmatched	2012	2011.1	22.2	6.54	0.000
	Matched- method3	2012	2012	0.1	0.02	0.983

Table 2.11. Method 1 (no project size controls) and 3 (controls for number of investors): Common support Evaluation for the global sample.

Treatment Assignment	Common support on support	Total
Untreated	4854	4854
Treated	1050	1050
Total	5904	5904

Table 2.12. Method 2 (Project size control included): Common support Evaluation for the global sample.

Treatment Assignment	Common support on support	Total
Untreated	4378	4378
Treated	1045	1045
Total	5783	5783

Table 2.13. Global sample: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
II	Unmatched	0.3009	0.2051	0.0957	0.0140	6.79	0.000
	ATT-Method 1	0.3009	0.2043	0.0965	0.0169	5.71	0.000
	ATT-Method 2	0.2985	0.2264	0.0720	0.0172	4.18	0.000
	ATT-Method 3	0.3009	0.2885	0.0123	0.0181	0.68	0.248

For method 2: the unmatched mean for the treated is 0.2985 and 0.2053 for the controls.

Table 2.14. Global sample: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Direct II	Unmatched	0.1666	0.0863	0.0803	0.0101	7.89	0.000
	ATT-Method 1	0.1666	0.0989	0.0677	0.0131	5.13	0.000
	ATT-Method 2	0.1655	0.1136	0.0518	0.0134	3.87	0.000
	ATT-Method 3	0.1666	0.1625	0.0041	0.0139	0.29	0.385

For method 2: the unmatched mean for the treated is 0.1655 and 0.0869 for the controls.

Table 2.15. Global sample: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Direct II	Unmatched	0.21048	0.1434	0.0671	0.0123	5.45	0.000
	ATT-Method 1	0.21048	0.1285	0.0819	0.0149	5.49	0.000
	ATT-Method 2	0.2086	0.1418	0.0668	0.0152	4.39	0.000
	ATT-Method 3	0.21048	0.1787	0.0318	0.0159	1.99	0.023

For method 2: the unmatched mean for the treated is 0.2086 and 0.1433 for the controls.

Table 2.16. Determinants of multilateral support (MLS) in infrastructure project finance transactions in developed and developing countries. The table reports the estimation results of the logit regression for the presence of MLS in the project. Clustered standard errors by country are presented between brackets. The 1%, 5%, and 10% significance levels are represented by ***, **, and *, respectively. The omitted category of reference for the sector is Power. The omitted category of reference for the Region is sub-Saharan Africa for all the models except (2A) and (2B) where and North America is the reference category. Models (1A) and (1B) use projects of the whole sample, (2A)-(2B) only projects in developed countries and (3A)-(3B) projects in developing countries.

MLS	(2A)	(2B)	(2C)	(3A)	(3B)	(3C)
Political Risk	0.022	0.019	0.013	-0.053**	-0.052**	-0.053**
	(0.192)	(0.020)	(0.206)	(0.022)	(0.023)	(0.024)
Economic Risk	-0.084***	-0.097***	-0.085***	-0.010	-0.027	-0.002
	(0.033)	(0.034)	(0.038)	(0.057)	(0.056)	(0.058)
Financial Risk	0.124***	0.144***	0.139***	-0.050	-0.055	-0.066
	(0.031)	(0.035)	(0.036)	(0.053)	(0.53)	(0.058)
Project size		0.001***			0.003**	
		(0.001)			(0.001)	
Number of debt providers			0.235***			0.143**
			(0.035)			(0.058)
Number of sponsors			0.148***			0.211***
			(0.029)			(0.067)
Greenfield	-0.126	-0.195	-0.209	0.163	0.082	0.066
	(0.211)	(0.215)	(0.204)	(0.190)	(0.183)	(0.208)
Financial Close Year	0.039*	0.031	0.040	0.002	-0.004	0.015
	(0.022)	(0.023)	(0.026)	(0.033)	(0.033)	(0.028)
Sector						
Renewables	-1.263***	-0.858***	-0.449	0.146	0.359*	0.469**
	(0.299)	(0.307)	(0.404)	(0.186)	(0.203)	(0.186)
Social & Defense	-1.528***	-1.182***	-0.752	-0.510	-0.336	-0.302
	(0.239)	(0.221)	(0.298)	(0.583)	(0.580)	(0.497)
Telecoms	-0.339	-0.145	-0.077	0.070	0.070	0.050
	(0.348)	(0.398)	(0.428)	(0.392)	(0.379)	(0.391)
Transport	0.070	-0.044	0.185	-0.366*	-0.348*	-0.371
	(0.275)	(0.245)	(0.283)	(0.214)	(0.195)	(0.258)
Water	-1.059**	-0.671*	-0.306	-0.540	-0.371	-0.258
	(0.409)	(0.376)	(0.504)	(0.562)	(0.577)	(0.557)
Region						
Asia Pacific	1.390***	1.368***	1.307***	-1.786***	-1.845***	-1.755***
	(0.240)	(0.350)	(0.440)	(0.430)	0.443)	(0.417)
Europe	1.587***	1.679***	1.815***	-1.475***	-1.632***	-1.400**
	(0.178)	(0.222)	(0.319)	(0.537)	(0.571)	(0.621)
Latin America	2.497***	2.766***	2.998***	-0.365	-0.346	-0.190
	(0.353)	(0.358)	(0.399)	(0.298)	(0.321)	(0.374)
MENA	2.505***	2.179***	2.006***	0.524	0.543	0.506
	(0.408)	(0.498)	(0.513)	(0.405)	(0.507)	(0.498)
N	4234	4234	4234	1668	1640	1668
Clusters	50	50	50	67	66	67

Table 2.17. Developed countries - Overall sample propensity score: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
II	Unmatched	0.3828	0.2240	0.1589	0.0201	7.91	0.000
	ATT-Method 1	0.3828	0.2509	0.1319	0.0243	5.41	0.000
	ATT-Method 2	0.3792	0.2643	0.1149	0.0251	4.58	0.000
	ATT-Method 3	0.3828	0.3385	0.0443	0.0269	1.64	0.051

Table 2.18. Developed countries - Overall sample propensity score: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Direct II	Unmatched	0.2539	0.0951	0.1588	0.0148	10.73	0.000
	ATT-Method 1	0.2539	0.1276	0.1263	0.0209	6.06	0.000
	ATT-Method 2	0.2534	0.1395	0.1139	0.0213	5.34	0.000
	ATT-Method 3	0.2539	0.2036	0.0503	0.0224	2.25	0.012

Table 2.19. Developed countries - Overall sample propensity score: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Indirect II	Unmatched	0.2520	0.1568	0.0951	0.0176	5.41	0.000
	ATT-Method 1	0.2520	0.1502	0.1018	0.0216	4.70	0.000
	ATT-Method 2	0.2495	0.1558	0.0938	0.0222	4.22	0.000
	ATT-Method 3	0.2520	0.1952	0.0567	0.0239	2.38	0.008

Table 2.20. Method 1 (no project size controls) and 3 (controls for number of investors) : Common support Evaluation for developed countries.

Treatment Assignment	Common support on support	Total
Untreated	3722	3722
Treated	512	512
Total	4234	4234

Table 2.21. Method 2 (Project size control included): Common support Evaluation for developed countries.

Treatment Assignment	Common support on support	Total
Untreated	3631	3631
Treated	510	510
Total	4141	4141

Table 2.22. Developing countries - Overall sample propensity score: Average Treatment Effect on institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
II	Unmatched	0.2230	0.1434	0.0797	0.0195	4.08	0.000
	ATT-Method 1	0.2230	0.1402	0.0828	0.0223	3.71	0.000
	ATT-Method 2	0.2206	0.1743	0.0463	0.0227	2.04	0.021
	ATT-Method 3	0.2230	0.2329	-0.0098	0.0230	-0.43	0.333

For method 2: the unmatched mean for the treated is 0.2206 and 0.1447 for the controls.

Table 2.23. Developing countries - Overall sample propensity score: Average Treatment Effect on direct institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Direct II	Unmatched	0.0836	0.0575	0.0261	0.0130	2.01	0.022
	ATT-Method 1	0.0836	0.0587	0.0250	0.0148	1.68	0.046
	ATT-Method 2	0.0822	0.0750	0.0072	0.0151	0.48	0.315
	ATT-Method 3	0.0836	0.1223	-0.0387	0.0153	-2.53	0.001

For method 2: the unmatched mean for the treated is 0.0822 and 0.0579 for the controls.

Table 2.24. Developing countries - Overall sample propensity score: Average Treatment Effect on indirect institutional investors' participation in infrastructure project finance deals with MLS. Matching method: Kernel. Method 1 doesn't include controls for the project size, Method 2 controls for project size and method 3 controls for the number of debt providers and the number of sponsors in a transaction.

		Mean					
Variable	Sample	Treated	Controls	Difference	S.E.	T-stat	p-value
Indirect II	Unmatched	0.1710	0.0991	0.0719	0.0171	4.21	0.000
	ATT-Method 1	0.1710	0.0971	0.0739	0.0198	3.74	0.000
	ATT-Method 2	0.1682	0.1221	0.0462	0.0201	2.3	0.010
	ATT-Method 3	0.1710	0.1507	0.0204	0.0203	1.00	0.158

For method 2: the unmatched mean for the treated is 0.1682 and 0.1005 for the controls.

Table 2.25. Method 1 (no project size controls) and 3 (controls for number of investors) : Common support Evaluation for developing countries.

Treatment Assignment	Common support on support	Total
Untreated	1130	1130
Treated	538	538
Total	1668	1668

Table 2.26. Method 2 (project size control included): Common support Evaluation for developing countries.

Treatment Assignment	Common support on support	Total
Untreated	1105	1105
Treated	535	535
Total	1640	1640

Table 2.27. Developed countries - Overall sample propensity scores: Balance tests. Only the balance tests for method 1 without controlling for project size are presented as balance is not achieved also with method 2 (controls for project size) and 3 (Controls for the number of investors).

	Matched means				
Variable	Treated	Control	%bias	t	p-value
Probability MLS	0.2404	0.2338	4.6	0.58	0.559
Project size	629.96	289.03	47.8	7.32	0.000
Number of debt providers	5.4219	2.5688	81.3	12.69	0.000
Number of sponsors	2.9355	1.9431	49.7	7.73	0.000
Political risk	86.865	82.843	28.4	3.75	0.000
Economic risk	43.36	41.593	17.2	2.23	0.026
Financial risk	45.05	42.824	20.2	2.63	0.009
Greenfield	0.8106	0.8509	-10.9	-1.72	0.085
Financial close year	2010.90	2011.40	-12	-1.88	0.06
Sector (Renewables=1)	0.3184	0.4558	-28.4	-4.56	0.000
Sector (Social & Defense=1)	0.1836	0.1557	6.7	1.19	0.235
Sector (Telecoms=1)	0.0254	0.0259	-0.4	-0.05	0.958
Sector (Transport=1)	0.2773	0.1989	20.3	2.96	0.003
Sector (Water=1)	0.0606	0.0552	2.6	0.37	0.712
Region (Asia Pacific=1)	0.2500	0.1565	24.3	3.74	0.000
Region (Europe=1)	0.5352	0.5503	-3.1	-0.49	0.626
Region (Latin America=1)	0.0801	0.0991	-8.6	-1.06	0.287
Region (MENA=1)	0.0703	0.1128	-20.4	-2.36	0.018

Table 2.28. Developed countries - subgroup propensity scores: Balance tests. Only the balance tests for method 3 with controls for the number of investors are presented. Method 1 (no controls for project size) and 2 (controls for project size) also achieve balance across all covariates except for project size and number of investors.

	Matched means				
Variable	Treated	Control	%bias	t	p-value
Probability MLS	0.3473	0.3409	3	0.37	0.71
Project size	629.96	549.65	11.2	1.47	0.141
Number of debt providers	5.4219	5.5598	-3.9	-0.44	0.659
Number of sponsors	2.9355	2.8428	4.6	0.59	0.553
Political risk	86.865	85.786	7.6	0.95	0.343
Economic risk	43.36	42.802	5.4	0.65	0.515
Financial risk	45.05	44.271	7.1	0.85	0.394
Greenfield	0.8106	0.8099	0.2	0.03	0.978
Financial close year	2010.9	2010.8	2.2	0.34	0.735
Sector (Renewables=1)	0.3184	0.3243	-1.2	-0.2	0.838
Sector (Social & Defense=1)	0.1836	0.1748	2.1	0.37	0.713
Sector (Telecoms=1)	0.0254	0.0281	-1.9	-0.27	0.789
Sector (Transport=1)	0.2773	0.2868	-2.5	-0.34	0.736
Sector (Water=1)	0.0606	0.0633	-1.3	-0.18	0.857
Region (Asia Pacific=1)	0.25	0.23647	3.5	0.5	0.614
Region (Europe=1)	0.5352	0.5093	5.2	0.83	0.408
Region (Latin America=1)	0.0801	0.0981	-8.2	-1.01	0.312
Region (MENA=1)	0.0703	0.0706	-0.2	-0.02	0.984

Table 2.29. Developing countries - Overall sample propensity scores: Balance tests. Only the balance tests for method 1 without controlling for project size are presented as balance is not achieved in method 2 (controls for project size) and 3 (Controls for the number of investors).

	Matched means				
Variable	Treated	Control	%bias	t	p-value
Probability MLS	0.3684	0.3677	0.5	0.07	0.945
Project size	446.95	347.38	12.8	2.27	0.024
Number of debt providers	3.9591	2.6044	41.8	7.43	0.000
Number of sponsors	2.1543	1.7984	28	4.37	0.000
Political risk	60.944	61.917	-16.4	-2.6	0.009
Economic risk	34.241	35.037	-25.5	-4.07	0.000
Financial risk	39.19	40.085	-26.3	-4.42	0.000
Greenfield	0.8643	0.8118	14.1	2.34	0.019
Financial close year	2013	2012.8	7.4	1.18	0.239
Sector (Renewables=1)	0.4647	0.3374	26.5	4.29	0.000
Sector (Social & Defense=1)	0.0353	0.0430	-3.9	-0.65	0.514
Sector (Telecoms=1)	0.0483	0.0479	0.2	0.04	0.971
Sector (Transport=1)	0.1784	0.2925	-26.8	-4.44	0.000
Sector (Water=1)	0.0242	0.0302	-3.7	-0.6	0.546
Region (Asia Pacific=1)	0.2082	0.2807	-15.9	-2.78	0.006
Region (Europe=1)	0.0929	0.0896	1.1	0.19	0.849
Region (Latin America=1)	0.3439	0.3670	-5.1	-0.79	0.428
Region (MENA=1)	0.1041	0.0498	22.4	3.36	0.001

Table 2.30. Developing countries - subgroup propensity scores: Balance tests. Only the balance tests for method 3 with controls for the number of investors are presented. Method 1 (no controls for project size) and 2 (controls for project size) also achieve balance across all covariates except for project size and number of investors.

	Matched means				
Variable	Treated	Control	%bias	t	p-value
Probability MLS	0.4688	0.4657	1.5	0.23	0.818
Project size	446.95	450.33	-0.4	-0.07	0.943
Number of debt providers	3.9591	4.0447	-2.6	-0.34	0.732
Number of sponsors	2.1543	2.2529	-7.7	-1.05	0.293
Political risk	60.944	61.236	-4.9	-0.77	0.441
Economic risk	34.241	34.277	-1.2	-0.18	0.854
Financial risk	39.19	39.169	0.6	0.1	0.92
Greenfield	0.8643	0.8745	-2.7	-0.5	0.621
Financial close year	2013	2013.1	-0.4	-0.06	0.952
Sector (Renewables=1)	0.4647	0.4647	0	0	0.999
Sector (Social & Defense=1)	0.0353	0.0284	3.5	0.65	0.516
Sector (Telecoms=1)	0.0483	0.0602	-5.6	-0.86	0.391
Sector (Transport=1)	0.1784	0.1814	-0.7	-0.12	0.901
Sector (Water=1)	0.0242	0.0261	-1.2	-0.2	0.841
Region (Asia Pacific=1)	0.2082	0.2314	-5.1	-0.92	0.359
Region (Europe=1)	0.0929	0.0885	1.5	0.26	0.798
Region (Latin America=1)	0.3439	0.3179	5.7	0.9	0.366
Region (MENA=1)	0.1041	0.0924	4.8	0.65	0.519

Chapter 3

Double-Sided Opportunism in Infrastructure Investment

This chapter is based on a joint work with Marian Moszoro[1] and Béatrice Boulu-Reshef[2].

3.1 Introduction

Since the 1980s, governments seek to increase private sector participation in financing infrastructure. In recent years, the so-called "public-private partnerships" have been a solution championed by the International Monetary Fund, the World Bank, and other multilateral development agencies. These long-term contracts have embedded profit and risk-sharing mechanisms between public sector entities and private investors. These public-private partnerships ('PPP' or 'P3' for short) are getting momentum, both for public sector entities seeking solutions for the construction and operations of public utilities and for investors who seek alternative asset classes to diversify their portfolio (Engel et al., 2014; Weber et al., 2016).

Investment in infrastructure is socially desirable, capital-intense, long-term, and risky. Private participation in infrastructure is made difficult by "serious contractual difficulties" (Williamson, 1985), which have their source in bounded rationality.

[1]International Monetary Fund and George Mason University.
[2]University of Orleans.

Due to substantial sunk assets, long-term payback, informational asymmetries, and unaligned goals, PPP contracts may be prone to opportunistic behavior. The risk of opportunistic behavior on either side—the government by capping profit and expropriating (Spiller, 2013); the investor by curbing investment (Hart et al., 2008)—has been, however, a powerful deterrent to many potentially successful PPP projects at best and a cause to contract breach at worst. Governmental opportunism and private opportunism backload themselves: the risk of deviation by the counter-party leads to *ex-ante* rigid contractual terms which in turn lead to contract non-closure or breach (Athias et al., 2018).[3]

To lessen the *ex-ante* aversion to opportunistic behavior, a potential solution is over-the-counter exit and bail-out options analogous to put and call options on the investor's present value of capital outlays (Moszoro, 2013). In other words, allowing the government or the investor to terminate the contract and exit the partnership under specific conditions. This paper investigates the behavioral micro-mechanisms that underlie such exit and bail-out options and thus contributes to explaining why they may help overcome the *ex-ante* fear of entering the partnership. A model of public-private partnerships using an infinitely repeated prisoner's dilemma game between the government and an investor captures the essential elements of the above-mentioned interaction. The theoretical predictions are tested experimentally: the impacts of introducing the possibility to terminate the partnership on the decision to enter the partnership as well as the cooperative behavior within the partnership are documented.

This paper contributes to the literature on PPPs with modelling the impact of exit and bail-out options on the interactions of public and private entities, at the entry

[3]There are many examples of PPP projects in Latin America and Europe that were canceled, renegotiated, or terminated by either the government or the investors in the wake of opportunism. In Poland in 2009-2017, out of 506 projects started, 328 (i.e., 64 percent) were void, and another 12 (i.e., 2.4 percent) were never completed.See https://www.ppp.gov.pl/Aktualnosci/Documents/2018_03_18_analiza_rynku_PPP_2017.pdf (accessed May 2018). On a sample of more than 1,000 concession contracts signed in Latin American countries between the mid-1980s and 2000, Guasch (2004) found that 78% of transportation contracts and 92% of water and sewage contracts were renegotiated.

and contract fulfilment levels. It also contributes to the literature on opportunism in PPPs by offering a potential solution to overcome double sided-opportunism in such interactions (Liu et al., 2016, 2017; Moszoro, 2013; Moszoro et al., 2012; Ruhashyankiko et al., 2006). Furthermore, the paper makes three contributions to the experimental literature on infinitely repeated prisoner's dilemma (PD) games with voluntarily separation. To start with, it is the first study that explores voluntary participation in PD games with voluntary separation. Second, it allows to extend our knowledge on cooperative behavior in the presence of voluntary separation as it adds voluntary participation, which had not been explored in this literature. Third, it compares partnership formation and cooperation rates for no exit options to one-sided exit options to double-sided exit options treatments. One-sided exit options are relevant to the PPP setting described in this paper, as usually only the government is allowed to unilaterally breach contracts for reasons such as public interest.

Our results suggest that concurrent exit and bail-out options increase partnership formation compared to situations without exit or unilateral exit. Furthermore, we observe higher cooperative behavior and higher partnership sustainability.

The remaining of the paper is organized as follows: In section 3.2, we introduce the mechanism of exit and bail-out options in public-private partnerships and we show that a PPP can be modeled as an infinitely repeated prisoner's dilemma game between the government and investor. In section 3.3, we present the theoretical predictions. In section 3.4, we present the literature on prisoner's dilemma games with voluntary separation. In section 3.5, we present the experimental design used. Section section 3.6 exhibit the results and section 3.7 concludes.

3.2 Modeling Exit and Bail-out Options in Public-Private Partnerships

A wide arrange of contracts governing private participation in infrastructure has been classified as "public-private partnerships." Hereinafter, we restrict our definition of PPP to long-term contracts between the state and investors for the construction and operations of public utilities that concurrently satisfy two conditions:

1. The government and investors co-invest and share residual rights in the utility company according to the size of their investment; and

2. The government and investors co-manage the utility company.

These restrictive conditions are a "touchstone" of PPPs—i.e., *qui potest plus, potest minus*. A simple way of modeling these conditions is to incorporate the government as a partial *shareholder* in the utility company (Moszoro, 2014, 2018b).[4] The government shares risk and payoffs with the investor commensurately to its capital outlays.

To reduce double-sided opportunism as a deterring factor of private investments in PPP, Moszoro (2013) propose over-the-counter exit and bail-out options to allow the investor to opt out and the government to buy out the investor from the PPP utility company at a strike price equal to the annualized value of the capital outlays.[5]

3.2.1 Exit and Bail-out Options

These over-the-counter exit and bail-out options are characterized with features germane to both financial and real options. Similarly to financial options, exit and bail-out options' underlying asset is stock in the utility company but contractible only over the counter due to project idiosyncrasies. Because utility companies are rarely publicly traded on stock exchanges, the pricing of the underlying asset is based

[4]This type of public-private arrangement is known as 'joint-venture PPP' or 'institutional PPP.'
[5]See "abandonment option" in Copeland et al. (1994) and "bail-out option" in Zerbe et al. (1994).

on discounted cash flow methods, and the option valuation is based on a binomial (lattice) model. Option holders can execute the options based on multiple criteria, including political factors and externalities. Exit and bail-out options are executable at any time, like American-type options, without expiration.[6]

Endowing governments the option to bail-out investors is not novel.[7] The government executes the bail-out option with the aim of renegotiating the terms of the contract or reselling the shares to another investor, which fosters a "dynamic cost" problem (Williamson, 1976) of short-termism in the incumbent investor's behavior (e.g., low long-term investment that could save maintenance cost). Bail-out options solve the "dynamic costs" problem of repeated auctions because the investor is compensated to the amount invested plus the opportunity cost of capital.

The government can execute the bail-out option due to:

1. Contract deviation by the investor regarding investment

2. Emergence of new technology which can improve the utility's efficiency: i.e., should a new investor be able to reduce costs deploying this new technology, it is beneficial for the government to repurchase the investor's share and re-auction a new PPP

3. Curbing production, lowering quality, or monopoly pricing by the PPP utility company: the government might find it beneficial to repurchase the shares from the investor and enter a new PPP, regulate the monopoly, or provide the service as a state-owned utility company

Another advantage quite significant, though harder to formalize quantitatively of the government's bail-out option is that it reduces concerns of the public at large (i.e., consumers and voters) about the monopolization of the utility by the investor.

[6]Sequential options renewed at the end of each period yield the same result.

[7]See, e.g., cable TV license contracts in Los Angeles (Williamson, 1985) and highway franchise in Chile (Engel et al., 2003). The bail-out option in highway franchise in Chile involved performance callable bonds from the franchise bidder during the construction stage and the possibility of buying back the franchise with a fair compensation after the twelfth year of the franchise (Engel et al., 2003).

The awareness about the existence of the bail-out option might prove an effective social "tranquilizer" and reduce the negative externalities related to political opportunism and contractual rigidity (Moszoro et al., 2019).

Exit and bail-out options provide both parties with notable advantages: the investor minimizes potential loss, while the government enhances the efficiency of the utility company, and lowers potential hold-up and opportunistic renegotiations. Furthermore, it reduces *ex-ante* fear of entering the PPP.

3.2.2 Public-Private Partnerships as an Infinitely Repeated Prisoner's Dilemma Game

A PPP contract can be modeled as a strategic game between a government G and an investor I. The government wishes to undertake an infrastructure project. The government's set of strategies is "public provision or " propose a partnership" to an investor for co-investment.[8]" The investor's strategies are "invest" or "not invest" conditional on partnership proposal by the government.

If the partnership is not formed, the government and the investor receive their opportunity costs: welfare v_G from the state-owned utility company for the government and v_I from investing in an alternative asset class with lower interest rate.

If the partnership is formed, the players play an infinitely repeated strategic game in which risks and payoffs are shared between both players according to their respective shares in the utility company with θ the investor's share. Conditional on partnership formation, the investor and government's set of strategies is: "Contract fulfillment" or "Contract Breach". Contract breach for the investor can be deviation from the contracted quality or price. For the government, this can include any type of transfer from the company to the state (including expropriation). All decisions are simultaneous.

[8]Public provision consists of the government undertaking the project alone without private investment.

In Table 3.1, each row presents the investor strategies and each column presents the government's strategies. All decisions are simultaneous, and each player chooses her strategy independently of the other player's strategy, which means that the government is unaware of whether the investor fulfills the contract or deviates and vice versa.

Table 3.1. This table presents the players' payoffs conditional on partnership formation. v_G is the welfare from the state-owned utility company, v_I is the investor's opportunity cost from investing in an alternative asset class with lower interest rate, θ is the investor's share, π_{ppp} is the PPP profit in case of mutual contract fulfillment, ϵ is the profit in case of contract breach by the government, A is the penalty applied by the government, π_m is the profit in case of contract breach by the investor and μ is the profit in case of mutual contract breach.

		Government	
		Contract fulfillment	Contract Breach
Investor	Contract fulfillment	$\pi_{ppp}\theta, \pi_{ppp}(1-\theta)$	$(\epsilon - A)\theta, (\epsilon + A)\theta$
	Contract Breach	$\pi_m\theta, \pi_m\theta - w$	$(\mu - A)\theta, (\mu + A)\theta - w$

Players share risks and payoffs according to θ. Players can choose between "Contract fulfillment" and "Contract breach". If both players choose "Contract fulfillment," they share π_{ppp}. If the investor chooses "Contract fulfillment" but the government chooses "Contract breach", the company's profit drops to ϵ and the government imposes a penalty A which increase the government's payoff at the expense of the investor's payoff.[9]

If the investor opts for "contract breach" and the government for "Contract fulfillment", they share profit π_m but the government bears a welfare loss w. If both parties breach the contract, the profit of the company drops to μ and the government imposes a penalty A and incurs a welfare loss w.

Each party has a discount rate r_G for the government and r_I for the investor. This can be considered as the cost of capital. Alternatively, we can think of the discount factor as the continuation probability δ of the game in case the PPP is formed with $\delta = 1/(1+r)$.

[9]The "penalty" strategy may also be understood as a harsh form of regulation, e.g., by setting the price below marginal cost, enforcing higher quality requirements, or increasing compliance cost with new regulations.

The partnership can be considered as a prisoner's dilemma (PD) game if for each player: the payoff of unilateral "Contract breach" by the player > the payoff of mutual "Contract fulfillment" > the payoff of mutual "Contract breach" > the payoff of unilateral "Contract fulfillment" by the player, and the sum of payoffs of unilateral "Contract breach" and unilateral "Contract fulfillment" < 2 x the payoff of mutual "Contract fulfillment". This can me summarized in the following three conditions:

1. $\pi_m > \pi_{ppp} > \mu > \epsilon$
2. $2\pi_{ppp} > \pi_m + \epsilon + A - w$
3. $\epsilon + A > \pi_{ppp} > \pi_m - w$

The game can be symmetrical or asymmetrical, Table 3.2 presents a possible matrix, with $\pi_{ppp} = 16$, $\theta = 0.5$, $\epsilon = 13$, $A = 9$, π_m, $w_m = 9$ and $\mu = 15$. In this game, the payoffs are symmetrical.

Table 3.2. This table presents a possible PPP game matrix with $\pi_{ppp} = 16$, $\theta = 0.5$, $\epsilon = 13$, $A = 9$, π_m, $w_m = 9$ and $\mu = 15$. v_G is the welfare from the state-owned utility company, v_I is the investor's opportunity cost from investing in an alternative asset class with lower interest rate, θ is the investor's share, π_{ppp} is the PPP profit in case of mutual contract fulfillment, ϵ is the profit in case of contract breach by the government, A is the penalty applied by the government, π_m is the profit in case of contract breach by the investor and μ is the profit in case of mutual contract breach.

		Government	
		Contract fulfillment	Contract breach
Investor	Contract fulfillment	8, 8	2, 11
	Contract breach	11, 2	3, 3

For simplicity, in the remainder of the paper, we consider a symmetrical PD game.[10] We set:

1. c = payoff of mutual "Contract fulfillment"
2. g = payoff of unilateral "Contract breach"
3. l = payoff of unilateral "Contract fulfillment"

[10]The results hold also for most asymmetrical PD Games.

4. d = payoff of mutual "Contract breach"

Table 3.3. Players' payoffs conditional on partnership formation in a symmetrical PD game. c is the payoff of mutual contract fulfillment, g is payoff of the player that breached the contract unilaterally, d is the payoff of mutual contract breach and l payoff of the player who fulfills the contract unilaterally.

		Government	
		Contract fulfill-ment	Contract breach
Investor	Contract fulfill-ment	c, c	l, g
	Contract breach	g, l	d, d

If the government proposes a partnership to the investor and the investor decides to invest, they enter into a long term PPP contract. The PPP is modeled as an infinitely repeated Prisoner's Dilemma game over a discrete time horizon $t = 1, 2, \ldots$ and the following conditions hold $g > c > d > l$ and $2c > g + l$. If the PPP is not formed, players are not directly rematched, they receive their outside options $v_{G,I}$ for each period of the theoretical partnership length (i.e. they receive the outside option forever). For simplification, we consider v_G=v_I. Furthermore, we adopt the usual assumption that the outside option v exceeds the payoff for mutual contract breach d but is less than the payoff for mutual contract fulfillment c ($g > c > v > d > l$). This is a standard assumption in PD games with exit options, $c > v$ ensures that both parties enter the partnership expecting that they could receive higher payoffs if they both choose contract fulfillment.

3.3 Theoretical Predictions

There are two main stages in the game, each player decides whether or not to enter the partnership and then each player decides whether they will fulfill the contract or deviate. We study the decision of participation and then contract fulfillment under three different settings.

We derive the theoretical predictions of the model using the matrix in Table 3.2 with the following parameters: If both players choose "contract fulfillment" they both get $c = 8$ and if they both choose "contract breach" they both get $d = 3$. If one player breaches the contract and the other fulfills it, the player that chose contract fulfillment receives $l = 2$, and the other player receives $g = 11$. The outside option is $v = 5$. The continuation probability δ of the game in case the PPP is formed is $\delta = 7/8$.

3.3.1 No Termination Options

In this setting, once the partnership is formed, players can not end the partnership voluntarily.

Decision to Enter the Partnership

A player will decide to enter the partnership, if the lifetime expected payoff that she would obtain from the partnership is higher than getting the outside option thereafter.

Conditional on partnership formation, a trigger strategy is considered in which players choose contract fulfillment i.e. cooperate within the partnership until one player deviates. If one deviates, players move to contract breach thereafter.

Given $g > c > v > d > l$, if a player believes that her partner will deviate in the first round, then, she has no incentive to enter.

If a player believes that her partner will choose contract fulfillment for a number of rounds, the player decides to enter the partnership. The length of the contract fulfillment phase -i.e. the number of rounds of cooperation- is at the core of the participation decision.

If a player believes that her partner will choose contract fulfillment in the first round, then the player can choose to deviate. Not entering the partnership is a

subgame perfect equilibrium (SPE) if it yields a higher expected lifetime payoff than entering and breaching the contract in the first round:

$$\frac{v}{1-\delta} \geq g + \frac{d\delta}{1-\delta} \tag{3.1}$$

$$\delta \geq \frac{g-v}{g-d} \tag{3.2}$$

Proposition 1 *For $c = 8$, $d = 3$, $g = 11$, $l = 2$ and $v = 5$, if $0 \leq \delta < \frac{6}{8}$, if a player believes that her partner will choose contract fulfillment for at least one round, then the player will enter the partnership.*

For any δ higher than this value, entering yields a higher expected lifetime payoff higher than not entering if both players can successfully choose contract fulfillment for T rounds before deviation. Not entering is a SPE if it yields higher expected lifetime payoff than entering the partnership:

$$\frac{v}{1-\delta} \geq c(1+\delta+...+\delta^T) + g\delta^{T+1} + \frac{d\delta^{T+2}}{1-\delta} \tag{3.3}$$

For a given $\delta \in \left[\frac{g-v}{g-d}, 1\right]$, entering is a SPE if both players can successfully choose contract fulfillment for at least T rounds before deviation :

$$T \geq log_\delta \left[\frac{c-v}{c-g+g\delta-d\delta}\right] - 1 \tag{3.4}$$

Proposition 2 *For $c = 8$, $d = 3$, $g = 11$, $l = 2$, $v = 5$ and $\delta = \frac{7}{8}$, if $\frac{6}{8} \leq \delta \leq 1$, if a player believes that her partner will choose contract fulfillment for at least T rounds, then the player will enter the partnership. For $\delta = 7/8$, T is equal to three rounds.*

Contract Fulfillment

Conditional on partnership formation, a trigger strategy is considered in which players choose contract fulfillment i.e. cooperate within the partnership until one

player deviates. If one deviates, players move to contract breach forever. For both players to conform to the strategy during the contract fulfillment phase, conforming should yield a higher expected lifetime payoff than deviating for each player:

$$\frac{c}{1-\delta} \geq g + \frac{d\delta}{1-\delta} \tag{3.5}$$

$$\delta \geq \frac{g-c}{g-d} \tag{3.6}$$

Proposition 3 *For $c = 8$, $d = 3$, $g = 11$, $l = 2$, $v = 5$ and $\delta = \frac{7}{8}$, conditional on partnership formation, contract fulfillment can be sustained for $\delta \geq \frac{3}{8}$.*

3.3.2 Concurrent Exit and Bail-out Options

In this setting, the government and the investor can put an end to the partnership.

Decision to Enter the Partnership

Conditional on partnership formation, a trigger strategy is considered in which players choose contract fulfillment until one player deviates. If one deviates, the other player ends the partnership and players get their outside option thereafter. Ending the partnership as soon as deviation occurs is the maximum equilibrium punishment ($v > d$).

Given $g > c > v > d > l$, if a player believes that her partner will deviate in the first round, then, she has no incentive to enter.

The player decides to enter the partnership if she believes that her partner will choose contract fulfillment for a certain number of rounds. If a player believes that her partner will choose contract fulfillment in the first round, the player can choose to deviate. Not entering the partnership is a SPE if it yields a higher expected lifetime payoff than entering and breaching the contract in the first round:

$$\frac{v}{1-\delta} \geq g + \frac{v\delta}{1-\delta} \tag{3.7}$$

$$\delta \geq \frac{g - v}{g - v} \tag{3.8}$$

$$\delta \geq 1 \tag{3.9}$$

Proposition 4 *In the presence of concurrent exit and bail-out options, a player will enter the partnership if she believes her partner will choose contract fulfillment for at least one round.*

Contract Fulfillment

Conditional on partnership formation, a trigger strategy is considered in which both players choose contract fulfillment until one deviates. Ending the partnership as soon as deviation occurs is the maximal equilibrium punishment ($v > d$).

In case of exit, both players receive their payoff accumulated during the partnership in addition to v forever. For both players to conform to the strategy during the contract fulfillment phase, conforming should yield a higher expected lifetime payoff than deviating :

$$\frac{c}{1 - \delta} \geq g + \frac{v\delta}{1 - \delta} \tag{3.10}$$

$$\delta \geq \frac{g - c}{g - v} \tag{3.11}$$

Proposition 5 *For $c = 8$, $d = 3$, $g = 11$, $l = 2$, $v = 5$ and $\delta = \frac{7}{8}$: conditional on partnership formation with concurrent exit and bail-out options, contract fulfillment can be sustained for $\delta \geq \frac{1}{2}$.*

3.3.3 Unilateral Exit

In this setting, only one party can end the partnership. Upon separation, however, both players receive their outside option.

Decision to Enter the Partnership

Conditional on partnership formation, a trigger strategy is considered in which players choose contract fulfillment until one player deviates. If one deviates, the option holding party ends the partnership and players get their outside option thereafter.

Given $g > c > v > d > l$, if a player believes that her partner will deviate in the first round, then, she has no incentive to enter.

The player decides to enter the partnership if she believes that her partner will choose contract fulfillment for a certain number of rounds. The condition to enter the partnership is similar to the case with concurrent exit an bail-out options. For any $\delta < 1$, a player will enter the partnership if she believes her partner will choose contract fulfillment for at least one round.

Proposition 6 *In the presence of unilateral exit options (government or investor), a player will enter the partnership if she believes her partner will choose contract fulfillment for at least one round.*

Contract Fulfillment

If we consider the same trigger strategy in which both players choose contract fulfillment until one deviates. If one deviates, option holding party will put an end to the partnership given that $g > c > v > d > l$. For the option holding party to conform to the strategy during the contract fulfillment phase, conforming should yield a higher expected lifetime payoff than deviating:

$$\delta \geq \frac{g - c}{g - v} \tag{3.12}$$

Given that the option holding party will end the partnership in case of deviation, the other party that can not put an end to the partnership, will choose contract

fulfillment if it yields higher expected lifetime payoff than deviating:

$$\delta \geq \frac{g-c}{g-v} \tag{3.13}$$

Contract fulfillment is sustainable under the same conditions as the concurrent exit and bail out options.

Proposition 7 *For $c = 8$, $d = 3$, $g = 11$, $l = 2$, $v = 5$ and $\delta = \frac{7}{8}$: conditional on partnership formation with unilateral exit options (government or investor), contract fulfillment can be sustained for $\delta \geq \frac{1}{2}$.*

3.4 Experimental Literature on Infinitely Repeated PD games

Experimental research on infinitely repeated PD games is abundant.[11] However, fewer studies have focused on voluntary termination.

The effects of voluntary termination in repeated PD games have been studied theoretically in the context of firm alliances by Arend et al. (2005) and tested in the laboratory (Seale et al., 2006), who find that increasing the value of the outside option lowers cooperation rates. They also find that asymmetry between players affect the cooperative behavior compared to symmetrical settings.

Fujiwara-Greve et al. (2009) study voluntary separation in a PD game in which a player can end the partnership and be assigned to a new partner immediately. The theoretical model suggests that players have to play a trust building strategy before moving to cooperation. Lee (2018) finds evidence for trust building strategies in the laboratory when separation is not costly (i.e players are rematched with new partners once separation occurs), but finds no effect on cooperation levels compared to a no separation setting. Furthermore, the author finds that costly termination increases cooperation rates in comparison to free voluntary termination. Hyndman et

[11] For a survey on PD games: see Dal Bó et al. (2018) and Mengel (2018).

al. (2019) find that voluntary separation hinders cooperation, they introduce reputation mechanisms as a remedy to boost cooperation. Our experiment can be considered a case of costly separation as players are not rematched directly after separation and have to wait until the last pair terminated their partnership.

Fujiwara-Greve et al. (2011) investigates how the structure of outside options affect cooperation in an infinitely repeated prisoner's dilemma game. Their model suggests that one-sided outside options do not facilitate cooperation unless they are uncertain i.e stochastic. The authors also find that two sided lowering exit options compared to their baseline level makes cooperation easier.

Wilson et al. (2017) experiment on a repeated joint production game with imperfect monitoring shows that voluntary separation increases cooperation regardless of the value of the outside option. In this experiment, the players receive an exit option upon separation and are not rematched immediately with another player. Our experiment differs from this experiment as we do not use imperfect monitoring.

The aforementioned experiments did not explore the differences in cooperation rates between one sided and two-sided termination options. Our definition of one sided exit option is different than the one introduced by Fujiwara-Greve et al. (2011). In our setting, players receive their outside option upon exit even if only one player have the possibility to terminate the partnership.

Furthermore, the effects of voluntary termination on partnership formation has not been explored. The above mentioned studies look at already formed partnerships; they did not study, however, how partnership termination options affect partnership formation and cooperation rates.

In evolutionary game theory, voluntary participation in a prisoner's dilemma game increases cooperative behavior of decision makers compared to compulsory interactions (Szabó et al., 2002). The decision to enter the prisoner's dilemma game or public good game can be linked to risk aversion of players (Hauert et al., 2003).

Our experimental design contributes to the literature in a twofold manner. First, we examine how termination options affect partnership formation and cooperation.

Second, we compare partnership formation and cooperation rates for no exit options to one-sided and double-sided exit options treatments.

3.5 Experimental Design

This experiment is designed to test the effect of allowing termination on the decision to enter the partnership as well as the cooperative behavior of decisions makers within the partnership.[12]

The experiment was conducted at the *Laboratoire d'Economie Expérimentale de Paris* (LEEP) in Paris.[13] Subject were randomly assigned to a computer station as they entered the laboratory, and asked to fill questionnaires for Social Value Orientation (SVO) as well as measures of risk aversion (Holt et al., 2002).

3.5.1 Treatments and Rounds

The experiment consists of three treatments: baseline, unilateral bail-out option, and concurrent bail-out and exit options. In total, 238 subjects participated in the experiment. The experimental design is between-subjects, i.e., each subject participates in only one treatment. 14 sessions were conducted across three treatments: four sessions for the baseline treatment [T0], five sessions for the treatment with unilateral bail-out options for the government [T1], and five session for the treatment with concurrent exit and bail-out options for the investor and the government [T2].[14]

Subjects are randomly assigned to one of two types: Type 1 is the government and Type 2 is the investor [15]. Players are randomly matched into pairs. They play the same game that was introduced in the theoretical model. Players of type 1 (government) can undertake a project on its own (public provision, i.e., no partnership

[12]The experiment was coded and conducted by Ingy Helmy. The code for the layout of the PD game used in the experiment is based on a code developed by Guillaume Frechette and Nathalie Lee, New York University.

[13]See http://leep.univ-paris1.fr/accueil.htm.

[14]Table 3.7 show the results of non parametric tests on the differences among the participants in different treatments. We find no statistical difference over gender nor risk aversion.

[15]Players only know if they are players of type 1 or 2, therefore there is no framing effect.

formation) or proposing to the player of type 2 (private investor) a co-investment partnership which she could reject. The experiment was described to players in neutral terms to avoid any framing effect.[16]

If a partnership is formed, players play the following infinitely repeated prisoner's dilemma game that was presented in subsection 3.2.2.

Table 3.4. This table presents the players' payoffs conditional on partnership formation.

		Government	
		Contract fulfillment	Contract breach
Investor	Contract fulfillment	8, 8	2, 11
	Contract breach	11, 2	3, 3

Following Roth et al. (1978) and most other experiments on infinitely repeated games, a random termination method is used. The discount factor δ is used as a continuation probability. When random termination occurs, it is applied to all subjects in the session. We made the choice to calculate the theoretical length of the partnership in advance. Using a discount factor of $\delta = 7/8$, at the beginning of each new rematching of players (new interaction), we draw a random number between 0 and 1, if the number is lower than $\delta = 7/8$ the game should continue. If the number is higher then the game should stop. The number of times we had to repeat the draw until the game should stop is the theoretical length of the partnership n. Players are not rematched directly in case of not forming a partnership or in case of separation and they have to wait until the last pair finishes their partnership. To avoid very long interactions, we limit the number of draws to 15.

If a partnership is not formed, both players get their outside option $v = 5$ forever (i.e for the theoretical length of the partnership n). Players are asked to solve a counting task to receive their payoff in case the partnership is not formed. This task aims at eliminating boredom effects and does not impact their payoff.

[16] Instructions are presented in Appendix C.

If a partnership is formed and one of the players decide to end it, players earn $\sum_{i=1}^{z-1} \pi_i + (n - z + 1) \times v$, where π_i is the sum of all ECU gained in the rounds played within the partnership and z the exit period and $v = 5$ is the outside option.[17]

The experiment consists of the three following treatments:

(a) **Baseline [T0]**:

In the baseline treatment, subjects play an infinitely repeated prisoner's dilemma and partnership termination is not an available action. This treatment allows us to observe the baseline rates of partnership formation and cooperation.

(b) **Unilateral bail-out option [T1]**:

In this treatment, the government can unilaterally exit the investment by bailing it out. The government (player type 1) has three possible actions: contract fulfillment, deviation, or bail out the partnership.

(c) **Concurrent exit and bail-out options [T2]**:

In this treatment, both the government and the investor have the option to exit the partnership. This treatment allows us to understand whether a concurrent bilateral options to end the partnership can act as a facilitator for partnerships' formation among the pairs in the game. Furthermore, it will help us understand whether this mechanism helps sustaining higher levels of cooperation within a partnership.

3.5.2 Hypotheses

The experiment allows to test several hypotheses derived from the theoretical predictions developed in section 3.3 and assess the efficacy of unilateral and concurrent exit/bail-out options for partnership formation and stability.

Entering the partnership in the treatment [T1] with unilateral bail-out options is expected to be more likely than in the baseline treatment with no termination option

[17] Suppose $n = 10$, a partnership was formed, players played 5 rounds out of 10, and player 1 decided to exit at round 6. Players will thus receive the payoffs accumulated in the partnership plus $5 \times (10 - 6 + 1)$ ECU.

for the government but also for the investor. In the baseline treatment, a player enters the partnership if she expects her partner to choose contract fulfillment for at least 3 rounds versus only 1 round in [T1] and [T2].

The government is expected to be more likely to propose partnerships in the treatment [T1] with unilateral bail-out options compared to the baseline treatment.

Hypothesis 1 *A bail-out option held by the government* [T1] *induces higher partnership proposal rate by the government in comparison to having no bail-out option* [T0].

In the case of unilateral bail-out options in [T1], the government is expected to exit once contract breach is observed. The investor is expected to be more likely to enter the partnership in [T1] compared to the baseline. However, the fact that she is not the party holding the option might be a deterrent for entry, explaining a higher acceptance rate when both players can terminate the partnership in [T2].

Hypothesis 2 *A bail-out option held by the government* [T1] *induces higher partnership acceptance rate by the investor in comparison to having no bail-out option* [T0] and lower than the concurrent exit and bail-out options treatment [T2].

Higher partnership proposal rate and acceptance rate lead to higher partnership formation.

Hypothesis 3 *Concurrent exit and bail-out options* [T2] *increase the rate of partnership formation in comparison to no option* [T0] *and to unilateral bail-out options* [T1].

Hypothesis 4 *Concurrent exit and bail-out options* [T2] *induces higher cooperation in comparison to no option* [T0] *and to unilateral bail-out options* [T1].

Hypothesis 5 *Conditional on partnership formation, concurrent exit and bail-out options* [T2] *increase the rate of partnership stability (measured as higher partnership length and lower termination rate) in comparison to no option* [T0] *and to unilateral bail-out options* [T1].

3.5.3 Earnings

An interaction refers to the pairing with a new partner. Within an interaction, if the partnership is formed, players play for a certain number of rounds. Players play as many interactions as possible for 60 minutes. After 60 minutes, they play until the ongoing interaction is terminated.

Players accumulate all ECU gained in the experiment. The exchange rate is 120 ECU for 1 euro. The gains from the experiment are added to a show-up fee and to gains in the the SVO and the risk aversion tasks. The show-up fee was 5 euors for [T1] and [T2], and 8 euros for [T0] as the gains of the main experiment were lower in comparison to the other treatments.

3.6 Results

3.6.1 Descriptive Statistics

Figure 3.1 plots the histogram of average gains for all games played (all rounds of each partnership) per subject, i.e., regardless of differences in session length. Subjects in the treatment with concurrent exit/bail-out options [T2] display higher gains than with no options [T0] and unilateral bail-out options [T1].

Table 3.8 shows the descriptive statistics for combined and single treatments. Partnership formation rate is a dummy variable that equals to 1 when a partnership is formed and zero otherwise. The number of total observations is 3,084. The mean for partnership formation rate in the treatment with concurrent exit/bail-out options [T2] is higher than in the baseline treatment with no options [T0] and the treatment with unilateral bail-out options [T1].

Partnership length is measured as the ratio of actual rounds played z to the total possible rounds that could have been played n [18], and proxies for the sustainability of the partnership.

[18] See subsection 3.5.1 for clarification on how n is calculated.

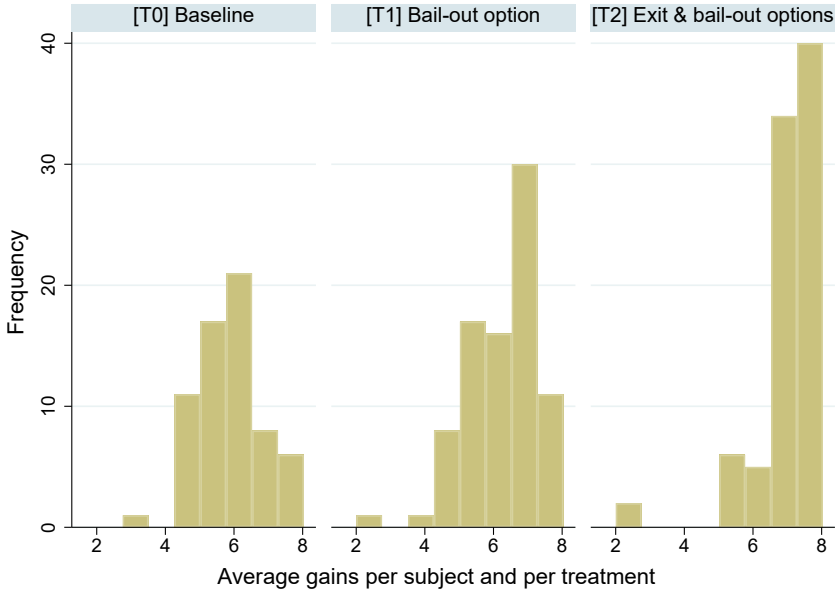


Figure 3.1. This figure presents the histogram of average gains by subjects per round and per treatment unconditional of session length and number of interactions. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project.

Termination rate is a dummy variable equal to 1 when the government or the investor exercise the termination option and zero otherwise. For the baseline treatment, all partnerships reach the end as there is no exit option. We observe no difference between the treatment with unilateral bail-out options [T1] and the treatment with concurrent exit/bail-out options [T2].

Cooperation rate is the ratio of contract fulfillment choices C to the total number of rounds played n. The treatment with concurrent exit/bail-out options [T2] display 74.4 percent cooperation rate compared to 59.3 percent and 59.5 percent for the baseline treatment with no options [T0] and the treatment with unilateral bail-out options [T1], respectively.

Absolute cooperation rate is the ratio of contract fulfillment choices by both players (both play cooperate) to the total number of rounds played. The treatment with concurrent exit/bail-out options [T2] display 60.3 percent cooperation rate compared to 44.9 percent and 44.3 percent for the baseline treatment with no options [T0] and the treatment with unilateral bail-out options [T1], respectively.

3.6.2 Hypotheses Testing

Table 3.9 summarizes the results of statistical tests. Table 3.10 presents the regression results for the main variables of interest. First, we study the decision to enter the partnership and partnership formation i.e. hypothesis 1, hypothesis 2 and hypothesis 3. We then conduct a multifaceted assessment on whether concurrent exit and bail-out options [T2] increase partnerships stability in comparison to the no-option [T0] and unilateral bail-out option [T1] treatments (Hypotheses 4 and 5). We examine three dimensions: cooperation rate, termination rate and partnership length.

Partnership Formation

We analyze participation in the partnership using the partnership proposal rate by the government (Hypothesis 1), the partnership acceptance rate by the investor (Hypothesis 2) and partnership formation rate (Hypothesis 3). The theory in section 3.3 predicts that the entry decision in the partnership is a SPE if the players can choose contract fulfillment for at least T rounds. In the baseline treatment, players enter if they cooperate for at least 3 rounds. For [T1] and [T2], players enter if they can at least choose contract fulfillment for at least one round. In the baseline treatment, we observe that conditional on partnership formation, 48.28% of participants choose contract fulfillment for at least 3 rounds. In [T1] where only the government can terminate the partnership, 67.80% of participants choose contract fulfillment for at least one round. In [T2] where both players can terminate the partnership, 80.38% choose contract fulfillment for at least one round.

We test the impact of providing a bail-out option onto the government's propensity to propose a partnership to test (Hypothesis 1). We find a higher propensity to propose a partnership by the government in the treatment with a unilateral bail-out option [T1] than in the baseline treatment without the termination option [T0] (see Figure 3.2, Figure 3.3, H1 row in Table 3.9 and Models (1a, 1b) in Table 3.10). Thus,

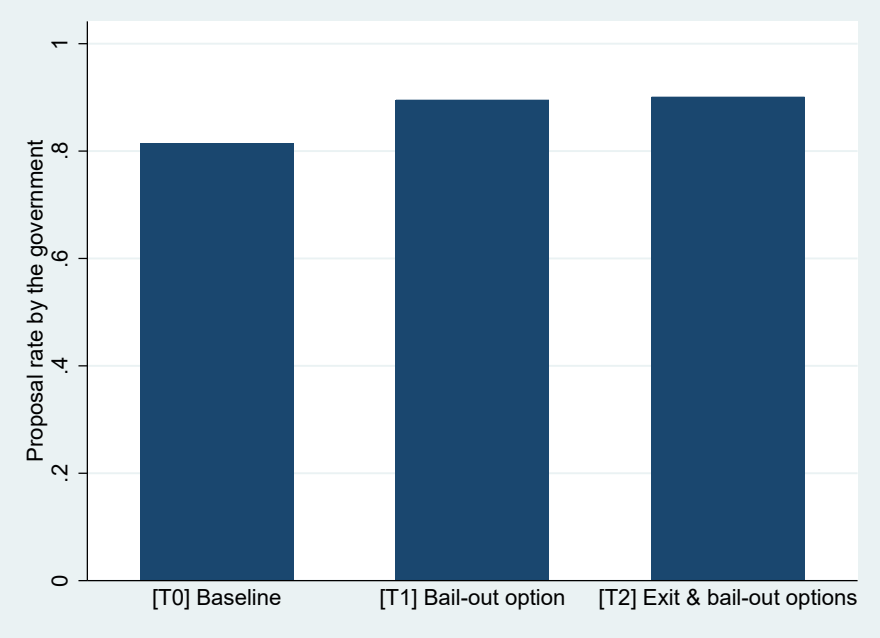


Figure 3.2. This figure presents the government's proposal rate. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project.

having the possibility to terminate the partnership facilitates the option-holder government to enter a partnership knowing it can potentially bail out the investment. As reported in Table 3.8, the government partnership proposal rate is of 81.3% in [T0] and 88.9% in [T1]. In addition, the provision of the exit option for the investor in [T2] does not impact marginally the propensity to propose a partnership by the government relative to [T1] (see Figure 3.2, H1 row in Table 3.9 and Models (1a, 1b) in Table 3.10).

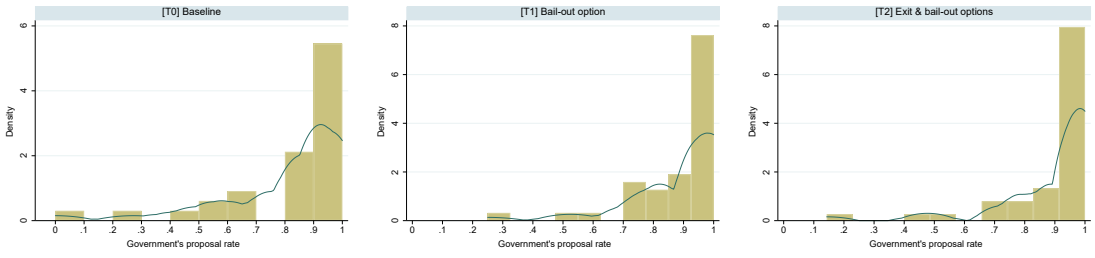


Figure 3.3. This figure presents the government's proposal rate distribution by treatment. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. The blue line is the Kernel density estimate.

For the investor, the impact of allowing separation by the government only does not increase its propensity to accept the partnership (see Figure 3.4 and Figure 3.5). The theory predicts that the acceptance rate by the investor should increase compared to the baseline treatment as a contract breach should be punished by an exit from the government immediately. However, we don't observe any change in the propensity to enter the partnership by the investor between the treatment with no termination options [T0] and the unilateral bail-out option treatment [T1] (see H2 row in Table 3.9 and Models (2a, 2b) in Table 3.10).

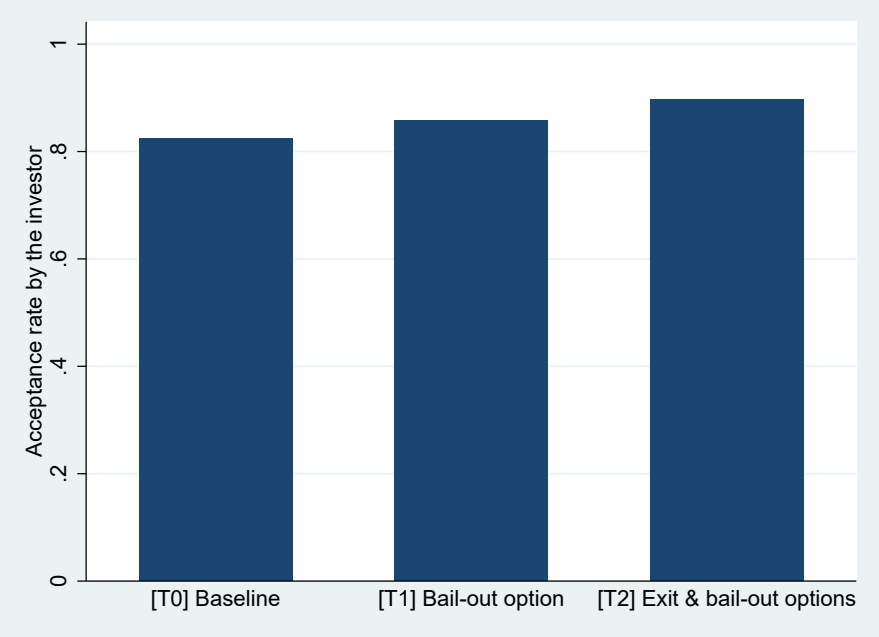


Figure 3.4. This figure presents the investor's acceptance rate. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project.

Furthermore, the partnership acceptance rate by the investor is higher in the case of concurrent exit and bail-out options [T2], even though the proposal rate by the government is unchanged between [T1] and [T2] (see Figure 3.4, H2 row in Table 3.9 and Models (2a, 2b) in Table 3.10). Allowing the investor to exit the partnership increases its propensity to enter the partnership. We find no relationship between the risk profile of participants and the decision to enter the partnership (see Table 3.11 and Models (1a, 1b, 2a, 2b) in Table 3.10).

The above mentioned results suggest higher partnership formation in the concurrent exit and bail-out options [T2] compared to the unilateral bail-out option

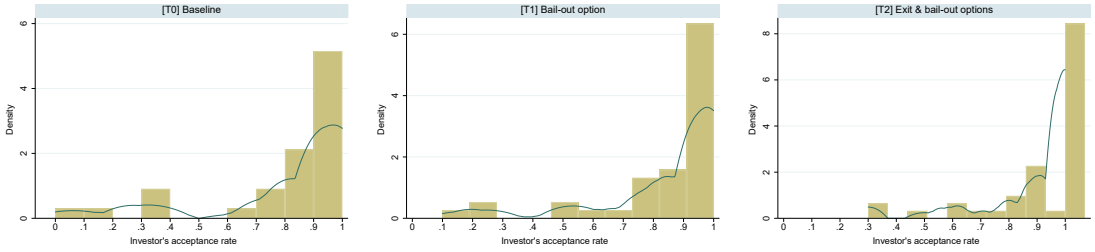


Figure 3.5. This figure presents the investor's acceptance rate distribution by treatment. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. The blue line is the Kernel density estimate.

treatment [T1] (see Figure 3.6 and Figure 3.7). They also highlight higher partnership formation in the unilateral bail-out option treatment [T1] compared to the baseline no-option treatment [T0].

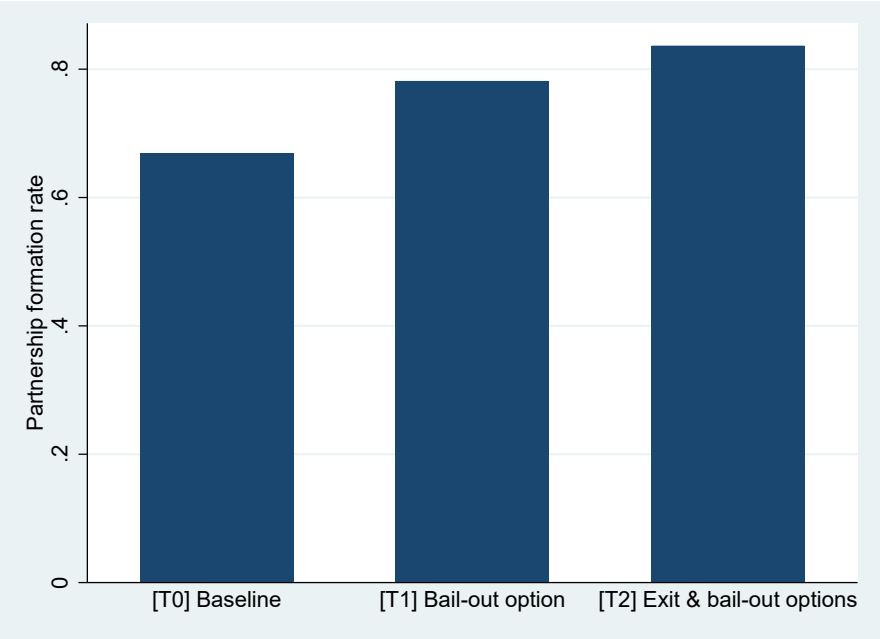


Figure 3.6. This figure presents partnership formation rates by treatment. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project at a predetermined strike price. [T2] is a treatment where the investor can exit and the government can bail-out the project.

We find strong evidence supporting Hypothesis 3. Partnership formation is higher in the treatment with exit and bail-out options [T2] than in the baseline treatment with no options [T0] and the treatment with unilateral bail-out options [T1] (see H3 row in Table 3.9 and Models (3a, 3b) in Table 3.10). Figure 3.6 presents the partnership formation rates by treatment. Concurrent exit and bail-out options

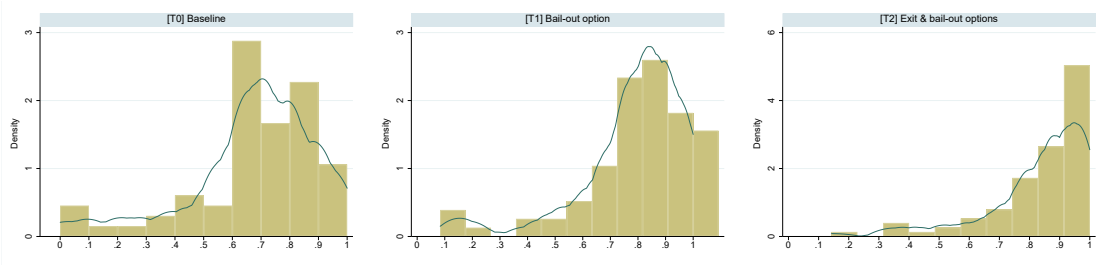


Figure 3.7. This figure presents partnership formation rates distribution by treatment. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. The blue line is the Kernel density estimate.

lower the *ex-ante* fear about the counter-party's opportunistic behavior, leading to an increase in partnership formation.

Contract Fulfillment

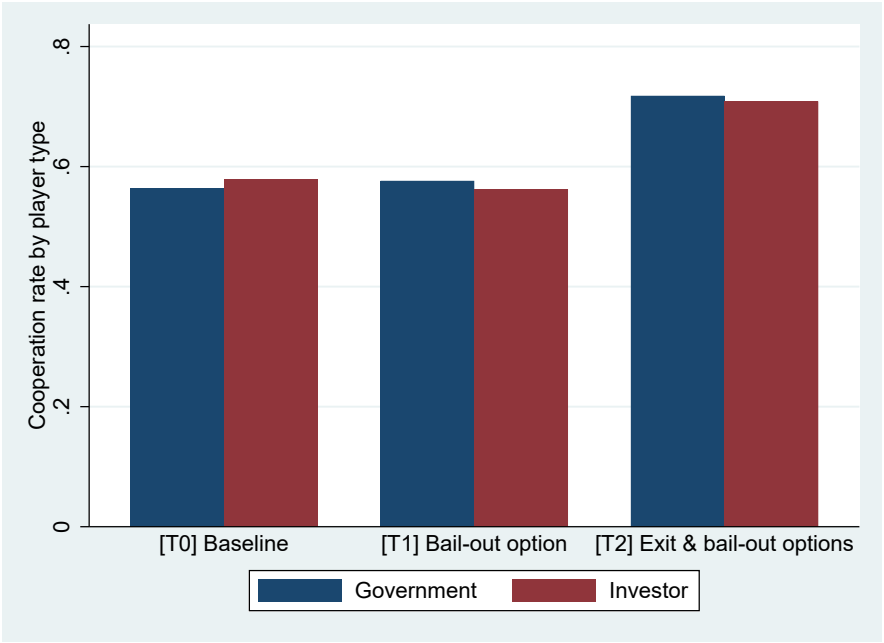


Figure 3.8. This figure presents cooperation rates by player type and treatment. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. Cooperation rate is the ratio of contract fulfillment choices to the total number of rounds played.

Ending the partnership in our experimental design is considered costly as players are not rematched immediately. Furthermore, participation in the partnership is voluntary.

Looking at the overall cooperation rate defined as the ratio of contract fulfillment choices to the total number of rounds played, we find that providing a bail out

option to the government only does not affect players' propensity to choose contract fulfillment. The change in the cooperation rate by type of player between the treatment with unilateral bail-out option for the government [T1] and the baseline treatment with no termination option [T0] is statistically insignificant. Looking at absolute cooperation rate defined as the ratio of simultaneous contract fulfillment choices by both players to total number of rounds played (Figure 3.9), we find that it is slightly lower in [T1] compared to [T0] but the difference is statistically insignificant (see H4 row in Table 3.9 and Models (4a, 4b) in Table 3.10).

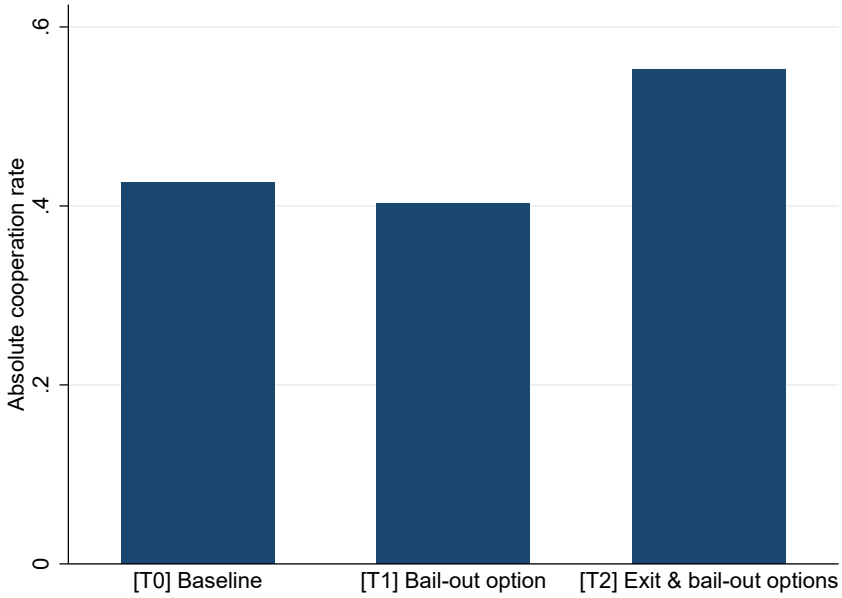


Figure 3.9. This figure presents the rate of both players play cooperate by treatment.[T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project at a predetermined strike price. [T2] is a treatment where the investor can exit and the government can bail-out the project.

Allowing only the government to end the partnership does not significantly affect the cooperative behavior of players. However, allowing both players to end the partnership induces higher cooperative behavior measured by the general cooperation rate and the absolute cooperation rate. In fact, we find evidence of higher cooperation rates for the government and the investor (see Figure 3.8). Furthermore, we find that absolute cooperation rate in the treatment with concurrent exit and bail-out options [T2] is higher than in the no-option [T0] and the unilateral bail-out [T1] treatments (see Figure 3.9 and Figure 3.10).

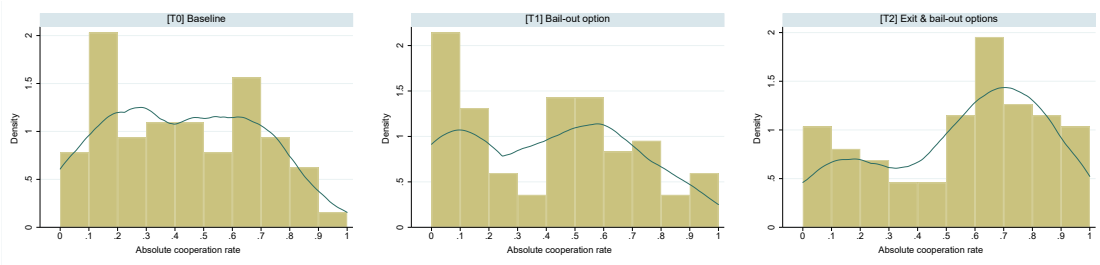


Figure 3.10. This figure presents the rate of both players play cooperate by treatment.[T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. The blue line is the Kernel density estimate.

The theoretical predictions in section 3.3 suggest that players should be able to sustain cooperation in all treatments. Figure 3.11 presents the cooperation rate defined as ratio of contract fulfillment choices to the total number of rounds played per period. A period is a new rematching between players. However, we observe that only in [T2] cooperation rates increase with experience. In the baseline treatment [T0] and the treatment where only the government can exit [T1], cooperation rates are lower than in [T2] and does not seem to evolve with experience in the lab.

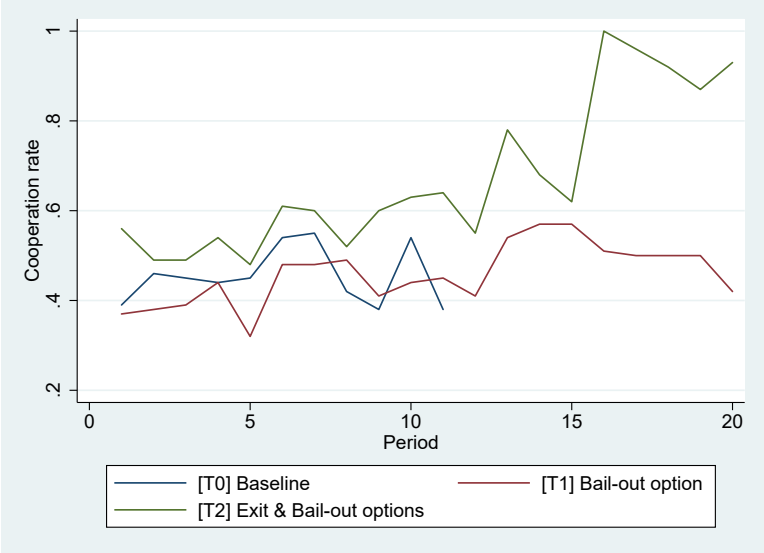


Figure 3.11. This figure presents the evolution of cooperation rate per period (partnership) by treatment. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. Cooperation rate defined as the ratio of contract fulfillment choices to the total number of interactions played.

We conclude that only concurrent exit and bail-out options increase the cooperative behavior of decision makers when participation in the partnership is voluntary.

Partnership Termination

Arguably, higher propensity to termination hinders partnership stability. Our results indicate that the government's termination rate is lower in the treatment with concurrent exit and bail-out options [T2] than in the treatment with unilateral bail-out option [T1] (cf. [T1] versus [T2] in Figure 3.12 and Figure 3.13).[19]

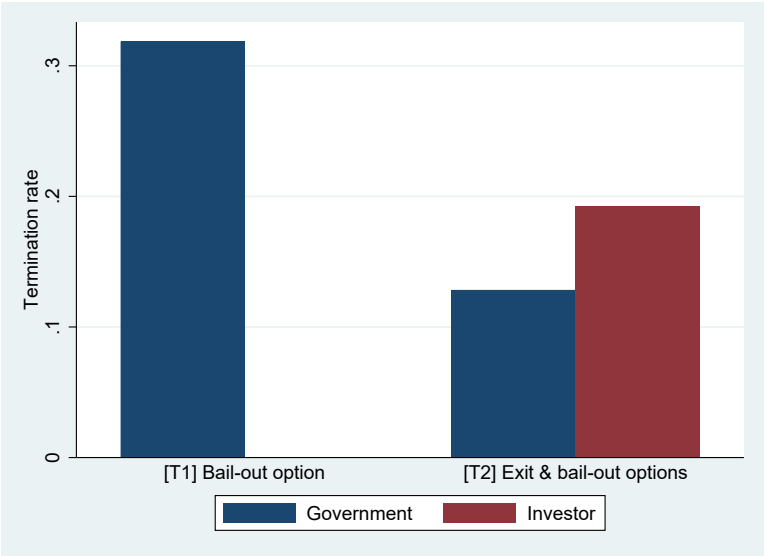


Figure 3.12. This figure presents termination rates for the government and investor by treatment. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. Termination rate is a dummy variable equal to 1 when the government or the investor exercise the termination option and zero otherwise.

The termination rate regardless of the type in [T1] and [T2] is statistically similar (See H4 row in Table 3.9 and Model (5) in Table 3.10.) and is equal to 31,6% for the bail-out option treatment [T1] and 30,5% for the exit and bail-out options treatment [T2] Table 3.8. From the results of hypothesis 3, we showed that partnership formation is higher in the exit and bail-out options treatment [T2] than the the bail-out option treatment [T1]. Given higher partnership formation in [T2] and similar termination rates in both treatments, the number of surviving partnerships will be automatically higher in [T2] compared to [T1]: 630 for [T1] and 709 for [T2].

The termination decision was initiated by either the government or the investor 296 times. Table 3.5 presents the outcomes for the exit initiator of the rounds prior to

[19]Note that in the baseline no-option treatment [T0] none of the players have the possibility to terminate the partnership and in the unilateral bail-out option treatment [T1] only the government has the option to terminate the partnership.

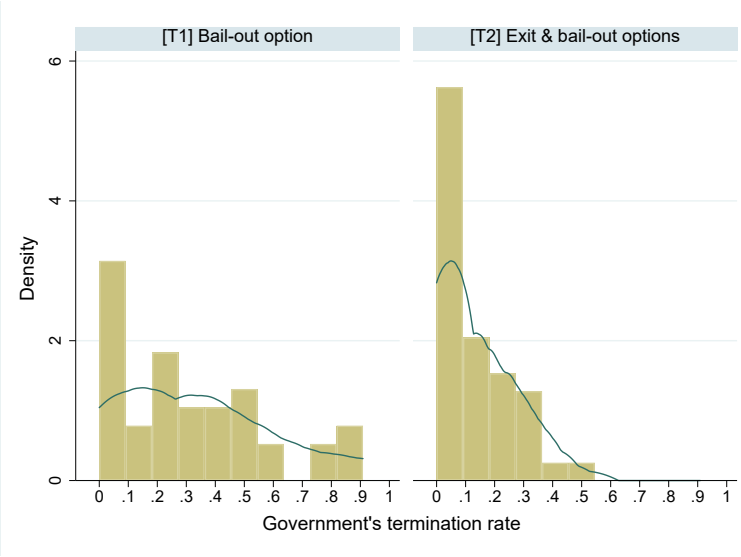


Figure 3.13. This figure presents the distribution of termination rates for the government by treatment. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. Termination rate is a dummy variable equal to 1 when the government exercises the termination option and zero otherwise. The blue line is the Kernel density estimate.

the termination decision. Comparing [T1] where only the government can terminate with [T2] where both parties can terminate the partnership, we find that termination caused by a breach to the contract by the partner is higher in [T2]. This can be explained by the fact in [T1] the investor can not punish the government by exiting, the only thing the investor can do following the contract breach by the government is to move to contract breach. This reason explains also why termination after mutual contract breach is higher in [T1] than in [T2].

Table 3.5. This table presents the outcomes of rounds before the termination decision by treatment. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project.

The round before termination	[T1]	[T2]
Mutual contract fulfillment	1%	5%
Mutual contract breach	55%	39%
Only the exit initiator breached the contract	20%	18%
Only the other breached the contract	24%	38%

We find that 34.80% of termination decisions occurs after the first contract breach in the partnership. Conditional on termination after first contract breach, Table 3.6 shows the reasons of termination. We observe that the most common reason of termination is breach by the other party. The proportion is higher in [T2] when both players have the possibility to terminate the partnership.

Table 3.6. This table presents the termination motives conditional on termination after the first contract breach. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project.

	[T1]	[T2]
Mutual contract breach	21%	5%
Only the exit initiator breached the contract	35%	25%
Only the other breached the contract	44%	69%

Figure 3.14 shows the number of rounds before partnership termination. Zero rounds indicates that the termination occurred right after the contract breach. Players didn't play one more round of the PD game. Terminating after one round means that players chose to play one more round of the PD game before deciding to terminate.

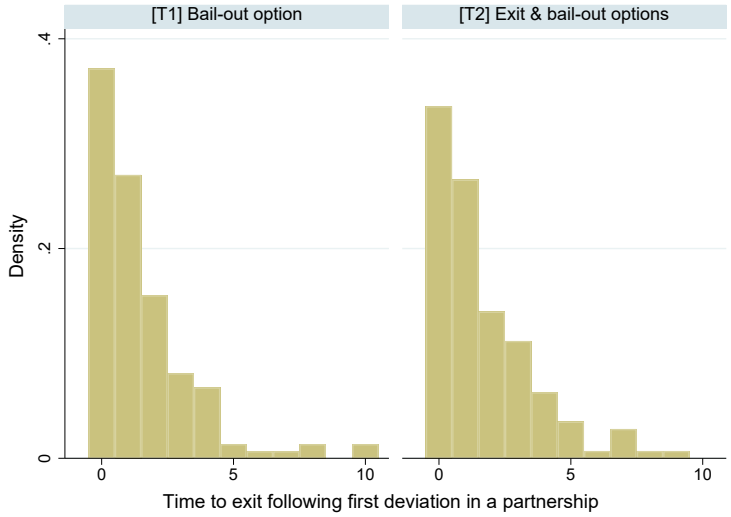


Figure 3.14. This figure presents the number of rounds to exit following the first contract breach within a partnership by treatment. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project.

On average the time to exit after the first contract breach is observed, in [T1] where only the government can terminate the partnership, is 1.66 rounds compared to 1.49 rounds in [T2]. However, this difference is not statistically significant. Figure 3.14 shows that 77% of termination decisions occurs between 0 and 2 rounds. This result indicate that some players prefer to continue in the partnership, which might be a signal to establish cooperation.

Partnership Length

Lastly, we look at partnerships' length measured by the ratio of actual rounds played within a partnership to the theoretical number of rounds that could have been played if an exit option was not used. A partnership could end for two reasons: forceful ending or the use of an exit option. In the case of forceful ending, the partnership reaches its random end.

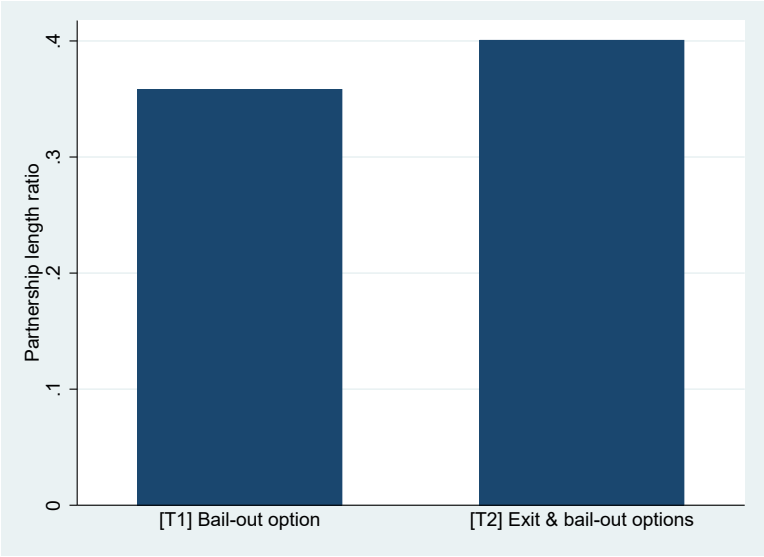


Figure 3.15. This figure presents partnership length ratio (conditional on non forceful ending) by treatment conditional on partnership formation. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. Partnership length is the ratio of actual rounds played to the total possible rounds that could have been played in a partnership.

We first look at partnership length for the latter case, where exit was chosen by one of the players. Figure 3.15 and Figure 3.16 show that in in the treatment with concurrent exit and bail-out options [T2], the ratio of actual rounds played to the theoretical number of rounds that could have been played in case of no exit is significantly higher than in the bail-out option treatment [T1].

From the results of termination rate across treatments (see Figure 3.12), we know that the difference in overall termination rates across the bail-out option treatment [T1] and the exit and bail-out options treatment [T2] is not statistically significant. Consequently, the ratio of partnerships reaching the end is thus similar: 68,5% and 69,5% for [T1] and [T2] respectively. The results in Figure 3.6 of hypothesis 3 showed that partnership formation is higher in the exit and bail-out options treatment [T2]

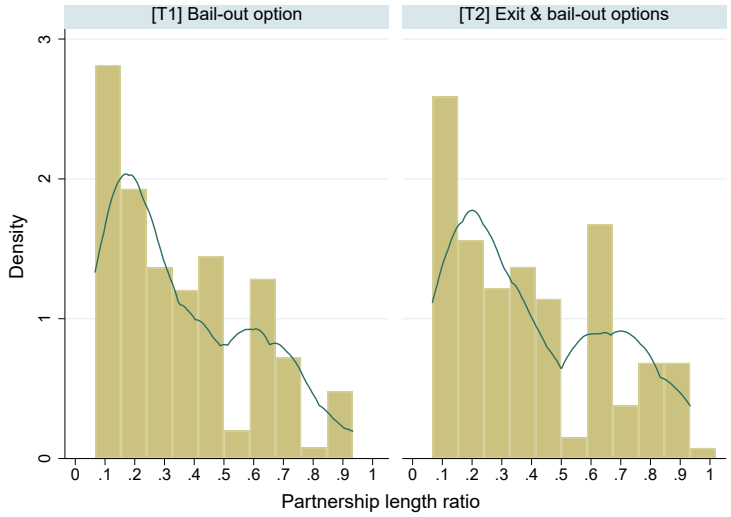


Figure 3.16. This figure presents the distribution of partnership length ratio (conditional on non forceful ending) by treatment. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. Partnership length is the ratio of actual rounds played to the total possible rounds that could have been played in a game. The blue line is the Kernel density estimate.

than the the bail-out option treatment [T1]. Given higher partnership formation in [T2] and similar termination rates in both treatments, the number of partnerships reaching the theoretical end will be automatically higher in [T2] compared to [T1]: 630 for [T1] and 709 for [T2].

Overall, we find a positive effect of concurrent exit and bail-out options on partnership formation, cooperative behavior, and partnership stability.

3.7 Concluding Remarks

The exit/bail-out option mechanism proposed by Moszoro (2013) reduces entry barriers by streamlining incomplete long-term contracts and avoiding contractual problems related to bounded rationality and opportunism. The flexibility of the option contracts enables a continuous process of enhancing cooperation between the investor and the government, or termination of cooperation without loss for any of the parties. If higher punishments (lower gains) are allowed in the next rounds through exit and bail-out options, the counter-party will not deviate because, even though she can gain considerably in one round, the other player will punish her by

executing the option in the follow-up round.

In this paper, we investigate the behavioral micro-mechanisms that could explain why introducing exit bail-out options in public-private partnerships can reduce entry barriers and enhance cooperation within the partnership. To do so, we modeled public-private partnerships as a infinitely repeated prisoner's dilemma (PD) game between the government and an investor with voluntary participation and termination. A government can suggest a partnership to the investor, and the investor can accept or refuse. We experimentally investigated the effects of allowing voluntary separation in a PD game with voluntary participation. We compared a baseline treatment where termination is not possible to [T1] where only the government can exit the partnership (bail-out) and to [T2] where both the government and the investor can exit the partnership (exit and bail-out options).

Our findings show that concurrent exit and bail-out options increase partnership formation, suggesting that allowing bilateral separation reduces *ex-ante* fear of entering an infinitely repeated PD game. In the treatment where only the government can terminate the partnership, we observe higher partnership formation rate caused only by an increase in the rate of government's partnership proposal rate to the investor. Furthermore, we find that the cooperation rate is significantly higher in the treatment with concurrent exit and bail-out option compared to the baseline treatment and and and the treatment where only the government can terminate the partnership. The cooperation rates are similar between the baseline treatment and the treatment where only the government can terminate the partnership. The absolute cooperation rates i.e. simultaneous cooperation by both players it is lower in the treatment when only the government can exit compared to the baseline treatment. Our results also show that conditional on non forceful ending i.e. partnerships that did not reach their random end, partnership length is higher in the treatment with concurrent exit and bail-out options compared to the baseline treatment.

Many institutions and relationships in the society are conditioned on players

agreement to enter the relationship and also their agreement to maintain the relationship. Our findings suggest that allowing voluntary bilateral separation in these settings can reduce entry barriers and can foster cooperation.

In the context of public-private partnerships, well designed exit and bail-out options set at the right strike price can reduce *ex-ante* entry barriers and increase the sustainability of the partnership.

Table 3.7. This table summarizes the results of Mann-Whitney tests or χ^2 between treatments over risk aversion, age, gender and social value orientations.

Variable	Comparison	Mann-Whitney test p-value
Risk aversion	[T0] Baseline vs [T1] Bail-out option	0.443
	[T0] Baseline vs [T2] Exit & bail-out options	0.908
	[T1] Bail-out option vs [T2] Exit & bail-out options	0.478
Age	[T0] Baseline vs [T1] Bail-out option	0.114
	[T0] Baseline vs [T2] Exit & bail-out options	0.016
	[T1] Bail-out option vs [T2] Exit & bail-out options	0.535
Gender	[T0] Baseline vs [T1] Bail-out option	0.261
	[T0] Baseline vs [T2] Exit & bail-out options	0.609
	[T1] Bail-out option vs [T2] Exit & bail-out options	0.505
SVO	[T0] Baseline vs [T1] Bail-out option	0.042
	[T0] Baseline vs [T2] Exit & bail-out options	0.003
	[T1] Bail-out option vs [T2] Exit & bail-out options	0.406

Table 3.8. This table presents the descriptive statistics for combined treatments and for each treatment separately. [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project at a predetermined strike price. [T2] is a treatment where the investor can exit and the government can bail-out the project at a predetermined strike price. Partnership formation rate is a dummy variable that equals to 1 when a partnership is formed and zero otherwise. Cooperation rate is the ratio of contract fulfillment choices to the total number of rounds played. Termination rate is a dummy variable equal to 1 when the government or the investor exercise the termination option and zero otherwise. Partnership length is the ratio of actual rounds played to the total possible rounds that could have been played n in a game conditional on a partnership formation.

Variable	Treatment	Obs.	Mean	St. dev.	Min	Max
Proposal rate by the government	All treatments combined	1542	0.879	0.326	0	1
	[T0] Baseline	347	0.813	0.391	0	1
	[T1] Bail-out option	595	0.889	0.314	0	1
	[T2] Exit and bail-out options	600	0.908	0.288	0	1
Acceptance rate by the investor	All treatments combined	1542	0.0.768	0.422	0	1
	[T0] Baseline	347	0.822	0.382	0	1
	[T1] Bail-out option	595	0.860	0.347	0	1
	[T2] Exit and bail-out options	600	0.911	0.283	0	1
Partnership formation	All treatments combined	3084	0,780	0,415	0	1
	[T0] Baseline	694	0.669	0.471	0	1
	[T1] Bail-out option	1190	0.773	0.419	0	1
	[T2] Exit and bail-out options	1200	0.850	0.357	0	1
Cooperation rate by the government	All treatments combined	1184	0.659	0.395	0	1
	[T0] Baseline	232	0.588	0.364	0	1
	[T1] Bail-out option	455	0.596	0.415	0	1
	[T2] Exit and bail-out options	497	0.739	0.366	0	1
Cooperation rate by the investor	All treatments combined	1184	0.659	0.395	0	1
	[T0] Baseline	232	0.596	0.369	0	1
	[T1] Bail-out option	455	0.592	0.419	0	1
	[T2] Exit and bail-out options	497	0.749	0.367	0	1
Cooperation rate	All treatments combined	2368	0.657	0.394	0	1
	[T0] Baseline	464	0.593	0.366	0	1
	[T1] Bail-out option	910	0.595	0.417	0	1
	[T2] Exit and bail-out options	994	0.744	0.367	0	1
Absolute cooperation rate	All treatments combined	2	0.465	0.257	0	1
	[T0] Baseline	464	0.449	0.425	0	1
	[T1] Bail-out option	910	0.433	0.456	0	1
	[T2] Exit and bail-out options	994	0.603	0.449	0	1
Termination rate by the government	All treatments combined	1184	0.173	0.378	0	1
	[T1] Bail-out option	455	0.316	0.466	0	1
	[T2] Exit and bail-out options	497	0.122	0.360	0	1
Termination rate (Overall)	All treatments combined	1449	0.309	0.462	0	1
	[T1] Bail-out option	455	0.316	0.466	0	1
	[T2] Exit and bail-out options	994	0.305	0.461	0	1
Partnership length (conditional on non forceful ending)	All treatments combined	590	0.380	0.248	0.066	0.933
	[T1] Bail-out option	287	0.358	0.237	0.066	0.928
	[T2] Exit and bail-out options	303	0.401	0.258	0.066	0.933

Table 3.9. This table summarizes the results by overall treatment (χ^2 test or Mann-Whitney test) and by participant (Mann-Whitney test). [T0] is a treatment where the players have no early termination options. [T1] is a treatment where the government can bail-out the project. [T2] is a treatment where the investor can exit and the government can bail-out the project. Partnership formation rate is a dummy variable that equals to 1 when a partnership is formed and zero otherwise. Partnership length is the ratio of actual rounds played to the total possible rounds that could have been played n in a game conditional on a partnership formation. Termination rate is a dummy variable equal to 1 when the government or the investor exercise the termination option and zero otherwise. Absolute cooperation rate is the ratio of simultaneous contract fulfillment choices by both players to the total number of rounds played.

	Variables	Comparison	Chi test p-value (overall)	Mann-Whitney test p-value (by participant)	Kolmogorov-Smirnov test p-value (by participant)		Comments
H1	Government partnership proposal rate	[T0] vs [T1]	0.001	0.058	0.05	[T0] <[T1]	H1 supported
		[T1] vs [T2]	0.270	0.818	0.977	[T1] = [T2]	
H2	Investor partnership acceptance rate	[T0] vs [T1]	0.159	0.656	0.988	[T0] = [T1]	H2 partially supported
		[T1] vs [T2]	0.007	0.055	0.06	[T1] <[T2]	
H3	Partnership formation rate	[T0] vs [T1]	0.000	0.000	0.000	[T0] <[T1]	H3 supported
		[T1] vs [T2]	0.000	0.014	0.066	[T1] <[T2]	
H4	Absolute cooperation rate	[T0] vs [T1]		0.584	0.429	[T0] = [T1]	H1 supported
		[T1] vs [T2]		0.000	0.002	[T1] <[T2]	
H4	Termination rate (Overall)	[T1] vs [T2]	0.684	0.696	0.469	[T1] = [T2]	H4b partially supported
	Government's termination rate	[T1] vs [T2]	0.000	0.001	0.004	[T1] >[T2]	
	Partnership length (conditional on non forceful ending)	[T1] vs [T2]		0.066	0.091	[T1] <[T2]	H4c Supported

Table 3.10. This table summarizes regression results. For dummy variables, the logit model was used. For variables between 0 and 1, OLS was used. [T0] is the reference category for all the regressions except for: Model 1b, 2b, 3b, 4b, 5, 6 and 7 where [T1] is the reference category. * ** ***denote statistical significance at 1% ,5% and 10% level respectively.

	(1a) Government proposal	(1b) Government proposal	(2a) Investor acceptance	(2b) Investor acceptance	(3a) Partnership formation	(3b) Partnership formation	(4a) Absolute cooperation	(4b) Absolute cooperation	(5) Termination	(6) Government termination	(7) Partnership length
[T0] Baseline											
[T1] Bail-out option	0.079		0.072		0.143		0.029				
[T2] Exit and Bail-out options	0.093*	0.002	0.133**	0.063*	0.213***	0.072***	0.171***	0.198***	-0.074***	-1.299***	0.042*
Age	0.003	0.000	-0.002	-0.001	-0.004*	-0.003*	-0.013***	-0.013***	0.023*	0.008	-0.000
Male	0.014	0.051	0.112***	0.11***	0.065***	0.082***	0.008	0-0.010	0.119	0.463*	-0.154
Risk averse	0.015	0.034	0.051	0.046	0.028	0.023	-0.012	-0.014	0.084	0.047	-0.057
SVO	0.000	0.000	0.003***	0.215	0.001*	0.001	0.004**	0.002*	-0.010*	0.003	-0.001
N	1542	1195	1356	1074	3084	2390	1904	2368	1904	952	590
Clusters	119	86	119	86	238	172	171	235	171	85	149

Table 3.11. This table shows the p-value for Mann Whitney test for the government partnership proposal rate, the investor's partnership acceptance rate and cooperation rate. Cooperation rate is the ratio of contract fulfillment choices to the total number of rounds played.

	Government proposal	Investor acceptance	Cooperation rate
Risk aversion	0.781	0.445	0.482

General Conclusion

The question of how to further increase private sector participation in infrastructure is at the top of policymakers' agendas. Traditional public and private i.e banks, financing sources are faced with strong constraints preventing them from addressing growing infrastructure financing needs. Institutional investors e.g. pension funds, insurance companies and sovereign wealth funds, with more than USD 100 trillion under management (OECD, 2018) are usually cited as a potential source for long term financing of infrastructure (Della Croce et al., 2013; Inderst et al., 2014). At the same time, given the low yield environment, institutional investors have started looking at infrastructure as a compelling investment opportunity that can allow them to achieve better diversification in their asset allocations (Blanc-Brude, 2013).

In recent years, the issue of attracting more capital from institutional investors has been widely discussed. Global efforts are being made in order to establish infrastructure as an asset class to attract more capital from such investors.

Despite a theoretical perfect match between institutional investors and infrastructure investments, allocations to infrastructure have been slow and small (OECD, 2018). In fact, certain barriers exist and might be hindering the unlocking of the full potential of institutional investors' capital (Inderst et al., 2014). The potential theoretical match is one thing but the practical question of "how" from a pure investment perspective remains under investigation.

The question of institutional investors' participation is still very much under-researched mainly due to lack of data on infrastructure projects and institutional

investors allocations. The purpose of this dissertation is to participate to the debate on how to make a better match between infrastructure investments and institutional investors. Most research on private participation in infrastructure focuses on private sector involvement at large and is mostly based on the World Bank Private Participation in Infrastructure (PPI) database (Basılio, 2017; Mansaray, 2018; Ruhashyankiko et al., 2006). This database raises three concerns. First, it does not allow differentiation by financing sources. Second, it includes infrastructure projects that are financed through various financing methods and thus do not have the same risk profile.[20] Third, most institutional investors' allocation is based in developed countries, the PPI database collects data on projects only in developing countries.

We overcome the scarcity of data on institutional investors participation by using a novel data set provided by IJGlobal on project finance transactions between 2000 and 2018. We analyse all project sponsors and debt providers per transaction to construct two important variables: the presence of an institutional investor and the presence of an asset manager or infrastructure fund. The latter is particularly relevant as institutional investors can access infrastructure investments through the indirect investment channel i.e through an asset manager or an infrastructure fund.

The dissertation contributes to the recent literature on private participation in infrastructure (Basılio, 2014; Moszoro et al., 2015; Ruhashyankiko et al., 2006) and shifts the debate from private participation in infrastructure as a public policy matter to what is needed to be done from an investment standpoint. It attempts to identify current problems and potential solutions that can facilitate the flow of capital from institutional investors to infrastructure. chapter 1 investigates how different

[20] In traditional or corporate finance, the sponsoring company (the company building the project) typically procures capital by demonstrating to lenders that it has sufficient assets on its balance sheets, to use as collateral in the case of default. The lender will be able to foreclose on the sponsor company's assets, sell them, and use the proceeds to recover its investment. In project finance, the repayment of debt is not based on the assets reflected on the sponsoring company's balance sheet, but on the revenues that the project will generate once it is completed.

project risks that are inherent to infrastructure investments affect projects' attractiveness for institutional investors. chapter 2 explores how efficient financial multilateral support was in crowding-in institutional investors' capital into infrastructure. It also highlights differences between developed and developing countries and sheds the light on the challenges faced by the latter. chapter 3 investigates how introducing an exit option for the investor and the government in infrastructure investments can help in overcoming *ex-ante* fear of investment.

The remainder of this conclusion briefly summarizes the main findings of this dissertation, discusses their implications, the limitations of the results and identifies areas for future research.

Summary of Main Findings and Contributions

In chapter 1, we focus on the importance of different infrastructure risks on projects' attractiveness for institutional investors. We also differentiate the effects by the investment route used: direct i.e. institutional investors directly investing in a project and indirect investment i.e. investment through an asset manager or an infrastructure fund. We consider three general risks: macroeconomic risk (interest rate and foreign exchange rate risk), regulatory and political risks as well as project specific risks: construction and demand risk.

Our results indicate that for the direct investment route: lower macroeconomic, political and regulatory risk are vital factors in increasing a project's attractiveness. For asset managers and infrastructure funds only lower regulatory risk seems to be playing a major role. Furthermore, we find no indication of higher attractiveness for brownfield projects compared to greenfield projects. We also find that projects without demand risk i.e. Availability payment are more attractive for both investment routes.

These results contribute to the literature on private investment in infrastructure (Basılio, 2017; Fay et al., 2018; Gemson et al., 2012; Moszoro et al., 2015; Ruhashyankiko

et al., 2006). First, and to the best of our knowledge, this is the first study to focus on institutional investors' participation in infrastructure per se. Our results shed the light on the importance of the investment environment of the hosting country for attracting institutional investors' participation. It also suggest that for riskier environments i.e. developing countries, investment by asset managers and infrastructure funds might be a more adapted route.

It should be made clear that institutional investors are subject to different regulatory regimes and can thus be limited in the possibility of taking certain risks (Gatzert et al., 2016). The key to attracting more institutional investors is isolating and packaging risks in a way that allocate them to the party that can best bears them. Furthermore, direct investment requires specific knowledge and capabilities limiting direct investment for only a fraction of big institutional investors. There is a need for well designed infrastructure financing vehicles and instruments. This is particularly true for developing countries.

Furthermore, our study is the first empirical study on infrastructure investments that adopt Blanc-Brude (2013) idea on the importance of underlying contractual arrangements rather than sector classification. Policymakers should integrate the idea that institutional investors consider infrastructure as an investment opportunity. Infrastructure development from a public policy perspective is focused on sectoral classification and needs. However, what dictates returns and performance of infrastructure are the underlying contractual arrangements and business models. Sectoral or industrial classification gives very little information on cash flow predictability. For example, an investor would be exposed to a different set of risks for projects within the same sector but with different business models i.e. a toll road versus an availability payment road (Blanc-Brude et al., 2016).

In chapter 2 of this dissertation, we focus on the role of financial multilateral support in crowding-in institutional investors' capital into infrastructure projects. We differentiate once again between the effect on the direct and indirect investment routes. Furthermore, we conduct sub group analysis to detect differences between

developed and developing countries.

Our results indicate that for developed countries there is a catalytic effect or financial *additionality*. Multilateral financial support aiming to build confidence in projects and markets succeeded in crowding-in institutional investors as well as asset managers and infrastructure funds between 2000 and 2018. However, for developing countries, the picture is quite different. We find no effect on crowding-in capital from asset managers and infrastructure funds and a crowding-out effect on direct institutional investors.

These results contribute to the literature on private participation (Basılio, 2017; Fay et al., 2018; Gemson et al., 2012; Moszoro et al., 2015; Ruhashyankiko et al., 2006) in infrastructure as well as the literature on the role of multilateral institutions in mobilizing private sector investment (Basılio, 2014; Bird et al., 2007, 2008; Clemens, 2002). It is the first study to focus on institutional investors' participation in specific and differentiate the role of multilateral support in developed versus developing countries. Prior research on the role of multilateral support in unlocking private sector investment are mostly focused on developing countries.

The results shed the light on the challenges facing developing countries. Situations of crowding-out institutional investors due maybe to better loan prices by multilaterals could be avoided if multilateral lending is based on the principle of *additionality*. Potential solutions such as co-lending platforms or investment vehicles aimed at attracting more investment from institutional investors should be designed. Multilateral agencies should leverage their limited resources and use it when no other sources of capital are available or otherwise as risk capital to encourage other investors. The main motive should be *additionality* and focus on avoiding situations of *substitution*.

In chapter 3 of this dissertation, we investigate how over-the-counter exit and bail-out options analogous to put and call options on the investor's present value of capital outlays can reduce *ex-ante* fear of investment in a public-private partnership (PPP). This chapter is relevant for investment through equity i.e sponsors

of the project. We use experimental and behavioral economics to test the micro-mechanisms at stake that might explain the efficacy of such options. To do so, we model PPP as an infinitely repeated prisoner's dilemma game with voluntary participation and separation.

Our results in the lab suggest that concurrent exit and bail-out options increase partnership formation compared to situations without exit or unilateral exit from the government only. Furthermore, we observe higher cooperative behavior and higher partnership sustainability under the concurrent exit and bail-out treatment.

The results contribute to the literature on infinitely repeated prisoner's dilemma games with voluntary separation (Arend et al., 2005; Fujiwara-Greve et al., 2009, 2011; Lee, 2018; Mengel, 2018; Wilson et al., 2017). In fact, it is to our knowledge the first paper to add voluntary participation in the game. Moreover, our results contribute to the literature on private participation in infrastructure and opprtunism in PPPs (Liu et al., 2016, 2017; Moszoro, 2013; Moszoro et al., 2012; Ruhashyankiko et al., 2006). Introducing an exit/bail-out option mechanism set at the right strike price can reduce entry barriers in PPPs by streamlining incomplete long term contracts and avoiding contractual problems related to bounded rationality and opportunism. For instance, this can be an effective solution for reducing fear of expropriation risk.

Avenues for Future Research

Two chapters of this dissertation are pure empirical work that are based on infrastructure project finance deals. Access to open and available data for infrastructure investments is particularly challenging. This is particularly true for data on institutional investors' allocation to infrastructure. The work presented in this thesis would have not been possible if extra work to identify institutional investors' participation in specific projects was not performed. Open data is constantly improving in terms of availability and quality, the empirical work presented can be improved upon availability of future data.

In particular, one limitation of this work is the absence of specific data on the amount of contributions of institutional investors. Lack of data on specific amounts of commitments limited our choice of statistical techniques. We lacked important information to conduct a more in-depth analysis of the degree and magnitude of investments committed.

In chapter 2, we only focused on financial multilateral support to infrastructure projects. Information about other multilateral support mechanisms was absent. Future research on other type of support such as guarantees, credit enhancement or advisory support is needed to better understand the role of multilateral agencies in infrastructure.

In chapter 3, even though allowing exit for the investor is present in certain investment settings in infrastructure, again the lack of data on infrastructure investments urged us to use experimental economics techniques to assess the mechanism at stake. Future research using contract data where exit is allowed for the investor can help policymakers better understand and design better investment products.

To conclude, we hope that this dissertation paves the way for future research focused more specifically on institutional investors' participation in infrastructure, as we strongly believe that they have a major role to play in bridging the infrastructure financing gap.

Appendix A

Comparative Analysis for projects with Direct versus Indirect Institutional Investors

Table 12. Comparison of projects with direct and indirect investment.

Time period		2000- 2008	2009- 2018	2000-2018
		Period 1	Period 2	Overall sample
(a) Project size (in million US$)				
With direct investment	N	142	453	595
	μ	387.73	516.15	485.50
With indirect investment	N	163	549	712
	μ	377.68	411.30	403.60
Z-value		-0.284	-3.002	-2.782
P value		0.776	0.002***	0.005***
(b) Number of investors				
With direct investment	N	142	462	604
	μ	7.30	7.77	7.6
With indirect investment	N	163	567	730
	μ	4.93	6.08	5.8
Z-value		-5.540	-6.294	-8.063
P value		0.000***	0.000***	0.000***

Mann Whitney U-test has been used for comparative analysis.
*** denotes statistical significance at 1%. Investors = sponsors + debt providers

Comparative Analysis for projects with and without Institutional Investors

Projects with and without institutional investors' participation. are compared. The comparison is focused on two aspects of the projects: project size and the total number of investors composed of sponsors and debt providers. The comparison is made for the overall sample between 2000 and 2018, as well as for two sub-periods: 2000-2008 and 2009-2018. The justification of looking at sub-periods is that investment in infrastructure took a strong momentum after the financial crisis in 2008. All the comparisons presented had been done using the Mann Whitney U-test.

Comparison for the overall sample (Table 13) shows that projects with institutional investors' contributions are bigger in size. This result is the same for the two sub-periods. Additionally, the comparison of the total number of investors involved in the projects is significantly higher in projects with institutional investors' participation. This result indicates that institutional investors are not replacing existing investors, but are rather bringing additional resources to help fund larger projects. In developed countries, the results are similar to those of the overall sample. Table 14 shows bigger projects with higher number of investors for projects with institutional investors.

Looking at developing countries, the results are slightly different (Table 15). For the first sub-period, we note no significant difference in size between projects with and without institutional investors' participation. However, we find a significant higher number of investors. This result indicates that for this sub-period, investors might have not been comfortable undertaking investments in developing countries. Institutional investors were not seen an additional source of capital but rather as a tool to spread the projects' risks across a higher number of investors. This result is in line with the results found by Gemson et al. (2012) for private equity investors in infrastructure in developing countries. Their analysis focused on the period 1990-2009. The results for the second sub-period and the overall time period are the same as the overall sample and the developed world.

Table 13. Comparison of projects with and without II participation.

Time period		2000- 2008	2009- 2018	2000-2018
		Period 1	Period 2	Overall sample
(a) Project size (in million US$)				
With II participation	N	305	1002	1307
	μ	382.36	458.70	440.89
Without	N	1466	3462	4928
	μ	264.29	278.90	274.55
Z-value		-4.564	-10.984	-11.760
P value		0.000***	0.000***	0.000***
(b) Number of investors				
With II participation	N	305	1029	1334
	μ	6.03	6.84	6.66
Without	N	1471	3566	5037
	μ	4.45	4.18	4.26
Z-value		-7.670	-19.868	-21.076
P value		0.000***	0.000***	0.000***

Mann Whitney U-test has been used for comparative analysis.
*** denotes statistical significance at 1%. Investors = sponsors + debt providers

Table 14. Comparison of projects with and without II participation in developed countries.

Time period		2000- 2008	2009- 2018	2000-2018
		Period 1	Period 2	Overall sample
(a) Project size (in million US$)				
With II participation	N	271	751	1022
	μ	370.86	418.52	405.88
Without	N	1235	2258	3493
	μ	240.23	228.45	232.62
Z-value		-4.686	-10.775	-11.399
P value		0.000***	0.000***	0.000***
(b) Number of investors				
With II participation	N	271	774	1045
	μ	5.78	6.41	6.25
Without	N	1238	2338	3576
	μ	4.26	6.41	4.10
Z-value		-7.124	-16.188	-17.450
P value		0.000***	0.000***	0.000***

Mann Whitney U-test has been used for comparative analysis.
*** denotes statistical significance at 1%. Investors = sponsors + debt providers

Table 15. Comparison of projects with and without II participation in developing countries.

Time period		2000- 2008	2009- 2018	2000-2018
		Period 1	Period 2	Overall sample
(a) Project size (in million US$)				
With II participation	N	34	251	285
	μ	474.00	578.93	566.41
Without	N	231	1204	1435
	μ	392.92	373.50	376.63
Z-value		-1.638	-5.756	-5.908
P value		0.101	0.000***	0.000***
(b) Number of investors				
With II participation	N	34	255	289
	μ	8.00	8.14	8.12
Without	N	233	1228	1461
	μ	5.45	4.48	4.63
Z-value		-3.782	-13.339	-13.717
P value		0.000***	0.000***	0.000***

Mann Whitney U-test has been used for comparative analysis.
*** denotes statistical significance at 1%. Investors = sponsors + debt providers

Appendix B

Table 16. The table reports the estimation results of the OLS regression for the presence of an institutional investor in the project. Clustered standard errors by country are presented between brackets. The 1%, 5%, and 10% significance levels are represented by ***, **, and *, respectively. For specification (2A), we include project size. For specification (3A) we include the number of debt providers and project sponsors.

II participation	(1A)	(1B)	(1C)
MLS	**0.073*** **	**0.055** **	**-0.003**
	(0.022)	(0.023)	(0.022)
Political Risk	0.007***	0.007***	0.006***
	(0.002)	(0.002)	(0.002)
Economic Risk	-0.002	-0.004	-0.002
	(0.006)	(0.006)	(0.005)
Financial Risk	0.005	0.006*	0.006***
	(0.003)	(0.003)	(0.003)
Project size		0.001***	
		(0.000)	
Number of debt providers			0.022***
			(0.004)
Number of sponsors			0.047***
			(0.007)
Greenfield	-0.005	-0.012	-0.016
	(0.027)	(0.025)	(0.025)
Financial Close Year	0.011**	0.011***	0.012***
	(0.003)	(0.003)	(0.003)
Sector dummies	included	included	included
Region dummies	included	included	included
N	5904	5783	5904
Clusters	116	115	116

Table 17. The table reports the estimation results of the OLS regression for the presence of a direct institutional investor in the project. Clustered standard errors by country are presented between brackets. The 1%, 5%, and 10% significance levels are represented by ***, **, and *, respectively. For specification (2A), we include project size. For specification (3A) we include the number of debt providers and project sponsors.

Direct II participation	(1A)	(1B)	(1C)
MLS	**0.052*** **	**0.041** **	**-0.0003**
	(0.017)	(0.019)	(0.022)
Political Risk	0.005***	0.005***	0.004***
	(0.001)	(0.001)	(0.001)
Economic Risk	-0.002	-0.004	-0.002
	(0.004)	(0.004)	(0.003)
Financial Risk	0.008***	0.008***	0.009***
	(0.002)	(0.002)	(0.003)
Project size		0.001***	
		(0.000)	
Number of debt providers			0.016***
			(0.003)
Number of sponsors			0.029***
			(0.006)
Greenfield	-0.001	-0.007	-0.008
	(0.017)	(0.017)	(0.016)
Financial Close Year	0.005**	0.005**	0.006***
	(0.002)	(0.002)	(0.002)
Sector dummies	included	included	included
Region dummies	included	included	included
N	5904	5783	5904
Clusters	116	115	116

Table 18. The table reports the estimation results of the OLS regression for the presence of an indirect institutional investor in the project. Clustered standard errors by country are presented between brackets. The 1%, 5%, and 10% significance levels are represented by ***, **, and *, respectively. For specification (2A), we include project size. For specification (3A) we include the number of debt providers and project sponsors.

Direct II participation	(1A)	(1B)	(1C)
MLS	**0.052*** **	**0.050** **	**0.014**
	(0.020)	(0.022)	(0.020)
Political Risk	0.005***	0.006***	0.005***
	(0.001)	(0.002)	(0.001)
Economic Risk	-0.001	-0.002	-0.001
	(0.004)	(0.004)	(0.004)
Financial Risk	0.0003	0.0004	0.001
	(0.002)	(0.003)	(0.003)
Project size		0.001**	
		(0.000)	
Number of debt providers			0.014***
			(0.003)
Number of sponsors			0.032***
			(0.005)
Greenfield	0.0003	-0.0002	-0.007
	(0.016)	(0.014)	(0.016)
Financial Close Year	0.009***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)
Sector dummies	included	included	included
Region dummies	included	included	included
N	5904	5783	5904
Clusters	116	115	116

Appendix C

The instructions presented here are a translation from the french version. The experiment was conducted in French.

Instructions

Thank you for taking part in this experiment. All decisions are anonymous. It is important that you remain silent. If you have any questions, raise your hand and we will come to answer your questions. You will be paid in cash at the end of the experiment. The amount you will earn will depend on your decisions and the decisions of the other participants present today.

- You will interact with another participant and your decisions will affect your own compensation and the compensation of the other participants you interact with.
- Your total compensation will be 5 euros, plus all your experimental units (ECU) earned in the main experiment converted with a conversion rate of 120 ECU for 1 euro, plus your earnings in two additional individual tasks. Your earnings in these tasks will be communicated to you at the end of the session. Instructions for these tasks will be communicated in the IT interface.

Participants

- There are two types of participants: Type 1 and Type 2.
- The types of participants are set for the entire experience. You will make decisions in groups of two.
- When an interaction ends, you will be rematched with another participant in a random manner.

Interactions

In the first period of each interaction:

- Type 1 participant wants to set up a project, he/she has the choice between:
  1. Establish an indefinite partnership with the Type 2 participant: the Type 1 participant can terminate this partnership at any time by choosing to exit the partnership;
  2. Set up the project alone.
- Type 2 participant has a choice between:
  1. Enter into the indefinite partnership with the Type 1 participant: the Type 2 participant can terminate this partnership at any time by choosing to exit the partnership;
  2. Do not enter into partnership.

If the Partnership is formed:

- The duration of the partnership is unknown to the participants. The partnership has a continuation probability of 7/8. The theoretical length of a partnership is the number of rounds until random termination. Random termination is the same for all participants in the lab. The game explained below will be repeated between the two participants unless a participant decides to terminate the partnership before the random end.
- Type 1 participant must choose between:
  1. option 1;
  2. option 2;
  3. Exit the partnership.
- Type 2 participant must choose between:
  1. option 1;
  2. option 2;
  3. Exit the partnership.
- At the end of each period, the decisions of both participants are made visible.
- **At each period, participants can exercise an exit option from the partnership. This option ends the partnership:** Each participant must then successfully complete an individual count task. Its result only affects its own remuneration. Instructions relating to this task will be communicated in the IT interface.
- **If both participants choose option 1:** Both participants receive 8 ECU.
- **If the Type 1 participant chooses option 1 and the Type 2 participant chooses option 2:** The remuneration of the Type 1 participant is 2 ECU and the remuneration of the Type 2 participant is 11 ECU.

- **If the Type 1 participant chooses option 2 and the Type 2 participant chooses option 1:** The remuneration of the Type 1 participant is 11 ECU and the remuneration of the Type 2 participant is 2 ECU.
- **If both participants choose option 2:** Both participants receive 3 ECU.
- **In case of exercise of the exit option by one of the two participants, participants receive:**
    1. Gains from the partnership;
    2. The non-partnership gain of 5 ECU per remaining period till the theoretical random termination (5ECUs* the number of periods that would have been played if the participants had remained in the partnership).

If the Partnership is not formed:

- Type 1 participant wants to set up a project, he/she has the choice between:
    1. Establish an indefinite partnership with the Type 2 participant: the Type 1 participant can terminate this partnership at any time by choosing to exit the partnership;
    2. Set up the project alone.
- Type 2 participant has a choice between:
    1. Each participant must successfully complete an individual task whose outcome does not impact the other participant.
    2. The gain for this off-partnership task is 5 ECU * the number of periods that would have been played if the participants had entered the partnership.

Layout Example

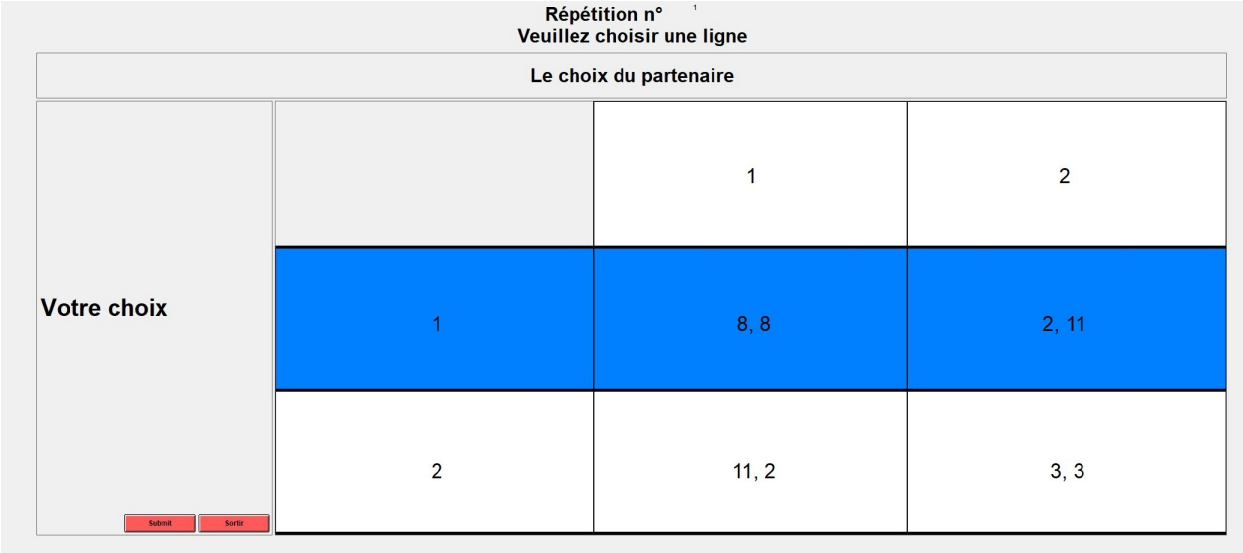


Figure 17. Screenshot of the PD game within a partnership.

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