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Article

State capacity and access to water: Panel data evidence from developing countries

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Abstract: The provision of clean drinking water is an important public service as more than 700 million people do not have access to this basic need. When it comes to delivering public services in developing countries, government capacity is a crucial element. This study investigates whether state capacity is a significant determinant in the provision of safe drinking water using panel data from 88 developing countries from 1990 to 2017. The paper applies ordinary least squares and fixed effects regression approaches and uses the Bureaucratic Quality Index and the Tax/GDP ratio as metrics of state capacity. The findings indicate that in developing nations, the availability of clean drinking water is positively correlated with state capacity.

Keywords: state capacity; drinking water; panel data; bureaucratic quality index; fixed effects; developing countries

1. Introduction

Much has been said about state capacity and its impact on development outcomes, but nothing about how it impacts access to clean drinking water, which is arguably one of the most critical areas of development. As states take a central role in development policymaking in developing countries, the ability of the states to successfully design and implement these policies becomes even more important. The provision of clean drinking water is one of the many public services governments are responsible for, and sustainable provision of clean drinking water is a challenging task for a multitude of reasons. Therefore, the state's capacity plays an important part in meeting this challenge.

In 2010, the United Nations (UN) declared access to water as a fundamental human right (UN, 2010); before that, it was included in Millennium Development Goals (MDGs) and later in 2015 in Sustainable Development Goals (SDGs). There is no universally accepted definition of safe drinking water (Dinka, 2018). WHO/UNICEF Joint Monitoring Program (JMP) defines safe drinking water as water from an improved source. JMP further defines an improved source as "household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collections." JMP defines access to safe drinking water as access to an improved source not more than 1 km away with the availability of 20 L per person per day (WHO/UNICEF, 2015).

Researchers have consistently highlighted the benefits of access to safe drinking

water. According to them, the cost-benefit ratio of investing in water projects is usually positive and can go substantially higher in developing countries (Dinka, 2018). Besides economic gains, clean drinking water has many social, health, educational, political, and environmental benefits at national, regional, and international levels (Biswas, 2004). Water is essential for sustainable development, and a strong nexus between water, food, and energy has been identified and emphasized (Bos et al., 2016; Connor, 2015).

It is estimated that about 90% of the world's population has access to water suitable for drinking (Organization, 2017), but the remaining 10% also makes a huge number of more than 700 million people. As the world's population is growing with almost no increase in freshwater resources, providing more people with access to safe drinking water is becoming harder. The problem is especially worsening in developing countries where a fast-growing population coupled with the inability of governments is making the problem worse (Connor, 2015).

Research has identified that most people lacking access to safe drinking water reside in developing countries (Water, 2014). Many challenging factors hamper water systems in developing countries. These factors include poor water infrastructure, inadequate pricing of water resulting in failure to recover costs, uncertainty about water availability due to climate change and transboundary water issues, knowledge gaps in hydrology, and poor water management (Amaliya and Kumar, 2014; Cunha et al., 2016; Molden et al., 2014; Rouse, 2013; Tortajada, 2014).

Providing clean drinking water is an essential public service mainly handled by governments in developing countries. This study embarks on to find if government capacity of developing countries has any impact on the people having access to clean drinking water.

The state capacity will contribute to improvement in access to clean drinking water by improving water governance through integrated water resource management or IWRM. IWRM is defined as "a process which promotes the coordinated development and management of water, land, and related resources, in order to maximize the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems" (Agarwal et al., 2000). According to Ben-Daoud et al. (2021) and Cosgrove and Loucks (2015), the capacity of the water manager is very important in the effective implementation of IWRM.

2. Review of literature

2.1. What is state capacity?

State capacity, which is commonly understood to represent the state's ability to accomplish its goals, has been connected to a number of significant social, political, and economic outcomes (Vaccaro, 2023). The recent debate about state capacity started with Geddes (1994) saying that after being brought back into the academic debate, the state has morphed into a "great clumsy creature that no one quite knows what to do with." In Fukuyama (2004), Francis Fukuyama defines state capacity as "the ability of the state to implement policies cleanly and transparently." The study uses the terms state capacity and state strength interchangeably. However, the debate on state capacity gathered steam after the publication of Fukuyama (2013).

Fukuyama focuses on governance from both political and bureaucratic perspectives in this study. He argues that scholars overly focus on studying institutions as a way to limit political power but keep ignoring the fact that states accumulate and exercise power through institutions like bureaucracy. The remarks by Fukuyama that scholars of political economy are more focused on research related to power limitation than on accumulation and execution of power have triggered an interest in the organizational capacity of states to successfully implement policies as well as state as an all-encompassing umbrella construct (Peters, 2015; Wu et al., 2015).

Cingolani (2019) categorizes theoretical literature on state capacity into four traditions, i.e., The Bellicist tradition, The Weberian tradition, The Relational tradition, and The Political Economy tradition. The Bellicist tradition is pioneered by Charles Tilly in a collection of essays exploring the role of war in state formation. Tilly's work Tilly (1992) and Tilly and Ardant (1975) are aimed at showing that external wars are necessary to build the capacity and the strength of the state. External wars push a country to increase its tax extraction capacity to fund military expenditures. Thus, state capacity in this tradition is primarily referred to as the tax extraction capacity of the state. Under this tradition, different scholars have explored state-building in different countries and regions. Herbst (1990) argues that the absence of external wars has prevented African states from building strong states with higher capacity.

In contrast, prolonged exposure to external wars positively affected states' ability to extract resources from the population and centralize their control in countries like Taiwan and South Korea. Similarly, Centeno (2002) takes the case of Latin America and argues that the absence of large-scale external wars was a reason that countries in Latin America could not build their capacity. The study maintains that small-scale internal wars did not encourage mass mobilization, centralized control, and greater extraction capacity, leading to weak states.

The most popular conceptions of state capacity are based on Weber's idea of the state as an institution having the power to establish and enforce laws, either directly or indirectly (Berwick and Christia, 2018). The Weberian tradition revolves around the role of modern bureaucracy in managing state affairs. Skocpol (1979) is a classical work in this tradition. The book acknowledges the role of skilled officials in implementing policies by saying, "Obviously, sheer sovereign integrity and the stable administrative-military control of a given territory are preconditions for any state's ability to implement policies. Beyond this, loyal and skilled officials and plentiful financial resources are basic to state's effectiveness in attaining all sorts of goals" (Skocpol, 1979). In "Bringing the State Back", Evans et al. (1985) move further along the Weberian tradition and define the state capacity as implementing official goals, notably over the real or prospective opposition of strong social groups or notwithstanding "recalcitrant socioeconomic circumstances." Dietrich and Evans (1985) contend that the quality and professionalism of bureaucracy and coordination among different state agencies are essential in building state capacity for economic transformation. Geddes (1994) explores the dilemmas politicians face in building the bureaucracy-backed administrative capacity of the state. The book argues that politicians and bureaucrats are self-interested individuals facing different behavioral incentives to further their career goals. Politicians try to balance the appointment of

competent managers with those of partisan managers to reassure their political support.

The Relational tradition links the capacity of the state to the society which it seeks to regulate. Migdal (1988), an important work in this tradition, defines state capacity as "the abilities of the state leaders to use the agencies of the state to get people in the society to do what they want them to do." The book divides states into weak and strong categories and argues that only strong states are able to centralize control and extract resources, while strong societies hinder the formation of high-capacity states. Mann (1986) categorizes state power into two categories, i.e., despotic power and infrastructural power. Despotic power is the ability of the state to enact a mandate over society, and infrastructural power is the ability of the state to invade territory and implement decisions. More recent works in this tradition include Acemoglu (2005), Fukuyama (2004), and Robinson (2008).

The Political Economy tradition is based on game-theoretic literature and focuses on incentives actors face while investing in state capacity. Levi (1988) is an important work in this tradition that takes state capacity as the ability of the state to provide public goods by extracting revenue. The study follows Tilly's approach but focuses on revenue extraction in relation to internal political conditions. According to the study, the leaders are self-interested revenue maximizers who focus on raising revenue as it helps them cling to power longer. For this purpose, rulers continuously interact with citizens to create compliance and, on the way, build the capacity to coerce people into compliance. Besley and Persson (2008, 2009) further explore and build on Levi's work. The studies take capacity building as an investment for future social valuation of public goods. These valuations may vary exogenously to the capacity investments, which may be taken as investments under uncertainty. Besley and Persson (2008) focus on how rulers invest in the capacity to tax people to provide public goods such as defense against external threats. Besley and Persson (2009) focus on investments in legal capacity to enforce contracts and property rights. Besley and Persson (2011) take state capacity as capital investment to build the ability for taxation, contract enforcement, coercion, and regulation. Other notable works in this tradition include Acemoglu et al. (2011) and Cárdenas (2010).

2.2. State capacity and developmental outcomes

It is widely acknowledged that state capacity is essential for many outcomes, such as public goods, labor rights, economic growth, peace, human capital, and democratic participation (Suryanarayan, 2023). There is a growing amount of literature on how state capacity impacts developmental outcomes. The literature covers many areas like conflict, industrialization, economic growth, and welfare policy outcomes. Fearon and Laitin (2003) argue that low state capacity can lead to higher instances of insurgency and guerilla activities in fragile states. Sobek (2010) maintains that high-capacity states can channel social demands in ways that can reduce the chances of insurgency. The study also argues that in the event of an insurgency or rebellion, it is easier for higher-capacity states to bargain their way out. On the other hand, the low capacity of the state reduces resistance to the spread of violence (Braithwaite, 2010). High capacity enables the states to make credible

commitments that increase the likelihood of peace, according to McBride et al. (2011), which uses a dynamic game-theoretic model to study the relationship between state capacity and peacebuilding.

In the area of exploring the impact of state capacity on industrialization and innovation, Evans (1992) and Weiss (2000) are important works. Evans (1992) coined a term called embedded autonomy, which is a combination of the coherence among governmental agencies and their external coordination with industry. The book argues that this embedded autonomy plays an important role in the fast neutralization of countries like South Korea. The embedded autonomy plays the role of midwifery in attracting capital and husbandry role in nurturing and developing specific industry sectors. Weiss (2000) extends the line of Evans and emphasizes the positive role of the transformative capacity of the state in bringing industrial growth. The study argues that transformative capacity is the key to the industrialization of fast-emerging economies like Taiwan and South Korea. State capacity is considered as an engine of economic growth (Mastrorocco and Teso, 2023). Geloso and Salter (2020) argue that there are no examples of states with high economic growth and low state capacity.

3. Materials and methods

Literature shows that the Bureaucratic Quality Index (BQI) developed by Political Risk Services Group (PRS) acquired from the International Country Risk Guide (ICRG) and WGI's (World Governance Indicators) Government Effectiveness Indicator provided by the World Bank, as well as other revenue indicators such as Tax/GDP, are occasionally used to measure state capacity. Similar to Bäck and Hadenius (2008), Hanson and Sigman (2013), and Knutsen (2013), this study employs the ICRG-PRS BQI to measure the state capacity. BQI is also recommended by Savoia and Sen (2012) as a proxy of the state's Implementation/administrative competence. The BQI is a skewed metric that spans from zero to four (0–4), with greater grades given to nations with high bureaucratic quality. Corresponding to the PRS group, "High points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. In these low-risk countries, the bureaucracy tends to be somewhat autonomous from political pressure and to have an established mechanism for recruitment and training. Countries that lack the cushioning effect of a strong bureaucracy receive low points because a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions."

For more in-depth information on why BQI is a good indicator for measuring administrative capacity, one can consult Hendrix (2010). The study analyses 15 different measures of state capacity and terms BQI as the most excellent among all, followed by the Tax/GDP ratio. The study concludes that from the perspective of construct validity, BQI is a satisfactory measure of bureaucratic capacity and that the BQI is the best indicator of government capability in terms of political pressure resistance, professionalism, and administrative competence to execute public services. Rendering Knutsen (2013), the BQI covers the most important components

of government capacity rather than limiting the idea of total state capacity to a single government function. Bäck and Hadenius (2008) also use BQI as a proxy for the administrative capacity of the state. The study argues that BQI is a good measure for many reasons. It is relevant to administrative capacity, and it offers a longer time series; it captures the quality and performance of administrative apparatus. Fukuyama (2004) also lists BQI as a potential measure of state capacity. The BQI dataset has data on 146 countries, including 88 developing countries included in this study.

The study's key dependent variable is access to improved water sources (as specified before), and data for this variable comes from the University of Oxford's Our World in Data website. The data spans the years 1990 to 2017. The analysis includes a panel data set of 88 developing nations. Panel ordinary least squares (OLS) and fixed effects (FE) approaches are used in the study to assess the link between state capacity and access to improved water sources, as well as how they are related. The Hausman Test favors fixed effects over random effects.

Fixed-effects regression, often known as FE regression, is a statistical technique that is particularly helpful in the context of causal inference (Gangl, 2010). In contrast to traditional OLS models, the major advantage of fixed effects estimations is that there are fewer possible sources of bias in the estimates. In OLS models, any association between the outcome or the relevant treatment variable and an unobserved variable leads to a skewed estimate of the treatment impact. Contrarily, FE models restrict the sources of bias to time-varying factors that, over time, correlate with both the treatment and the outcome. This requirement is far more attainable in the majority of applications than the stringent exogeneity assumption of OLS models (Collischon and Eberl, 2020).

When doing a multi-level regression, it is necessary to make the assumption that there is no unobserved unit-specific or group-specific heterogeneity. This assumption is often broken when dealing with non-experimental data, like the kind we have here, because of self-selection at the group level. Nevertheless, if the researcher makes use of FE models, then the premise that there is no unobserved heterogeneity may be reduced. A regression with fixed effects is one that is set on the level of the units and that incorporates constants that are group-specific (also known as "fixed effects"). In FE models, the only assumption that has to be made is that there is no unit-specific unobserved heterogeneity. This is because group-specific fixed effects eliminate any and all group-specific unobserved heterogeneity. When compared to traditional regression models, FE models have the advantage of enabling the identification of a causal impact under more lax conditions. Clearly, this is one of the reasons why FE models are appealing to social researchers who are doing causal analyses (Brüderl and Ludwig, 2015).

The basic econometric model used in this study is represented by the equation below.

$$\mathrm{WAcc}_{it} = \alpha_{it} + \beta_{it}\mathrm{GC}_{it} + \lambda_{it}V_{it} + \eta_i + \mu_{it} \quad (1)$$

where WAcc_{it} is the percentage of a nation's population who has gained access to better water sources in the country i and year t. This is the primary dependent variable as well. it is the government capacity variable. V_{it} is a vector of macroeconomic and demographic control factors that are thought to influence access

to better water resources. These include growth in GDP per capita, the "KOF index of globalization", population growth, foreign direct investment (FDI) as a percentage of GDP, and the percentage of the population living in urban areas. The country-specific fixed effects are represented by η_i, while the unobservable components are represented by μ_{it}. α is constant, and β and λ are the parameters that need to be calculated.

We also ran the same regressions on a different measure of state capacity, which, unlike the BQI, is based on objective data. Various tax revenue metrics are commonly used as proxies to measure the government's fiscal or extractive capabilities. According to Fukuyama (2013), "Tax extraction measures capacity in two ways: First, it takes capacity, however, generated, in order to extract taxes; second, successful tax extraction provides resources that enable the government to operate in other domains. Tax extraction rates can be measured both by the percentage of taxes to gross domestic product as well as by the nature of taxation—that is, whether it is based on income or wealth or indirect taxation (as income and wealth taxes are much more difficult to extract than indirect taxes)". Different studies have utilized fiscal or extractive capability as a measure of gauging state capacity. We utilize tax income as % of GDP as another measure of state capacity, following Besley and Persson (2008), Besley and Persson (2009), Thies (2010), and Cárdenas et al. (2010). The data on taxes and GDP comes from the publicly accessible IMF database (IMF).

4. Results

Table 1 shows the descriptive statistics for various variables used in the analysis.

Table 1. Descriptive statistics.

Variable	No. of Obs	Mean	Std. Dev.	Min	Max
Total Access	2224	76.952	18.605	13.2	100
Urban Access	2251	90.783	9.829	24.1	100
Rural Access	2224	66.418	21.773	3	100
BQI	2396	1.594	0.85	0	4
Tax/GDP Ratio	1992	14.549	6.734	0.3	53.328
Population Growth	2276	1.833	1.174	−3.074	7.603
GDP/Capita Growth	2359	2.114	6.812	−64.996	122.968
KOF Index	2430	50.661	11.791	21.269	81.408
FDI % of GDP	2302	3.657	8.136	−82.892	159.719
Urban Population %	2464	49.502	19.78	11.076	91.749

The label "Total Access" represents the percentage of a country's total population having access to improved water sources. Similarly, labels Urban Access and Rural Access represent the percentage of the urban and rural population, respectively, having access to improved sources of water. BQI is the Bureaucratic Quality Index used as a proxy to measure state capacity along with the Tax/GDP ratio.

Table 2 shows our main regression results. In most cases, the state capacity proxied by the Bureaucratic Quality Index has a strong positive impact on the percentage of the population having access to improved water sources. All the values of the BQI coefficient for the total population and rural population are positive, statistically significant, and high in magnitude.

Table 2. Regression outcomes of the state capacity using BQI.

	Total Access		**Urban Access**		**Rural Access**	
	OLS	**FE**	**OLS**	**FE**	**OLS**	**FE**
BQI	4.019***	1.127*	2.487***	0.416	4.982***	1.656**
	(0.314)	(0.602)	(0.212)	(0.37)	(0.404)	(0.713)
Pop. Growth	−3.87***	0.829	−1.474***	0.952	−4.955***	0.614
	(0.247)	(0.746)	(0.15)	(0.589)	(0.406)	(0.77)
GDP/PC Growth	0.179***	0.031	0.054	0.005	0.204***	0.006
	(0.046)	(0.039)	(0.037)	(0.031)	(0.063)	(0.046)
KOF Index	0.511***	0.48***	0.306***	0.174***	0.89***	0.834***
	(0.031)	(0.082)	(0.017)	(0.051)	(0.038)	(0.074)
FDI as % of GDP	−0.049	0.019	−0.06**	0.024	−0.062	0.017
	(0.036)	(0.015)	(0.025)	(0.019)	(0.047)	(0.019)
Urbanization	0.329***	0.313*				
	(0.015)	(0.166)				
cons	35.468***	33.649***	74.18***	79.412***	21.707***	19.472***
	(1.639)	(6.942)	(1.092)	(3.369)	(2.438)	(4.413)
Observations	2021	2021	2034	2034	2021	2021
R-squared	0.664	0.509	0.382	0.102	0.538	0.562
Robust standard errors are in parentheses						

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

For robustness purposes, we run the same regressions, replacing BQI with Tax/GDP, which is a different objective-data-based measure of state capacity. Various tax revenue indicators are typically used as proxies for the government's fiscal or extractive capability when estimating it. Various studies have utilized fiscal or extractive capability as a proxy for gauging state capacity. In line with Besley and Persson (2008) and Besley and Persson (2009), Thies (2010), and Cárdenas et al. (2010), we employ tax income as a % of GDP as an additional proxy for state capacity. The Tax/GDP data is obtained from the publicly accessible IMF database. The results are displayed in **Table 3**.

According to **Table 3**, the state's capacity, as measured by the tax-to-GDP ratio, positively affects access to safe drinking water. The majority of the values are statistically significant and positive.

Table 3. Regression results state capacity using Tax/GDP ratio as a measure of state capacity.

	Total Access		**Urban Access**		**Rural Access**	
	OLS	**FE**	**OLS**	**FE**	**OLS**	**FE**
Tax/GDP Ratio	0.007	0.212**	0.137***	0.177**	−0.016	0.312**
	(0.045)	(0.101)	(0.041)	(0.086)	(0.058)	(0.143)
Pop. Growth	−4.166***	0.139	−1.5***	0.732	−5.596***	−0.243
	(0.263)	(0.669)	(0.166)	(0.478)	(0.422)	(0.838)
GDP/PC Growth	0.084	0.041	−0.022	−0.005	0.084	0.01
	(0.058)	(0.029)	(0.043)	(0.02)	(0.075)	(0.038)
KOF Index	0.619***	0.39***	0.321***	0.107**	1.033***	0.723***
	(0.031)	(0.073)	(0.018)	(0.042)	(0.039)	(0.07)
FDI as % of GDP	−0.119***	0.004	−0.108***	0.004	−0.149***	0.001
	(0.044)	(0.018)	(0.031)	(0.023)	(0.058)	(0.026)
Urbanization	0.325***	0.281**				
	(0.016)	(0.137)				
cons	37.789***	40.384***	76.228***	82.03***	24.73***	25.512***
	(1.757)	(5.969)	(1.134)	(2.755)	(2.643)	(4.278)
Observations	1922	1922	1933	1933	1922	1922
R-squared	0.638	0.504	0.347	0.096	0.509	0.558
Robust standard errors are in parentheses						

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Discussion

According to the research, state capacity has a positive relationship with economic and developmental variables. Using a combined multidimensional indicator of state capacity, Knutsen (2013) presents a statistical assessment of the individual and collective effects of regime and state capacity on economic development. The study demonstrates that state capacity positively affects economic growth in low democratic regimes. More studies have demonstrated the positive and significant impact that state capacity has on economic performance; Dincecco and Katz (2016), Dincecco and Prado (2012), Evans and Rauch (1999), Hamm et al. (2012) are some of those.

Capacity of the state machinery is essential for water outcomes as well. According to Cosgrove and Loucks (2015), both current and future water managers will need to be knowledgeable in a wide range of relevant disciplines and have the ability to communicate with a variety of experts, stakeholders, and users. These managers and their organizations must possess the necessary technical, economic, social, financial, and environmental abilities to interact effectively with experts and other interested parties in areas where better water management is required.

For implementing any water management strategy, including IWRM, water governance plays a critical role (Nepal et al., 2021). Water governance is the arrangement of water institutions to achieve desired policy outcomes and depends on the capability of the government machinery (Ahmed and Araral, 2019). Cooper (2018) recommends increasing the government's capacity, including managerial

capacity and financial management capacity, to improve water management and governance in the Punjab and Khyber Pakhtunkhwa provinces of Pakistan.

The state may have to regulate public services, including the provision of water, if it is not directly providing the services. The purpose of regulation is to ensure that services are delivered in a way that is effective, equitable, and environmentally responsible, all while taking into account the social goals established by policymakers at both the national and local government levels. According to the findings of research conducted on non-state providers in 2004 and financed by DFID, instances of successful public service regulation were more likely to occur in situations in which the regulator had information and was able to enforce standards (Batley and Mcloughlin, 2009).

State capacity is also important in the successful implementation of contracts if the governments opt to contract the provision of public services, including water. Without a supporting external environment consisting of public sector institutional norms, regulations, laws, and policies, it is impossible for public sector organizations to uphold promises, and as a result, it is difficult to acquire the trust of contractors. It is possible for there to be substantial cultural and institutional restrictions in unstable situations. These might take the shape of social and political opposition to change, as well as a lack of adaptive ability in the face of entrenched vested interests. It is possible that there may be few opportunities for formal contracting in places where governments are unable to secure either political or economic stability or a legal structure that would protect contractual rights (Batley, 2006). It is probable that unstable nations lack or do not have the capacity to define contractual criteria, evaluate bids, devise performance metrics, and monitor contracts. According to the findings of research that looked at the privatization of urban water supply and healthcare in Africa and South Asia, various types of contracts need varying degrees of capability on the side of the government (Batley et al., 2006).

6. Conclusions

The provision of clean drinking water is an important public service and is mostly carried out by the governments in developing countries. In this study, we attempt to measure how government capacity impacts access to clean drinking water in developing countries. We use panel data on 88 developing countries from 1990 to 2015 and find that state capacity has a strong positive impact on access to safe drinking water in developing countries. We use BQI as a primary measure of state capacity and Tax/GDP ratio to check the robustness of estimates. There are a few limitations as well.

Whether many elements ought to be used to measure distinct facets of state capacity or if a single marker is adequate to gauge the notion as a whole is a topic of debate among scholars. Possible new indicators and Cingolani (2013) multidimensional approach could be used by researchers in the future. The academic community has the potential to advance the field by creating a more reliable and broadly acknowledged proxy for the state's capacity. The reliability of certain indicators may also be called into doubt; for instance, the BQI is assessed instinctively and may be susceptible to biases and unsystematic error (Henisz, 2000).

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