Access to basic drinking water and sanitation in Africa: Does financial inclusion matter?

Mustapha Immurana*, Abdul-Aziz Iddrisu, Zaidan Mohammed and Toby Joseph Mathew K.K.

Abstract: A major challenge confronting most countries in the world including those in Africa, is lack of access to basic drinking water and sanitation. This has given birth to several studies investigating the factors that influence access to basic drinking water and sanitation. Notwithstanding, while financial inclusion is highly extolled for its welfare-enhancing effects and hence could play a major role in accessing basic drinking water and sanitation services, there is a dearth of empirical evidence in this regard, especially in the African context. This study, therefore, attempts at providing the foremost empirical evidence of the effect of financial inclusion on access to basic drinking water and sanitation in Africa using a sample of 33 countries for the period 2004 to 2018. The random effects and the fixed effects regressions are used as baseline estimation techniques and the Instrumental Variable Fixed Effects (IVFE) regression is employed as a robustness check. Our findings show that, financial inclusion enhances access to basic drinking water and sanitation services, irrespective of the estimator used. The implication is that, expanding financial inclusion can be used as an effective strategy towards enhancing access to basic drinking water and sanitation services in Africa.

Subjects: Health & Development; Population & Development; Sustainable Development; Finance; Human Geography; Physical Geography

Keywords: Basic drinking water; basic sanitation; financial inclusion; Africa

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PUBLIC INTEREST STATEMENT

In this paper, we assess whether financial inclusion can be used to enhance access to basic drinking water and sanitation services in Africa. This is necessary because a significant number of Africans do not have access to basic drinking water and sanitation services. Our findings suggest that, prioritizing financial inclusion can be a very useful tool in the quest to improve access to basic drinking water and sanitation services in Africa.
1. Background
While access to basic drinking water and sanitation facilities remains very essential to human life, a significant number of people in the world lack access to these services. For instance, in 2017, estimates have shown that 785 million people in the world had no access to basic drinking water services with about 144 million of these people drinking surface water. In the same year, 2 billion people in the world were estimated to have no access to basic sanitation facilities, of which 673 million engaged in open defecation. Basic drinking water service is defined as an improved source of drinking water, which can be collected in a 30 minutes round trip, and basic sanitation service is defined as a sanitation facility that separates excreta from human contact hygienically but not safely managed1 (World Health Organization [WHO], 2019a, WHO, 2019b; WHO & United Nations Children Fund [UNICEF], Joint Monitoring Programme [JMP], n.d). With regard to developing regions such as Africa, the situation is even more alarming. This is because in 2015 for instance, about 48% (319 million people) of the global population without access to improved drinking water lived in sub-Saharan Africa (SSA). In the same year, 695 million people in SSA had no access to improved sanitation facilities. Similarly, in 2017, only 34% and 12% of the population in SSA had access to basic drinking water and sanitation services, respectively (UNICEF & WHO, 2015, 2019).

The lack of access to basic drinking water and sanitation facilities, therefore, compounds the global challenges with population health (especially in the wake of the Coronavirus disease 2019 (COVID-19) pandemic which requires frequent hand washing with soap as well as other good hygienic practices as some of its preventive measures) and economic development in general. This is because, it has been estimated that, about 829 thousand people in the world are killed by diarrhoea each year due to unsafe drinking water, hand hygiene and sanitation. In 2017, more than 220 million people in the world needed schistosomiasis (which is contracted by contact with water infested with parasitic worms) preventive treatment. Thus, improving access to basic drinking water and sanitation would not only avert these deaths but also reduce the spread of diseases and health expenditure, as well as make people more economically productive (WHO, 2019a, 2019b), hence leading to economic growth and development.

While it is obvious that, various governments in Africa are unable to provide basic drinking water and sanitation facilities for all their citizens, especially the poor, a major approach that can be employed in enhancing access to these facilities is financial inclusion. Financial inclusion is defined as responsible and sustainable means of making accessible, relevant (useful) and affordable financial products and services to businesses/individuals (World Bank, 2020a). Financial inclusion has been recognised or documented as an enabler of employment opportunities as well as poverty alleviation and hence, decreasing income inequality or increasing income levels (Abimbola et al., 2018; Ali et al., 2020; Koomson et al., 2020; Omar & Inaba, 2020). Therefore, based on the theory of demand as well as the capability theory (of Nussbaum, 2011; Sen, 1999), the rise in income or wealth levels, would make people, especially the poor, more capable of affording basic drinking water and sanitation facilities, all other things being equal. Financial inclusion can also make it easy for individuals to access credit facilities in order to acquire basic drinking water and sanitation facilities (see, Immurana et al., 2021).

Notwithstanding, majority of the studies on the determinants of access to basic drinking water and sanitation facilities in Africa did not examine the role of financial inclusion (see for example, Mulenga et al., 2017; Armah et al., 2018; Akpakli et al., 2018; Angoua et al., 2018; Nyanza et al., 2018; Akoteyon, 2019; Azage et al., 2020; Marks et al., 2020; Simelane et al., 2020). Among the studies that examined the role of financial inclusion in Africa, most of them focused on its effect on poverty reduction (see for example, Mohammed et al., 2017; Abimbola et al., 2018; Omar & Inaba, 2020; Koomson et al., 2020; Nsiah et al., 2021) with very few devoted to how financial inclusion affects access to basic drinking water and sanitation facilities (see, Ezenwaji & Otti, 2013; Waste, 2020; Immurana et al., 2022).
However, the few studies that reported on the role of financial inclusion in enhancing access to basic drinking water and sanitation were single-country studies and did not examine the effect of a combined index of financial inclusion (an index constructed based on a number of financial inclusion variables). Meanwhile, using data on several countries over different time periods (panel data) ensures better accuracy of the inference of parameters, higher ability to take into account complex human behaviour as well as higher control over omitted variable bias, among others (Hsiao, 2007). Also, the use of single indicators of financial inclusion may not depict the degree of financial inclusion, hence, can be misleading. What is therefore suggested, is the usage of a number of variables to construct a single index of financial inclusion. Doing so may not only provide in detail the extent of financial inclusion but will also facilitate easy comparisons among countries, as well as tracking overtime, the successes of financial inclusion programmes (Cámara & Tuesta, 2015; Goel & Sharma, 2017; Sarma, 2008).

To this end, this study therefore examines the effect of a combined index of financial inclusion on access to basic drinking water and sanitation in 33 African countries from 2004 to 2018, making it to the best of our knowledge, the first of its kind, especially in the African context. This helps in enhancing the generalizability of the findings of the study overtime and also in bringing to light how financial inclusion can be used as an instrument towards improving access to basic drinking water and sanitation in Africa.

The rest of the study therefore proceeds as follows: The next section is devoted to a review of related studies, and the third section covers data and methods. Results and discussion are outlined in section four, and the final section provides concluding remarks.

2. Review of empirical literature

In this section, we present related studies on the determinants (including financial inclusion) of accessing water and sanitation services as well as the effect of financial inclusion on other socioeconomic indicators, especially poverty, placing more emphasis on Africa.

Concerning the studies that did not account for financial inclusion, Mulenga et al. (2017) in Zambia, found sex of household head and wealth to be associated with access to improved water. Also, sex of household head, wealth, residence type and region were found to be associated with access to improved sanitation. A study by Armah et al. (2018) among 15 countries in SSA from 1990 to 2015 found that, urban rich households were 329% and 227% more probable to have access to improved water and sanitation relative to urban poor households respectively.

Akpakli et al. (2018) found that gender, age, educational level, socioeconomic status, marital status and occupation of heads of households were the drivers of access to improved sanitation among households in rural areas of Southern Ghana. A study by Angoua et al. (2018) in Abidjan, Cô’té d’Ivoire, found that, settlement features and socioeconomic status significantly influenced access to improved sanitation and water. Nyanza et al. (2018) conducted a study among pastoralists in Ngorongoro District of northern Tanzania and found that, family size, socioeconomic status, history of diarrhoeal disease, having under-five children in the household, motivation to enhance defecation place, as well as receiving education on sanitation influenced access to sanitation facility.

Another study by Akoteyon (2019) found that, income, cost and water source were the main drivers of water supply among households in Lagos, Nigeria. In a related study, Gomez et al. (2019) assessed the effects of socioeconomic factors on access to water in rural areas of middle and low-income countries. The findings showed that, female primary school completion rate, Gross National Income (GNI), rural population growth, agriculture as a percentage of Gross Domestic Product (GDP) and governance indicators were associated with access to water.
A related study conducted by Marks et al. (2020) examined the sanitation and water services in Bushenyi-Ishaka Municipality in Uganda and found urban households to be more likely to pay for water regularly as well as use improved water sources relative to rural households. Simelane et al. (2020) also found rising wealth index and households in urban areas to be more likely to be associated with access to improved drinking water sources in Eswatini. Notwithstanding, rising household size was found to decrease access to improved drinking water sources relative to lesser household size.

Turning to the studies that considered financial inclusion, as stated already, most of them examined the effect of financial inclusion on poverty or income. For example, Mohammed et al. (2017) found higher net wealth and welfare benefits among the poor in SSA who were financially included relative to those who were not. Abimbola et al. (2018) found the majority of financial inclusion indicators to enhance per capita income in Nigeria.

Similarly, Omar and Inaba (2020) found financial inclusion to reduce poverty in a sample of developing countries. Also, Koomson et al. (2020) found financial inclusion to reduce poverty and vulnerability to poverty in Ghana, and Nsiah et al. (2021) found financial inclusion to reduce poverty in SSA beyond a threshold level of 0.365. In a related study, Immurana et al. (2021) found financial inclusion to enhance population health in a sample of African countries.

Concerning the studies that examined the effect of financial inclusion on access to water and sanitation in the African context, Ezenwaji and Otte (2013) found that making available informal financial inclusion to women improved access to sanitation facilities among Nigerian households. Also, Waste (2020) reported that making available sanitation loans among others improved access to sanitation facilities in Kenya. Last but not the least, Immurana et al. (2022) found financial inclusion to be associated with a reduction in open defecation in Ghana.

From the review above, while the majority of the studies that examined the determinants of access to basic drinking water and sanitation facilities did not consider financial inclusion, the studies that examined the effect of financial inclusion focused more on its poverty effects relative to its effect on access to basic drinking water and sanitation facilities. Moreover, all the studies examining the access to basic drinking water and sanitation effects of financial inclusion were single-country based and did not use a combined index of financial inclusion.

This study therefore fills these lacunae by investigating the effect of a combined index of financial inclusion on access to basic drinking water and sanitation in 33 African countries from 2004 to 2018.

3. Data and methods

The study uses data from 2004 to 2018 on 33 countries in Africa (see Table A1). The number of countries and the study period are largely dictated by data availability. Linear interpolation is employed to fill gaps in the data. We use the number of people with access to at least 2 basic drinking water (Water) and sanitation (Sanitation) services as dependent variables. Financial inclusion is used as the main independent variable. Moreover, GDP, gross primary school enrollment (Primary) and population growth (Population) are used as control variables. The control variables are selected based on literature (see for example Akpakli et al., 2018; Gomez et al., 2019; Immurana et al., 2022; Immurana et al., 2022). Except data on financial inclusion that is sourced from the International Monetary Fund (2020), data on all other variables are sourced from the World Bank (2020b). The financial inclusion indicator (FIid) is obtained using indicators of both financial access and usage; number of Automated Teller Machines (ATMs), commercial bank branches (BRR), outstanding deposits (ODs) and number of borrowers from commercial banks (BRR). Thus, these indicators are used to construct a financial inclusion index (FIid) with the aid of Principal Component Analysis (PCA).
Therefore, following Anarfo et al. (2019) with regard to the PCA, the \( h \)th factor index can be specified as:

\[
\text{FII}_h = M_{h1}Y_1 + M_{h2}Y_2 + \ldots + M_{hk}Y_k
\]

(1)

where financial inclusion is represented by \( \text{FII}_h \). \( M_h \) refers to the weight of the parameter of the factor score, \( Y \) is the initial value of the respective component, and \( K \) indicates the number of variables employed in constructing the index. For the purpose of this study, financial inclusion is specified as:

\[
\text{FII} = f(\text{ATMs, BBR, ODs, BORR})
\]

(2)

The meanings of the variables are as stated above. All variables used in constructing the financial inclusion index are measured per 100,000 adults with the exception of outstanding deposits that is measured as a percentage of GDP. The number of people with access to basic drinking water and sanitation services are measured as a percentage of the population. Gross primary school enrollment is measured as a ratio of the number of people in the age category recognised for primary education, and population growth is measured in the form of a percentage. GDP is measured in per capita terms.\(^3\)

Therefore, to examine the effect of financial inclusion on access to basic drinking water and sanitation, we have the following function:

\[
\text{WS} = f(\text{FII}, \text{GDP, Primary, Population})
\]

(3)

Where WS refers to access to basic drinking water and sanitation indicators, and all the remaining variables are as already defined. For estimation purposes, equation 3 is re-specified as follows:

\[
\text{WS}_it = \alpha_0 + \alpha_1\text{FII}_it + \alpha_2\text{GDP}_it + \alpha_3\text{Primary}_it + \alpha_4\text{Population}_it + \epsilon_it
\]

(4)

where \( \alpha_0 \) is the intercept and all other \( \alpha \)s are coefficients of their associated variables, \( \epsilon \) is the disturbance term, \( i \) indicates countries and \( t \) indicates years, while all other variables remain as already defined.

Concerning the empirical estimation techniques, we employ the random effects and the fixed effects regressions as our baseline models. Notwithstanding, the relationship between financial inclusion and access to basic drinking water and sanitation is likely to be endogenous (simultaneity). Thus, people with access to basic drinking water and sanitation services are more likely to be healthy. Hence, based on the labour productivity hypothesis, they would be more probable to be employed because they will have higher productivity (see, Finlay, 2007). With employed people being more likely to have higher incomes implies, they are more likely to save in financial institutions and hence enjoy its associated benefits such as credit facility among others (Immurana et al., 2021). The above therefore indicates the possible endogenous nature of financial inclusion, which might make the random effects and the fixed effects estimates biased, since these estimators are unable to control for endogeneity.

Therefore, for robustness purposes, this study employs the Instrumental Variable Fixed Effects (IVFE) estimator given its ability to deal with endogeneity. The IVFE is chosen because the test of overidentifying restrictions between the random effects and the fixed effects shows the fixed effects model to be the most appropriate (see Table B1). Since the IVFE requires instruments to be used, this study uses the first lag of financial inclusion, the number of telephone subscriptions per 100 people, the first lag of gross-fixed capital formation as a percentage of GDP and the second lag of regulatory quality as instruments.\(^4\) We do so because the past values of regulatory quality and financial inclusion can affect the willingness of financial institutions to operate in a particular country or region, given that they respectively, reflect the quality of governance and market size in a country. Further, gross-fixed capital formation and the number of telephone subscriptions show
the degree of infrastructural development, which can affect the influx of financial institutions, hence access to financial services in a country.

In this study, we wish to stress that in order to control for any possible heteroscedasticity and autocorrelation, cluster robust standard errors are used. Also, to confirm the absence of multicollinearity, the Variance Inflation Factor (VIF) is used (see Table C1) as suggested by Tabachnick and Fidell (2012).

4. Results and discussion
In this section, we present and discuss the results of PCA, correlation and regression analyses.

4.1 PCA construction and correlation analysis
This sub-section presents and discusses the results of PCA used in constructing the financial inclusion index as well as correlation analysis among the variables used by the study.

In Table 1, we present the results of PCA, where it is found that only one component (Comp1) can be used based on the decision rule of Eigenvalue greater than one. Moreover, the Bartlett test of sphericity indicates that the variables used in constructing the financial inclusion index (FIid) are appropriate. It must be noted that the financial inclusion index (FIid) is standardized to 0–1, where higher figures indicate more financial inclusion.

The correlation analysis (Table 2) shows relatively high positive correlation between financial inclusion and access to basic drinking water and sanitation, hence the need for further multivariate analysis. However, the correlation coefficients among the independent variables are all relatively low, which suggests the absence of multicollinearity. Further, as indicated already, we use the VIF (see Table C1) to confirm the absence of multicollinearity.

4.2 Regression analysis
This sub-section presents and discusses the regression results of the effect of financial inclusion on access to basic drinking water and sanitation in the selected 33 African countries. The results are therefore presented in Tables 3 and 4.

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### Table 1. PCA results of financial inclusion index (FIid)

| Component | Eigenvalue | Variables used | Eigenvectors | Bartlett test of sphericity (P-value) |
|-----------|------------|----------------|--------------|--------------------------------------|
| Comp1     | 2.6898     | ATMs           | 0.5698       | 0.000                                |
| Comp2     | 0.7282     | BBR            | 0.5199       |                                      |
| Comp3     | 0.4602     | ODs            | 0.3741       |                                      |
| Comp4     | 0.1218     | BORR           | 0.5149       |                                      |

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### Table 2. Matrix of correlations

| Variables     | (1) | (2)  | (3)  | (4)  | (5)  | (6)  |
|---------------|-----|------|------|------|------|------|
| (1) Water     | 1.000 |     |      |      |      |      |
| (2) Sanitation| 0.779 | 1.000 |      |      |      |      |
| (3) GDP       | 0.436 | 0.589 | 1.000 |      |      |      |
| (4) Primary   | 0.006 | 0.012 | −0.306 | 1.000 |      |      |
| (5) Population| −0.550 | −0.413 | −0.061 | −0.240 | 1.000 |      |
| (6) FIid      | 0.633 | 0.599 | 0.497 | 0.061 | −0.505 | 1.000 |
In Table 3, with regard to the effect of financial inclusion on accessing basic drinking water and sanitation services, we find financial inclusion to have a positive significant effect on access to basic drinking water services at 1% level. Specifically, a unit increase in financial inclusion
increases the number of people using at least basic drinking water services by 23.19 percentage points and 22.99 percentage points in the random effects and fixed effects models, respectively. Concerning access to basic sanitation services, we find that a unit increase in financial inclusion increases the number of people using at least basic sanitation services by 26.14 percentage points and 26.48 percentage points in the random effects and the fixed effects models, respectively, at 1% level of significance.

Given that the poor are mostly those without basic drinking water and sanitation facilities, the above outcomes on the role of financial inclusion are not surprising. This is because financial inclusion has been documented to reduce poverty (see, Mohammed et al., 2017; Abimbola et al., 2018; Omar & Inaba, 2020; Koomson et al., 2020; Siah et al., 2021). This reduction in poverty would result in a rise in income among poor households, hence bolstering their ability to afford basic drinking water and sanitation services. The findings therefore confirm basic demand theory as regards the effect of a rise in income on the demand for goods and services, ceteris paribus. Moreover, our findings support the vulnerable group theory of financial inclusion. This is because, the vulnerable group theory posits that financial inclusion programmes should be targeted towards vulnerable groups, such as the poor, women, the elderly and young people since they are more adversely affected by economic challenges (Ozili, 2020). Doing so will widen their freedom to choose essential goods and services, such as basic drinking water and sanitation facilities as the theory of capability postulates (see, Nussbaum, 2011; Sen, 1999).

Our findings are in tandem with Bhandarkar (2021) who reported that, in India, financial inclusion enhanced the availability of toilet facilities at home for several girls and women. Also in Nigeria, the provision of credit by a women association has been found to enhance access to sanitation facilities (Ezenwaji & Otta, 2013). Similarly, in Kenya, among other factors, accessibility to improved sanitation facilities was found to have improved as a result of the provision of sanitation loans (Waste, 2020). More recently, Immurana et al. (2022) found financial inclusion to be associated with a reduction in open defecation among households in Ghana.

Surprisingly, we find primary school enrollment to decrease access to basic sanitation services (Table 3). This outcome conflicts with Akpakli et al. (2018) who found education to be associated with access to improved sanitation among households in rural areas of Southern Ghana as well as Gomez et al. (2019) who revealed that, female primary school completion was associated with access to water in rural areas of middle and low-income countries. This outcome further conflicts with the theory of demand for health given the role of education in enhancing the demand for health inputs (see, Grossman, 2000). Moreover, education has been found to increase the probability of using other health enabling goods (see for example, Immurana & Arabi, 2016a, 2016b; Immurana & Urmij, 2018a, 2018b, 2017). Nonetheless, the reason for our outcome could be that, while school enrollment increases as a result of rising population, efforts are not being made to increase sanitation facilities, which is typical of a number of African nations.

As indicated already, given that there is the likelihood of endogeneity between financial inclusion and access to basic water and sanitation, we employ the IVFE estimates in Table 4 as a form of robustness check.

Our findings show that, a unit increase in financial inclusion increases the number of people with access to at least basic drinking water and sanitation services by 28.84 percentage points and 26.64 percentage points respectively, at 1% level of significance (Table 4).

Also gross primary school enrolment is found to decrease the number of people with access to at least basic drinking water and sanitation services by 0.10 percentage point and 0.16 percentage point at 10% and 1% level of significance, respectively (Table 4).
The above findings therefore confirm the robustness of the random effects and the fixed effects estimates. In fact, similar results are found even when individual financial inclusion indicators are used (see Tables D1-D4), although we prefer to concentrate on the results of the financial inclusion index given its added advantages.

5. Conclusion

Globally, as well as in Africa, a significant number of people don’t have access to basic drinking water and sanitation facilities, which serves as a major threat to the fight against water and sanitation-related diseases. Access to basic drinking water and sanitation becomes more imperative in the wake of the current global COVID-19 pandemic. While a number of studies have been done on the empirical determinants of access to basic drinking water and sanitation, very little attention has been given to the role of financial inclusion. This study therefore provides the first empirical evidence of the role of financial inclusion in enhancing access to basic drinking water and sanitation services across several African countries. We use data covering 33 countries for the period 2004 to 2018. The random effects and the fixed effects regressions are used as the baseline estimation techniques, while the IVFE estimator is used for robustness checks due to its ability to deal with endogeneity. The findings show that, financial inclusion enhances access to basic drinking water and sanitation services irrespective of the estimator used. Given that the poor are mostly those without access to basic drinking water and sanitation facilities, our findings therefore lends support to the vulnerable group theory of financial inclusion as well as the theory of capability.

It can therefore be concluded that, in African governments’ attempts to enhance access to basic drinking water and sanitation services, paying attention to financial inclusion can be a very useful strategy. Doing so, access to basic drinking water and sanitation would improve leading to the prevention of several diseases that are associated with lack of access to basic drinking water and sanitation services.

Notwithstanding the above, our study uses only 33 African countries and hence caution should be exercised in extending the findings to represent those African countries not included in this study although they may share similar characteristics with the countries covered by this study.

Funding
The authors have no funding to report.

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Citation information
Cite this article as: Access to basic drinking water and sanitation in Africa: Does financial inclusion matter? Mustapha Immurana, Abdul-Aziz Idrissu, Zaidan Mohammed & Toby Joseph Mathew K.K, Cogent Social Sciences (2022), 8: 2057057.

Notes
1. Improved water sources include boreholes or tube-wells, piped water, protected springs, packaged, or delivered water and protected dug wells, while improved sanitation facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; composting toilets or pit latrines with slabs and ventilated improved pit latrines (World Bank, 2020b).
2. At least basic drinking water and sanitation services include safely managed drinking water and sanitation services (World Bank, 2020c).
3. The measurements of all variables are as used in the specified data sources.
4. Aside from data on regulatory quality that is obtained from the World Bank (2020c), data on all remaining instruments (with the exception of financial inclusion that has been stated already) are obtained from the World Bank (2020b).

Disclosure statement
No potential conflict of interest was reported by the author(s).

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Appendixes

Table A1. List of countries

| Egypt, Arab Rep. | Algeria | Mauritius | Uganda |
|------------------|---------|-----------|--------|
| Equatorial Guinea | Angola  | Mozambique | Zambia |
| Eswatini | Botswana | Namibia | Zimbabwe |
| Ghana | Burundi | Nigeria | |
| Guinea | Cabo Verde | Rwanda | |
| Kenya | Cameroon | Seychelles | |
| Lesotho | Central African Republic | Sierra Leone | |
| Madagascar | Chad | South Sudan | |
| Malawi | Comoros | Tanzania | |
| Mauritania | Congo, Dem. Rep. | Tunisia | |

Table B1. Test of overidentifying restrictions between random effects and fixed effects

| Water Model | Sanitation Model |
|-------------|------------------|
| Test of overidentifying restrictions (Sargan-Hansen statistic) | Test of overidentifying restrictions (Sargan-Hansen statistic) |
| 39.406*** | 37.267*** |

***p < 0.01
### Table C1. Variance inflation factor

|        | VIF  | 1/VIF |
|--------|------|-------|
| Fiji   | 1.934| .517  |
| GDP    | 1.616| .619  |
| Population | 1.473| .679  |
| Primary| 1.214| .823  |
| Mean VIF | 1.559|       |

### Table D1. Effects of financial access indicators on access to basic drinking water services

|        | (1) | (2) | (3) | (4) |
|--------|-----|-----|-----|-----|
|        | Random effects | Fixed effects | Random effects | Fixed effects |
| ATMs   | 0.240*** | 0.244*** |     |     |
|        | (0.0865) | (0.0860) |     |     |
| GDP    | 0.0000630 | −0.000380 | 0.000521 | 0.000309 |
|        | (0.000515) | (0.000572) | (0.000679) | (0.000707) |
| Primary| −0.0345 | −0.0348 | −0.0314 | −0.0317 |
|        | (0.0598) | (0.0611) | (0.0576) | (0.0592) |
| Population | −0.265 | 0.153 | −0.0109 | 0.413 |
|        | (0.698) | (0.748) | (0.691) | (0.782) |
| BBR    |     |     | 0.707*** | 0.678** |
|        |     |     | (0.259) | (0.265) |
| Constant | 65.95*** | 67.64*** | 61.10*** | 62.25*** |
|        | (6.840) | (6.409) | (6.412) | (6.694) |
| Observations | 384 | 384 | 400 | 400 |
| Countries | 33 | 33 | 33 | 33 |
| Overall R² | 0.395 | 0.248 | 0.379 | 0.348 |
| F- stat | 2.303 |       | 1.875 |       |
| Chi2  | 10.58 |       | 9.776 |       |
| Overall p-value | 0.0317 | 0.0800 | 0.0444 | 0.139 |

*Cluster robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01
|          | (1)     | (2)     | (3)     | (4)     |
|----------|---------|---------|---------|---------|
|          | Random effects | Fixed effects | Random effects | Fixed effects |
| ODs      | 0.109*** | 0.107** | 0.000982 | 0.000581 |
|          | (0.0411) | (0.0454) | (0.000772) | (0.000851) |
| GDP      | 0.00130* | 0.00103 | 0.000581 | 0.000581 |
|          | (0.000766) | (0.000772) | (0.000819) | (0.000851) |
| Primary  | -0.0272  | -0.0302 | 0.0204   | 0.0187   |
|          | (0.0606) | (0.0626) | (0.0542) | (0.0575) |
| Population| 0.167   | 0.719   | -0.924   | -0.423   |
|          | (0.748) | (0.858) | (0.650) | (0.615) |
| BORR     | 0.0295*** | 0.0293*** | 0.0295*** | 0.0293*** |
|          | (0.0106) | (0.0100) | (0.0106) | (0.0100) |
| Constant | 59.76*** | 61.53*** | 61.53*** | 61.53*** |
|          | (7.216) | (7.318) | (6.797) | (6.757) |
| Observations | 400     | 400     | 350     | 350     |
| Countries | 33      | 33      | 33      | 33      |
| Overall R² | 0.318  | 0.264  | 0.397  | 0.389  |
| F- stat   | 2.139   | 3.123   | 3.123   | 3.123   |
| Chi2      | 11.36   | 13.62   | 11.36   | 13.62   |
| Overall p-value | 0.0228 | 0.0988 | 0.00861 | 0.0282 |

Cluster robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

(Continued)
|       | (1)          | (2)          | (3)          | (4)          |
|-------|--------------|--------------|--------------|--------------|
|       | Random effects | Fixed effects | Random effects | Fixed effects |
| Overall R² | 0.390        | 0.297        | 0.439        | 0.417        |
| F- stat | 2.190        | 11.13        |              |              |
| Chi²  | 10.34        | 45.16        |              |              |
| Overall p-value | 0.0351     | 0.0924       | 3.69e-09     | 0.00000905   |

Cluster robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

|       | (1)          | (2)          | (3)          | (4)          |
|-------|--------------|--------------|--------------|--------------|
|       | Random effects | Fixed effects | Random effects | Fixed effects |
| ODs   | 0.120**      | 0.118**      |              |              |
|       | (0.0494)     | (0.0514)     |              |              |
| GDP   | 0.00189**    | 0.00156*     | 0.00172      | 0.00124      |
|       | (0.000831)   | (0.000854)   | (0.00105)    | (0.00105)    |
| Primary | −0.0266   | −0.0283      | −0.0710      | −0.0748      |
|       | (0.0462)     | (0.0476)     | (0.0586)     | (0.0599)     |
| Population | 0.265      | 0.553        | 0.455        | 0.860        |
|       | (1.269)      | (1.330)      | (1.413)      | (1.505)      |
| BORR  |              |              | 0.0237**     | 0.0243**     |
|       |              |              | (0.0116)     | (0.0109)     |
| Constant | 33.72***    | 35.77***     | 41.68***     | 43.95***     |
|       | (7.032)      | (5.669)      | (8.377)      | (7.054)      |
| Observations | 400         | 400          | 350          | 350          |
| Countries | 33          | 33           | 33           | 33           |
| Overall R² | 0.437        | 0.407        | 0.335        | 0.292        |
| F- stat | 2.272        | 2.263        |              |              |
| Chi²  | 11.32        | 10.33        |              |              |
| Overall p-value | 0.0232     | 0.0831       | 0.0353       | 0.0841       |

Cluster robust standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01
