**Reducing Women's Time Poverty: The Impact of Foreign Aid Allocation on Access to Water and Sanitation in sub-Saharan Africa**

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**Abstract**

The Millennium Development target of halving the share of the population without access to clean water and sanitation is a cross-cutting target that has implications for reducing the time poverty of women in sub-Saharan Africa. However, achieving this target has remained a major challenge for the region, with the ability of governments to expand access constrained by limited financial resources. In this paper, we investigate whether targeting foreign aid to the water and sanitation sector can help achieve the goal of expanding access to water and sanitation services. This study undertakes an econometric analysis of the impact of aid on access to water and sanitation in developing countries with a focus on sub-Saharan Africa. It specifically examines whether sectoral allocation of aid has an impact on access to water and sanitation. The analysis is based on pooled cross-sectional and panel data estimation techniques controlling for country specific effects, potential outliers, and potential endogeneity of regressors. The empirical results show that increasing the amount of aid targeted to the supply of water and sanitation appears to be associated with increased access to these services.

Key words: Water and sanitation; official development aid; sub-Saharan Africa.

**Introduction**

Access to social services – education, health care, potable water, adequate sanitation – is vital to securing and sustaining human development, and to reducing poverty (UN 2014). Their importance is reflected in the priority given to these areas in the Millennium Development Goals. However, while education and health care have received significant attention from governments as well as from bilateral and multilateral donors, less attention is paid to the provision of water and sanitation. In sub-Saharan Africa, this is reflected in the uneven nature of progress towards achieving the different MDGs. While the region appears to have made some progress in improving health and education outcomes, the provision of safe drinking water and basic sanitation remains a major challenge (World Bank, 2014). Not only does the region lag behind other regions in access to water and sanitation (Figure 1), it also lags behind relative to Target 7c of the United Nations' Millennium Development Goals (MDGs), which aims to "halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation." Thirty-seven percent of the region's population does not have access to an improved water source, and 567 million people lack access to improved sanitation (UN, 2013). Between 1990-2012, the share of the population with access to adequate sanitation increased by only 6 percentage points, compared with an overall increase of 22 percentage points worldwide.

This state of affairs is worrying, given the implications of adequate access to water and sanitation for other dimensions and indicators of human and economic development: health, education, productivity, economic growth and equity. The Millennium Development target of halving the share of the population without access to clean water and sanitation is a cross-cutting target that has implications for the achievement of the other MDGs. In a region in which

agriculture is the main source of livelihood for the majority of the population, access to water is a pre-condition for poverty reduction because of its impact on increasing the productivity of human and physical capital in this sector.

Access to clean drinking water and sanitation is also directly linked to health outcomes, especially for infants and children. Despite some gains in reducing child mortality, SSA has the highest under-five mortality rate (at 98 deaths per 1000) and is the only region to have reduced the rate by less than half between 1990 and 2011 (World Bank, 2014). Worldwide, diarrheal diseases, most commonly caused by gastrointestinal infections and transmitted through the oral-faecal route are the most common cause of childhood deaths (Botting et al., 2010). Frequent occurrences of diarrheal and other disease resulting from lack of access to water and sanitation impacts human capital formation and lowers the productivity of adults who fall sick or who must care for the sick. Improving access to water and sanitation can go a long way to preventing the incidence of diarrheal and other diseases, improving health outcomes and alleviating the related impacts on human capital, productivity, and health expenditures.

Inadequate access to water sources and sanitation also has implications for MDG 3: promoting gender equality (especially in the areas of education and labor force participation) and empowering women. SSA continues to lag behind other regions in lowering the gap in male-female enrolment rations at all levels of education, and girls remain at a significant disadvantage in access to primary and secondary education (United Nations, 2013). In many countries in SSA, it is women and girl-children who are responsible for fetching water and caring for the sick. Spending more time on these activities increases the likelihood that girls will be withdrawn from school to help with these activities, and reduces the time that women have to undertake paid market work. Efforts to narrow the gender gaps in education and paid employment, which

tend to be significantly higher in rural areas, will continue to be hampered by the lack of access to potable water and improved sanitation.

Improving access to water and sanitation is therefore a top priority in the region. However, financing remains an important constraint on the ability of governments to expand and maintain water and sanitation infrastructure, and efforts to expand access to water and sanitation have focused on mobilizing more financial resources, both domestically and through increased aid inflows to bridge the financing gaps in the provision of water and sanitation services.  In recognition of this fact, the G-8 summit of 2005 resulted in a commitment to double aid to the continent to improve the delivery of public services and build infrastructure for health, education, water and sanitation (Wolf, 2007).  However, the share of aid going to the water and sanitation sector remains low, despite having increased in real terms to 4.1% in 2008, after having fallen to a low of 2.8% in 2002 (Salami et al., 2011).  Moreover, simply increasing the volume of aid without targeting the water and sanitation sectors may not lead to expanded access to these services, since water and sanitation compete with other public services for funding, and physical infrastructure such as roads tend to receive priority if aid is not targeted to the water and sanitation sector.

In this paper, we investigate whether targeting foreign aid to the water and sanitation sector can help achieve the goal of expanding access to water and sanitation services. Specifically, we use OECD/DAC data to examine the impact of foreign aid targeted to water and sanitation on access to these social services. We focus on access by the rural population given the wide rural-urban divide where 84 percent of the 328 million people in the region without access to potable water live in rural areas (Salami et al., 2011), and only a third of the poorest rural households have access to these services (WHO, 2013).

Efforts to expand access to social services such as water and sanitation in Africa have typically focused primarily on mobilizing additional financial resources and much less on how the allocation of resources across various uses helps achieve development goals. This is an important part of the fundamental problem encountered in the assessment of the effectiveness of foreign aid, which has largely relied on aggregate data to identify the linkages between foreign aid and economic outcomes. The evidence from the few studies that focus on specific human development indicators suggests that targeted aid interventions can achieve positive results at the micro-level (see Ndikumana (2012) for a review). For example, Gormanee et al. (2005) find that aid is associated with improvements in the Human Development Index. Similarly, Mishra and Newhouse (2009) find that foreign aid contributes to reducing infant mortality rates, while Michalowa and Weber (2006) and Dreher, Nunnenkamp, and Thiele (2008) find evidence that foreign aid may help increase primary school enrolment. An important weakness of most of these studies is that they use data on aid commitments. This is problematic because aid commitments often differ significantly from actual aid disbursements.

One exception in this literature is a recent study by Pickbourn and Ndikumana (2013) which uses actual aid disbursements disaggregated by sector to examine the impact of foreign aid on specific development outcomes. The authors find that increased allocation of foreign aid to the health and education sectors reduces maternal mortality as well as the gender gap in youth literacy in recipient countries. They find substantial cross-regional differences, with SSA performing worse than other regions.

This paper adds to the thin body of empirical literature on aid effectiveness by sector by examining the impact of foreign aid on access to clean water and improved sanitation in SSA. It specifically investigates the impact of the allocation of official development aid to the water and

sanitation sector on access to these services in the rural areas. The study makes important contributions to the literature at four levels. First, unlike the standard practice in the aid literature, the study utilizes disaggregated data on aid allocation by sector, which enables us to link access to water and sanitation with the amount of aid allocated to these sectors. This may shed light on the micro-macro paradox observed in the assessment of aid effectiveness (see Ndikumana, 2012). Second, we use actual disbursements of foreign aid to recipient countries rather than aid commitments, thus linking impact to actual flows of resources. Third, we focus on access to water and sanitation in rural areas, given the substantial rural-urban gaps in access to water and sanitation, and the disproportionate burden borne by rural women due to the lack of access to water and sanitation.  This enables us to draw implications of the results for equity along gender and geographical dimensions. Finally we focus on Sub-Saharan Africa, which lags behind other regions in access to water and sanitation despite receiving a substantial amount of total aid relative to other developing regions. Thus, the analysis may shed light on strategies to improve effectiveness of foreign aid in SSA. To our knowledge, this is the first paper to carry out such a detailed analysis using data on actual aid disbursements disaggregated by sector in sub-Saharan Africa.

**Data, Regression Variables and Methodology**

This study uses data on bilateral official aid disbursements at the project level from the OECD Creditor Reporting System (CRS) database. We aggregated aid from all donors to obtain total aid as well as aid targeted to the water and sanitation sector by recipient country.  Data on access to water and sanitation are from the World Bank's World Development Indicators (WDI). Country-level social and economic indicators used as control variables in the econometric analysis are also taken from WDI. A governance indicator used to control for the institutional

dimension of service delivery is obtained from the International Country Risk Guide (ICRG). The main variables, the indicators of access to water and sanitation, are only available from 1990. Therefore the sample period is 1990-2010. The list of regression variables, their definition and data sources are given in Table A.1 in the Appendix, and summary statistics are reported in Table 1.

The impact of foreign aid on access to water and sanitation is investigated by regressing, alternatively, the percentage of the rural population with access to improved water or sanitation on aid disbursements to the water and sanitation sector as a percentage of GDP, controlling for other determinants of access to these services. The model is specified as follows:

$$Access_{s,it} = b_0 + \theta\,Aid_{s,it} + \mathbf{Z}'_{it}\mathbf{\Gamma} + u_i + \omega_{it} \tag{1}$$

where the subscripts *i, t,* and *s* denote the country, time, and sector (water or sanitation). *Access* is the share of the rural population that has access to improved drinking water or sanitation, *Aid* is foreign aid disbursements targeted to the water and sanitation sector, $\mathbf{Z}$ is a vector of control variables consisting of determinants of access to water and sanitation other than aid, $u$ is a term that accounts for unobserved country-specific factors, and $\omega$ is a random error term.

The control variables included in the analysis are: real GDP per capita, the age dependency ratio, the literacy rate, government expenditure as a percentage of GDP, and governance measured by a government stability index. GDP per capita and government expenditure measure the capacity of the government to provide social services. They are expected to be positively correlated with access to water and sanitation. The literacy rate captures the demand for social services – including political pressure on the government – as well as capacity to afford the services. This indicator is therefore expected to be positively

related to access to water and sanitation. The age dependency ratio accounts for both demand for services and pressure on public resources for alternative needs. In the context of limited public resources as is typical in all SSA countries, a high dependency ratio is expected to be negatively associated with access to water and sanitation. The governance indicator is a proxy for both commitment and effectiveness of the government in delivering social services. We also include a dummy variable for the post-2000 period to capture the observed acceleration of growth and social development in SSA since the turn of the century. This also corresponds with the era of the MDGs.

Equation 1 is estimated using panel data regression techniques, taking into account country-specific time-invariant factors as well as potential endogeneity of regressors. The large size of the CRS data base, the substantial heterogeneity in the sample, and imperfections in data reporting imply a risk of bias in the results especially due to outliers. This potential problem is addressed by using the iteratively reweighted least squares (IRLS) estimation method. Determinants of access to services that are not adequately captured in our model may also affect the results. Problems likely to arise from omitted variable bias are addressed by using the fixed-effects estimation method. Potential problems associated with endogeneity of regressors are addressed by using the generalized method of moments (GMM). Each of these three methods has its individual strengths and limitations. The IRLS does not account for country-specific fixed effects while results from the fixed-effects and GMM estimation methods are subject to bias due to outliers. Therefore, by using these various estimation methods, we are able to assess the robustness of the results.

**Econometric Results**

The econometric estimation results are presented in Table 2. Columns 1-3 report the results on access to water and columns 4-6 contain those on access to sanitation. The results vary based on the regression method. In the case of access to water, the fixed-effects results (column 2) which take into account omitted country-specific factors indicate that the amount of aid allocated to the water and sanitation sector has a positive effect on the percentage of the rural population that has access to an improved source of drinking water. The impact is also quantitatively large: a one percent increase in aid to the sector (as a percentage of GDP) is associated with a 0.6 percentage increase in the share of the rural population that has access to water. However, the impact of aid on rural access to an improved water source is not statistically significant in the regressions that account for possible outliers (IRLS results, column 1) or possible endogeneity of regressors (GMM estimates, column 3).

As for access to improved sanitation, the estimation results where we control for possible outliers (IRLS estimates, column 4) show that aid to the sector has a positive effect on the percentage of the rural population that has access to improved sanitation. However, the result is not statistically significant in the fixed-effects estimation results (column 5), suggesting that other country-specific factors not explicitly included in the regression matter for access to sanitation. The regressions accounting for possible endogeneity of regressors (GMM estimates, column 6) do not show a positive impact of aid on access to sanitation; in fact, the coefficient is negative albeit insignificant.

The results generally suggest that while an increase in official development aid that is explicitly allocated to water and sanitation is likely to have a positive impact on access to these services, the effects may vary across countries based on country-specific circumstances. This

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justifies our inclusion of country-level determinants of access to water and sanitation in the regression analysis as control variables. The results on the control variables are presented briefly in the remainder of this section.

As expected, income per capita and government expenditure are positively related to access to water and sanitation. The results reflect the impact of higher capacity to spend on water and sanitation for any given level of aid to these sectors. The age dependency ratio is negatively associated with access to water and sanitation, consistent with the expectation that a higher dependency ratio increases competition over public resources, therefore reducing the amount allocated to the provision of these services. A higher literacy rate positively affects access to water and sanitation. One interpretation may be that higher literacy induces greater political participation and awareness, which may hold governments more accountable vis-à-vis delivery of social services. Another way to explain the result is the positive relationship between literacy and income, suggesting higher demand and capacity to pay for social services. Government instability is negatively associated with access to water, as expected. The result suggests that the institutional environment matters for social services delivery. In particular, it suggests that a stable government is more capable of planning expenditures and delivering social services.

**Conclusion**

This study has produced new evidence on the impact of aid on access to social services in sub-Saharan Africa. In particular, it has attempted to link access to water and sanitation in rural areas with disbursements of aid targeting these services. The empirical results are consistent with the evidence from earlier studies that show that aid is important in improving social development outcomes. The evidence shows that increases in the allocation of aid to water and sanitation
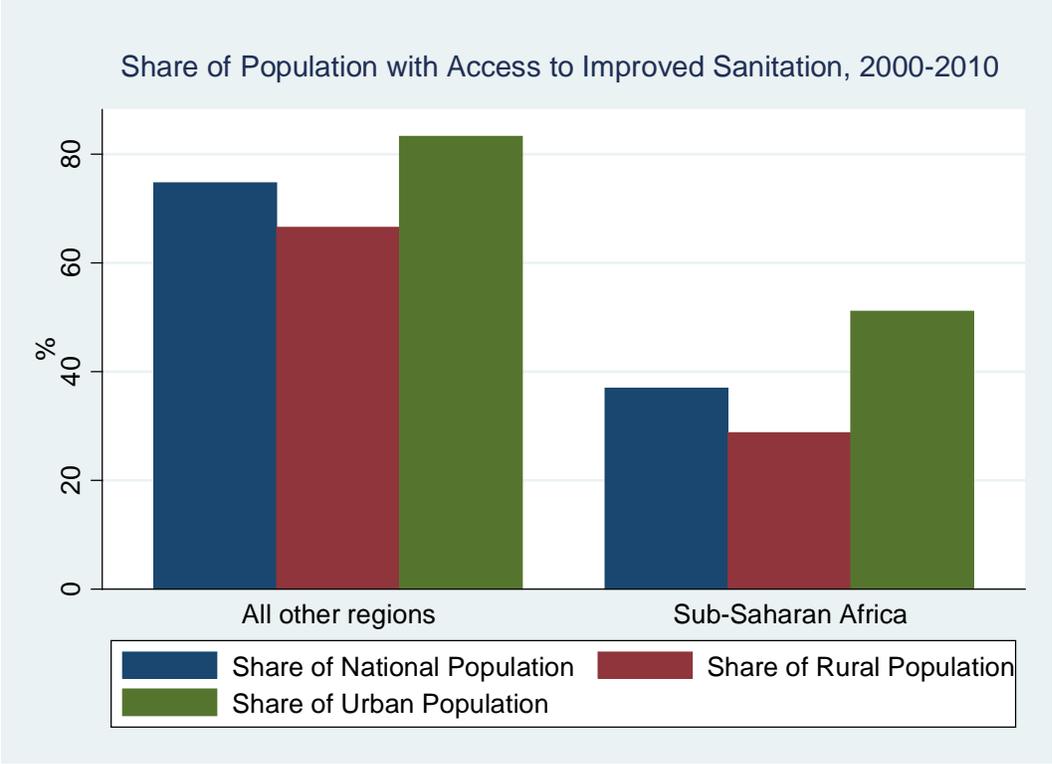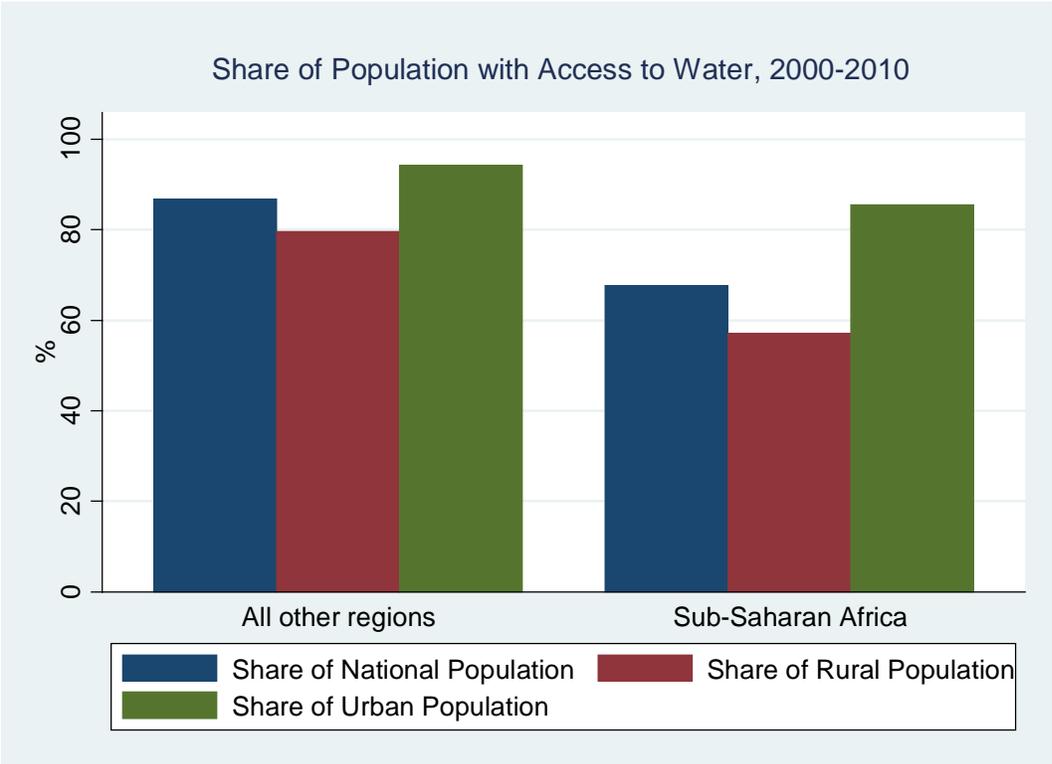
infrastructure is associated with increased access to clean drinking water and improved sanitation facilities in the rural areas in sub-Saharan African countries. This implies that targeted aid is an important tool for accelerating human development. The policy message is that in addition to scaling up aid disbursements to sub-Saharan African countries, donors also need to explicitly increase the allocation to water and sanitation as well as other areas where the region exhibits the most substantial gaps vis-à-vis its development goals and relative to other regions.

The findings in this study also have important implications for the role of official development aid in reducing gender inequalities as well as rural-urban disparities in social and human development. To the extent that aid helps to alleviate constraints to access to water and sanitation, aid to these sectors can help to lower the time spent by women and girls in fetching water (see Elson, 2002). It can also help reduce the incidence of water-borne illnesses, which would reduce both the disease burden on women and the time spent by women in caring for sick family members. This would free up women's time to be used for other productive activities, while also reducing gender gaps in education outcomes, with substantial positive effects on economy-wide productivity (see World Bank, 2011).

Improved access to water and sanitation in the rural area has substantial spillover effects on productivity and overall wellbeing of the population. Of course, expanded access alone does not ensure that these services will be used by all who need them, or in the case of sanitation, in the way that they are intended to be used. Uptake of water and sanitation services by the population is impacted by a variety of socio-cultural, economic and demographic factors. However, once the services are made available, these constraints can be overcome by devoting resources to ensuring that they are fully utilized by the population. In this way, increasing the amount of aid going to support water and sanitation projects in sub-Saharan Africa can

substantially help accelerate progress towards achieving not only the MDG on access to water and sanitation, but also the MDGs on gender equality and health as well as other development goals.

**Figure 1: Access to Water and Sanitation**



Share of Population with Access to Water, 2000-2010

Legend: Share of National Population, Share of Rural Population, Share of Urban Population



Share of Population with Access to Improved Sanitation, 2000-2010

Legend: Share of National Population, Share of Rural Population, Share of Urban Population

**Table 1: Summary statistics for regression variables**

| Variable | Mean | Median | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Access to water (share of rural population) | 54.1 | 51 | 21.4 | 5.1 | 99.0 |
| Access to sanitation (share of rural population) | 27.1 | 18 | 24.9 | 1.0 | 94.0 |
| Aid disbursement to water and sanitation sector (% of GDP) | 0.4 | 0.1 | 0.8 | 0.0 | 11.04 |
| Log GDP per capita | 6.1 | 5.9 | 0.9 | 3.9 | 9.1 |
| Age dependency ratio | 88.7 | 90.9 | 11.9 | 40.4 | 112.7 |
| Overall literacy rate (% of population aged 15 and above) | 56.8 | 57.3 | 24.3 | 8.6 | 99.6 |
| Public expenditure (% of GDP) | 6.1 | 5.1 | 4.1 | 0.4 | 46.1 |
| Government index (1=mostly unstable, xx=mostly stable) | 0.4 | 0.4 | 0.2 | 0.03 | 0.9 |

Source: OECD/DAC Country Reporting System; World Development Indicators; International Country Risk Guide (ICRG).

**Table 2: Foreign Aid and Rural Access to Improved Water and Sanitation in SSA**

| | Rural Access to Water | | | Rural Access to Sanitation | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | IRLS | FE | GMM | IRLS | FE | GMM |
| Aid to water & sanitation | 0.956 | 0.641** | 0.025 | 5.951*** | 0.162 | -0.025 |
| | (0.122) | (0.035) | (0.510) | (0.000) | (0.299) | (0.222) |
| Log GDP per capita | 7.220*** | 6.420*** | 0.527 | -1.187 | 5.300*** | 0.071 |
| | (0.000) | (0.000) | (0.275) | (0.248) | (0.000) | (0.784) |
| Age dependency | -0.689*** | 0.115* | -0.003 | -0.097 | -0.198*** | 0.012 |
| | (0.000) | (0.085) | (0.937) | (0.255) | (0.000) | (0.359) |
| Adult Literacy | -0.025 | 0.691*** | -0.026 | 0.591*** | 0.120*** | 0.018** |
| | (0.520) | (0.000) | (0.265) | (0.000) | (0.000) | (0.012) |
| Public expenditure | 0.571*** | 0.296*** | 0.072*** | -0.520** | 0.084 | 0.004 |
| | (0.008) | (0.004) | (0.002) | (0.022) | (0.109) | (0.465) |
| Government instability | 4.269 | -4.128** | 0.196 | 7.519 | -0.655 | -0.172** |
| | (0.377) | (0.020) | (0.256) | (0.142) | (0.471) | (0.032) |
| post_2000 | 3.517** | | | -6.939*** | | |
| | (0.037) | | | (0.000) | | |
| Lagged access to water | | | 1.003*** | | | |
| | | | (0.000) | | | |
| Lagged access to sanitation | | | | | | 0.988*** |
| | | | | | | (0.000) |
| Constant | 60.731*** | -38.741*** | -1.311 | 7.863 | 4.788 | -2.064 |
| | (0.000) | (0.001) | (0.700) | (0.530) | (0.417) | (0.167) |
| Overall R-squared | 0.465 | 0.244 | | 0.533 | 0.194 | |
| Within R-squared | | 0.483 | | | 0.437 | |
| Between R-squared | | 0.201 | | | 0.179 | |
| Test for 1st order AR | | | -3.487 | | | -3.992 |
| | | | (0.000) | | | (0.000) |
| Sargan Test (H$_o$: instruments are valid) | | | 20.451 | | | 22.155 |
| | | | (1.000) | | | (1.000) |
| Observations | 448 | 448 | 407 | 448 | 448 | 407 |
| Number of countries | | 29 | 28 | | 29 | 28 |

Notes: The dependent variable is, alternatively, the percentage of the rural population with access to water (columns 1-3) and access to sanitation (columns 4-6). Robust p-values are in parentheses. Level of significance: *** p<0.01, ** p<0.05, * p<0.1

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**Appendix**

Table A.1: Variables, definition and data sources

| Variable and definition | Source | Coverage |
|---|---|---|
| Total disbursement of aid to water and sanitation sector (constant USD); entered in the regression as percentage of GDP | OECD DAC, WDI and authors' calculations | 1973-2010 |
| Real GDP per capita (constant USD) | World Development Indicators | 1973-2010 |
| Public expenditure as percentage of GDP | World Development Indicators | 1995-2010 |
| Age dependency ratio | World Development Indicators | 1973-2010 |
| Percentage of rural population with access to improved sanitation facilities | World Development Indicators | 1990-2010 |
| Percentage of rural population with access to improved water source | World Development Indicators | 1990-2010 |
| Adult literacy rate (% of people aged 15 and above) | World Development Indicators | 1975-2010 |
| Government stability index | ICRG | 1984-2010 |
| Post_2000 (a dummy variable = 1 if year is between 2000-2010) | | |