The role of foreign direct investment (FDI) in promoting access to clean water

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Abstract

Does foreign direct investment (FDI) decrease access to clean water in developing nations? Governments use economic growth from globalization to fund investment in infrastructure to improve water access, but FDI is hindering these efforts through pollution and increased water usage that put pressure on the supply of this public good. I test the hypothesis that growing pressure from increased use and pollution of water by foreign investors reduces water access in developing countries, where impacts are felt more acutely than in developed countries where public goods institutions are stronger. Using a country-year fixed effects regression model on a panel data set of over 130 countries from 1990 to 2010, I assess whether FDI increases or decreases potable water access in developing countries, and the role that development plays in moderating this effect. I find strong evidence of a negative relationship between FDI and access to potable water in developing countries.

Keywords

Developing Countries; Development; Foreign Direct Investment; Globalization; International Political Economy; Natural Resources; Water

Introduction

Increases in foreign direct investment (FDI) lead to reduced water access. The literature on the effects of FDI varies, finding both positive and negative effects on issues of economic development, wages, income inequality, capital distribution across sectors, labor rights, and the environment (Mosley and Uno, 2007; Kentor, 1998; Firebaugh, 1996; Dixon and Boswell, 1996a; Dixon and Boswell 1996b; Bandelj, 2007: 17). Included in this is the debate over the influence that foreign investment has on environmental degradation, natural resource depletion, and the institutes that protect the environment (Bues, 2011; Garcia-Johnson, 2000; Grimes & Kentor, 2003; Jorgenson, 2006a, 2007). However, despite the positive effects that FDI may have, i.e. introducing new 'environmentally friendly' technologies and policies, the negative effects, i.e. water use and pollution, significantly impact the water quantity and quality available to the population. This study will address these effects of FDI through the lens of potable water access, and further the debate over whether FDI is a help or a hinderance to developing countries.

Governments in developing countries face ever-increasing challenges in improving access to potable water as populations rise, urbanization becomes more prevalent and climate change limits water resources. Potable water is a particularly challenging resource to manage because governments must supply it in both the quality and quantity needed for consumption across different temporal and spatial scales,[2] and it is essential to the health and well-being of the nation. Water quality alone does not capture the issues between the government and the people, that can be caused by not only wastewater discharge and chemical pollutants infiltrating the waterways but also alterations of water flows for power supplies or industrial uses. Previously, variations in water access have been linked to countries with increased participation in the global economy, but these studies have just started to investigate the relationship between the globalized economy and water access. For instance, a study by Rudra (2011) looked at the way that trade is linked to changes in potable water access in developing countries over a ten year period. Rudra discovered a relationship between reduced potable water access and an increase in trade. However, the findings of this study fail to account for changes that occur due to more robust drivers of developing economies: FDI. This paper explores the in-depth interplay

[2] A measure of potable water is not just a measure of quality or quantity individually but a measure that captures both quantity and quality at the same time. By only looking at one or the other you are not accurately encompassing the two features that are needed for consumption. People can only consume water that is of drinkable quality, and it must be in a quantity large enough fulfill their daily needs or there is fear of sickness, malnutrition and death. See the World Bank Development Report (2010).

between FDI and resource management started in other research and will evaluate the negative effects of FDI that must be addressed to seek new ways to provide resources better in the future.

How does FDI influence access to potable water? Research shows that FDI has been proven to be the strongest driver of trade and economic growth in developing countries since the 1980s (Fontagne, 1999). Giving these multinational companies the power to appeal to the water management institutions for policies and regulations which allow them to use water anyway they wish for their own interests (Cole et al. 2006; Jorgenson, 2007). During this time, investment has intensively used water both directly, i.e. pollution and use, and indirectly, i.e. water used in supply chain, leading to decreases in water quantity and quality (Bornschier and Chase-Dunn, 1985; Cadbury, 1997; Fontagne, 1999; Jorgenson, 2007; Levallois et al. 1998). At the same time foreign investors have increased environmental policies and brought new technologies and supply chain management techniques that reduce corporate environmental impacts (Garcia-Johnson, 2000; Rudra and Jensen, 2011). However, none of these studies have directly tied the changes in foreign investment to changes in potable water access, that has implications for both the direct effects, i.e. pollution and water use, and indirect effects, i.e. water used in supply chain and policy influence, of foreign investment that may be having independent negative and positive effects on water access.

This paper's purpose is two-fold: first, to use potable water access as a new way to systemically test the relationship between FDI and the environment and provide new conclusions to the debate over whether investment is a help or hinderance. Second, to show the disparate impact depending on level of development, as the least developed countries have weaker infrastructure and institutions. I hypothesize a strong negative relationship between Foreign Direct Investment (FDI) and potable water access in developing countries, due to a need for FDI that increases their willingness to give concessions to investors in order to promote development, and the potential for investors to use these countries as "pollution havens"—locations of comparatively large amounts of environmental degradation (Redclift and Sage, 1996). I test this hypothesis in a country-year fixed effects regression model on a panel data set of over 130 developing countries from 1990 to 2010.

This research contributes to the globalization-natural resources debate in two ways. First, the use of the potable water variable contributes to the debate on governance of natural resource, and forms a comprehensive study of the link between globalization and water pollution (Bossio et al. 2012; Bues and Theesfeld, 2012; Jorgenson, 2007; Liu et al. 2013; Rudra, 2008; Sebastian and Warner, 2013). The potable water variable reflects both quality and quantity of water supply and is more salient to the general population who needs access to potable water on a daily basis. It has been used in the

comparative political economy literature to examine the relationship between trade and environmental degradation, and it is an important tool to be used to show how increased engagement with foreign multinational corporations might persuade developing countries to ignore behaviors that affect the supply of some natural resources.

Second, I build on a common claim in comparative politics that FDI wields more influence over domestic politics and institutions in developing countries than in developed countries. Developing countries often attract investors in resource extraction and heavy manufacturing, which generate large demands on the water supply and large pollution loads. Additionally, these multinational corporations are influential on the governments because developing countries are willing to overlook the environmental effects of certain industries in order to encourage needed economic growth.

In the next section I show the links (both implicit and explicitly) in the political science literature to water and introduce key variables that influence access to water: regime type, inequality, as well as other social and economic factors. In the third and fourth sections, I introduce my argument and my main hypothesis: *that growing pressure from increased use and pollution of water by foreign investors reduces water access in developing countries*. The fifth and sixth sections introduce my country-year fixed effects model and displays evidence to suggest that FDI has a negative effect on potable water access. Finally, I draw conclusions for these findings, and the implications that it has on the larger political economic literature.

Potable Water Access and Politics

According to the World Bank (2010) up to 40 percent of the world's population may be suffering from water stress by 2030, with some areas expected to see increases of up to 85 percent of the population affected by water stress (United Nations Development Programme, 2006). This study evaluates potable water access (see Rudra, 2008) rather than water stress as it the combined impacts of water quality and access. As defined by the World Bank (2012), access to potable water is measured as a percentage of people with reasonable access to clean water from an improved source near their home.[3]

By looking at only one aspect—quantity or quality—research is not accurately encompassing the full effect that a reduction of potable water can have on the political will of the people. Previous

[3] For example, a protected well or spring, public works, or household connection, which must meet a quantity standard of at least 20 liters per day per person from a source within one kilometer of their home. A measure of potable water is not just a measure of quality or quantity individually but a measure that captures both quantity and quality at the same time.

studies have mainly focused on the issues of water quality, and the overall impact of pollutants on water resources (Cao and Prakash, 2010; Jorgenson, 2007). By focusing on issues of pollution impacts alone, they miss other important impacts, i.e. poorer citizens who are denied access to water even when it is clean, and their connection to wider government policy. By looking at quantity and quality of water access we are better able to connect political dissent to issues of water access. Allowing this study to further identify infrastructure and policy accomplishments or problems that are connected to the population's access to appropriate amounts of potable water.

Potable water access issues more often exist in poorer nations, where the majority of citizens are not politically active and where institutions do not exist to protect these groups. This inspires the motivating questions for this analysis: have policymakers in developing countries had the political will to ensure that high pollution problems and water usage from FDI do not affect access to safe drinking water? Will these policymakers, as compared to developed country actors, take the measures necessary to ensure that water pollution does not adversely affect the population by reducing the availability of potable water? What other factors in developing countries make them more or less vulnerable to the impacts of FDI on water access?

Important political, social, and economic growth factors explored in international economic studies impact potable water access. For example, as states develop increases in the gross domestic product (GDP) are linked to increases in industrialization and consumption, as a result developing countries with higher income that lack institutions of environmental regulation may produce more pollution and use more natural resources, which can severely reduce access to resources, such as potable water (Grossman and Krueger, 1995; Liu and Zhang, 2018). At the same time, economic growth and a higher GDP also leads to technological improvements that reduce pollutants and strengthen the regulatory environment, which improves water access. More development also means more residents moving to urban centers which can have both positive and negative effects on water access. When states lack infrastructure capacity fast-growing municipalities put increased pressure on a state's infrastructure, resulting in decreased access to potable water (Jorgenson, 2007; Khan and Siddique, 2000; Rudra, 2011), but municipalities also see faster gains in access to piped water, between 1990 and 2012 more than twice as many people in urban areas as opposed to rural areas gained access to an improved water source (WHO and UNICEF, 2014).

The type of government and institutions available to citizens affect the capacity to supply water (Li and Reuveny, 2006; Neumayer, 2002). Democracies have been shown to provide greater access to potable water and have a greater ability to overcome the stresses that infrastructure problems cause

on public good supplies. Democratic institutions also provide more access points for members of society to communicate their dissatisfaction to governments, as a result, democratic governments should respond more quickly to water access problems. Even when governments have the capacity to increase water access benefits are not equally distributed, and countries with high levels of inequality give water access preference given to some groups over others, particularly those with more power and economic means (Rodrik, 1999). In these situations, powerful interest groups, like domestic investors, trade partners and foreign investors, have their own demands, and are able to influence policy makers when economic growth is prioritized (Mulligan et al. 2004).

The Effect of FDI on Potable Water Access

The globalization-natural resources literature has long debated whether FDI is a contributor to the "race to the bottom" or to the "race to the top", but evidence suggests that the overall effect of foreign investment on the environment is negative. FDI is able to influence environmental outcomes because it makes developing countries more vulnerable to global-economic conditions that can influence different environmental outcomes. On one hand, the "race to the bottom" literature finds that engagement with foreign multinational corporations increases pollution and water use and leads to weaker environmental regulations and pollution havens (Grimes and Kentor, 2003; Jorgenson, 2006a, 2006b, 2007). On the other hand, the "race to the top" literature foreign investors facilitate economic development, which, in turn, increases environmental standards, as it provides access to improved technologies and the regulation of supply chains (Garcia-Johnson, 2000; Rudra and Jensen, 2011). This literature also finds evidence to suggest that developing countries are not a haven from pollution, and multinationals are not flocking there to take advantage of weak environmental standards and enforcement (Eskeland and Harrison, 2003; Redclift and Sage, 1996; Thompson and Strohm, 1996).

However, the globalization literature is criticized for failing to fully investigate the negative externalities of foreign investment, and for a failure to address the large percentage of investment into developing countries in the manufacturing and extractive sectors. Negative externalities can result from the positive features of foreign investment, like when newer technologies demand more water or create new pollutants. In one such case, clean technology transfer resulted in improvements to production methods to clean up atmospheric pollution, but at the same time they increased levels of water pollution (Duhigg, 2009).

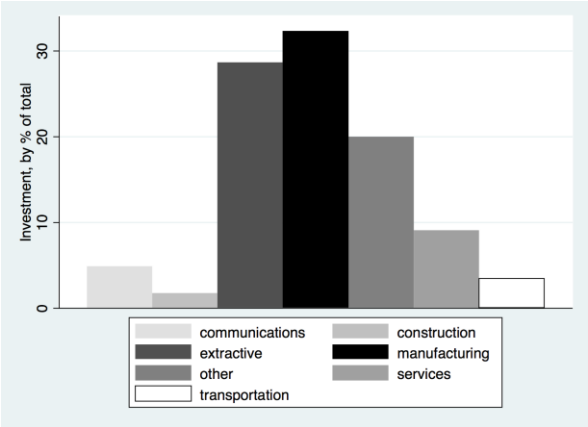

Figure 1: Capital investment into developing countries, 2003-2015
Source: Author, Data: FDImarkets (2016).

Moreover, FDI into developing countries is mostly focused on the manufacturing and extractive sectors, see figure 1.[4] Studies show that these resource intense sectors causes increased water usage creating a water quantity issue (Bues and Theesfeld, 2012), and increased contamination of water sources, creating a water quality issue (Jorgenson, 2007; Roberts et al 2006). It is also common for countries to divert water streams for increased investment, so that even when foreign investors are improving the quality of water diverted streams and water usage reduces the overall water quantity available. These direct effects of FDI has even been shown to disrupt the infrastructure improvements that governments have already made to water quantity and quality (Jorgenson, 2007).[5]

Additionally, due to the perceived benefits of FDI, states become increasingly willing to make the political environment more hospitable for foreign investors (over domestic investors) that are only looking for the promise of adequate infrastructure with natural resource exploitation promise (Bellos, 2010; Bellos and Subasat, 2012; Bues, 2011; Hu et al. 2013; Jessup, 1999; Oneal, 1994). FDI has allowed developing countries to stimulate their domestic growth, increase research and technological domestic know-how, deregulate, stabilize, and liberalize the economy, while creating jobs and increasing the skills of workers (Mosley and Uno 2007; Javorcik 2004; Blomstrom and Kokko 1997; Balasubramanyam et al. 1999). This entices governments to provide concessions to foreign investors that create problems when these investors are not interested in the environmental impact their decisions make in the pursuit of profit (Borregard and Dufey, 2002). Leading to tradeoffs where there

[4] This bar graph shows all Greenfield foreign investment from 2003 to 2015. Over 60 percent of investment is into developing countries is in the manufacturing and extractive sectors. The other sector is made up of all other sectors including shipping, hotels, and real estate groups.
[5] For examples of weak regulatory policies see Kahn and Yardley (2007) and French (2007).

are gains in terms of economic development and labor standards, but weakening of standards in other areas, most importantly water.

Why focus the study on foreign investment rather than domestic investment? First, some studies have argued that domestic investment does less harm to the environment than foreign investment (Jorgenson, 2006b; Rivera, 2004). Domestic investments do not have the same disincentive to ignore environmental concerns or limit water access (Borregard and Dufey, 2002; Jorgenson, 2006a, 2007). Second, not all foreign investors carry significantly better environmental policies and technology than the recipient country's domestic corporations (Rivera, 2004). This increases the likelihood that investors will participate in environmentally harmful activities and will be less motivated by local interest and stakeholder groups to protect natural resources. The sharp contrast between domestic and foreign investors further increases the importance in studying the effects of FDI.

Particular cases have also shown that while foreign investment does have some positive effects, it may overall have a negative effect on potable water access. In India, reports have shown how polluting of the waterways by Pepsi resulted in reduced access to ground water and contamination of rivers throughout the country (Brady, 2007). India is not alone in this, however; studies have linked the increase in FDI to water contamination and pollution problems in Ecuador (Cueto, 1996), Ethiopia (Bossio et al. 2012; Bues, 2011), etc. and yet, there are limited studies looking into this connection between potable water and FDI. In developing countries, such as India, Ethiopia, and Ecuador, the inflows of FDI have led to high-polluting, labor-intensive manufacturing processes that are not ecologically efficient (Clapp, 1998; Jorgenson, 2006b; Roberts et al. 2003, 2006) and contribute to pollution in both the air and water within a state (Grimes and Kentor, 2003; Jorgenson, 2006b, 2007). This is further supported by a study by the World Resource Institute (2005), showing that sectors associated with high amounts of water contamination and water usage all tend to be sectors that are heavily funded by FDI inflows in developing countries.

These attributes of FDI create a barrier to clean water, and lead to my hypothesis: that increases in FDI lead to higher levels of water consumption and pollution by the investor, and indirect consequences through their supply chain management and policy influences, thus causing adverse effects on access to potable water. The first hypothesis is thus as follows:

Hypothesis 1: Foreign direct investment (FDI) will have a negative effect on potable water access.

The Moderating Effect of the Level of Development

FDI is an international induced constraint on a natural resource that is vital to the well-being of a nation, and there are political considerations that should influence the degree to which trade affects water access. In developed county, institutions largely prevent water access from being affected, even in some of the largest polluting nations like the United States and Japan. This is harder to achieve in developing countries where there is less institutionalization and policy is more malleable (Acemoglu et al. 2001).

Policy makers see foreign investment as critical to a developing economy, and fear any policy that might bring about the threat of capital flight (Wallerstein, 2005). To prevent this, they will try to keep labor costs low, lower environmental standards, and suppress labor rights in order to promote economic growth. In many cases allowing foreign investors to shape government policies in directions that favor their interests and harm the interests of the poor and the environment.

The trade-off is such that economic growth and material prosperity have tangible benefits that citizens can quickly realize (Rogoff, 1990). *Until development has reached such a level* that the citizens can be motivated to engage in collective action to improve the environmental situation, governments in developing countries will be motivated to prioritize growth over environmental resources (Grossman and Krueger, 1995; Panayotou, 1993; Yandle, Bhattarai, & Vijayaraghavan, 2004). Many developed countries also faced issues of unclean water when economic growth was accompanied by industrialization, and only after pressure from political coalitions did these countries create reforms for water and sanitation (Szreter, 1997).

In sum, domestic political process and institutions in developing countries are at a disadvantage, whether democratic or authoritarian, and that it is only through further development that countries will reach a point by which they will start environmental reforms. As a result, actors affected by FDI's impact on water in developing countries are more likely to suffer from collective action problems and poor water policies. These factors are exacerbated when inequality is high and the economy is growing. The second hypothesis is:

Hypothesis 2: FDI's ability to reduce potable water access will be moderated by the country's development level.

Methodology and Variables

The primary goal of this study is to empirically evaluate the extent to which FDI affects the percentage of the population able to access potable water. Using a country-year fixed effects regression

model, I conduct a series of quantitative cross-national analyses of water access. I use a panel data set[6] of about 136 countries from 1990 to 2010 in the middle (high and low) and low income brackets, defined as developing countries by the United Nations (2017) (see country list in appendix). Potable water data[7] is only collected every five years (i.e., 1990, 1995, 2000, 2005, 2010), while most other variables are available every year. The univariate statistics are laid out in Table I, and include my measures of trade, domestic investment, inequality, political regime (polity), gross domestic product (GDP), measures of GDP growth, and urban population growth.

Table I: Summary of Univariate Statistics. Source: Author, Data: QoG Standard Dataset (Teorell et al. 2013).

	Source		***Obs***	***Mean***	***Std. Dev.***	***Min***	***Max***
Dependent Variable							
Water Access	World Development Indicators		787	78.83	18.99	4.94	100
Independent Variables							
FDI Flows (percent of GDP)	World Development Indicators	5-year average	583	4.31	10.17	-22	187.3
Domestic Investment (percent of GDP)	United Nations Statistics Division	5-year average	665	22.72	10.12	2.5	85.1
GINI coefficient	World Development Indicators		140	43.4	9.5	25.6	62.8
Trade (percent of GDP)	World Development Indicators	5-year average	590	79.4	38.7	1.53	241.02
Rapid economic growth (logged)	World Development Indicators	5-year average	750	4.07	3.89	-21.7	39.34
Percent Urban Population (logged)	World Development Indicators	5-year average	806	2.81	-2.01	-3.22	18
GDP per capita (logged)	World Development Indicators	5-year average	743	7.32	1.25	4.36	11.54
Freedom House Polity	Freedom House Polity IV	5-year average	677	5.01	2.91	0	10
Population (logged)	World Development Indicators	5-year average	348	15.35	2.23	9.07	21.02
Human Development Index	United Nations Development Programme		966	0.62	0.14	0.32	0.9

[6] Panel data comes from the QoG Standard Dataset (Teorell et al., 2013).
[7] World Bank data that measured percent of the population with access to a refined source (World Bank, 2007).

Dependent Variable

The dependent variable is water access, measured as the percent of the population with access to at least 20 liters of water per person a day from an improved source within one kilometer of the dwelling (World Bank, 2007). Measures are gathered by the World Bank every five years, I am using the logged value of this data. This value is logged to control for outliers and variance in the water data as can be seen in the summary of the data.

Independent Variable

The measure of net inflows of Foreign direct investment (FDI),[8] as a percentage of gross domestic product (GDP) is used, as it is considered the more appropriate measure for this study. This data is taken from the World Bank (2012), and the average lagged measurement of FDI is appropriate as the expected impact of FDI would not be immediate and instead would take time to affect the overall domestic water situation. Net inflows of FDI as a percent of GDP take into account the economic size of a country and can allow a better comparison as country's with larger economies attract more FDI allowing us to compare between countries and regimes more succinctly (Choi and Samy, 2008). I use net inflows rather than total FDI because I am looking at change over a period of time, which would be influenced by new inflows during that time period. This will give a more accurate assessment of how FDI flows directly impact changes in potable water access.

Control Variables

To further test resource management issues, this model will control for variables that would be expected to impact water access and help the model more accurately predict the effects of FDI. I use eight control variables to account for economic, social and political factors that affect potable water access according to the literature linking water to political science and economics. *GDP, GDP growth, populations,* and *urban population growth* variables are all logged, and come from the World Bank's (2012) world development indicators list. *Inequality* is measured by the GINI co-efficient, in which higher scores represent higher levels of inequality. This measure is not reported in all countries during all time periods. These variables are important in the literature as they have impacts on potable water access and infrastructure within the country and, by controlling for them, I can further isolate the effects of FDI.

[8] FDI is an investment in the managing stock of a company, measured by the World Bank of any purchase over 10 percent of controlling stock, outside of the investor's home country (2012).

Domestic investment measured through gross fixed capital formation (GFCF), which was formerly known as gross domestic direct investment, and is included for a more rigorous assessment of FDI. This variable controls for any domestic level investment in fixed assets and allows testing for foreign controlled manufacturing. It also removes the effect of pressure from domestic investors and local communities that may seek "greener" methods of production (Jorgenson, 2007; Young, 1997). This measure comes from the United Nations Statistics division and is measured as a percentage of the GDP.

Trade as a percent of GDP is used to further isolate the effects of FDI. Previous studies have found trade to have negative effects on potable water access (Rudra, 2011) and will provide a test for the robustness of FDI. This model will also use the Freedom House (2011) dataset to control for levels of *polity*. This is a 10-point scale that measures the level of democracy from zero to 10, from less to more democratic, and this variable will be called polity. It is then averaged across countries for the five-year period between the measurements to capture the average level of democracy over that time period.[9]

The Model

My model is a country-year fixed effects regression model, in which the variables (where possible) are five-year averages in order to estimate the effect in water access over a five-year period.[10] For example, FDI is available for all years and is aggregated into five-year averages so as to identify the average impact of FDI inflows, as a percentage of the gross domestic product (GDP), has on potable water access.[11] The model also uses year dummy variables to account for annual trends and clustered standard errors to account for serial correlation.[12] The data includes all developing countries for which water and FDI data were available, with control variables.

The following model assesses the effect of FDI on potable water access:

$$\log(water_{it}) = \alpha + \beta_1 FDI_{it-1} + \beta_j year_i + \beta_k controls_{it} + u_i + \varepsilon_{it}$$

[9] W*ater privatization* is not included because total water privatization, which prevents water access for the poor, is in decline (Izaguirre and Hunt, 2005). Findings by Rudra (2011) show that water privatization activity was heavily skewed by an outlier, the Philippines.

[10] Fixed effects are used because it is assumed that the intercept varies across the cross-sectional units and across the time periods. This was confirmed through a Hausman test.

[11] Even when using total FDI rather than averaged FDI, the coefficient is still statistically significant. But the use of averaged FDI considers variation during the five-year period.

[12] I also tested my model without the lagged dependent variable and found the direction and magnitude not substantially changed, thus finding no evidence that this variable had any adverse effects on my model (see Achen, 2001).

In this equation, $water_{it}$ denotes the percentage of the population with access to potable water in every five-year period when data was collected. $\beta_1$is the change in log(water) when there is a one unit change in FDI_{it-1}, the net inflows of FDI into country *i* at period *t-1*, average of the prior five-year period. $Year_i$ denotes a time dummy, ε denotes independent and identically distributed random errors, and $controls_{it}$ are the various independent variables that account for any extraneous factor that affect the parameter of interest.

Results

Overall, Table II shows strong empirical support for my hypothesis that countries with higher foreign investment inflows have lower access to potable water. The increase in water-intensive and wastewater-inducing production processes due to increases in FDI adversely affects the percent of the population with access to potable water. The first column in Table II reports the results of the baseline results of my model, which focuses on the unconditional and separate effects of FDI, column two reports the effects of FDI controlling for all factors but the inequality score, which limits the data due to data availability, and column three shows the effects of FDI controlling for all other factors.

The effect of FDI is significant, it would be expected that for every increase in FDI, as a percentage of GDP, potable water access will decrease by approximately 1.4 percent, all other factors held constant (column 3). A one standard deviation increase in FDI leads to a decrease of about 13 percent of the population with access to potable water all other factors held constant in this model. Thus, I find that FDI pressure by itself slows the improvements to water access, even in the presence of political, environmental, and other economic controls.

FDI has more robust coefficients than domestic investment or trade. Domestic investment has a positive effect, as predicted by the literature, and trade does not show any significant impact on potable water access (but as expected from the literature the sign is negative). They are also both smaller than FDI. This shows us that FDI is a better indicator of access to potable water in developing countries and has a stronger effect than other economic indicators. The model also shows the sensitivity of potable water access to GDP, population, level of democracy, inequality, and urban growth rates.

The impact of trade is not as robust as previous studies have indicated, though it is in the direction expected. Even when FDI was removed from the data, the impact of trade remains insignificant in this new data set. This shows us that FDI is a better indicator of access to potable

water in developing countries. FDI also has more robust and significant coefficients than domestic investment, which as expected has a positive effect on water access.

Table II: Impact of FDI on (logged) Potable Water Access (with controls)
Source: Author, Data: QoG Standard Dataset (Teorell et al. 2013).

	(1)	(3)	(2)
FDI Flows	-0.0008*	-0.006***	-0.014**
(percent of GDP)	(0.00045)	(0.0019)	(0.007)
Lagged Domestic Investment	0.0011	0.005***	0.012***
(percent of GDP)	(0.0007)	(0.0013)	(0.003)
GDP per capita	-0.011	0.07*	-0.33***
(logged)	(0.031)	(0.04)	(0.10)
Freedom House Polity		0.007*	0.03**
		(0.004)	(0.01)
Trade		0.0003	-0.00032
(percent of GDP)		(0.0003)	(0.0007)
Rapid economic growth		0.02*	0.04
(logged)		(0.01)	(0.03)
Urban Growth Rate		0.12	0.45*
(logged)		(0.14)	(0.23)
Population		0.10	-0.48**
(logged)		(0.17)	(0.16)
GINI coefficient			-0.007**
			(0.003)
Constant	4.32***	1.40	12.81**
	(0.22)	(3.00)	(2.11)
Observations	567	275	68
R-squared	0.49	0.57	0.92
Number of Countries	136	98	47

Standard errors clustered at country level in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Findings on urban growth rates, GDP and population all confirm the literature. GDP has a significant and positive relations with water access, until inequality is controlled for, and then GDP has a negative effect. Populations has a significant negative effect on water access, and urban growth rates improve the access that populations have to water. Finally, as expected democracy has a positive

association with potable water access. Confirming the literature that democratic governments are more inclined to respond the demands of their population.[13]

To further assess the robustness of the negative effects of FDI, I also tested data on the percent of the total population with access to potable water from both the World Development Index and the Environmental Performance Index. These indices provide alternative tests on the relationship between FDI and potable water. As the analysis in the article predicts, the coefficient was negative and significant, suggesting that greater flows of FDI lead to adverse effects on potable water access. The primary findings thus consistently remain stable and confirm the robustness of the results.

Regional Variation

Due to variability in levels of development and political landscapes across regions, I further investigate my theory by looking at the regional variation of the effects of FDI in table III, using the variables from model 2.[14] Foreign direct investment remains significant and has a negative impact in Africa and South Asia, it is only in Latin America does the sign of FDI change but does not have a significant impact on water access. A one percent change in FDI (as a percent of GDP) can result in an approximate 0.44 percent change in access to water. While in South Asia, each percentage increase in FDI can lead to decreases of 5 percent in potable water access. A majority of countries in South Asia and Africa are least developed countries supporting the literature that weaker institutions struggle to counter influxes of FDI in the manufacturing and extractive industries that use more water and produce more water pollution (Grimes and Kentor, 2003; Jorgenson, 2006b, 2007).

Table III also includes a few notable observations. Domestic investment retains a positive effect, with significance in Latin America and South Asia, further confirming the literature that domestic investment is greener. Variations on GDP and urban growth rates should be further explained as these may be related to different political landscapes and social factors. Interestingly,

[13] In the appendix you can find models that include a succession of relevant control variables that, as stated above, have their own effects on the ability of the population to access water. It also includes models using water as an absolute value, to differentiate from the logged value of water. These provide a robustness check for my model, by including tests of different controls that even when added do not change the significance of FDI. To further test my findings, I reduced all models to the same observations that appear in my earlier models and found that significant adverse effects of FDI remained consistent.

[14] Model 3 is not used because the GINI coefficient reduces the observations down to a very small sample size that is untestable due to collinearity.

trade is significant and positive in South America, which departs from the findings in the literature and is an area for further study (Rudra, 2011).

Table III: Impact of FDI on (logged) Potable Water Access (with controls) by Region
Source: Author, Data: QoG Standard Dataset (Teorell et al. 2013).

	(4)	(5)	(6)	(7)	(8)
	Africa	East and South East Asia	Eastern Europe	Latin America	South Asia
Lagged FDI Flows	-0.0044*	-0.0046	-0.00005	0.0009	-0.05***
(percent of GDP)	(0.00)	(0.007)	(0.003)	(0.003)	(0.01)
Lagged Domestic Investment	0.0023	0.007	0.0014	0.004**	0.01**
(percent of GDP)	(0.00)	(0.004)	(0.0015)	(0.002)	(0.003)
Trade	0.0007	-0.0003	-0.0012	0.0019***	-0.001
(percent of GDP)	(0.00)	(0.00)	(0.0007)	(0.0005)	(0.0008)
Freedom House Polity	0.013	-0.0015	-0.01	-0.002	0.01
	(0.01)	(0.01)	(0.04)	(0.01)	(0.004)
Rapid economic growth	0.02	0.04	-0.02	0.040	0.002
(logged)	(0.02)	(0.05)	(0.02)	(0.01)	(0.02)
Urban Growth Rate	-0.12	0.41	-0.16	-0.29*	1.06
(logged)	(0.19)	(0.27)	(0.25)	(0.15)	(0.61)
GDP per capita	0.07	0.14	-0.06	-0.19**	0.23***
(logged)	(0.06)	(0.08)	(0.05)	(0.07)	(0.05)
Constant	0.32	-15.94**	2.88	4.61**	-10.89*
	(1.62)	(6.67)	(3.28)	(2.04)	(5.97)
Observations	145	30	28	43	24
R-squared	0.48	0.88	0.74	0.83	0.98
Number of Countries	51	10	14	14	6

Standard errors clustered at country level in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Developed versus Developing Countries

My regional models find that FDI is significant and has a negative effect in regions of the world that are the least developed, which leads me to ask if FDI has a unique effect only experienced by the least developed countries? FDI still largely goes to developed countries, only about 40% goes to developing countries, but this amount is steadily increasing (World Bank, 2018). Research contends that populations in the least developed countries will face undersupplied public goods (i.e. water

access) due to insufficient infrastructure, greater collective action problems, and less participatory governance institutions, I want to consider whether the effect of FDI on water access varies between levels of development, to do this I use the same country-year fixed effects regression model with an interaction between FDI and my measurement of development, the human development index (HDI):

$$\log(water)_{it} = \alpha + \beta_1 FDI_{it-1} + \delta_0 HDI + \delta_1 FDI * HDI + \beta_j year_i + \beta_k controls_{it} + u_i + \varepsilon_{it}$$

All parameters and variables remain the same except the inclusion of the human development index as a continuous variable for development and the interaction term. The human development index (HDI) variable is a composite index that measures a country on the basic dimensions of human development (UNDP, 2018). includes all countries of the world that have data. This is a continuous measure that increases as a country becomes more developed. I interact FDI with the HDI to address the question "does the effect of foreign direct investment on water access vary on the level of development". Where, β_1 the is the change in potable water access associated with a one-unit change in foreign investment (as a percent of GDP), and $\beta_1 + \delta_1$ is the change in potable water access associated with a one-unit change in FDI as HDI increases.

In Table IV, I evaluate the extent to which higher developed countries are able to counter the effects of foreign investment, because of better institutional development. I find that for each unit change in HDI, the slope of FDI's effect on potable water access increases by 0.04. A positive value for the effect of the interaction term implies that the more developed a country is, the more positive the effect of FDI on potable water access. I can accept the hypothesis that FDI has a stronger positive relationship to potable water access as countries become more developed. These findings show that FDI at low levels of development will reduce access to potable water, but as nations develop, FDI can have more positive effects on water access. These results indicate that institutional change as a country develops could be moderating the negative effects of foreign investment seen in previous models.

Conclusions

Finding that FDI has a negative effect on potable water access has consequences for several different literatures, most particularly the "race to the bottom" literature. This paper finds further evidence to support the "race to the bottom" side of the ongoing debate over global economic expansion. I hypothesized that foreign direct investment would have a negative effect on public goods provision due to its impact on resource management institutions. The findings indicate that developing countries are unable to overcome the influence of global economic activities, and as a result parts of the population lose access to water. On average developing countries receive FDI equivalent to about

Table IV: Multiple regression interaction of the effect of FDI on (logged) potable water access dependent on developed or developing
Source: Author, Data: QoG Standard Dataset (Teorell et al. 2013).

	(8)
Lagged FDI Flows	-0.03**
(percent of GDP)	(0.02)
FDI*HDI	0.04**
(interaction)	(0.02)
Lagged Domestic Investment	0.002
(percent of GDP)	(0.0013)
Trade	-0.0005
(percent of GDP)	(0.0004)
Freedom House Polity	0.013
	(0.009)
Rapid economic growth	0.02*
(percent change)	(0.01)
Urban Growth Rate	0.53***
(percent change)	(0.18)
GDP per capita	-0.21***
(logged)	(0.08)
Population	-0.23
(logged)	(0.15)
Inequality Index	-0.009***
	(0.003)
Constant	8.05***
	(2.51)
Observations	106
R-squared	0.87
Countries	65

Standard errors clustered at country level in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

4% of their GDP, but this amount of FDI could have adverse effects for more than 1 percent of the population, rising to decreases of 4 percent in South Asia. Meaning that FDI is slowing infrastructure improvements that developing countries are making in providing potable water access and creating a "race to the bottom" in countries that are not equipped to manage public goods.

This research also confirms the findings in the literature that development moderates the effects of FDI. As countries develop they see fewer negative effects from FDI, it is possible that their institutions are using increases in FDI to expand potable water access. I conjecture that this is related to the literature that indicates that developing countries are often prioritize economics over the environment, and that institutions in developing countries are unable to keep up with the water demands from development. Further study into institution building as it relates to environmental resources management and globalization is needed in the case of potable water management.

Finally, this analysis points out how international sources of degradation can be more impactful than domestic sources and can have practically large effects on the conditions of the domestic population. Domestic sources of investment have a positive association with potable water access, as would be expected in the literature, because they are connected to the local communities. It may be worth exploring how stronger connections

between foreign investors and the local communities influence their impact on local resources and management.

The logic of this argument may hold insights for other resources subject to overuse or pollution. Arable land, forests and fisheries have attributes similar to water; they are consumable goods that impact the lives of the citizens in a state. For example, the recent increase in shale oil to replace depleted easy to access crude oil has led to the use of arable land for fuel supplies rather than food. The depletion of these resources in pursuit of economic growth could have lasting effects on the livelihood and future employment of citizens. Expanding multinational corporations provide incentives to governments to increase the use and depletion of these resources beyond what is sustainable for the population in the absence of an effective management regime. It may be worth exploring whether increasing FDI in developing countries with ineffective domestic institutions affects availability of other natural resources.

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Appendix

Data

All data used can be found on the **QoG Standard Dataset** website (Teorell et al., 2013)**:** https://qog.pol.gu.se/data/datadownloads/qogstandarddata.

Developing Countries included in all models when data is available

Afghanistan	Sao Tome and Principe	Mongolia	Equatorial Guinea
Angola	Senegal	Morocco	Fiji
Bangladesh	Sierra Leone	Nicaragua	Gabon
Benin	Solomon Islands	Nigeria	Grenada
Bhutan	Somalia	Pakistan	Guyana
Burkina Faso	Sudan	Papua New Guinea	Iran
Burundi	Tanzania	Philippines	Iraq
Cambodia	Timor-Leste	Sri Lanka	Jamaica
Central African Republic	Togo	Swaziland	Kazakhstan
Chad	Tuvalu	Syria	Lebanon
Comoros	Uganda	Tajikistan	Libya
Congo, Democratic Republic	Vanuatu	Tunisia	Macedonia
Djibouti	Yemen	Ukraine	Malaysia
Eritrea	Zambia	Uzbekistan	Maldives
Ethiopia	Zimbabwe	Vietnam	Marshall Islands
Gambia	Armenia	Albania	Mauritius
Guinea	Bolivia	Algeria	Mexico
Guinea-Bissau	Cameroon	Antigua and Barbuda	Micronesia
Haiti	Cape Verde	Argentina	Montenegro
Kiribati	Congo	Azerbaijan	Namibia
Korea, North	Cote d'Ivoire	Belarus	Palau
Laos	Egypt	Belize	Panama
Lesotho	El Salvador	Bosnia and Herzegovina	Paraguay
Liberia	Georgia	Botswana	Peru
Madagascar	Ghana	Brazil	Russia
Malawi	Guatemala	Bulgaria	Samoa
Mali	Honduras	China	Seychelles
Mauritania	India	Colombia	South Africa
Mozambique	Indonesia	Costa Rica	St Kitts and Nevis
Myanmar	Jordan	Cuba	St Lucia
Nepal	Kenya	Dominica	St Vincent and the Grenadines
Niger	Kyrgyzstan	Dominican Republic	Suriname
Rwanda	Moldova	Ecuador	

Thailand	Turkey	United Arab Emirates
Tonga	Turkmenistan	Venezuela

Developed Countries in Interaction Model

	Norway
United States	Denmark
Canada	Iceland
Bahamas	Israel
Trinidad and Tobago	Saudi Arabia
Barbados	Kuwait
Chile	Bahrain
Uruguay	Qatar
United Kingdom	Oman
Netherlands	Korea, South
Belgium	Japan
Luxembourg	Singapore
France	Brunei
Monaco	Australia
Switzerland	New Zealand
Spain	
Andorra	
Portugal	
Germany	
Poland	
Austria	
Hungary	
Czechoslovakia	
Slovakia	
Italy	
Malta	
Croatia	
Slovenia	
Greece	
Cyprus	
Romania	
Estonia	
Latvia	
Lithuania	
Finland	
Sweden	

Additional Table

Table IV: Robustness Checks: Impact of FDI on Changes in Potable Water Access (with controls)
(Source: Author, Data: QoG Standard Dataset (Teorell et al. 2013))

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	Log(Water)	Water	Water	Water	Log(Water)
Lagged FDI Flows (percent of GDP)	-0.00**	-0.07*	-0.28***	-0.73**	
	(0.00)	(0.04)	(0.09)	(0.33)	
Lagged Domestic Investment (percent of GDP)	0.00	0.05	0.11*	0.76***	0.00
	(0.00)	(0.04)	(0.06)	(0.17)	(0.00)
Trade (percent of GDP)	0.00		0.00	0.05	-0.00
	(0.00)		(0.02)	(0.05)	(0.00)
Freedom House Polity	0.01*			1.36***	0.02**
	(0.00)			(0.43)	(0.01)
Rapid economic growth (percent change)				1.53	0.01
				(1.13)	(0.03)
Urban Growth Rate (percent change)			4.27	27.53**	-0.19*
			(6.34)	(12.45)	(0.11)
GDP per capita (logged)	0.02	0.61	1.85	-18.65***	-0.32***
	(0.03)	(1.86)	(2.09)	(4.60)	(0.11)
Population (logged)	0.23**			-30.01***	-0.39*
	(0.11)			(9.80)	(0.22)
Inequality Index				-0.28	
				(0.18)	
Constant	-0.16	68.73***	-85.45	589.09***	9.96**
	(1.90)	(13.29)	(98.26)	(165.31)	(3.74)
Observations	454	561	448	68	69
R-squared	0.56	0.55	0.61	0.94	0.90
Number of Coutnries	113	134	111	47	48

Standard errors clustered at country level in parentheses *** p<0.01, ** p<0.05, * p<0.1