Public Disclosure Authorized

Public Disclosure Authorized

WPS6569

Policy Research Working Paper 6569

The Effects of Country Risk and Conflict on Infrastructure PPPs

Gonzalo Araya
Jordan Schwartz
Luis Andres

The World Bank
Sustainable Development Network
Infrastructure Policy Unit
August 2013

Policy Research Working Paper 6569

Abstract

Through an empirical analysis of the relationship between private participation in infrastructure and country risk, the paper shows that country risk ratings are a reliable predictor of infrastructure investment levels in developing countries. The results suggest 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, and a 41 percent higher level of investment in dollar terms. The predictive ability of country risk ratings exists for all sectors of infrastructure and for both greenfield and concessions. On average, energy investments exhibit a higher sensitivity to country risk than transport, telecommunications, and water investments. Concessions are more sensitive than greenfield investments to country risk, although country risk is a good predictor of investment levels for both contractual forms. Although foreign direct investment is found to be sensitive to country risk, the causal relationship is not nearly as sensitive as it is with private participation in infrastructure. Finally, an analysis of private participation in infrastructure patterns for those countries emerging from conflict reveals that conflict-affected countries typically require six to seven years to attract significant levels or forms of private investments in infrastructure from the day that the conflict is officially resolved. Private investments in sectors where assets are more difficult to secure--such as water, power distribution, or roads--are slower to appear or simply never materialize.

This paper is a product of the Infrastructure Policy Unit, Sustainable Development Network. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at gonzaloarayaa@gmail.com, jschwartz3@worldbank.org, and landres@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Produced by the Research Support Team

The Effects of Country Risk and Conflict on Infrastructure PPPs

Gonzalo Araya, Jordan Schwartz, and Luis Andres[1]

(1) Key Words: risk, infrastructure, public-private partnerships (PPPs), conflict, energy, transport, water, telecommunications, foreign direct investment (FDI)

(2) AEA Jel Classifications: D81, E22, F21, G32, H54, O18

(3) Sector Board: Infrastructure Panel

[1] Gonzalo Araya is a doctoral student at Toulouse School of Economics (TSE) and a former Junior Professional Associate in the Sustainable Development Department of the World bank's Latin America and Caribbean Region; Jordan Schwartz is Manager of Infrastructure Policy at the World Bank, based at the Bank's Center for Infrastructure & Urban Development in Singapore; and Luis Andres is Lead Economist in the Sustainable Development Department for the South Asia Region of the World Bank. They are grateful to Marianne Fay, World Bank Chief Economist for Sustainable Development, for her thorough review and quality assurance of this paper, to Tito Cordella for early guidance on the approach, and to Karina Izaguirre and Alex Jett for their support with the PPI Database. The findings, interpretations and conclusions expressed herein do not necessarily reflect the views of the Board of the Executive Directors of the World Bank or the governments they represent. The authors' email addresses are: gonzaloarayaa@gmail.com, jschwartz3@worldbank.org, and landres@worldbank.org.

1. Introduction

The impact of infrastructure endowment and quality on growth and development indicators is well documented as are the complementary roles of the public and private sectors in service provision.[2] The role of the private sector as an operator of infrastructure assets, and an investor, part-owner or partial-financier of capital assets has become a common and growing feature of infrastructure provision in developing countries over the last twenty years—particularly in electricity generation and supply, telecommunications, ports, rail and airports. Private financing and operations of highways, bridges and road networks are also becoming more commonplace. To a lesser degree, urban services such as water supply and sanitation and Bus Rapid Transit systems have also benefited from private operations and investment.[3]

There has been an important increase in infrastructure PPPs--herein referred to as "private participation in infrastructure (PPI)"—so as to capture management contracts on one extreme of the risk spectrum and asset sales, auctions and privatizations on the other--over the last two decades. Annual commitments[4] to PPI projects have more than doubled over the last five years from levels seen in the previous ten years. For the period 2006-2010, total commitment to PPI projects reached US$757 billion (Figure 1).

Despite the overall growth trends, levels of investment in PPI vary across countries. There are countries of similar GDP with huge disparities in the levels of private infrastructure investment. For example, Angola benefited from US$ 2.0 billion in PPI between 2000 and 2010 while Tunisia attracted US$ 5.5 billion[5]. Likewise, Peru received more than US$10 billion in PPI over that period while Azerbaijan received less than US$0.8 billion in the same period.

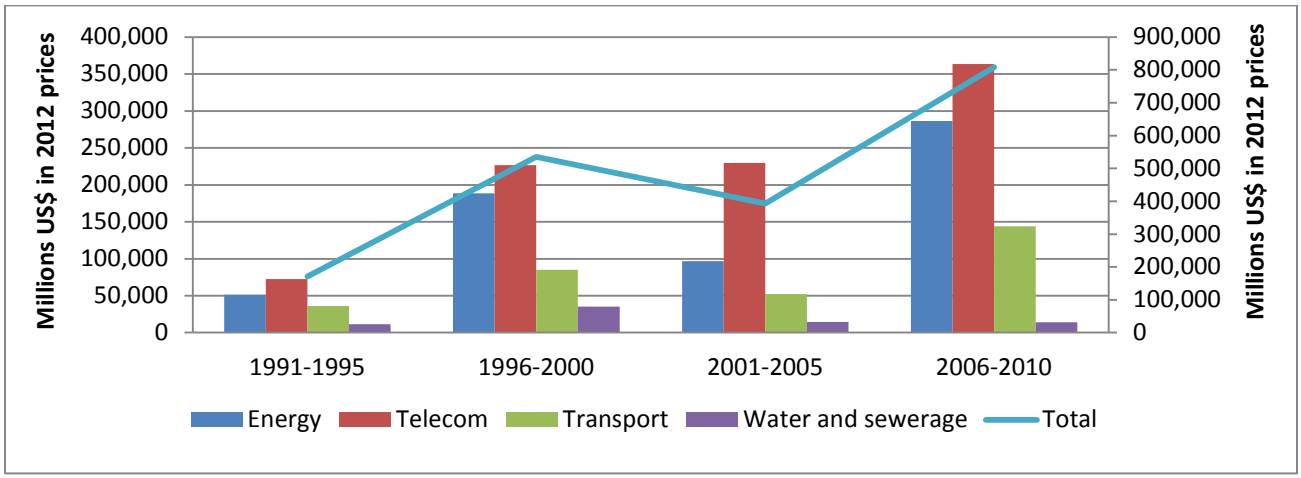
[2] Serven & Calderon (2004); Straub (2008)

[3] See the PPI Database home page at ppi.worldbank.org.

[4] Investment in this paper refers to the resources the project company commits to invest in facilities during the contract period. Investments can be either in new facilities or in expansion and modernization of existing facilities. Data entry varies across sectors: For projects other than telecommunications and large energy utilities, the total cost of developing or expanding the facility during the contract period is entered as investment data in the year of financial closure (for which data are typically available). For telecommunications projects and some large energy utilities, annual investments on facility expansion and modernization are entered as investment data in the year of investment when information is publicly available. Investments are recorded in millions of US dollars in either the year of financial closure or year of investment as indicated above.

[5] The GDP per capita for Angola is US$ 4,422 and US$4,198 for Tunisia in 2010.

Figure 1: Overall trends in PPI Levels in five years periods, by sector (US$ millions, 1991-2010)



Source: World Bank PPI Database

For policy makers trying to leverage private capital and attract operational efficiencies in infrastructure and basic service provision, understanding the underlying factors that influence levels of PPI is of central importance. That understanding can influence the timing of market offerings, the prioritization and sequencing of sectors or projects, decisions about the use of credit enhancements, expectations for investment commitments, and the form of contract pursued by governments. Moreover, if a relationship between public policies and levels of investment in PPI can be demonstrated, it raises the visibility of PPI success or failure above the level of line agencies. It can focus senior officials from ministries of finance, economy and planning as well as legislators and offices of the president, on public policy shortcomings—such as decisions on national debt restructuring, rules governing repatriation of capital, or expropriation practices—which previously may have seemed irrelevant to the considerations of market interest in a single investment opportunity.

This raises the question of whether country risk ratings—which agglomerate several political, economic, credit and financial conditions and behaviors at the sovereign level—can be used to explain a part of the differences among countries trying to attract investments, and, if so, whether that difference is significant over the years. Simply asked, does sovereign risk play a significant role as a predictor of PPI in developing countries? With panel data on both risk ratings and investment commitments, it is possible to identify which are the most sensitive sectors and forms of PPI to changes in country risk ratings. It is then possible to contrast the effects of risk on investments in energy, telecommunications, water and transport. Likewise, we can test the relative sensitivity of greenfield investments as well as concessions of existing assets to country risk.

As described below, previous work on foreign direct investment suggests a modest but significant correlation between risk and Foreign Direct Investment (FDI). By using the same panel data on risk ratings for both PPI and FDI, we are able to contrast the relationship of PPI to risk with the relationship of FDI to risk. Of course, FDI and PPI panels have some endogeneity—that portion of FDI which flows into infrastructure sectors overlaps with the portion of PPI which is derived from both private equity and foreign sponsors. However, the foreign investment component of PPI is central to the business of private investment in infrastructure so much so that isolating domestic-generated investments would render the exercise meaningless. That is, since an objective of the analysis is to see how investors respond to sovereign risk when partnering with a government in long-term investments, capturing foreign investors in the data set is central to the analysis.

Embedded within country risk are traits such as political instability so that civil and cross-border conflict affects risk ratings proportionate to their severity on economic activity. In order to isolate the unique risks associated with long-term investments, such as those in infrastructure, the authors look at PPI data for conflict-affected countries and zero out the years in which a set of conflict-affected countries exited their conflict periods. This reveals patterns related to how long it takes countries to see PPI begin to flow into their country after conflict ends, and which sectors are most likely to benefit from investment.

In order to address these questions this paper is structured as follows: Section 2 summarizes the existing literature regarding country risk and investments, both FDI and the more limited literature on private infrastructure investments. In Section 3, we describe the data used in this paper. Section 4 describes the methodology. In Section 5 the results of the models are shown and, finally, in Section 6 we offer possible explanations for the relationships and trends as well as their policy implications.

2. Existing Literature

There is considerable economic and financial literature attempting to explain the determinants of investment and the relationship between investment and risk. Much of that literature is focused on foreign direct investment rather than infrastructure investments and most of the works utilize cross-country specifications. For example, Chakrabarti (2001) concludes that market size is a robust determinant of FDI and Nunnenkamp (2002) identifies exchange rate, openness, growth rate, and trade balance as determinants of overall investment levels.

Jun and Singh (1996), using polled panel data, note the relationship between political risk, business conditions, macroeconomic variables and FDI. Busse and Hefeker (2005) explore the linkages between political risk, institutions and FDI, concluding that political stability and basic democratic rights are highly significant determinants of FDI.

As mentioned, the literature on infrastructure investments and risk is thinner. In the case of PPI transactions, Hammami et al. (2006), using the World Bank PPI Database concludes that lower levels of corruption and more effective rule of law are associated with more Public-Private Partnership projects. This study captures only the effect on the number of projects committed, not the investment levels per se, leaving room for further study, especially if we consider that bigger projects (committing more resources) may be more sensitive to the risk of the country.

3. Data

In order to obtain PPI levels, we utilized the World Bank PPI Database. The PPI database offers detailed information by year, country, sector and form of public-private partnership. Within sectoral categories, it distinguishes among primary and secondary sectors by investment.[6] It also provides the form of private investments, so we can distinguish between greenfield projects and concessions of existing assets among other types of partnerships and investments.

The database, however, captures both public contributions to the infrastructure investments as well as private contributions. That is, the database notes total project size in commitments—later adjusted to actual disbursements, investments or transfers, where information is available. Those commitments combine private and, in many cases, public sources. The threshold for consideration is that the project involves a private service provider building Greenfield assets for its own operation, or—in the case of existing assets—purchasing, concessioning or leasing assets, or otherwise contracting for provision of the infrastructure services. Only projects that have come to financial closure are included in the database. If a purely public investment is carried out in tandem with a private operator or a private management contractor, the database does not include a value for those public investments. All project figures are noted in the year that the project comes to financial closure.

[6] As examples, Energy and Transport are "primary sectors" whereas Electricity Distribution and Airports are "secondary sectors."

For the purpose of this paper, the PPI database is an appropriate source of information because it reports the *commitments* of the investments for each year by country and by sector once a contract has come to financial closure—that is, a license, sale, concession, lease, BOT or other contractual agreement is signed by both parties and financial arrangement have been secured. Having the commitments instead of the actual investments allows us to establish a clearer relationship between investments and country risk at a given point in time. The decision of investing (commitment) and the willingness of financiers to come to closure on that commitment are made, inter alia, in the context of the political conditions, economic performance, sovereign credit worthiness and fear of expropriation at the time of financial closure. Because there may be exogenous reasons for differentiation between an original commitment to invest and the eventual disbursement levels—including external shocks, canny renegotiations or changes in tariffs or relative prices--the best time to value an investment relative to country risk is the moment that the commitment comes to financial closure.

Taking the data from the PPI database we gather information regarding 130 developing countries from 1990 until 2010. The panel data were complemented with data from World Development Indicators with variables such as GDP, GDP growth, inflation, country openness, and foreign direct investments.

For completeness in matching with the PPI database, we chose Euromoney's Country Risk ratings. While both Euromoney and the International Country Risk (ICR) ratings move similarly and are highly correlated[7], Euromoney provides a larger sample, covering countries like Cambodia, Georgia, Rwanda and Tajikistan that are not covered by ICR ratings. The Euromoney country risk index is a weighted average of the following indicators: i) Political risk (25%—non-payment or non-servicing of payment for goods or services, loans, trade-related finance and dividends; and non-repatriation of capital); ii) Economic performance (25%—GNP per capita, and average from poll of economic projections); iii) Debt indicators (10%); iv) Debt in default or rescheduled (10%); v) Credit ratings (10%—average of Moody's, S&P and Fitch IBCA); vi) Access to bank finance (5%); vii) Access to short-term finance (5%); viii) Access to capital markets (5%); and ix) Discount on forfeiting (5%) (Average maximum tenor for forfeiting and average spread over riskless countries).

The country risk index goes from 0 to 100, where the highest risk is associated with an index of 0. The sample covers 131 countries over 21 years.[8] The list of countries covered by the sample is presented in the Appendix 1.

[7] With a Pearson's correlation of 0.66

[8] The database increases throughout the years, with information of 80 countries in 1990 to 131 countries in 2010.

For the conflict analysis (the last exercise of this paper), conflict-affected and post-conflict countries were selected according to the Singer and Small criteria (Singer and Small 1994) . There are 31 countries that meet this definition or are still under conflict (presented in Appendix 1). Countries that exited from war or civil strife prior to 1990 were not considered as conflict affected. The period of analysis is from 1990 until 2010.

4. Methodology

4.1 Private participation in infrastructure

The first step we take is to determine whether the country is likely to have a private investment in infrastructure. For that we utilize a probit model.

$$\Pr(Y = 1|X) = \Pr(Y^* > 0) = \Pr(X'\beta + \varepsilon > 0) = \Phi(X'\beta) \qquad (1)$$

where Y is binary (Y takes the value 1 if the country i does have a commitment in the year t and takes the value 0), that is it can have only two possible outcomes which we will denote as 1 and 0. We also have a vector of regressors X, which are assumed to influence the outcome Y. Pr denotes probability, and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution. The parameters β are typically estimated by maximum likelihood. ε ~ N(0, 1). Then Y can be viewed as an indicator for whether this latent variable is positive. In our case X'β is $\alpha + \beta_1 CR_{it} + \beta_2 RestRegion_{it}$

The variable CR_{it} is the country risk of the country i at time t and the variable $\mathrm{Re}\,st\,\mathrm{Re}\,gion_{it}$ is the PPI commitments of the rest of the region where the country i belongs at time t. The regions considered are Latin America and the Caribbean, South Asia, East Asia and Pacific, Europe and Central Asia, Middle East and North Africa and Sub-Saharan Africa.

We identify how the country risk affects the probability to invest and check if the private commitments are more likely when the country is inserted in a region where the investments are larger.

4.2 Intensity of private participation in infrastructure

Next we explore the intensity of the country risk effect. We follow Busse (2005) to link both components as shown in the equation (2).

$$\log I_{it} = \alpha_i + \beta_1 CR_{it} + \beta_2 \log GDP_{it-1} + \beta_3 \log GROWTH_{it-1} + \beta_4 \log INFLATION_{it-1} + \beta_5 \log OPENNESS_{it-1} + \varepsilon_{it} \quad (2)$$

Equation (2) shows that, where $\log I_{it}$ equals logarithms of the levels of investment for country i at the period t and CR_{it} , the country risk of each country i also in period t. Most econometric specifications dealing with GDP and Investments suffer from endogeneity. We address this problem by assuming that the investments are being affected by events of the previous year. GDP_{it-1} is the Gross Domestic Product PPP in current US millions dollars for the country i in the year t-1. $GROWTH_{it-1}$ is the GDP's growth and both are expected to have a positive impact on Investment levels. $INFLATION_{it-1}$ captures the monetary instability for the country i in the year t-1 and is expected to have a negative impact. $OPENNESS_{it-1}$ is a proxy of the openness of the country calculated as the sum of exports and imports over the GDP; it is expected to have a positive impact on the investments. Since the participation decisions can be explained also by events of more than one year ago, we estimate the equation with two, three and four years lag.

Table 1: Descriptive Statistics

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Country Risk	2,566	35.1	13.7	1.2	83.3
GDP PPP (MMUS$)	2,646	134,000	512,000	99.8	10,100,000
GDP Growth (%)	2,764	3.6	6.9	-51.0	106.3
Inflation (%)	2,756	68.6	674.8	-32.8	26762.0
Openness (%)	2,606	79.6	39.1	0.2	280.4

Source: Authors' calculations

Table 2: Correlation of the explanatory variables and the Country Risk

	Country Risk	GDP	GDP Growth	GDP per cap	Inflation	Openness
Country Risk	1					
GDP	0.330	1				
GDP Growth	0.132	0.068	1			
GDP per cap	0.470	0.185	0.004	1		
Inflation	-0.123	-0.006	-0.210	-0.047	1	
Openness	-0.002	-0.167	0.034	0.214	0.029	1

Source: Authors' calculations

Since the model is specified in logarithms, for those countries in which there is no investment in a given year, the observations are dropped. We address this running a fixed effect model as

suggested by MaCurdy (1981) where the unobserved variables that are explaining the likelihood to invest are captured in the fixed term per country, so as to avoid selection problem. We also do a robustness check for the parameters estimated with the fixed effects model, applying a two-step Heckman, where in the first step we estimate the probability to invest and in the second, adding the inverse of the mills ratio, we estimate the impact on the level of investment. This methodology is applied to estimate the effect of country risk by sector and by type of investments to see if the impacts vary among the energy, transport, telecom and water sectors and between greenfield or concession contracts.

We also apply these estimations to foreign direct investments to analyze their relationship with country risk and compare it with the results for PPI. The motivation is to contrast FDI with PPI to determine which are more sensitive to risk.

To understand the behavior of PPI in Post-Conflict Countries we had to homogenize the data—or "zero out" the year in which conflict ended. Since nearly every post-conflict country has a different "end of conflict" year, we designed a timeframe where we can compare each year after conflict for the post-conflict countries. We break down the PPI by sector to see which sector is more likely to appear in the first period after crisis and what other trends are identifiable in the post-conflict years. The full list of post-conflict countries is in Appendix 2.

5. Results and Analysis

5.1 Total private-participation investments

The first step is to see how likely it is to bring to financial closure a private participation in infrastructure deal given country risk rating; i.e. the model of equation (1).

As illustrated in Table 3, the coefficient associated with country risk is positive and statistically significant. That is, the lower the risk of the country, the greater the probability of commitments in public-private infrastructure. This result holds even if we control for commitments in the rest of the region. As we can see an improvement in the country risk has an important effect on the likelihood to invest in developing countries.

The results show that once the main characteristics of the economies—i.e., size, Inflation and Openness—have been taken into consideration, and according to specification (3), improving an Standard Deviation (SD), 13.8 point, in the country risk, implies a 27 percent increase in the probability of undertaking PPI. The results show that the country risk is a good predictor of the

likelihood of PPI commitments even controlling for fundamental characteristics of the economies.

Table 3: The Effect of Country Risk on the Probability of Undertaking PPI Commitment

VARIABLES	Inv. Commitment (1)	Inv. Commitment (2)	Inv. Commitment (3)
Country Risk	0.0408***	0.0485***	0.0196***
	(0.0040)	(0.0036)	(0.00598)
Rest of Region	4.59e-05***		3.62e-05***
	(3.70e-06)		(4.87e-06)
Log GDP PPP			0.670***
			(0.0728)
Log GDP Growth			0.0154
			(0.0544)
Log Inflation			-0.161***
			(0.0412)
Log Openness			0.445***
			(0.168)
Constant	-1.685***	-1.378***	-17.87***
	(0.1650)	(0.144)	(1.969)
Observations	2,566	2,566	1,753
Number of countries	131	131	121

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Note: Running the equation (1) and (2) with the same observations of the column (3), the coefficient associated to the country risk are: 0.046 and 0.052 respectively.

The relation between the country risk and the intensity of the commitments is estimated through the model in equation (2).

The results presented in Table 4 are those resulting from the fixed effect model, since the Hausman test rejected the hypothesis there is no difference between estimators and therefore the coefficients of the random effect model are not consistent.[9] The importance of the fixed effect model is that it allows capturing unobservable variables that explain the likelihood to participate in a PPI. Therefore, there is no selection bias problem. As robustness check we provide estimation results of the Heckman two step procedures in Appendix 4.

[9] The Haussmann test rejected the null hypothesis that there is no difference between the coefficients of the random effects model and the fixed effects model. In other words, there is no evidence to support the assumption that there is no correlation between regressors and the random effects. In this way we assume that the idiosyncrasy of each country is also playing an important role.

As we can see in Table 4, the risk rating of the country also explains the level of investment; the lower the risk of the country, the greater the level of investment in private participation in Infrastructure Investments, even if we take out most of the controls.

In the specifications of column (5) the overall r-squared is over 65 percent; a high value for a panel data model.[10] Also, the between r-squared is very high with a value around 75 percent. The variables are statistically significant at 95 percent confidence with the exception of GDP growth. This presents a positive impact but only with 90 percent confidence. Openness is not significant.

Table 4: The Effect of Country Risk on PPI Commitments

VARIABLES	(1)	(2)	(3)	(4)	(5)
Country Risk	0.0531***	0.0359***	0.0274***	0.0280***	0.0300***
	(0.00508)	(0.00491)	(0.00554)	(0.00563)	(0.00574)
Log GDP PPP		1.461***	1.475***	1.484***	1.419***
		(0.0952)	(0.0990)	(0.103)	(0.119)
Log GDP Growth			0.131***	0.0981*	0.100*
			(0.0505)	(0.0526)	(0.0538)
Log Inflation				-0.0846**	-0.0808**
				(0.0401)	(0.0409)
Log Openness					0.134
					(0.212)
Constant	2.866***	-32.02***	-32.21***	-32.25***	-31.34***
	(0.203)	(2.269)	(2.366)	(2.485)	(2.562)
R2 within	0.0729	0.2228	0.2150	0.2266	0.2262
R2 between	0.3158	0.7218	0.7300	0.7328	0.7535
R2 overall	0.2842	0.6211	0.6296	0.6373	0.6475
Observations	1,518	1,464	1,283	1,219	1,201
Number of countries	127	124	120	120	119

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Note: These results are from the random effect model as well. Appendix 3 provides the results for the fixed effect model. The results show the same message. As robustness check, we also estimate the equation with three, four and five lags, which results are in the Appendix 5.

[10] Values over 10 percent are accepted in the common literature, due to the bi-dimensional nature (countries and time) of the panel data model.

The marginal effect of an improvement in country risk has a positive effect on the level of PPI investment in Infrastructure. The model of column 5 shows that an improvement of one point in the country risk rating produces on average an increase of 3 percent in the level of private investments in infrastructure. In other words, an one-standard-deviation improvement in the country risk (13.8 points) will imply a 41 percent more PPI commitment.

5.2 Private-participation investments per sector

The PPI database provides data on commitments into private infrastructure projects separated by sectors: energy, telecom, transport, and water and sewerage.

In every sector, the effects of country risk are present and statistically significant. The lower the country risk, the greater is the likelihood of an investment. Table 5 summarizes these results.

The sensitivity is very high and statistically significant in the sectors of energy, transport, and water and sewerage (at the level of 0.01). In the case of Telecom the marginal effect of the country risk is lower than the other sectors and not as statistically significant as the other sectors. This may be explained by the nature of many telecommunications investments—particularly in the mobile sub-sector—which have high rates of return and shorter cost recovery periods than traditional forms of infrastructure.

Table 5: Probability of Undertaking PPI Investment by Sector

VARIABLES	PPI Energy (1)	PPI Telecom (2)	PPI Transport (3)	PPI Water (4)
Country Risk	0.0265***	0.0154**	0.0296***	0.0214***
	(0.00573)	(0.00615)	(0.00604)	(0.00696)
Log GDP ppp	0.359***	0.943***	0.410***	0.414***
	(0.0527)	(0.112)	(0.0556)	(0.0626)
Log GDP Growth	0.0491	-0.0236	0.115*	-0.00944
	(0.0596)	(0.0565)	(0.0682)	(0.0878)
Log Inflation	-0.126***	-0.219***	-0.0288	-0.129**
	(0.0431)	(0.0420)	(0.0495)	(0.0618)
Log Openness	0.000283	0.754***	-0.139	-0.166
	(0.156)	(0.183)	(0.156)	(0.177)
Constant	-10.32***	-25.15***	-11.88***	-11.90***
	(1.484)	(2.752)	(1.579)	(1.788)
Observations	1,753	1,753	1,753	1,753
Number of countries	121	121	121	121

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

When we estimate the effect of the country risk on the level of the investment, we see that the energy sector remains the most sensitive to changes in country risk ratings not only in the likelihood of undertaking PPI investments but also when predicting the level of the investments.

A change of one point in country risk is linked on average to an increase of 3.8 percent in investments in energy. After energy comes transport with a 2.5 percent and then telecommunication with 1.6 percent, while "Water and Sewerage" does not have a statistically significant effect. Hence, improving an SD (13.8 points) in the country risk, implies a 53.4, 34.6, and 22.4 percent increase in the probability of undertaking PPI in energy, transport, and telecom sectors, respectively. In the "Water and Sewerage" sector the country risk explains the likelihood to commit but not the level of commitment as in other sectors, mainly explained by the fact that almost every water and sewerage investments in PPI database are greenfield projects (around 98%). The nature of the projects is analyzed in the following section.

Table 6: The Effect of Country Risk on PPI Investment Levels by Sector

VARIABLES	Log PPI Energy (1)	Log PPI Telecom (2)	Log PPI Transport (3)	Log PPI Water (4)
Country Risk	0.0387***	0.0162***	0.0251*	0.0151
	(0.0110)	(0.00552)	(0.0128)	(0.0184)
Log GDP ppp	0.396	1.816***	1.108***	1.071*
	(0.255)	(0.118)	(0.324)	(0.622)
Log GDP Growth	0.00770	0.116**	0.432***	-0.340
	(0.101)	(0.0515)	(0.142)	(0.216)
Log Inflation	-0.160*	-0.0350	-0.0751	-0.283*
	(0.0920)	(0.0397)	(0.0988)	(0.149)
Log Openness	-0.230	0.0134	-0.160	-1.266
	(0.474)	(0.202)	(0.556)	(1.023)
Constant	-5.224	-40.60***	-24.51***	-18.36
	(5.475)	(2.556)	(7.161)	(14.10)
R2 within	0.0513	0.2987	0.1417	0.1323
R2 between	0.4441	0.7776	0.2745	0.0693
R2 overall	0.3687	0.6461	0.3108	0.0393
Observations	476	1,063	313	140
Number of countries	83	111	69	39

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

5.3 Private-participation investments per types of projects

The evidence shows that concessions are on average a little more sensitive to country risk than greenfield projects. Table 7 shows the specifications for each type of project. The importance of country risk for both types of projects can also be observed in its relation with the intensity of the investments. In the table we can see the effect of country risk is higher for concession not only on the probability to commit the investment but also higher in the intensity of the commitments.

This finding is consistent with the nature of concessions vis-à-vis greenfield projects. Many greenfield projects—particularly energy generation, and water and wastewater treatment plants—are backstopped by power purchase or off-take agreements. In those cases, the revenue source is a public utility or government agency. Greenfield toll roads generally have some form of minimum traffic or revenue guarantee associated with them. These agreements effectively cover many of the economic risks incorporated in sovereign risk, such as change in demand due to economic growth or contraction as well as currency or inflation risks. Concessions, in contrast, are more frequently used for existing assets such as power and water distribution companies. These investments expose the PPI investor to commercial and economic risks that are not easily ring-fenced or backstopped by government.

Table 7: Probability of Undertaking an Investment in Greenfield Projects and Concessions

VARIABLES	PPI Green F	PPI Concess
	(1)	(2)
Country Risk	0.0192***	0.0224***
	(0.00599)	(0.00600)
Log GDP ppp	0.855***	0.324***
	(0.0898)	(0.0516)
Log GDP Growth	-0.0169	0.0245
	(0.0547)	(0.0643)
Log Inflation	-0.141***	-0.0405
	(0.0410)	(0.0471)
Log Openness	0.712***	-0.258*
	(0.171)	(0.155)
Constant	-23.15***	-8.766***
	(2.368)	(1.443)
Observations	1,753	1,753
Number of countries	121	121

*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' calculations

Table 8: The Effect of Country Risk on the Level of Investment, by Type of Investment

VARIABLES	PPI Green F (1)	PPI Green F (2)	PPI Concess (3)	PPI Concess (4)
Country Risk	0.0261***	0.0308***	0.0320**	0.0334***
	(0.00581)	(0.00495)	(0.0133)	(0.0117)
Log GDP ppp	1.517***	1.683***	0.770**	0.626**
	(0.122)	(0.0973)	(0.375)	(0.243)
Log GDP Growth	0.108**		-0.0295	
	(0.0551)		(0.143)	
Log Inflation	-0.131***		-0.124	
	(0.0430)		(0.112)	
Log Openness	0.428**		-0.444	
	(0.216)		(0.635)	
Constant	-35.31***	-37.85***	-14.14*	-12.55**
	(2.653)	(2.341)	(8.158)	(6.196)
R2 within	0.2719	0.2618	0.0569	0.0513
R2 between	0.6965	0.7070	0.3351	0.2612
R2 overall	0.6324	0.6024	0.2918	0.2413
Observations	1,088	1,333	318	376
Number of countries	113	119	74	80

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

5.4 Contrasting public-private partnerships for infrastructure and foreign direct investment

In order to illustrate the importance of country risk on the levels of investment in infrastructure, Table 9 contrasts the relationship between the level of private investment in infrastructure and country risk, and the relationship between the level of FDI and country risk. As shown in column (2) of the table, PPI investments are more sensitive to country risk than FDI When the telecom sector is excluded, the effect of country risk is even higher. This is explained by the nature of the telecommunications sector—namely, higher profit margins and faster cost recovery periods--which is more akin to the nature of non-infrastructure sectors of foreign direct investments.[11]

Therefore, if we set aside telecommunication investments and reduce our scope to energy, transport and water and sewerage, we can make a more stark comparison between infrastructure investments and FDI.

[11] As we see in Table 5, the effect of the country risk on the probability to commit investments in the telecom is lower than in the other sector due to the tradable nature of this kind of investments.

Table 9: The Effect of Country Risk on PPI and FDI

VARIABLES	Log FDI (1)	Log PPI (2)	Log PPI* (3)
Country Risk	0.0136***	0.0300***	0.0342***
	(0.00486)	(0.00574)	(0.0109)
Log GDP ppp	1.667***	1.419***	0.738***
	(0.101)	(0.119)	(0.255)
Log Gdp Growth	0.0350	0.100*	0.0901
	(0.0457)	(0.0538)	(0.105)
Log Inflation	-0.0287	-0.0808**	-0.183**
	(0.0350)	(0.0409)	(0.0917)
Log Openness	0.648***	0.134	-0.378
	(0.179)	(0.212)	(0.472)
Constant	-37.89***	-31.34***	-12.85**
	(2.155)	(2.562)	(5.467)
R2 within	0.3523	0.2262	0.0571
R2 between	0.6451	0.7535	0.5291
R2 overall	0.6283	0.6475	0.4091
Observations	1,146	1,201	614
Number of _country	116	119	94

*** p<0.01, ** p<0.05, * p<0.1. PPI* excluding Telecom

Source: Authors' calculations.

The country risk and the size of the economy are main variables that explain the level of the commitment in both types of investments, but the effect of country risk is much higher on PPI than on FDI. An improvement of one point in country risk is linked to an increase of 3.4 percent in infrastructure investment. In the case of FDI, such an improvement equals about 1.3 percent more. In other words, foreign investors overall—including those in extractive industries such as coal, gas, oil, forest products, metals or minerals—are more readily able to find returns from their investments commensurate with the country risks they are assuming than investors in infrastructure alone.

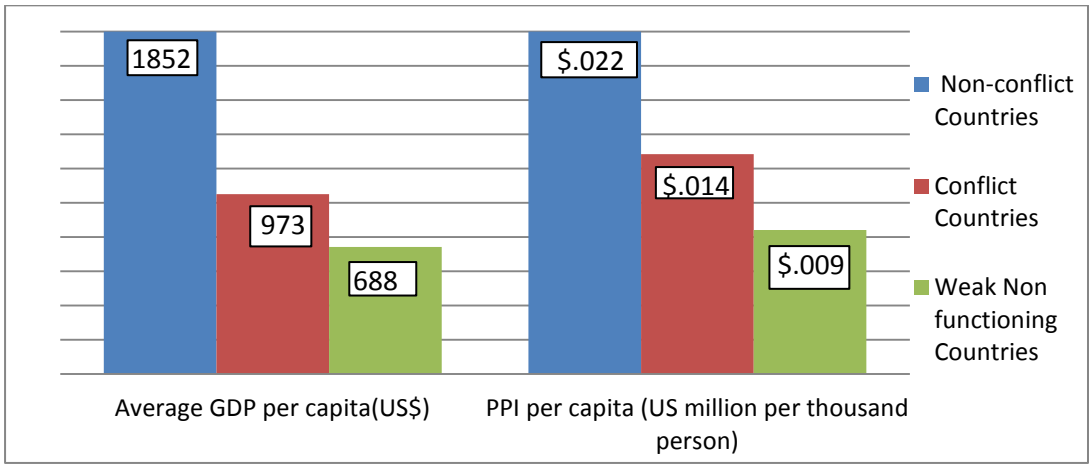
The evidence shows that openness is not a key variable for investment in infrastructure as it is for FDI. This is due to the tradable nature of FDI.

5.5 Conflict-affected states analysis

Few investments can be considered higher risk than those that go into fragile and conflict-affected countries. This section reviews the basic features and timing of PPI in conflict-affected countries to see if they suffer from particular prejudice in trying to attract PPI.

As Figure 2 illustrates, conflict-affected countries are poorer than other developing countries, have smaller economies, and attract less private participation in infrastructure, both in absolute terms and as a share of their population. Not surprisingly, levels are lower still in those countries characterized as having weak or non-functioning governments.[12] Whereas a developing country that has not suffered from recent conflict will attract, on average, US$22 of PPI per capita, conflict-affected countries with functioning government will attract about US$14 per capita of PPI and countries with non-functioning governments will attract about $9 per capita—most of which is coming from the mobile telephony sub-sector.

Figure 2: GDP and PPI per capita in Developing Countries, Conflict-affected Countries and Conflict-affected Countries with Weak or Non-Functioning Governments.



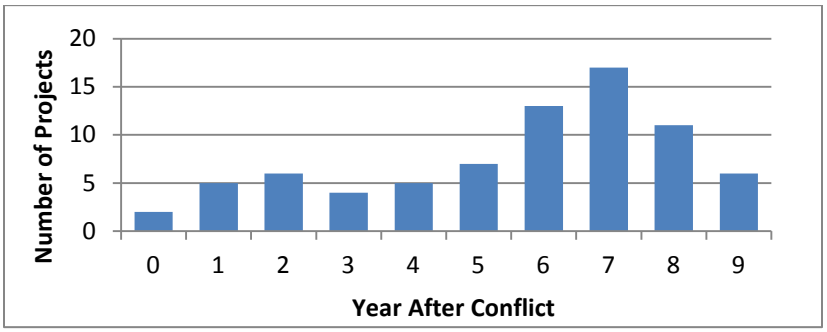
Source: PPI Database and WDI. Authors' calculations.

How long, then, does it take for investments in the form of private infrastructure commitments to return to conflict-affected countries? What sectors are more likely to attract private partners or investors and to close transactions? By zeroing out end-dates of conflicts for a set of 31 countries that have suffered from conflict over the last 20 years, we can establish a fixed point from which to consider investment trends. That is, "Year 0 (Zero)" is the year at which a conflict is considered to have terminated in a country so that conflicts which ended 15 years apart can be put on the same timeline. By creating this normalized timeline, we can see that investments

[12] The conflict-affected countries are: Countries with Weak or-non Functioning Governments: Afghanistan, Algeria, Angola, Azerbaijan, Bosnia and Herzegovina, Burundi, Cambodia, Congo, Dem. Rep. Congo, Rep. El Salvador, Ethiopia, Georgia, Iraq, Lebanon, Liberia, Mozambique, Myanmar, Nicaragua, Rwanda, Sierra Leone, Somalia, Sudan Tajikistan, Yemen, and Rep. Yugoslavia. The Post Conflict-functioning countries are: Colombia, Peru, Philippines, Russian, Federation, Sri Lanka, and Turkey.

trickle in over the first five years and then begin to increase after year five, finding their peak at the seventh year (Figure 3).

Figure 3: Total Number of Private Infrastructure Investments and PPPs in Post-conflict Countries



Source: PPI Database. Authors' estimations.

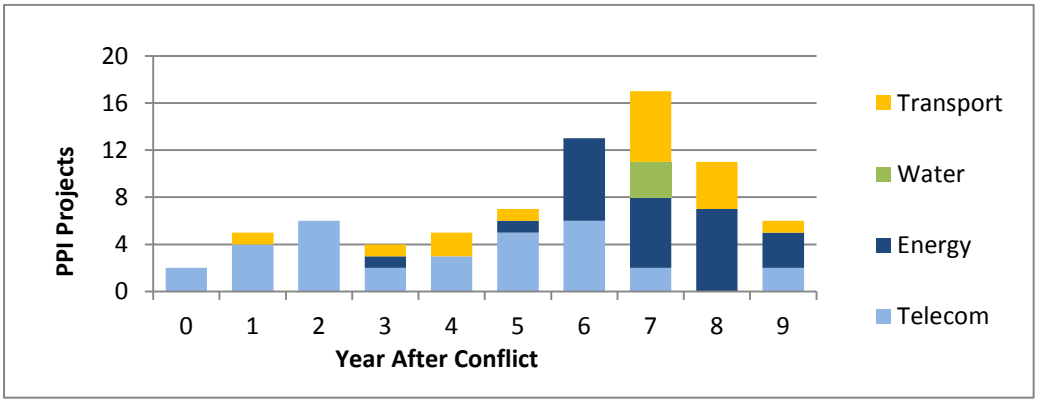
When the data are viewed by sector, however, the story becomes more intriguing. In the first four years, with only a few exceptions, only telecom investments have found their way into countries that have just emerged from conflict. These are almost entirely from mobile licenses and related investments. This single sector concentration may be because the cost recovery period for mobile investments is extremely low, the technology sufficiently diffused and the price elasticity of demand sufficiently high for mobile operators to accept higher levels of country risk. Mobile investors have been active in countries like Somalia during a time when there is little government structure, or Iraq in a matter of weeks after the country was last invaded.

As can be seen in Figure 4, other sectors with larger investment requirements, longer cost-recovery periods, and greater sensitivity to user willingness to pay—such as toll roads, electricity and water utilities—have longer lag times. Private investors in those sectors do not enter conflict-affected countries until six years have passed with only a few exceptions.

By focusing on a sector that has longer-term cost recovery periods, it is easier to see the effects of conflict on investment. In energy, among the 31 countries studied, there is only one case of a private investment in the first five years post-conflict. Disaggregating the sub-sectors of energy, it is clear that the majority of investments are in power generation. In these cases, off-take agreements for power purchasing can minimize exposure to commercial risk—as can other credit enhancements, including political risk insurance. This is consistent with the regressions run on the relationship of country risk to greenfield projects versus concessions. In addition, the assets can be physically protected and secured more easily than distribution networks. Out of 28 total energy projects in these 31 countries, 19—or two-thirds of the total—are in electricity generation. Only one electricity distribution investment was made in the first six years from the

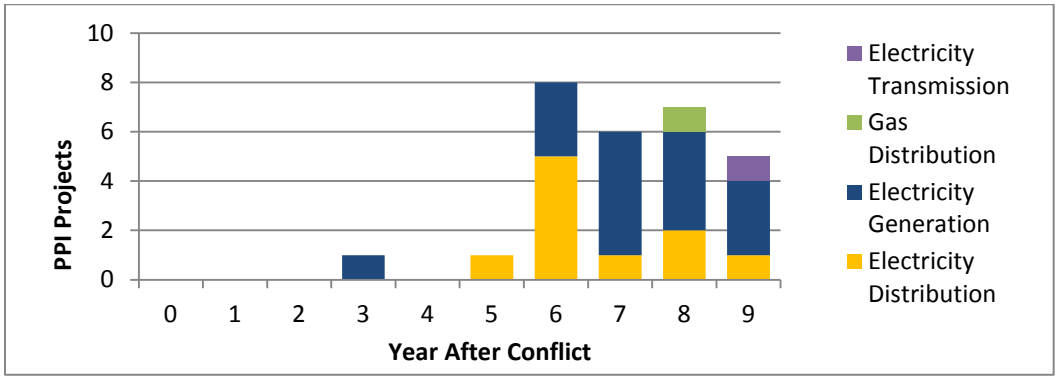
time the conflict ends. The only gas distribution investment came eight years after conflict ended (Figure 5).

Figure 4: Number of Private Infrastructure Investments and PPIs in Post-conflict Countries by Sector



Source: PPI Database. Authors'estimations.

Figure 5: Number of Private Energy Projects in Post-Conflict Countries by Sub-Sector



Source: PPI Database. Authors' estimations.

6. Conclusions

Through a quantitative analysis that looks at the relationship between private participation in infrastructure (PPI) and country risk, we conclude that investment in infrastructure is highly sensitive to sovereign risk. That is, country risk ratings are a reliable predictor, on average, of PPI levels in developing countries. The predictive ability of risk ratings exists for all sectors of infrastructure and for both greenfield and concessions, however, with important variations among them. Our results suggest 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 PPI commitment. That difference is also associated with a 41 percent higher level of commitments in dollar terms. By sector, on average, energy investment levels exhibit a higher sensitivity to country risk, while water and sewerage are much less sensitive. This is due to the form of PPI investment in water and sanitation, which to date has overwhelmingly been undertaken through greenfield water and wastewater treatment plants, rather than in "utilities" or distribution assets that are exposed to retail risk.

Transport sector investments have much greater standard errors than the other sectors, suggesting that individual investment policies, such as the use of guarantees, off-take agreements and other credit enhancements, play a critical role, or perhaps the risk profiles of sub-sectors (e.g., ports and airports versus railroads and highways) may vary widely among them.

As for the form of PPI contract, concession investments are more sensitive than greenfield agreements to country risk. As noted in the water sector analysis, greenfield investments often shield investors from economic and commercial risks that are part and parcel of sovereign risk, such as fluctuating demand (drive by changes in economic activity) and currency depreciation. Still, both forms of investment have a good statistical adjustment, meaning country risk is a predictor of investment levels for both concessions and for greenfield investments.

Comparable regressions were run on FDI to see whether country risk ratings were as strongly correlated as they are for PPIs, showing interesting results. PPI investments are more sensitive to country risk than FDI. Moreover, the size of the economy (i.e. GDP) is a better predictor of FDI than it is for PPI. This suggests that FDI is more likely to flow into high risk countries—particularly those with large economies—than PPI. The role of extractive industries and the relative value of tradable investments may explain the lower sensitivity of FDI to sovereign risk than that of PPI.

For conflict-affected countries, data on numbers of PPI transactions successfully transacted within nine years of a conflict ending illustrate how difficult it is for these countries to attract private infrastructure investments of any form. Very few investments took place in the first five years after conflict ended, and nearly all of those investments were in the telecommunications sector—primarily in mobile telephony. Energy investments took six or seven years to mobilize and came primarily in electricity generation—investments that are often characterized by sovereign-backed power purchase agreements, dollar denominated transfers and an asset footprint that is much easier to protect from attack than a distribution network.

References

Amemiya, T. 1981. Qualitative response models: A survey. *Journal of Economics Literature 19*: 1483-1956.

Asiedu, Elizabeth (2002), On the Determinants of Foreign Direct Investment to Developing Countries: Is Africa Different? World Development, Vol 30, No. 1, pp 107-119.

Chakrabati, Avik (2001), The Determinants of Foreign Direct Investment: Sensitivity Analyses of Cross-Country Regressions, Kyklos, Vol. 54, No. 1, pp 89-113.

Calderon C. and Servén L. (2004), The Effects of Infrastructure Development on Growth and Income Distribution. World Bank Policy Research Working Paper No. 3400.

Canning D. and P. Pedroni (2004), The Effect of Infrastructure on Long Run Economic Growth.

Busse, M. and C. Hefeker (2005). Political Risk, Institutions and Foreign Direct Investment. European Journal of Political Economy. Vol. 23 Issue 2. pp 397-415.

Hammami M, Ruhashyankiko J, Yehoue E (2006). Determinants of Public-Private Partnerships in Infrastructure. IMF Working Paper No 06/99.

Jun, K. and Harinder Sigh (1996) Some New Evidence on The Determinants of Foreign Direct Investment in Developing Countries. World Bank Policy Research Working Paper No. 1531,

MaCurdy, Thomas E. (1981). An Empirical Model of Labor Supply in a Life-Cycle Setting. The Journal of Political Economy, Vol 89, No. 6 (Dec 1981), 1059-1085.

Nunnekamp P. (2002). Determinants of Foreign Direct Investment in Developing Countries Has Globalization changed the rules of the game?. Kiel University Working Papers. No. 1122

Sanchez-Robles, B. (1998), Infrastructure Investment and Growth: Some Empirical Evidence. Contemporary Economic Policy, 16: 98–108.

Schwartz, J. Hahn S. and I. Bannon I. (2004). The Private Sector`s Role in the Provision of Infrastructure in Post-Conflict Countries: Patterns and Policy Options. World Bank Social Development Papers. Conflict Prevention & Reconstruction. Paper No. 16.

Straub S. (2008), Infrastructure and Growth in Developing Countries: Recent Advances and Research Challenges. World Bank Policy Research Working Paper No. 4460.

Appendix 1

Table 10: Countries covered in the sample

Afghanistan	Djibouti	Liberia	Senegal
Albania	Dominica	Libya	Serbia
Algeria	Dominican Republ	Lithuania	Seychelles
Angola	Ecuador	Macedonia (FYR)	Sierra Leone
Antigua and Barb	Egypt, Arab Rep.	Madagascar	Solomon Islands
Argentina	El Salvador	Malawi	Somalia
Armenia	Eritrea	Malaysia	South Africa
Azerbaijan	Ethiopia	Maldives	Sri Lanka
Bangladesh	Fiji	Marshall Islands	St Lucia
Belarus	Gabon	Mauritania	St. Vincent and
Belize	Gambia, The	Mauritius	Sudan
Benin	Georgia	Mexico	Suriname
Bhutan	Ghana	Micronesia, Fed.	Swaziland
Bolivia	Grenada	Moldova	Syrian Arab Repu
Bosnia and Herze	Guatemala	Mongolia	Tajikistan
Botswana	Guinea	Morocco	Tanzania
Brazil	Guinea-Bissau	Mozambique	Thailand
Bulgaria	Guyana	Myanmar	Togo
Burkina Faso	Haiti	Namibia	Tonga
Burundi	Honduras	Nepal	Tunisia
Cambodia	India	Nicaragua	Turkey
Cameroon	Indonesia	Niger	Turkmenistan
Cape Verde	Iran, Islamic Re	Nigeria	Uganda
Central African	Iraq	Pakistan	Ukraine
Chad	Jamaica	Panama	Uruguay
Chile	Jordan	Papua New Guinea	Uzbekistan
China	Kazakhstan	Paraguay	Vanuatu
Colombia	Kenya	Peru	Venezuela, RB
Congo, Dem. Rep.	Korea, Dem. Rep.	Philippines	Vietnam
Congo, Rep.	Kyrgyz Republic	Romania	Yemen, Rep.
Costa Rica	Lao PDR	Russian Federati	Zambia
Cote d'Ivoire	Lebanon	Rwanda	Zimbabwe
Cuba	Lesotho	Sao Tome and Pri	

Appendix 2

Table 11: List of Post Conflict Countries

Conflict Countries: Weak or Non-Functioning State, Widespread Conflict	Conflict Countries: Functioning State, Regional Conflict
Afghanistan (Low Income)	Colombia (Lower Middle Income)
Angola (Low Income)	Peru (Lower Middle Income)
Algeria (Lower Middle Income)	Philippines (Lower Middle Income)
Azerbaijan (Low Income)	Russian Federation (Lower Middle Income)
Bosnia and Herzegovina (Lower Middle Income)	Sri Lanka (Lower Middle Income
Burundi (Low Income)	
Cambodia (Low Income)	
Congo, Democratic Republic of (Low Income)	
Congo, Republic of (Low Income)	
El Salvador (Lower Middle Income)	
Ethiopia (Low Income)	
Georgia (Low Income)	
Iraq (Lower Middle Income)	
Lebanon (Upper Middle Income)	
Liberia (Low Income)	
Mozambique (Low Income)	
Myanmar (Low Income)	
Nicaragua (Low Income)	
Rwanda (Low Income)	
Sierra Leone (Low Income)	
Somalia (Low Income)	
Sudan (Low Income)	
Tajikistan (Low Income)	
Yemen, Republic (Low Income)	
Yugoslavia, FR (Lower Middle Income)	

Appendix 3: Specifications using Random Effects

Table 12: Effect of the Country Risk on PPI Investments using Random Effects Model

VARIABLES	Log PPI	Log PPI	Log PPI	Log PPI	Log PPI
Country Risk	0.0591***	0.0361***	0.0274***	0.0257***	0.0264***
	(0.00462)	(0.00435)	(0.00480)	(0.00482)	(0.00488)
Log GDP ppp		0.838***	0.876***	0.885***	0.917***
		(0.0434)	(0.0449)	(0.0445)	(0.0448)
Log Gdp Growth			0.135***	0.113**	0.103**
			(0.0497)	(0.0515)	(0.0525)
Log Inflation				-0.148***	-0.143***
				(0.0379)	(0.0384)
Log Openness					0.424***
					(0.131)
Constant	2.349***	-16.80***	-17.56***	-17.38***	-20.04***
	(0.213)	(0.991)	(1.023)	(1.010)	(1.236)
R2 within	0.0729	0.2147	0.2086	0.2160	0.2184
R2 between	0.3158	0.7226	0.7317	0.7383	0.7603
R2 overall	0.2842	0.6220	0.6304	0.6410	0.6466
Observations	1,518	1,464	1,283	1,219	1,189
Number of country	127	121	120	120	116

Source: Authors' calculations

Table 13: Correlation of the explanatory variables and the Country Risk

	Country Risk	**GDP**	**GDP Growth**	**GDP per cap**	**Inflation**	**Openness**
Country Risk	1					
GDP	0.3303	1				
GDP Growth	0.1318	0.0682	1			
GDP per cap	0.4701	0.1853	0.0045	1		
Inflation	-0.1229	-0.0064	-0.2096	-0.0471	1	
Openness	-0.0018	-0.1673	0.0341	0.2135	0.0294	1

Source: Authors' calculations

Table 14: Correlation of the explained variables and the Country Risk

	Country Risk	PPI	FDI	PPI over GDP	FDI over GDP
Country Risk	1				
PPI	0.2965	1			
FDI	0.3002	0.447	1		
PPI over GDP	0.0603	0.1203	0.0017	1	
FDI over GDP	-0.0028	-0.0253	0.0237	0.1108	1

Source: Authors' calculations

Appendix 4: Heckman Estimations

Table 15: Heckman and Heckman two steps Estimations

	Heckman Procedure	heckman 2 steps Procedure
VARIABLES	lnppi	lnppi
Country Risk	0.0287***	0.0274***
	(0.00497)	(0.00483)
lnGDPppp	0.815***	0.815***
	(0.0576)	(0.0573)
Lngrowth	0.161***	0.0955*
	(0.0589)	(0.0516)
Lninflation	-0.105**	-0.120***
	(0.0412)	(0.0389)
Ln Openness	0.282**	0.271**
	(0.140)	(0.136)
Inverse Mills ratio	-0.299	-0.430**
	(0.187)	(0.185)
Constant	-17.12***	-16.82***
	(1.649)	(1.627)
Observations	1,062	1,161
Number of _country	116	116

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 5: Robustness check

Table 16: PPI explained by events in t-2, t-3, t-4

	(1)	(2)	(3)
Country Risk	0.0293***	0.0307***	0.0298***
	(0.00559)	(0.00585)	(0.00607)
lnGDPppp t-2	1.304***		
	(0.119)		
Lninflation t-2	-0.0139		
	(0.0403)		
LnOpenness t-2	0.162		
	(0.211)		
Lngrowth t-2	0.150***		
	(0.0543)		
lnGDPppp t-3		1.191***	
		(0.131)	
Lninflation t-3		-0.00321	
		(0.0400)	
LnOpenness t-3		0.331	
		(0.222)	
Lngrowth t-3		0.106**	
		(0.0514)	
lnGDPppp t-4			1.305***
			(0.142)
Lninflation t-4			-0.00995
			(0.0392)
LnOpenness t-4			0.360
			(0.231)
Lngrowth t-4			0.116**
			(0.0513)
Constant	-28.74***	-26.59***	-29.38***
	(2.529)	(2.813)	(3.087)
Observations	1,200	1,167	1,122
Number of _country	117	118	119
R-squared	0.206	0.173	0.174

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1