UNIVERSIDAD COMPLUTENSE DE MADRID
FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES

TESIS DOCTORAL

The impact of Official Development Assistance on health and access to water in the era of the Millennium Development Goals

El impacto de la ayuda oficial para el desarrollo en la salud y el acceso al agua en la era de los Objetivos de Desarrollo del Milenio

MEMORIA PARA OPTAR AL GRADO DE DOCTOR

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To my parents, Leonardo and Purificación, who deserved a better son.

To my supervisor, José Antonio, who deserved a better student.

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Abstract

The impact of Official Development Assistance on health and access to water in the era of the Millennium Development Goals

Introduction. Since the advent of the idea of development following the end of the Second World War, the international community has sought to define and agree upon an agenda of priorities. The approval of the Millennium Development Goals (MDGs) in 2000 and the Sustainable Development Goals (SDGs) in 2015 are recent examples of this endeavor. In both sets of goals, those related to health are of capital importance, inasmuch as a healthy life develops capabilities that allow the achievement of other goals including good education, decent work, or political participation, among others.

Foreign aid is an important support for any development agenda, particularly for the poorest countries. However, the effectiveness of such aid has been questioned since its beginnings, mainly due to the lack of evidence around its impact on economic growth. Considering that aid is intended for multiple sectors not directly related to economic growth, it is meaningful to ask whether aid targeted to any particular sector has indeed been generally effective. In this regard, the health sector is especially relevant as it forms a crucial aspect of the development purpose, and vast amounts of aid have been disbursed throughout past decades, intended to reduce morbidity and mortality and to promote healthy habits across the developing world.

Objectives and results. This thesis has three main objectives which in combination make up a comprehensive assessment of both the direct and indirect effects of foreign aid on health-related indicators in a large set of developing countries between 1990 and 2015, which is the period considered as a reference for assessing progress by the MDGs.

The first objective is to test whether Official Development Assistance (ODA) has had, on average, an impact on the evolution observed in seven indicators relevant to the health-related MDGs, namely: 1) the under-age-five mortality rate; 2) the under-age-one mortality rate; 3) the maternal mortality ratio; 4) HIV prevalence among females; 5) the rate of contraceptive prevalence; 6) the incidence of malaria; and 7) the incidence of tuberculosis. Fixed effects panel data models have been used as an empirical strategy.

Other goals included within both the MDGs and the SDGs are likewise closely related to health. Among these, access to safe drinking water and basic sanitation stands out. For that reason, a second objective of this thesis is to test whether ODA has had, on average, an impact on access to improved water and sanitation (WS). Both fixed effects panel data models and panel vector autoregressive (PVAR) models have been used as an empirical strategy.

Finally, an important consideration for the global development agenda is the reduction of inequality both within and among countries. An essential manifestation of within-country inequality is the urban-rural gap in health, which is related to the urban-rural gap in access to improved WS. The third and final aim of this thesis is to test whether ODA has had a differentiated impact on access to WS in rural and urban settings, thereby helping to reduce within-country inequality in access to those services. To that end, both fixed effects panel data models and PVAR models have been used as an empirical strategy.

According to the results, the average impact of health-targeted ODA would amount to a reduction in the under-five mortality rate, equivalent to 0.5–38% of the actual reduction observed in the MDG era. A similar impact is found in under-one mortality rates (1.3–30.3%). ODA may also have been responsible, on average, for 0.9–10% of the reductions observed in maternal mortality. Regarding HIV prevalence among females, even if aid has been unable to stop its rise, the results suggest that this increase was lower than it would have been in the absence of aid targeted to fighting sexually transmitted diseases. This type of ODA has also had a positive impact on the prevalence of modern contraceptive practices, and it has been effective in reducing the incidence of tuberculosis. Health-targeted ODA is further associated to a reduced incidence of malaria.

As for the relation of ODA with access to WS, this is found to be dynamic in nature, meaning that the impacts of aid accumulate over time. The findings suggest that both ODA for WS infrastructure and ODA for the promotion of hygienic practices have had a positive impact on the use of improved water services. Nonetheless, evidence has been found that it is necessary to pay closer attention to the maintenance of infrastructure if these achievements are to be permanently maintained. As for the impact of ODA for infrastructure on access to sanitation, no general conclusion has been found. Regarding the third and final aim of this study, the findings suggest that ODA for WS infrastructure has had a greater impact in rural than in urban areas and has contributed to reduced urban-rural gaps in access to WS.

Conclusions. All in all, the results suggest that both aid targeted to the health sector and that targeted to the WS sector have contributed, at least to some extent, to the progress observed in the evolution of their respective target variables during the MDG era. These findings add evidence to the idea that foreign aid is a useful instrument to be used in pursuit of the objectives set by the global development agenda. While a consistent relationship between aid and growth has proved difficult to confirm, due to both theoretical and empirical limitations, the evaluation of aid's impact at the sectoral level allows for better identification of causal pathways and provides evidence that can help improve the design and implementation of development cooperation policy.

The conclusions arrived at by this study should be used with great caution to inform policy advice. The estimated effect is only an average across a very heterogeneous set of countries. Furthermore, information on health-related indicators is often unreliable in developing countries. More and better quality data are needed in order to ensure the validity of empirical studies, and theoretical improvements are likewise needed. The literature on aid effectiveness generally lacks a sound theoretical framework to identify

causal relations between the variables of interest. Even if this study has tried to set the basics for a theoretical understanding of the causal mechanisms between ODA and access to water and sanitation, further development will be essential.

Resumen

El impacto de la ayuda oficial para el desarrollo en la salud y el acceso al agua en la era de los Objetivos de Desarrollo del Milenio

Introducción. Desde el nacimiento de la idea de desarrollo tras las Segunda Guerra Mundial, la comunidad internacional ha intentado definir una agenda compartida de prioridades. La aprobación de los Objetivos de Desarrollo del Milenio (ODM) en 2000 y los Objetivos de Desarrollo Sostenible (ODS) en 2015 son los ejemplos más recientes de este empeño. En ambos conjuntos de objetivos, los relacionados con la salud son de capital importancia, dado que una vida saludable conlleva el desarrollo de capacidades que permiten alcanzar otros objetivos como una buena educación, un trabajo digno, o la participación política, entre otros.

La ayuda extranjera es un apoyo importante para cualquier agenda de desarrollo, particularmente en los países más pobres. Sin embargo, la eficacia de esta ayuda ha sido cuestionada desde sus orígenes, fundamentalmente debido a la falta de evidencia sobre su impacto en el crecimiento económico. Considerando que la ayuda está destinada a múltiples sectores no directamente relacionados con el crecimiento económico, tiene sentido preguntarse si la ayuda destinada a un sector en particular ha sido generalmente efectiva. En este sentido, el sector de la salud es particularmente relevante dado que es una parte crucial de los propósitos de desarrollo y grandes cantidades de ayuda han sido desembolsadas durante las pasadas décadas, destinadas a reducir la morbilidad y la mortalidad y a promover hábitos saludables en el mundo en desarrollo.

Objetivos y resultados. Esta tesis tiene tres objetivos principales, que en combinación constituyen una evaluación comprehensiva de los efectos directos e indirectos de la ayuda extranjera en indicadores relacionados con la salud en un conjunto amplio de países en desarrollo desde 1990 hasta 2015, periodo considerado como referencia por los ODM para evaluar los progresos realizados.

El primer objetivo es contrastar si la ayuda oficial para el desarrollo (AOD) ha tenido, en promedio, un impacto en la evolución observada en siete indicadores relevantes para los ODM relacionados con la salud. Estos indicadores son: 1) mortalidad infantil, 2) mortalidad en menores de cinco años, 3) ratio de mortalidad materna, 4) prevalencia de VIH en mujeres, 5) prevalencia de prácticas contraceptivas, 6) incidencia de malaria, y 7) incidencia de tuberculosis. Como estrategia empírica se han usado modelos de efectos fijos con datos de panel.

Otros objetivos incluidos tanto en los ODM como en los ODS también están estrechamente relacionados con la salud. Entre ellos, destaca el acceso al agua y el saneamiento. Por ello, esta tesis tiene como segundo objetivo contrastar si la AOD ha tenido un impacto en el acceso a servicios mejorados de agua y saneamiento (AS). Como

estrategia empírica se han usado tanto modelos de efectos fijos como modelos de vectores autorregresivos con datos de panel (PVAR).

Finalmente, una consideración importante para la agenda de desarrollo es la reducción de la desigualdad entre países y dentro de cada país. Una manifestación básica de la desigualdad intrapaís es la brecha en salud entre el mundo urbano y el rural, la cual está relacionada con la brecha en el acceso a AS. El tercer objetivo de esta tesis es contrastar si la AOD ha tenido un impacto diferenciado en el acceso a AS en entornos rurales y urbanos, ayudando así a reducir la desigualdad intrapaís en el acceso a estos servicios. Como estrategia empírica se han usado modelos de efectos fijos y modelos PVAR.

Según los resultados obtenidos, el impacto promedio de la AOD destinada a la salud en la reducción de la mortalidad en menores de cinco años equivaldría al 0.5–38 % de la reducción observada en la era de los ODM. Un impacto similar habría tenido en la mortalidad infantil (1.3–30.3 %). La AOD también habría sido responsable, en promedio, del 0.9–10 % de la reducción observada en la mortalidad materna. En cuanto a la prevalencia de VIH en mujeres, aunque la ayuda no pudo parar su ascenso, los resultados indican que este incremento fue menor del que se habría dado en ausencia de ayuda destinada a la lucha contra enfermedades de transmisión sexual. Este tipo de ayuda también ha tenido un impacto positivo en la prevalencia de prácticas contraceptivas, y ha reducido la incidencia de tuberculosis. La AOD para salud también está asociada a reducciones en la incidencia de malaria.

En cuanto a la relación de la AOD con el acceso a AS, se ha observado que los impactos de la ayuda se acumulan en el tiempo. Tanto la AOD para infraestructura de AS como la AOD para la promoción de prácticas higiénicas han tenido un impacto positivo en el uso de servicios mejorados de abastecimiento de agua. Sin embargo, parece necesario prestar mayor atención al mantenimiento de la infraestructura si se quiere que los logros se mantengan de forma permanente. En lo relativo al impacto de la AOD para infraestructura en el acceso al saneamiento, no se ha encontrado ninguna norma general. Respecto al tercer y último objetivo de este estudio, los resultados sugieren que la AOD para infraestructura de AS ha tenido un mayor impacto en las áreas rurales y ha contribuido a reducir la brecha entre el mundo urbano y el rural en el acceso a AS.

Conclusiones. Los resultados obtenidos sustentan la idea de que la ayuda extranjera es un instrumento útil para la consecución de los objetivos establecidos por la agenda de desarrollo. Mientras que la investigación ha encontrado dificultades al intentar encontrar una relación entre ayuda y crecimiento, debido a limitaciones tanto teóricas como empíricas, la evaluación del impacto de la ayuda a nivel sectorial permite identificar mejor mecanismos de causalidad y puede proveer evidencia que ayude a mejorar el diseño y la implementación de la política de cooperación para el desarrollo.

Las conclusiones alcanzadas en este estudio, sin embargo, deben ser usadas con cautela en el asesoramiento sobre políticas. El impacto estimado es solo un promedio entre una muestra muy heterogénea de países. Además, la información sobre indicadores de salud proveniente de países en desarrollo a menudo es poco fiable. Aún se necesitan más y

mejores datos para asegurar la validez de los estudios empíricos. También son necesarias mejoras teóricas, pues la literatura sobre la eficacia de la ayuda carece de un marco teórico sólido para identificar relaciones causales entre las variables de interés. Aunque este estudio ha tratado de establecer las bases de una comprensión teórica de los mecanismos causales entre la AOD y el acceso a AS, es imprescindible seguir avanzando en esta senda.

1. Introduction

1.1. Towards a global development agenda

1.1.1. The road to the Millennium Development Goals

Since the advent of the idea of development following the end of the Second World War, the international community has sought to define and agree upon an agenda of priorities. Global promises around eradicating or rapidly reducing human deprivation can be found stretching back to the Universal Declaration of Human Rights of 1948 and its stipulation that 'everyone has the right to a standard of living adequate for the health and well-being of himself and of his family including food, clothing, housing and medical care and necessary social services' (United Nations, 1948).

The United Nations took on that task, and initial efforts led to the 'Development Decades' lasting until the 1990s. The 1960s were declared to be the first UN Development Decade, sparking a rash of target-setting. However, processes for monitoring targets and mechanisms for producing plans of action were not created, and the results often fell far short of the rhetoric. At many subsequent summits, a 'common pattern of behavior' could be identified: 'First, national ministers declare a grand goal [education, food, small island nations, medicines]. Subsequently this goal has some general influence on activity but it is not systematically pursued. At the next UN summit or conference, the minister (or his/her successor) agrees to the same or a reduced goal for a later date.' The only exceptions were 'the health goals,' which 'seem to have had much more systematic influence on policy and practice and in terms of impacts' (Hulme, 2009, p. 8).[1]

It was certainly difficult for a multilateral organization to reach a global consensus on development in the Cold War era. At least two broad socio-economic models were in conflict, with little interest in building bridges between them. Even theoretical approaches differed on both the causes and strategies to address underdevelopment. For example, developmentalists such as Albert O. Hirschman, Paul Rosenstein-Rodan, or Ragnar Nurkse considered that poorer countries could enter a path of development thanks to international cooperation and public investment, while dependency theorists such as Paul Alexander Baran or Samir Amin, more proximate to the socialist alternative, argued that the global South could never develop within a capitalist world order.

In this context, the 1980s saw the stalling of UN global summits and goal-setting, and the emergence of a new dominant approach in the intellectual debate on development. The UN's influence waned, while that of the International Monetary Fund (IMF) and the World Bank increased. These institutions imposed a recipe of liberalization, privatization

[1] The chronological account of the evolution of the Millennium Development Goals by Hulme (2009) served as the main source of information for this section.

and reduced government – the so-called Washington Consensus – on the increasing numbers of poor countries approaching them for loans, leading to what many have seen as development's 'lost decade'. Towards the end of the 1980s, however, more evidence began to emerge that structural adjustment was not delivering on the promise of growth and prosperity, and that fiscal restraints were damaging education, health and other essential services (Cornia et al, 1987; Mosley et al, 1995). Political space began to open up for those with alternatives to structural adjustment, and in the 1990s, UN summits returned.

Against the backdrop of the dissolution of the Soviet Union and the end of the Cold War, a tendency emerged in the intellectual debate on development to soften the more distinct elements of each perspective and incorporate some aspects from the others. Big theoretical perspectives and policy schemes gave way to more pragmatic approaches, increasingly focused on individuals rather than on aggregates. Within this new environment, 1990 can be seen as a 'pivotal year' in the history of the global development agenda (Hulme, 2009, p. 8). It was then that the World Bank shifted its priorities 'from investing in concrete to investing in people',[2] that is, from economic growth to poverty reduction, a change reflected in the *World Development Report 1990*. Moreover, the United Nations Development Programme (UNDP) published its first *Human Development Report*, which gave birth to the human development approach and the human development index (HDI). This approach to development was based on the capabilities approach to human well-being, credited to Amartya Sen and Martha Nussbaum, which emphasized the importance of ends (like well-being) over means (like income per capita). Human development is recognized as 'a process of enlarging people's choices', the most critical of these wide-ranging choices being 'to live a long and healthy life, to be educated and to have access to resources needed for a decent standard of living' (UNDP, 1990, p. 1).

Along with these World Bank and UNDP reports, the third 'event' that made 1990 pivotal was the re-activation of UN summits and conferences, with four such meetings held that year: the World Conference on Education for All (Jomtien), the UN World Summit for Children (WSC), the UNCTAD Conference on the Least Developed Countries, and a Conference on Drug Problems. The most influential of these was the WSC, which set specific goals for child and maternal mortality, reduction in malnutrition, and universal access to safe water and sanitation services, among others. The summit also set in motion more serious implementation and monitoring processes. National governments around the world were promoted to develop and implement serious plans, and this proved to be highly successful as 'some 155 countries submitted national programs of action and over 100 countries conducted monitoring surveys' (Schechter, 2005, p. 114).

The WSC was foundational to the formation of the MDGs. Not only did it advance an agenda for improving the lives of the world's children, it proved that successful summits could generate political commitment and additional financial resources. Thus, it

[2] Aid for the World's Poorest [Editorial] (1995, Oct. 18). *The New York Times*, p. A22. Retrieved from https://www.nytimes.com/1995/10/18/opinion/aid-for-the-world-s-poorest.html.

'provided the model for subsequent summits' (Emmerij, Jolly and Weiss, 2001, p. 112). However, at that time no one realized that they had embarked on such a route. The idea of an authoritative list of specified development goals did not arise until 1995, and the idea of using the coming turn of millennium as the means to engineer a global consensus around a list of goals came a year or two later.

After the WSC, various meetings were held. The UN Conference on Environment and Development, known as the 'Earth Summit' or 'Rio Summit' (June 1992), mobilized public attention on the environment and development. This was followed by the International Conference on Food and Nutrition in Rome (December 1992). One of the targets set here – to halve the number of hungry people in the world – would come to prominence in the MDGs.

In 1995, two highly influential summits were held: the World Summit on Social Development (WSSD) in Copenhagen, and the UN Fourth World Conference on Women (FWCW) in Beijing. The WSSD declared total poverty eradication as its overarching goal. As one of the means to achieve this goal, the 20/20 initiative was agreed. This had been proposed in the *Human Development Report 1992*, calling on national governments in developing countries to allocate 20 percent of their public expenditure to basic social services, and challenging aid donors to match this by allocating 20 percent of aid budgets to those services. It was argued that this would ensure that resources be made available for universal coverage in primary education, primary health care, nutrition support programmes, and safe water and sanitation.

The FWCW was 'arguably the moment that the transformational approach to gender relations had the greatest chance' (Eyben, 2006, p. 598). It defended the mainstreaming of gender equality in all public policies and the empowerment of women as pillars of change, and it proved extremely influential, although the energy and drive released at the conference was not reflected by its ultimate impact on global targeting exercises. Its relatively radical agenda of transformation did not make it to the MDGs, and the issue of gender equality was not seriously addressed until approval of the SDGs in 2015.

After the WSSD and the FWCW in 1995, the UN summits continued with the Second UN Conference on Human Settlements (known as Habitat II) in Istanbul and the World Food Summit in Rome in 1996.

However, while national leaders and ministers were making grand promises at global summits, total levels of official development assistance (ODA) were in long-term decline. The environment for aid was not propitious. The Cold War was over, so there was no need to use foreign aid to buy allies in poor countries. Critics on the right were arguing that aid did not work. On the left, aid had acquired a negative image after the experience of structural adjustment. Declining aid budgets were a particular problem for the donor club, the OECD's Development Assistance Committee (DAC). A high-level meeting held in 1995 ended with support for the European Union's proposal (under the French Presidency) 'to set up a *Groupe de Réflexion* with a view to review the future of development aid and the role of the DAC' (DAC, 1995, p. 8).

One task of the *Groupe* was to draw up a list of the declarations agreed at UN summits and to see whether these could be pulled together into something more coherent. The listing exercise led to debates amongst *Groupe* members about what should and should not be included, but an agreement was finally reached. The final document *Shaping the 21st Century: The Contribution of Development Cooperation* was released in May 1996. Three mega-goals, which would later be called International Development Goals[3] (IDGs), were defined: 1) economic well-being; 2) social development; and 3) environmental sustainability and regeneration. The first mega-goal translated mainly into income-poverty reduction, while the heading 'social development' subsumed four goals on education, child and maternal mortality, and reproductive health (see Table 1). The 20/20 initiative agreed at the WSSD in 1995 was notably absent from the DAC document.[4]

Table 1. The International Development Goals

Goal 1: Economic well-being
The proportion of people living in extreme poverty in developing countries should be reduced by at least one-half by 2015.
Goal 2: Social development
There should be substantial progress in primary education, gender equality, basic health care, and family planning, as follows: a) There should be universal primary education in all countries by 2015. b) Progress toward gender equality and the empowerment of women should be demonstrated by eliminating gender disparity in primary and secondary education by 2005. c) The death rate for infants and children under the age of five years should be reduced in each developing country by two-thirds the 1990 level by 2015. The rate of maternal mortality should be reduced by three-fourths during this same period. d) Access should be available through the primary health-care system to reproductive health services for all individuals of appropriate ages, including safe and reliable family planning methods, as soon as possible and no later than the year 2015.
Goal 3: Environmental sustainability and regeneration
There should be a current national strategy for sustainable development, in the process of implementation, in every country by 2005, so as to ensure that current trends in the loss of environmental resources — forests, fisheries, fresh water, climate, soils, biodiversity, stratospheric ozone, the accumulation of hazardous substances and other major indicators — are effectively reversed at both global and national levels by 2015.

Source: DAC (1996, pp. 9-11).

The IDGs were endorsed at several OECD ministerial meetings and by the G7 at its 1996, 1997 and 1998 meetings. They also had an impact on the international financial institutions. As for the World Bank, one clear impact to which the IDGs seemed related was the launch in 1997 of the *Global Monitoring Report*, featuring the IDGs as a

[3] In the UK, these are more commonly known as the International Development Targets.

[4] Between 1996 and 2000, the IDGs evolved. The most obvious change was the separation of the infant/child mortality goal from the maternal mortality goal. A number of the goals were expanded, with new indicators and targets.

monitoring framework. It took the IMF a little longer to commit to the IDGs, but it finally did so in 1999.

From the UN and its agencies, so heavily involved in organising the summits and conferences from which the IDGs were drawn, there was some confusion about how to respond. The DAC appeared to be taking control of a UN agenda, and OECD political concerns had determined what could and could not be put on the list. The UNDP's position on global development differed from that of the DAC on at least three issues: 1) what the overarching goal should be; 2) the reason that goal should be pursued; and 3) how it could be achieved.

For the UNDP, the overarching goal of any agenda-setting exercise should be total poverty eradication, as declared at the WSSD in 1995. The DAC was more modest, opting for poverty reduction. As stated by Hulme (2009, p. 20), while the UN was 'promoting a vision', the DAC was 'looking for SMART[5] targets'. Concerning the reasons for setting grand goals, the UNDP (1997, p. 106) highlights the moral arguments for poverty eradication. By contrast, the DAC is less idealistic and balances the moral argument with an argument for self-interest: the IDGs would be good for the poor as well as for the rich. The UNDP is still pursuing a grand human rights approach, building on the Universal Declaration of Human Rights of 1948. The DAC's focus is much narrower, making the case for increased foreign aid and demonstrating that aid will be used effectively.

Finally, another difference is the contrast between the relative role of economic growth in achieving the final goal. Both organizations acknowledge the difficulties of poverty reduction without growth. However, the DAC implicitly places a higher priority on growth, with 'economic well-being' heading its IDGs, and with income-poverty reduction appearing first. The UNDP (1997, pp. 108-109) reverses this, focusing on human development goals and placing growth at the end of its discussion. These different ideologies set in motion a twin-track process that would lead to the production of different sets of global development goals.

Indeed, by late 1998 the UN was about to re-enter the game of global target-setting. It had started to lay plans for the 'Millennium Assembly' to be held in New York in September 2000. An event that happens only once every thousand years creates an opportunity to raise ambitions, and a series of meetings with member states and NGOs was held to select topics that should be the focus of the Millennium Assembly and of a Millennium Declaration. To ensure that the Assembly would produce a coherent Declaration, a document based on declarations from previous UN conferences and summits was produced for all UN members to examine. This became *We the Peoples: The Role of the United Nations in the 21st Century* (Annan, 2000), launched in April 2000. Revisions to this document would form the basis for the final Declaration.

[5] SMART = Stretching, Measurable, Agreed, Recorded and Time-limited. The DAC tried to sharpen the IDGs and started to identify detailed indicators that would reveal whether a goal was or was not being achieved. Initial goals were associated with subsidiary indicators, and as these progressed this was further refined into goals, targets and indicators. These needed to be precise and measurable and, ideally, reasonable quality data should be readily available on these factors for all developing countries.

Apart from keeping the UN's membership on board with his own proposed goals, UN Secretary-General Kofi Annan needed to coordinate UN agreements on global poverty reduction with those of the other big players: the World Bank, the IMF and the OECD. He did this by signing on to the DAC's IDGs, which already had endorsements from the Bank and IMF. In June 2000 the leaders of the four major development multilaterals launched a common document, *A Better World for All: Progress towards the International Development Goals* (IMF, OECD, UN and World Bank, 2000), which reiterated the DAC's IDGs with only slight reforms. However, in spite of this agreement among the multilaterals, there were some important differences between the IDGs and the document *We the Peoples* that was being discussed among national governments in order to arrive at the Millennium Declaration. With six grand overarching principles and 80 pages of text, *We the Peoples* covered a much wider range of topics, and its approach did not lend itself to goal-setting and performance-management, as the IDGs did. If a full agreement among the major multilaterals was to be reached, further coordination and harmonization would be needed once the Millennium Declaration had been approved.

The Millennium Declaration was unanimously approved on 8 September 2000. The eleven bullet points or 'resolutions' included in the 'development and poverty eradication' section (III) were divided into two paragraphs. First, paragraph 19 ('We resolve further') includes the items to be put forward as concrete items for implementation in the plan of action, set to follow the Millennium Assembly. Second, paragraph 20 ('We also resolve') lists agreements that would not be put forward as concrete items for implementation. In effect, this created a two-class system of goals. Among the resolutions included in paragraph 19, the first bullet point was devoted to poverty, hunger, and access to safe drinking water. Education ranked second, and health issues (maternal mortality, under-five mortality, and infectious diseases) were addressed in three points out of a total of six.

A narrow account might argue that the goals were set formally at the Millennium Assembly. But that listing was later significantly revised to produce the MDGs in September 2001. Within the Declaration were the materials for drawing up an authoritative set of goals that could be pursued with unprecedented political commitment, resourcing, and coordination. But if the resolutions from the Millennium Declaration were to be effective, coordination of UN agreements with those of the other big players (the World Bank, the IMF, and the OECD) were urgently needed.

After the approval of the Millennium Declaration, the next stage was for the Secretary-General to draw up a plan of action as to how the world would achieve the stated goals. In this process, it was crucial to finalize the list of goals and draw up subsidiary targets and indicators. Technical specialists and statisticians from the UN liaised with co-professionals at the DAC, who were ahead of them in the task of target-setting and monitoring.[6] There were two possible ways that the monitoring process might move

[6] The exception was for the targets deriving from the World Summit for Children. UNICEF and WHO had already started work on the Multiple Indicator Cluster Surveys that eventually laid the basis for the ChildInfo system that the UN adapted into their DevInfo system for monitoring the MDGs.

along. The first option was to continue with a twin-track process, with two separate sets of goals: 1) the IDGs agreed by the multilaterals in *A Better World for All*, and 2) the goals to be specified from the Millennium Declaration. The second option was to merge these two sets of goals. This issue came to a head at a meeting entitled 'From Consensus to Action' in March 2001. Finally, an agreement was reached. A task force would be set up to merge the two sets of goals, with members from the DAC (representing the OECD), the World Bank, the IMF, and the UNDP.

In merging the IDGs and the resolutions contained in the Millennium Declaration, some issues lost ground while others gained (or recovered lost) ground. As an example, reproductive health might have been an explicit goal in the DAC's IDGs, but the UN could not entertain such a concept due to objections from a small part of its membership. The compromise reached was that 'improved maternal health' could become a goal in its own right. The HIV/AIDS goal included 'contraceptive prevalence rate' as an indicator, in a partial compensation for reproductive health advocates. Other goals on the list lost ground. For instance, the Declaration's 'safe drinking water' goal — which ranked first along with poverty and hunger — was demoted to indicator status. This was matched by adding an indicator for improved sanitation, so that both sides of the water and sanitation sector were now included.

The Millennium Development Goals were finally agreed[7] and approved on 6 September 2001 with the publication of the report of the Secretary-General *Road map towards the implementation of the United Nations Millennium Declaration* (United Nations, 2001). Most UN members subsequently started to refer to these goals, and many used them as part of their policy and planning processes. Even if the Millennium Project's plans for MDGs achievement would not be launched until 2005, by that date the goals were already being targeted in many countries through plans of action. In fact, most goals were pursued in some way immediately after the specific conferences that approved them in the 1990s. For this reason, 1990 was the baseline year established in the *Road map* to assess progress, in an acknowledgment that the process that led to the Millennium Declaration and the MDGs, as well as the efforts to achieve them, had begun at least a decade earlier.

Eight goals were formulated, with the fight against extreme poverty and hunger ranking first (see Table 2). Second and third were, respectively, education and gender equality (limited to the access of girls and women to education). Health, considered to be 'among the most important conditions of human life and a critically significant constituent of human capabilities' (Sen, 2002, p. 660), emerged as a particularly important goal within the full scope of the MDGs, as revealed by their definition. Indeed, even though eight separate goals were formulated, it is clear that three may be conveniently clustered under the broad category of 'health': goals 4) reduce child mortality; 5) improve maternal health; and 6) combat HIV/AIDS, malaria, and other diseases.

[7] Or at least almost agreed. There was a note declaring that the indicators for goal 7 (ensure environmental sustainability) and goal 8 (develop a global partnership for development) were 'subject to further refinement'. Morever, the agreement was later amended with the addition of targets for reproductive health and decent work.

Table 2. The Millennium Development Goals*

Goal 1: Eradicate extreme poverty and hunger
Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day
Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger
Goal 2: Achieve universal primary education
Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
Goal 3: Promote gender equality and empower women
Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
Goal 4: Reduce child mortality
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
Goal 5: Improve maternal health
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio
Goal 6: Combat HIV/AIDS, malaria, and other diseases
Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS
Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
Goal 7: Ensure environmental sustainability
Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation
Target 11: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum-dwellers
Goal 8: Develop a global partnership for development
Target 12: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system. Includes a commitment to good governance, development, and poverty reduction – both nationally and internationally
Target 13: Address the special needs of the least developed countries. Includes: tariff- and quota-free access for least developed countries' exports; enhanced programme of debt relief for HIPC and cancellation of official bilateral debt; and more generous ODA for countries committed to poverty reduction
Target 14: Address the special needs of landlocked countries and small island developing States (through the Programme of Action for the Sustainable Development of Small Island Developing States and the outcome of the twenty-second special session of the General Assembly)
Target 15: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
Target 16: In cooperation with developing countries, develop and implement strategies for decent and productive work for youth
Target 17: In cooperation with pharmaceutical companies, provide access to affordable, essential drugs in developing countries
Target 18: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications

* As specified in the report of the Secretary-General of 6 September 2001 (United Nations, 2001). In 2005, two new targets were included: 'decent work' (in goal 1) and 'reproductive health' (in goal 5).

Even though several goals were not met, the MDGs helped tackle the most important challenges faced by humanity. Extreme poverty declined significantly. In 1990, nearly half of the population in the developing world lived on less than $1.25 a day; that proportion dropped to 14% in 2015. The proportion of undernourished people in the developing regions fell by almost half, from 23.3% in 1990 to 12.9% in 2015. The literacy rate among youths aged 15 to 24 increased globally from 83% to 91% between 1990 and 2015. The gap between women and men narrowed. The developing regions as a whole have achieved the target to eliminate gender disparity in primary and secondary education. The global under-five mortality rate declined by more than half, dropping from 90 to 43 deaths per 1,000 live births between 1990 and 2015. The maternal mortality ratio declined by 45% worldwide (UNDP, 2015).

1.1.2. Beyond the MDGs: the 2030 Agenda

Hulme (2009) called the MDGs 'the world's biggest promise'. Indeed, the approval of the Millennium Declaration and the subsequent setting of the MDGs was one of the most successful and influential initiatives promoted by the international community in the last half-century: a global agreement to reduce poverty and human deprivation at historically unprecedented rates through collaborative action. The ample agreement reached on those objectives galvanized political commitment around certain developmental goals as never before. They were conceived as a shared commitment by the international system, which assumed that the fight against poverty, in all its forms, was a shared responsibility. Quantitative goals were defined and associated to a precise deadline for implementation, which helped to monitor progress and focus national efforts. As a result, human rights and the fight against poverty received significant international attention, encouraging international institutions and national governments alike to be held accountable for their contribution to those goals.

However, if the achievements of the MDGs are well known, so are some of their limitations. One of these is that the emphasis on the fight against extreme forms of poverty led to a simplification of the development agenda. Secondly, the process of defining the MDGs was chiefly deployed in the sphere of bureaucracy and international organizations, while society and governments barely participated (Fehling, Nelson and Venkatapuram, 2013). Another important limitation is that the MDGs set challenges for developing countries while they imposed hardly any commitments on developed countries: the targets included in MDG 8 'to build a global development association' were particularly vague, and its goals were imprecise and partial (Alonso and Ocampo, 2015).[8]

[8] From more critical approaches such as dependency theory the MDGs were considered impossible to achieve as they would be incompatible with capitalism. According to Amin (2006, p. 5), the MDGs would be 'a litany of pious hopes [...] accompanied by conditions that essentially eliminate the possibility of their becoming reality.'

With the lessons learned from the MDGs, a new agenda was drawn up as 2015 approached. This was created around one of the most complex and ambitious participative exercises ever run by the United Nations: specialized agencies, eminent experts, national governments, private companies, and civil society all participated in the process. Finally, on 25 September 2015, the 193 member States of the UN General Assembly unanimously adopted Resolution 70/1, entitled *Transforming our world: the 2030 Agenda for Sustainable Development*. At this point, the era of the MDGs drew to its conclusion and the era of the SDGs began. The eight MDGs were replaced by 17 SDGs and 169 targets, and on 1 January 2016, the world officially began implementation of the 2030 Agenda for Sustainable Development to address urgent global challenges over the next 15 years.

The 2030 Agenda is a road map that builds on the relative success of the MDGs while at the same time seeking to overcome their limitations. It is far more comprehensive than the MDGs, tackling not only the fight against poverty but also the promotion of more inclusive and sustainable development across many dimensions (see Table 3). Changes in the international context and the experience gained from the MDGs suggested the need to take into account a number of additional elements such as the fight against inequalities and environmental sustainability, which had been omitted from or relegated by the previous agenda.[9] Furthermore, the 2030 Agenda transcends the traditional North-South split and defines itself as universal by setting objectives that challenge all countries, whatever their level of development. This is an important change from prior development agendas (including the MDGs) that had been defined mainly in orientation to poor countries. Finally, while international aid had a crucial role in the Millennium Agenda, financial requirements for making the SDGs a reality clearly go beyond aid. The 2030 Agenda requires a mobilization of capacities and resources greater than the scope of development cooperation (a transition from *billions* to *trillions*, as noted by the World Bank), thus forcing the addition of resources and capacities from diverse sources, national and international, public and private.

The inclusion of the fight against inequality 'within and among countries' (SDG 10) in the 2030 Agenda responds to the fact that levels of heterogeneity in the developing world have grown significantly. Today, these countries are situated along a wider spectrum of development than in the past, with very diverse conditions and possibilities for progress. At the same time, notwithstanding the significant decrease in extreme poverty over the past two decades, the trend of the number of relatively poor people (taking into account each country's level of development and its consequent national poverty line) has scarcely changed (Chen and Ravallion, 2012). This result is consistent with the increase of domestic inequality in a broad group of countries with different levels of development. In fact, due to the recent economic growth of countries with an ample volume of poor people (particularly China, Indonesia, India, Nigeria, and Pakistan), most poverty (almost two-thirds) is currently located in middle-income countries (MICs), and not in low-income countries (LICs) as before (Edward and Summer, 2013).

[9] Although the fight against extreme inequality was mentioned in the Millennium Declaration, it never became part of the MDGs.

Table 3. The Sustainable Development Goals

Goal 1: End poverty in all its forms everywhere
Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3: Ensure healthy lives and promote well-being for all, at all ages
Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5: Achieve gender equality and empower all women and girls
Goal 6: Ensure availability and sustainable management of water and sanitation for all
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
Goal 10: Reduce inequality within and among countries
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12: Ensure sustainable consumption and production patterns
Goal 13: Take urgent action to combat climate change and its impacts
Goal 14: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss
Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
Goal 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Source: United Nations (2015).

Therefore, fighting inequality has emerged as a crucial objective if social cohesion is to be preserved. Achieving such objectives will require active redistributive policies not only internationally, but also within countries. For that reason, the 2030 Agenda mentions, among other aspects, the need to 'progressively achieve and sustain income growth of the bottom 40 percent of the population at a rate higher than the national average' (target 10.1), to promote 'the social, economic and political inclusion of all' (10.2), to 'ensure equal opportunity and reduce inequalities of outcome' (10.3), and to 'adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality' (10.4).

Along with inequality, some of the most important novelties introduced by the SDGs are related to environmental sustainability. In the MDGs this subject was limited to areas related to access to water and sanitation, the protection of biodiversity, and the generic appeal for applying principles of sustainability to national policies. Such an approach

proved clearly insufficient. As environmental conditions continued to deteriorate, it seemed urgent that the new agenda make these components a central part of its efforts. In fact, what was barely a goal in the MDG system has been transformed into several goals in the SDGs. Some of the specifically environmental goals include the statement to 'ensure access to affordable, reliable, sustainable, and modern energy for all' (SDG 7), to 'ensure sustainable consumption and production patterns' (SDG 12), to 'take urgent action to combat climate change and its impacts' (SDG 13), to 'conserve and sustainably use the oceans, seas, and marine resources' (SDG 14), and to 'protect, restore, and promote sustainable use of terrestrial ecosystems' (SDG 15), among others.[10]

In addition to those goals on inequality and sustainability, which may be considered the main novelties in the SDGs, the 2030 Agenda includes a new goal (SDG 16) referring to some important immaterial components of development, such as peace, justice, and strong institutions. These aspects were missing from the MDGs.

In balance, there are also a number of SDGs that can be considered extensions or more ambitious versions of preceding MDGs. As an example, if MDG 1, target 1, set out to reduce by half the proportion of people living in extreme poverty, that objective is now more ambitious, as SDG 1 seeks to 'eradicate extreme poverty'. Similarly, the reduction by half of the proportion of those who suffer from hunger (MDG 1, target 2) is now a commitment to 'end hunger' (SDG 2). As for the target on access to water and sanitation, which was considered a priority in the Millennium Declaration but demoted to indicator status within MDG 7 on environmental sustainability, was recovered as a goal in its own right in SDG 6, 'ensure availability and sustainable management of water and sanitation for all'.

The extension of MDG 3 on gender equality was particularly relevant. While this had only considered the elimination of gender disparity in the education system,[11] SDG 5 now extends to spheres that were previously neglected, calling for an end to 'all forms of discrimination against all women and girls' (target 5.1), including violence, sexual and other types of exploitation (5.2), and 'harmful practices such as child, early, and forced marriage and female genital mutilation' (5.3). A similar increase is seen in the degree of ambition proposed for the education sector. While MDG 2 concentrated its attention on achieving 'universal primary education', SDG 4 goes further, seeking to ensure 'inclusive and equitable quality education and promote lifelong learning opportunities for all.' This

[10] Nonetheless, despite the numerical prominence of these goals in the 2030 Agenda, there is a growing body of literature warning that the SDGs as expressed today vastly underperform on sustainability. See, for instance, Wackernagel, Hanscom and Lin (2017) or Jain and Jain (2020). Related to this critique but more radical in essence is the one that comes from post-developmentalists, who reject the very concept of development whatever the adjective that accompanies it. In this view, development would not only be unattainable (both economically and environmentally) but also undesirable for the global South. Each nation should pursue its own aims in line with indigenous culture, with no room for universal goals (Kothari et al., 2019).

[11] After the integration of the IDGs and the resolutions contained in the Millennium Declaration, the *Road map* of 2001 included as subsidiary indicators in the assessment of progress towards MDG 3 the 'share of women in wage employment in the non-agicultural sector' and the 'proportion of seats held by women in national parliament', while the only target within this goal continued to be defined exclusively in terms of equality in access to education (United Nations, 2001).

goal deals with ‘complete free, equitable, and quality primary and secondary education’ (target 4.1), but also with ‘early childhood development, care, and pre-primary education’ (4.2), and ‘equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including university’ (4.3) or the promotion of relevant skills in view of ‘employment, decent jobs, and entrepreneurship’ (4.4).

Regarding health, it has already been noted that this was a central subject for the MDGs. Indeed, three out of the eight MDGs could be conveniently clustered under the broad category of ‘health’: goal 4) reduce child mortality; goal 5) improve maternal health; and goal 6) combat HIV/AIDS, malaria, and other diseases. This clustering was actually undertaken in the 2030 Agenda, and new targets were added to form SDG 3, ‘ensure healthy lives and promote well-being for all at all ages’, thus signaling the intention to address health issues in a more comprehensive way (see Table 4). The range of health problems mentioned is wider, including the ‘prevention and treatment of substance abuse’ (target 3.5), the goal to ‘halve the number of global deaths and injuries from road traffic accidents’ (target 3.6), and the substantial reduction of ‘the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination’ (target 3.9).

The first three targets included within SDG 3, however, have as their objective variables identical to those in MDGs 4-6, with maternal and child mortality and epidemics of AIDS, tuberculosis, malaria, and other diseases being the key issues to be addressed (see Table 4). The inclusion of revised and extended forms of MDGs 4-6 within SDG 3 was required because progress in the MDG era had not been sufficient (as was the case with maternal and child mortality) or else because it was considered necessary to set a more ambitious goal (incidence of communicable diseases).

Maternal, newborn and child mortality rates have declined sharply since 1990 but remain unacceptably high. Between 1990 and 2015, the global maternal mortality ratio declined by 44%, to an estimated 216 deaths per 100,000 live births, falling short of the three-quarters reduction envisaged in MDG 5 and far above the target of 70 maternal deaths per 100,000 live births established in the 2030 Agenda. Globally, in 2015, approximately three in four women of reproductive age (15 to 49 years) who were married or in a union satisfied their need for family planning by using modern contraceptive methods. The global under-five mortality rate declined by more than half to 43 per 1,000 live births from 1990 to 2015. This was short of the two-thirds reduction envisaged in MDG 4 (United Nations, 2016).

As for the incidence of major communicable diseases, this is declining, but hundreds of millions of people are still newly infected each year. The incidence of HIV, malaria, and tuberculosis declined globally by 2015, indicating that MDG 6 was achieved. However, ending these epidemics will require reinvigorated efforts. In 2015, the number of new HIV infections globally was 0.3 per 1,000 uninfected people, and an estimated 2.1 million people became newly infected that year. The incidence of HIV was highest in sub-Saharan Africa, with 1.5 new cases per 1,000 uninfected people. In 2014, 9.6 million new cases of tuberculosis (133 per 100,000 people) were reported worldwide, with 58% of

them in South-Eastern Asia and the Western Pacific. Almost half of the world's population is at risk of malaria and, in 2015, the incidence rate was 91 new cases per 1,000 people at risk — an estimated 214 million cases. Sub-Saharan Africa accounted for 89% of all malaria cases worldwide, with an incidence rate of 235 per 1,000 people at risk (United Nations, 2016).

Table 4. SDG 3: ensure healthy lives and promote well-being for all, at all ages

Target 3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births
Target 3.2: By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-five mortality to at least as low as 25 per 1,000 live births
Target 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria, and neglected tropical diseases and combat hepatitis, water-borne diseases, and other communicable diseases
Target 3.4: By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment, and promote mental health and well-being
Target 3.5: Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol
Target 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents
Target 3.7: By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information, and education, and the integration of reproductive health into national strategies and programmes
Target 3.8: Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality, and affordable essential medicines and vaccines for all
Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination
Target 3.a: Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate
Target 3.b: Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all
Target 3.c: Substantially increase health financing and the recruitment, development, training, and retention of the health workforce in developing countries, especially in least developed countries and small island developing states
Target 3.d: Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction, and management of national and global health risks

Source: United Nations (2015).

From these figures and other trends discussed in this section, it can be concluded that the range of problems needing to be tackled is much wider today than in the past. Some of these problems have emerged recently, or become more pronounced, such as the threat of climate change. Others, inherited from the past, have seen some progress but still need to

be resolved, such as continued poverty, inequality, and hunger, the exclusion of significant sections of the world's population from access to basic services (education, health, water and sanitation), or the denial of basic rights to women and other groups in many parts of the world. In order to face these challenges, target-setting and monitoring within the framework of an agreed global development agenda have proved useful and are likely to remain essential within global development policy for decades to come.

1.2. Foreign aid for development: has it been effective?

National governments and the societies they represent are chiefly responsible for the success of the development agenda, insofar as national states are still the central pillars on which global governance is built (and will continue to be so in the immediate future). Public resources are mainly gathered and managed at a national level, and only national states are capable of producing mechanisms of citizen representation, organizing the political processes for aggregating the preferences of individuals into social preferences, and balancing the procedures of demands and accountability that are at the basis of democracy. However, given the magnitude, nature and effects of some of the challenges to be faced, individual action by countries, while absolutely necessary, appears to be insufficient. Therefore, both the MDGs and the SDGs entrust the viability of the global development agenda to the creation of a 'global partnership' for development, in which participants from different areas unite resources, capabilities, and knowledge to implement agreed intentions.

In this global partnership, both multilateral and bilateral cooperation play a central role. MDG 8, target 13, calls for addressing 'the special needs of the least developed countries', including 'more generous official development assistance for countries committed to poverty reduction' (United Nations, 2001, p. 58). Similarly, SDG 17, target 17.2, establishes that developed countries should 'implement fully their official development assistance commitments' (United Nations, 2015, p. 26). International cooperation, then, remains important in the development agenda, even if it 'should be considered mainly as a catalytic and not central factor to promoting development' (Alonso, 2012, p. 5).

Arguably, the role of foreign aid might be expected to prove weak, knowing that aid has decreased its share in the international financing of developing countries since the 1990s, mainly due to the processes of innovation and deregulation of capital markets. These trends led to an unprecedented expansion in the volume of international financial flows, a significant part of which were directed towards developing countries (particularly those with emerging markets). During the 1990s and early 2000s, the rate of growth of the volume of international aid was slower than that of workers' remittances, direct investment, and other private flows. As a consequence, there was a notable shift in the structure of international financing of developing countries, with private finance gaining in importance at the expense of public funding. Aid clearly lost weight as a source of funding for developing countries. However, these aggregate figures mask divergences

among individual countries within the various groups of countries. In the case of the upper middle-income countries, the contribution of aid to total sources of financing was indeed irrelevant, but it was more significant in the case of the lower middle-income countries, and by far the greatest source of international funding in the case of the LICs and the least-developed countries (Alonso, 2012).

Moreover, the relevance of funding sources should be considered not only in terms of volume, but also in terms of their predictability. In this aspect, aid clearly remains more predictable than private flows, as a clear relationship between foreign aid budgets and the economic cycles of donors has proven hard to find. For example, Pallage and Robe (2001) and Round and Odedokun (2004) find hardly any evidence that aid is pro-cyclical with respect to donors' economic performance; Hallet (2009) and Mold and Prizzon (2012) find a weak correlation between aid and OECD donors' growth. Finally, Dang, Knack and Rogers (2010) find evidence that decreasing aid is significantly correlated with episodes of crisis in donor countries. Without attributing a counter-cyclical character to aid, it may at least play a part in smoothing out trends in private flows to developing countries. The lower elasticity of aid with respect to the economic cycle (compared to that of private financing), along with the importance of aid in the external financing of low-income economies, are reasons that justify the importance of aid, even in a world of open financial markets (Alonso, 2012).

In spite of the attested relevance of foreign aid for many countries, there have always been widespread doubts about its effectiveness. For instance, it has been argued that the management of aid by recipient countries is usually not adequate, or that the proliferation of donors and fragmented interventions render aid useless. These doubts have motivated donors to revise their aid management practices in a process that can be tracked back to the DAC's 1996 document *Shaping the 21st Century*. At the end of the 1990s, the drive for reform received a renewed boost due to the revision of the highly indebted poor countries (HIPC) initiative, the debates around the Millennium Declaration, and the outcomes of the Monterrey Conference on Financing for Development.

This reforming spirit was translated into a series of high-level meetings organized by the DAC. In one such meeting that resulted in the 2005 Paris Declaration, five central principles were defined. First was recipient *ownership* of development interventions, meaning that the recipient defines its priorities more clearly and the donor identifies those areas in which it wants to contribute. Second was *alignment* of donor strategies and procedures with strategies and management systems of the recipient countries, in order to ensure fuller integration of donors' initiatives in the budgetary process of partner countries. Third was *harmonization* among donors to support budgets in a coordinated way. Fourth was *management through results*, both for donors and recipients, and fifth was *mutual accountability*. These principles, which are all recommendations that stem directly from studies on aid effectiveness, were revised and expanded in the 2008 Accra Agenda for Action and in the 2011 Busan Partnership for Effective Development Cooperation. However, implementation of the agreed reforms seems to be progressing slowly (OECD, 2011; Rueda and Gozalo, 2015), and doubts about the effectiveness of

aid are still widespread, fueled by essays with high media impact that vary in approach and in quality (Easterly, 2006; Hubbard and Duggan, 2009; Moyo, 2009), as well as by meticulous research papers.

Research on aid effectiveness from an aggregate point of view has tended to focus on the relationship between overall aid and economic growth. This literature is extensive and difficult to summarize briefly.[12] In spite of continuous efforts in this field of research, producing numerous empirical studies, definitive answers have been hard to find. Studies, although carried out within a relatively similar theoretical framework, vary in design, sample, and methodology, particularly in relation to the control variables used in the convergence equations, the way of handling the endogenous nature of aid, and the assumption of linearity of aid's impact. This also means that the results change considerably along a spectrum ranging from positive effects to negative ones, with others claiming that aid and growth are not related at all. Thus, the literature provides a hazy picture on aid effectiveness. Neither the use of insights from microeconomic theory nor the use of increasingly sophisticated econometric methods has eliminated the controversies underlying the results of the studies.

Different viewpoints have changed over time. The 1980s and early 1990s were a period of profound skepticism about the usefulness of aid. Mosley (1986) launched the idea of a 'micro-macro paradox' in aid's impact: positive impacts of aid could be identified at the project level, but not at the economy level. In an influential book, Mosley (1987) proposed a number of reasons for the paradox, notably incentive effects on behavior and the political economy of aid. This thread was picked up in the seminal study of White (1992) on the macroeconomics of aid, highlighting the econometric difficulties in establishing a causal impact from aid to growth.

In the early 1990s, a rather more optimistic perception emerged: aid could be effective, but that result would depend on contingent factors, in particular the institutional framework and policies put into place by the recipient country. Among the studies that take this approach, the influential work of Burnside and Dollar (2000a) stands out. After including an interactive term between aid and policies in the growth equation, the authors observe that the aid coefficient is not significant and that correlation to the interactive term is positive and significant. This became a corner stone in the World Bank's Assessing Aid paradigm, and selectivity in aid allocation gained traction among some aid providers. However, other studies did not find that the effects of aid depend significantly on contingent factors. Easterly, Levine and Roodman (2004) claimed that even allowing for the design of policy, and using the same basic data as Burnside and Dollar, aid is ineffective. In contrast, Hansen and Tarp (2000) concluded that aid is effective even in the absence of good domestic policy.

The approach of Burnside and Dollar (2000a, 2004) was followed by a number of authors who incorporated an additional variable related to the recipient country's selected specific

[12] Detailed reviews can be found in Alonso (2012, 2014), Arndt, Jones and Tarp (2016), and Addison, Morrissey and Tarp (2017). This section largely draws on many of their conclusions.

circumstances. Among the factors considered, authors include an export price shock in the affected countries (Collier and Dehn, 2001), the degree of vulnerability of the economies (Guillaumont and Chauvet, 2001), previous conditions of violence in the country (Collier and Hoeffler, 2004), the level of democracy (Svensson, 1999), or the limited size of the government (Economides, Kalyvitis and Philppopoulos, 2008). All these papers find the effectiveness of aid to be conditioned by the recipient country's circumstances, although the results are highly sensitive to the methodologies used in the respective estimations (Roodman, 2007a, 2007b).

Additional evidence of non-linearity of aid effectiveness is the presence of diminishing returns. Many of the studies incorporate the existence of decreasing marginal returns (Rajan and Subramanian, 2008) stating that the effect of aid is not necessarily conditioned by policies (Hansen and Tarp, 2001; Lensink and White, 2001; Dalgaard, Hansen and Tarp, 2004).

This new generation of studies also opened up some new issues worth considering. For example, Lensink and Morrissey (2000) and Arellano et al. (2009) found that instability of aid flows negatively affects aid effectiveness. In these studies, aid effectiveness is related not so much to the characteristics of the recipient but to the donor's methods of operation. The importance of donors' behavior is also underlined by Minoiu and Reddy (2009). Some studies claim that the effects of aid depend on the type of aid and the motives of donors, with the effects on economic growth being positive when aid is motivated by recipient need rather than donor interest (Kilby and Dreher, 2010; Dreher, Eichenauer and Gehring, 2013).

Some authors consider that aid can be effective in some places and not in others. For example, Dalgaard et al. (2004) find evidence that aid is not effective in countries located in the tropical zone, but it has a positive effect on growth in the rest of countries. Unfortunately, as Roodman (2007b) highlights, these results are highly dependent on the behavior of a limited number of countries. In the same vein, Herzer and Morrissey (2009) conclude that aid has, on average, a negative effect on GDP, but in about one-third of the countries included in their sample, aid influences growth positively. Government size, religious tensions, and the rule of law and order are considered as potentially explanatory factors of this divergent impact.

After this strand of literature that considered the impact of aid to be conditioned by several factors, a new generation of pessimistic aid-growth studies emerged, arguing that this impact does not exist whatever the local conditions or donor's practices. Among the most skeptical and influential studies are those by Rajan and Subramanian (2005, 2008). They do not find any robust relationship between aid and growth and argue that the absence of a relationship is due to two potentially negative aid effects. First, aid may have a negative impact on the political and institutional climate of the recipient country by deteriorating governance (Rajan and Subramanian, 2009b), a conclusion also reached by Djankov, García-Montalvo and Reynal-Querol (2008) but challenged by Alonso and Garcimartín (2011). Second, aid can potentially cause real-exchange rate appreciation, with adverse

consequences for the production of tradables, which is known as ‘Dutch disease’ (Rajan and Subramanian, 2009a).

The evidence on this last issue, however, is mixed. Fielding (2010) finds that aid is associated with real exchange rate appreciation in only three out of ten small island states in the Pacific with high aid dependence, also showing that characteristics such as increased trade openness or greater government effectiveness can substantially mitigate any adverse effects of aid. Selaya and Thiele (2010), in an analysis of 65 developing countries over 40 years, find that aid has a positive and equally strong effect in both tradable and nontradable sectors. Addison and Baliamoune-Lutz (2017), focusing on the cases of Morocco and Tunisia, find that the effect depends on the policy response to the inflow, thus highlighting the importance of the macroeconomic framework in which aid is provided and the key role for infrastructure and other supply-side improvements in determining the final real-economy impact of aid.

Other authors have derived their conclusions from meta-studies based on the results generated by the specialized literature. But, as noted by Bird and Choi (2020, p. 8), ‘even survey articles that attempt to identify the preponderance of one finding reach different conclusions.’ Doucouliagos and Paldam (2008) use meta-regression analysis and find no overall evidence that aid encourages economic growth. Meanwhile, using the same methodology and the same set of nearly 70 studies, Mekasha and Tarp (2013) conclude that aid is effective. Arndt, Jones and Tarp (2009) carry out an application of the Rubin Causal Model on the publications on the effect of aid. Their results suggest that the aid-to-GDP-ratio elasticity of growth is somewhere between 0.10 and 0.23 for the longest time periods. According to the value of the confidence intervals, the authors cannot rule out the possibility that the aid elasticity falls into the negative zone, but that it is positive wherever the results are the most solid.

In the 2010s, the debate on aid effectiveness continued, even though the review by Arndt, Jones and Tarp (2016) concluded that recent empirical studies had provided consistent support for the view that aid has a positive average effect on growth when viewed over an extended time frame. Their observations are underpinned by Juselius, Møller and Tarp (2014), who find a positive impact of aid on growth in the long run by making use of multivariate time series analysis as an empirical strategy. However, Nowak-Lehmann et al. (2012), who investigate the aid per capita-income nexus over a period of 47 years through panel estimations with dynamic feasible generalized least-squares, conclude that aid generally has an insignificant or minute negative significant impact on per capita income (particularly in highly aid-dependent countries). Bird and Choi (2020) take into account foreign direct investment, remittances, and aid simultaneously, and they find the impact of aid to be equally ambiguous, although usually insignificant.

A particularly interesting approach is that of Galiani et al. (2017), exploiting as a quasi-experiment the fact that, since 1987, eligibility for aid from the International Development Association (IDA) has been based partly on whether or not a country is below a certain threshold of per capita income. As other donors tend to reinforce IDA graduation, aid as a share of gross national income (GNI) drops by about 59% on average

after countries cross the threshold. Focusing on the 35 countries that exceeded the income threshold between 1987 and 2010, a positive, statistically significant, and economically sizable effect of aid on growth is found.

As argued by Bourguignon and Sundberg (2007, p. 316), the unclear and ambiguous results of this empirical literature are to be expected, 'given the heterogeneity of aid motives, the limitations of the tools of analysis, and the complex causality chain linking external aid to final outcomes'. Similarly, Qian (2015, p. 277) warns that 'the evidence on the impact of aggregate foreign aid is hindered by problems of measurement and identification, which partly result from the heterogeneous nature of aid.' Clemens et al. (2012) point out that one would not expect all the diverse types of aid to have similar effects, and that it is often this diversity that accounts for the wide-ranging results reported in the literature. For that reason, they refine the aid flows considered in their analysis, leaving only those elements that are expected to have an effect on growth within a relatively short time period. Some categories like humanitarian aid (which has no relationship at all to the recipient's growth) and aid targeted to health or education (which may have short-term impacts on mortality or schooling, but which produce only positive effects on growth in the very long term) are excluded. After that data disaggregation, the results point to a positive robust relation between aid and growth in periods of less than four years. That result is also independent of the quality of applied policies and other control variables.

The mixed results of the impact of aid on growth have led some researchers to look for the impact of aid on non-growth outcomes. Proponents of this approach have argued that focusing exclusively on the effect of aid on growth may overlook important benefits from aid on other outcomes of direct interest, such as education or health. The study of these effects may also benefit from clearer causal chains linking disbursements in specific sectors and directly related indicators. Additionally, because factors such as education and health are theoretically considered to be fundamental causes of long-run growth, they may help disentangle the causal chain through which aid may affect growth in the long term. As stated by Arndt et al. (2011, p. 1), 'quantifying transmission channels provides a coherence test for the aid-growth relation. If no robust evidence for a relationship can be found between aid and various intermediate outcomes, then the impact of foreign aid on growth is likely to be negligible.' Thus, this strand of literature may prove useful in opening the 'black box' of aid effectiveness (Arndt, Jones and Tarp, 2011, 2015).

Following this approach, another body of research assesses the effectiveness of international aid on more precise development outcomes, such as education and health.[13] For example, Bhaumik (2005) finds for African countries that World Bank assistance has significantly positive effects on completing primary education and a significantly negative effect on infant mortality. Michaelowa (2004) finds a positive effect of education aid (also when taken per unit of GDP or per capita) on primary enrolments, which is confirmed by Birchler and Michaelowa (2013) in connection with effects on the related

[13] A survey of this literature can be found in Ziesemer (2016). For a detailed review of the literature on aid effectiveness regarding health indicators, see section 2.3.

facilities and teachers, and an incentive effect from secondary schooling; they do not find a positive effect on achievements in tests. Dreher, Nunnenkamp and Thiele (2008) find a positive effect of per capita aid for education on primary school enrolment but not for total disbursed aid.

In these cases, as noted by Alonso (2012), a positive effect of aid has been more frequently established. Nevertheless, some doubts remain. D'Aiglepierre and Wagner (2010) find a significantly positive effect of aid per capita earmarked for education on enrolments and also a favorable impact on the following achievement variables: gender parity in enrolment, the primary completion rate, and the repetition rate. Hudson (2015) finds that social infrastructure aid, defined as the sum of aid for education, health, water, and government, has a positive impact on primary school completion rates, whereas other forms of aid do not.

Williamson (2008) finds that aid per capita earmarked for the health sector has no impact on five health indicators in a fixed effects estimate using 5-year and 3-year averages of data for 208 countries. In contrast, Mishra and Newhouse (2009), using lagged dependent variables, find a reduction of infant mortality through health aid per capita or per unit of GDP but no such effect of overall aid. Pickbourn and Ndikumana (2013) estimate the effect of disbursed health and education aid on maternal mortality and on health and education indices. They find mixed results, depending on the estimation method used.

Kotsadam et al. (2018, p. 59) state that 'the scholarly literature remains inconclusive when it comes to the question to what extent development aid actually works,' and this 'is true both for the general studies of aid effectiveness for overall economic growth, but also for studies on the impact of aid on non-growth outcomes, such as education and health.' Similarly, for Ziesemer (2016, p. 1359) 'the literature on effects of aid on education and health is as contradictory in terms of results as that of aid and growth.' These statements might be a bit exaggerated. By and large, studies that focus on the effectiveness of sectoral aid are more likely to find an impact on specific outcomes than the literature dealing with the effects of overall aid on growth, which has proved particularly inconclusive. However, it is true that the literature on the impact of aid on education or health is not free from unclear and ambiguous results.

1.3. Objectives and main results

This thesis falls within the scope of public policy evaluation. It has three main objectives which are framed by the global development agenda agreed within the UN system in the last years of the 20th century, after the end of the Cold War. This agenda, influenced by the human development approach (the dominant approach in development theory from the early 1990s onwards), emphasizes the importance of living conditions of the individuals over economic aggregates, which is reflected in the definition of eight Millennium Development Goals (MDGs) on poverty, health, education and other

subjects. At the same time, the MDGs are based on the assumption that international cooperation may help developing countries to achieve these aims,[14] but the extent to which aid from developed countries has actually been effective is a matter of continouos debate. The three main objectives of this thesis, in combination, make up a comprehensive assessment of both direct and indirect effects that foreign aid may have had during the period 1990-2015 on a series of indicators related to health (and included in the MDGs as targets to be achieved) in a large set of developing countries.

The first objective is to test whether Official Development Assistance (ODA) has had, on average, any impact on the evolution observed in seven indicators relevant to health-related MDGs between 1990 and 2015 (the period considered as a reference to assess progress by the MDGs). As discussed in section 1.1.1, health proved to be an especially important goal within the full scope of the MDGs, with three out of eight goals directly related to this sector. These are goals 4) reduce child mortality, 5) improve maternal health, and 6) combat HIV/AIDS, malaria, and other diseases. These goals were later clustered in the 2030 Agenda to form SDG 3, 'ensure healthy lives and promote well-being for all at all ages' (see Table 4).

The inclusion of revised and extended versions of MDGs 4-6 within the current SDG 3 indicates that health promotion is still an urgent matter in international development. Maternal, newborn, and child mortality rates have declined sharply since 1990 but are still unacceptably high. Between 1990 and 2015, the global maternal mortality ratio declined by 44% to an estimated 216 deaths per 100,000 live births, falling short of the three-quarters reduction envisaged in MDG 5 and above the target of 70 maternal deaths per 100,000 live births established in the 2030 Agenda. The global under-five mortality rate declined by more than half from 1990 to 2015, but this was short of the two-thirds reduction envisaged in MDG 4 (United Nations, 2016). As for the incidence of major communicable diseases such as HIV, malaria, and tuberculosis, this declined globally by 2015, indicating that MDG 6 was achieved. However, hundreds of millions of people are still newly infected each year. Inasmuch as the new goal seeks not only to stop the spread but to 'end the epidemics of AIDS, tuberculosis, malaria' and other communicable diseases (SDG 3, target 3.3), renewed efforts are urgently needed.

Other goals included under different categories within both the MDGs and the SDGs are likewise known to be closely related to health. Among these, access to safe drinking water and basic sanitation (MDG 7, target 10; SDG 6) stands out (see section 2.6). Therefore, a comprehensive evaluation of the effects of ODA on health in the MDG era would not be complete without a careful consideration of progress towards MDG 7, target 10. After all, as noted by Martínez-Santos (2017, p. 517), the concept of 'safe drinking water' as

[14] Other development theorists such as structuralists or dependentists consider that the subjects included in the MDGs are only consequences, or 'symptoms', of underdevelopment, and even if they could be addressed through international cooperation, the improvement would only be temporary in the absence of structural changes in the world economy. The debate on the big questions about long-run development, however, is out of the scope of a policy evaluation exercise like this one.

worded in the MDGs is ‘essentially a health concept’, since ‘by definition, safe water is that which is free of harmful microorganisms and other toxic substances’.

For that reason, this study has as a second objective to test whether ODA had, on average, any impact on the evolution of the rates of access to water and sanitation in developing countries as a group between 1990 and 2015. The knowledge gleaned from this analysis may provide some insights that will help achieve SDG 6: ‘By 2030, achieve universal and equitable access to safe and affordable drinking water for all.’ This, in turn, is expected to contribute to better addressing SDG 3, target 3.3, which seeks to end not only the epidemics of AIDS, tuberculosis and malaria, but also ‘waterborne diseases’ (United Nations, 2015, p. 16).

Finally, an important consideration for global development, as highlighted by SDG 10, is the reduction of ‘inequality within and among countries’. In this regard, an essential manifestation of within-country inequality is the multifaceted urban-rural gap. This translates into differences in income (Wei, 2015) between urban and rural areas, but also in morbidity and mortality (see section 4.1.1), this urban-rural gap in health being also related with an urban-rural gap in access to water and sanitation (section 4.1.2). Indeed, the economic challenge regarding water policy differs considerably between urban and rural areas in terms of scale, demand, institutions, and finance; hence the different levels of coverage between these settings (Hope et al., 2020).

Therefore, a complete evaluation of the direct and indirect effects of ODA on health-related indicators must test whether foreign aid had a differentiated impact on access to water and sanitation in rural and urban settings, thus making it possible to observe whether aid has had any effect on the urban-rural gap in access to these services. This is the third and last aim of this study, bringing inequality into the picture and thus considering a wider conception of development, in accordance with the 2030 Agenda.

By and large, the results suggest that both aid targeted to the health sector and aid targeted to the water and sanitation sector have had, on average, an impact on the evolution of their respective target variables in a large set of developing countries during the period 1990-2015.

According to the results from fixed-effects panel data models, the average impact of health-targeted ODA would amount to a reduction in national under-age-five (U5) mortality figures equivalent to 0.5–38% of the actual reduction observed in the MDG era, with a confidence of 95%. A similar impact is found in under-age-one (U1) mortality rates (1.3–30.3%) with a confidence of 90%. Although the impact on U1 is somewhat less clear in statistical terms than the effect on U5, they are fairly comparable in magnitude. ODA may also have been responsible, on average, for 0.9–10% of the reductions observed in national maternal mortality ratios in the MDG era. Regarding HIV prevalence in females, even if aid was unable to stop its rise between 1990 and 2015, the results suggest that this increase was lower than it would have been in absence of aid targeted to the fight against sexually transmitted diseases (STDs). This type of ODA has also been found to have a positive impact on the prevalence of modern contraceptive

practices, and to be effective in reducing the incidence of tuberculosis. The fight against malaria seems also supported by health-targeted ODA, with increases in aid associated to reduced rates of incidence.

As for the relation of ODA with access to water and sanitation, this has been found to be dynamic in nature, meaning that the impacts of aid accumulate over time and are expected to be persistent in the medium term. The findings from panel vector autoregressive models (PVAR) suggest that both ODA for water and sanitation infrastructure and ODA for the promotion of hygienic practices seem to have a positive and persistent impact on the use of safe water supply services. Nonetheless, evidence has been found that it is necessary to pay closer attention to the maintenance of infrastructure already built, if achievements are to be permanently maintained. As for the impact of ODA for infrastructure on access to sanitation, no general rule could be found. It is commonly known that this sector has been under-considered in comparison to water supply, which might account for that result.

Additionally, regarding the third and final aim of this study, the findings suggest that ODA for water and sanitation infrastructure had a greater impact in rural than in urban areas and contributed to the reduction of the urban-rural gaps in access to water and sanitation. Nonetheless, this contribution is expected to be small, with other factors (yet to be studied) probably representing the main determinants of evolution of the urban-rural gap in access to water.

All in all, the findings of this study suggest that both aid targeted to the health sector and aid targeted to the water and sanitation sector have had, on average, an impact on the evolution of their respective target variables in a large set of developing countries during the period 1990-2015. Thus, they would have contributed, at least to some extent, to the progress observed during the MDG era. Moreover, regarding the impact of ODA on access to water and sanitation, not only does this seem to have contributed to reducing inequalities among countries, but also within countries, lowering inequalities between urban and rural areas. As the fight against inequalities has been given a central role in the 2030 Agenda, efforts in the water and sanitation sector may be crucial if the SDGs are to be achieved.

The conclusions of a panel study like this, however, should only be used with great caution to inform policy advice for a particular country. While these results provide evidence that ODA has been effective ‘on average’, and while there is a low probability that ODA may have had no impact or even caused harm, these possibilities are not and cannot be completely ruled out. The estimated effect is merely an average across a very heterogeneous set of countries. Local factors could greatly influence the impact of aid in very specific contexts, so these must be taken into account when designing and implementing local development programs.

Furthermore, the results of any empirical study on aid effectiveness critically depend on the quality of the data used. In this regard, although the collection and reporting of data have improved over recent decades, information on health-related indicators is often

unreliable in developing countries, and further improvement is needed in order to ensure the validity of empirical studies. Better data on ODA disaggregated by urban and rural areas are also needed in order to perform future evaluations of the role played by ODA in the evolution of spatial inequalities in access to water and sanitation.

Moreover, not only empirical but also theoretical improvements are urgently needed. The literature on aid effectiveness largely lacks a sound theoretical framework to identify causal relations between the variables of interest. Regarding this, the evaluation of aid effectiveness at the sectoral level (health, education, etc.) make it easier to define cause-effect relationships than is the case with effects of overall aid on aggregate socioeconomic indicators such as economic growth. However, even if this study has sought to set the basics for a theoretical understanding of the causal mechanisms between ODA and access to water and sanitation (see section 3.4), further development is essential.

1.4. Structure of the thesis

This thesis is structured into five chapters. The first is this introduction, which summarizes the process that led to the approval of a global development agenda (section 1.1), outlines the role that foreign aid is expected to play in the achievement of global goals and reviews the literature on aid effectiveness (section 1.2), and presents the objectives and main results of the different chapters (section 1.3).

The three main objectives of this study are addressed in chapters 2, 3 and 4. Chapter 2 analyzes the impact of foreign aid on a set of health-related indicators established as targets by the MDGs, namely: 1) the under-age-five mortality rate; 2) the under-age-one mortality rate; 3) the maternal mortality ratio; 4) HIV prevalence among females; 5) the contraceptive prevalence rate; 6) the incidence of malaria; and 7) the incidence of tuberculosis.

Chapter 3 is devoted to the assessment of aid effectiveness in the water and sanitation sector; the specialized literature on the close relationship between this sector and some of the health indicators included as objective variables in chapter 2 is reviewed in section 3.1.1.

Chapter 4 incorporates within-country inequality into the analysis by assessing the impact of foreign aid on inequalities between urban and rural areas in access to water and sanitation. Section 4.1.1 discusses the existence of an urban-rural gap in health, based on the specialized literature. Section 4.1.2 discusses the existence of an urban-rural gap in access to water and sanitation, in relation with the gap in health. The effects of foreign aid on within-country inequalities in access to water and sanitation are tested following two different strategies. Section 4.6.1 seeks to test whether aid has had a differentiated impact on rural and urban areas separately. Section 4.6.2 assesses the direct impact of foreign aid on the urban-rural gap in access.

Finally, chapter 5 summarizes the main findings, conclusions, and implications drawn from the results previously discussed in each individual chapter, as well as the limitations of this set of studies and potential lines for future research.

2. The impact of foreign aid on health

2.1. Introduction

The final decades of the 20th century and the first of the 21st saw substantial improvement in key health indicators throughout the world. Among these indicators, mortality among children has been a focus of especially significant international attention, beginning with the Convention on the Rights of the Child (1989), accelerating with the approval of the Millennium Development Goals (MDGs) in 2000, and continuing with the Sustainable Development Goals (SDGs) and the 2030 Agenda from 2015 onwards. Global progress in reducing death among children younger than five has been noteworthy. While in 1990 the under-five mortality rate (U5) at the global level was 93.4 per thousand children, in 2015 that figure had dropped to 42.2. That represents a 54.8% decrease, similar to the 51.5% reduction observed in the under-one mortality rate (U1) from 64.8 to 31.4‰.

These figures at the global level certainly hide important differences between world regions and countries with vastly different socioeconomic structures and paths of development. Some countries made extraordinary progress. For instance, in Mongolia the U5 fell by 82.7% and the U1 by 79.2% between 1990 and 2015; in Bangladesh, they fell by 74.8% and 70.2%, respectively; and in Malawi, by 74.6% and 70.1%. Other nations, by contrast, reported an increase in child mortality rates: Lesotho (from 91.3 to 97.9‰ in U5, and from 73.1 to 74.5‰ in U1); Swaziland (from 65.8 to 71.3‰ in U5, from 50.3 to 53.1‰ in U1); and Dominica (from 17.1 to 33‰ in U5, from 14 to 30.2‰ in U1).

Table 5. Summary statistics for health indicators (1990, 2015)

Variable	Year	Mean	Std. Dev.	Min.	Max.	Obs.
Under-five mortality rate (‰)	1990	72.4	69	6.3	328.9	193
	2015	31.4	31.3	2.2	136.7	193
Under-one mortality rate (‰)	1990	49.4	40.4	4.6	172	193
	2015	23.5	21.1	1.7	91.2	193
Maternal mortality ratio (per 100,000 births)	1990	339.6	451.1	5	2630	183
	2015	168.7	232.4	3	1360	183
HIV prevalence, 15-49 years (%)	1990	0.95	2.30	0.1	14.9	131
	2015	2.07	4.62	0.1	27.5	131

Source: WDI (2018). For detailed information, see section 2.5.

However, even if the pace of change has certainly been uneven across regions and countries, fair progress has been made globally. The average U5 worldwide dropped from 72.4 to 31.4‰, and some extremely high rates also went down. In 1990, almost one in three children died before reaching the age of five in Niger (328.9), followed by Liberia (257.9) and Mozambique (247.7). Not much less than a third of countries (62 out of 217) showed U5 rates remarkably higher than 136.7‰, while in 2015 so high a rate was observed only in Somalia. Similarly, the average U1 fell from 49.4 to 23.5‰, and some

of the highest rates in 1990 (172 in Liberia, 165.1 in Mozambique, 155.5 in Sierra Leone) were significantly reduced by 2015 (52.9 in Liberia, 55.1 in Mozambique, 86.2 in Sierra Leone).

As those countries with high initial mortality rates progressed, the differences across the world were also reduced. In 1990 the standard deviation from the mean of U5 was 69‰, while in 2015 it had dropped to 31.3‰. The standard deviation from the mean of U1 also fell from 40.4 to 21.1‰. This was possible because, as shown in Graph 1, those countries with higher initial U5s lowered them most, as indicated by the negative slope of the regression line. An additional per thousand point (ptp) in the U5 in 1990 is associated with a 0.598 ptp decrease over the period 1990-2015. As for the U1, a similar relation is observed: an additional ptp in 1990 is associated with a 0.538 ptp reduction (see Table 6).

Graph 1. Under-five mortality rate, variation against initial level (1990-2015)

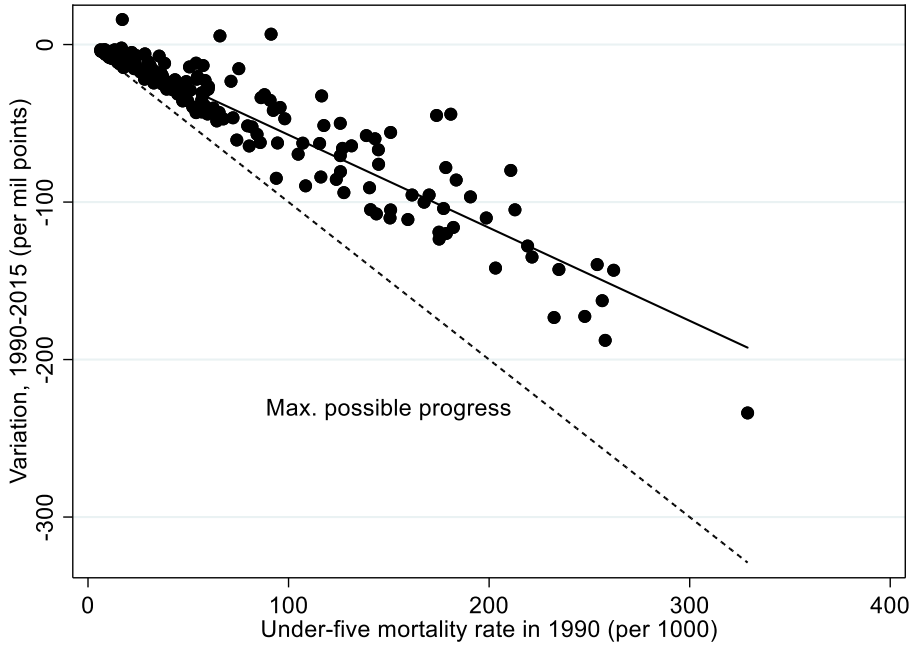


Table 6. The relation between the initial level in U5 and U1 and variations (1990-2015)

Dependent variable	β coefficient	SD	R^2	Obs.
Variation in under-five mortality rate (per thousand points)	-0.598***	0.015	0.89	193
Variation in under-one mortality rate (per thousand points)	-0.538***	0.018	0.83	193

*** p < 0.01, ** p < 0.05, * p < 0.1.
Source: WDI (2018). For detailed information, see section 2.5.

Arguably, the figures on U5 and U1 cannot be assumed to provide an exact measure of real child mortality, nor can other health indicators, since national capacities for reporting and registering data differ widely in capacity and willingness to collect or report information (see section 2.5). Nonetheless, the general trends conveyed by the data point to a clear improvement in recent decades.

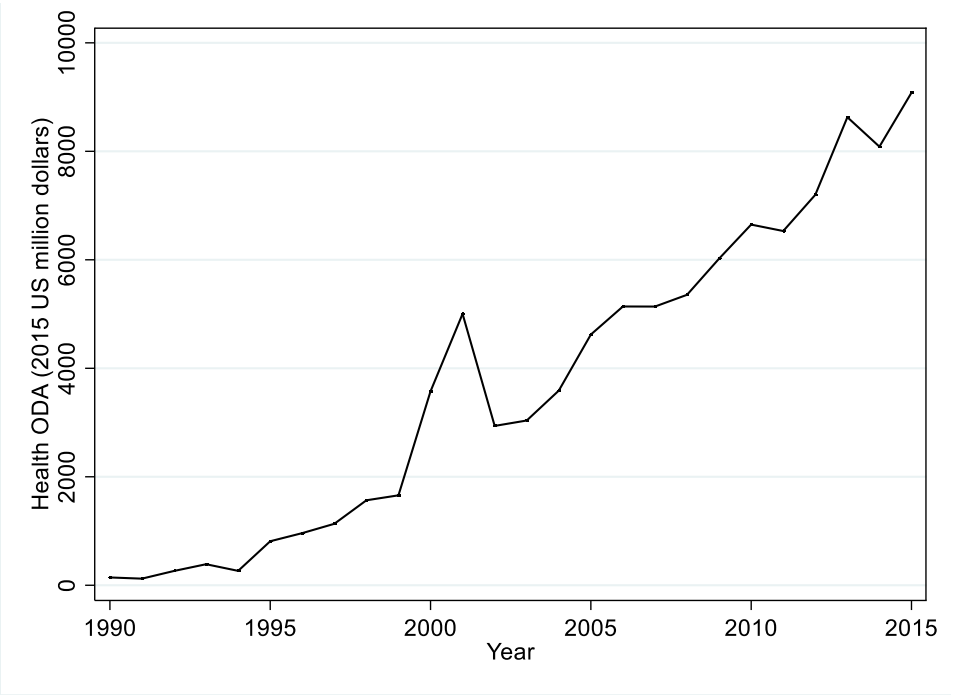
Although child mortality has been a focus of special attention, similar conclusions can be drawn from other health-related indicators such as the number of women who die from complications of pregnancy and childbirth (the maternal mortality ratio or MMR, measured per 100,000 live births). These are the leading cause of death among women of reproductive age in developing countries (Mayor, 2004), and they have likewise been observed to have declined along the period 1990-2015. From 385 deaths of women per 100,000 live births in 1990, this indicator fell 44% to 216 in 2015 at the global level. The cross-country mean dropped 50.3%, from 339.6 to 168.7 per 100,000 live births. Again, many countries still face a serious challenge. For instance, 1,360 women per 100,000 live births died in Sierra Leone in 2015, this being the maximum value for the MMR reported in that year; but this is about half of the 2,630 women that died (per 100,000 live births) in that same country in 1990.

However, the darkest note regarding the evolution of global health between the late 20th and early 21st centuries comes from the spectrum of conditions known as human immunodeficiency virus infection and acquired immune deficiency syndrome (HIV/AIDS). Far from improving, the prevalence of HIV (percentage of people ages 15-49 who are infected) rose globally from 0.3 to 0.8% between 1990 and 2015. The situation is extremely serious in some countries such as Eswatini, where 27.5% of the population were infected in 2015. In 1990, the highest rate of infection was the noticeably lower 14.9% reported by Zimbabwe. It is not surprising, therefore, that special attention has been paid to tackling the spread of HIV/AIDS.

The pandemic of HIV was also a driving force behind the resurgence of tuberculosis throughout the 1990s, mainly in sub-Saharan Africa and Asia, with the largest burden of disease borne by impoverished communities in the same geographic areas where malaria and HIV are endemic (Corbett et al., 2003). Fortunately, in this case, the spread of disease was largely stopped, and even reversed. From 2000 to 2015, the global incidence of tuberculosis was reduced from 173 to 142 new cases per 100,000 population per year. However, although many advances have been made, much action is still needed to achieve global elimination (Raviglione and Sulis, 2016).

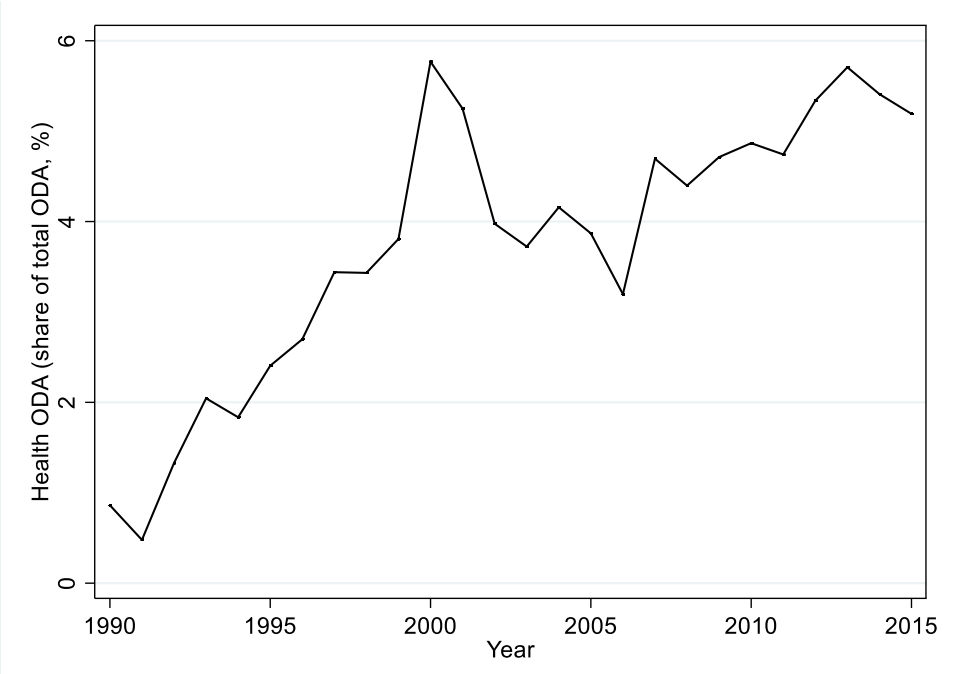
Due in part to the spread of these infectious diseases, but also due to a general increase in interest around social sectors such as health and education from the late 20th century onwards, a continuous rise in ODA targeted for health was seen between 1990 and 2015. Over this period, health ODA disbursements per year multiplied by 62 in real terms, from US$ 144 million to US$ 9.081 billion in 2015 dollars (see Graph 2). At the same time, health ODA also increased as a share of total ODA from 0.86% to 5.19%, thus revealing the growing importance of health in the global development agenda. As can be seen in Graph 3, increased interest in health by donors of development assistance did not commence with the approval of the MDGs in 2000, but at least a decade before the turn of the century.

Graph 2. The evolution of health ODA (1990-2015)



Source: Creditor Reporting System (CRS). See section 2.5.

Graph 3. The evolution of health ODA as a share of total ODA (1990-2015)



Source: Creditor Reporting System (CRS). See section 2.5.

Even if the increase in health ODA disbursements between 1990 and 2015 is a well-established fact, many have cast doubt on its effectiveness in improving health-related indicators. This debate goes back to the time of the Cold War, when political criteria were commonly thought to be the main drivers of aid allocation. However, since the end of the Cold War, a widespread view has emerged that a greater share of aid has been allocated based on development criteria (McGillivray, 2003). As for the allocation of health ODA over the period 1990-2015, those countries that had higher U5 rates in 1990 seem to have received more aid per capita. This relation, nonetheless, appears to be weak (see Graph 4 and Table 7).

Graph 4. Health ODA per capita received and initial level in U5 (1990-2015)

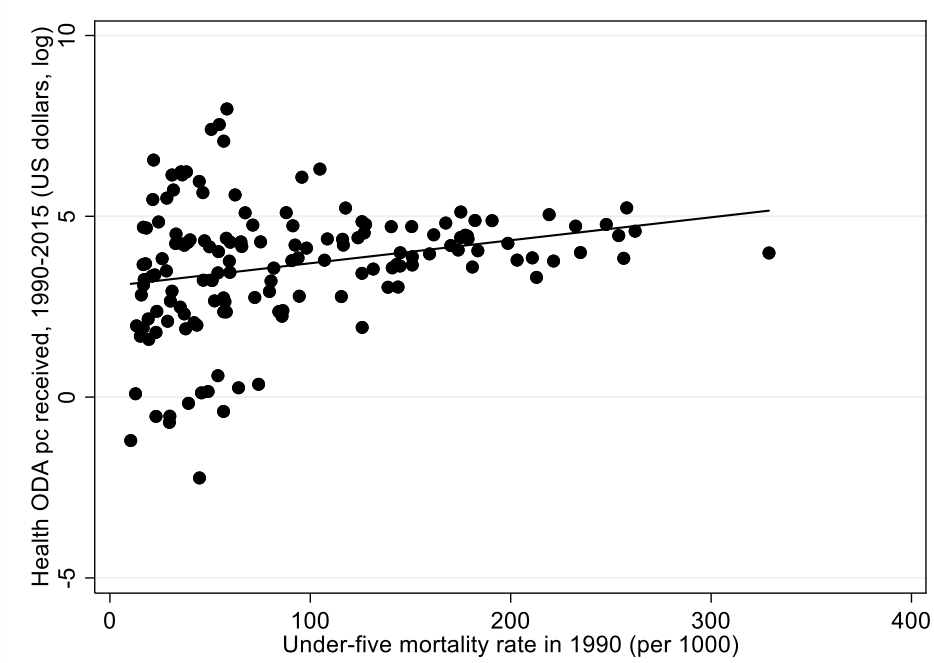


Table 7. The relation between the initial level in U5 and health ODA received (1990-2015)

Dependent variable	β coefficient	SD	R^2	Obs.
Health ODA received (2015 US$ millions)	0.0064***	0.0020	0.06	148

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

Source: CRS (2018) and WDI (2018). For detailed information, see section 2.5.

The weak relation between need and aid (among other factors) calls into question whether aid has had any impact on the improvement in health indicators such as children's or maternal mortality rates observed over the period 1990-2015. How were these outcomes achieved? Did foreign aid play any role in the process?

2.2. Objectives and relevance

As discussed in section 2.1, a number of health indicators showed remarkable progress worldwide between 1990 and 2015. However, knowledge about the determinants behind this process is largely uncertain. As the dramatic increased in health ODA ran hand in hand with improvements in health, it is meaningful to wonder whether health ODA might have played a role. In order to shed some light on this question, this study seeks to test whether health ODA had any impact on the evolution of a set of health-related indicators in a sample of 127 aid-recipient countries[15] during the period 1990-2015.

In order not to make a discretional choice among the numerous health-related indicators that can be used as dependent variables, which might influence the results of evaluation, it has been preferred to adhere to those indicators officially established as target variables by the MDGs. By doing so, not only will aid be evaluated according to its own objectives, but a common set of empirical measures can be adopted by the scholarly community in order to achieve better comparability of research on the topic. In regard to this, Yogo and Mallaye (2015, p. 1179) have noted: 'One of the major concerns in this literature is the wide variety of health indicators used [...]. This complicates the comparison of studies.' Indeed, it is possible that investigating the impact of health aid on different health outcomes may produce different results. That being the case, the MDGs are a good reference for choosing the variables on which health ODA may be supposed to have an impact.

The international community decided 'to put health firmly at the center of the Millennium Development Goals' (Sarbib and Baudouy, 2004, p. 9). Even though eight separate goals were formulated, it is clear that three may be conveniently clustered under the broad category of 'health': 4) reduce child mortality; 5) improve maternal health; and 6) combat HIV/AIDS, malaria, and other diseases. In turn, these three goals were particularized in four targets: 5) 'reduce by two-thirds, between 1990 and 2015, the under-five mortality rate'; 6) 'reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio'; 7) 'have halted by 2015 and begun to reverse the spread of HIV/AIDS'; and 8) 'have halted by 2015 and begun to reverse the incidence of malaria and other major diseases'.

A total of fifteen indicators were approved to assess progress towards targets 5-8 and goals 4-6 (see Table 8). This study tries to evaluate the impact that health ODA had on seven of these indicators, which are most directly identified with their broader goal and have profited from better monitoring efforts, thus providing the necessary data to carry out an empirical exercise of impact evaluation. These indicators are: 1) the under-five mortality rate; 2) the under-one mortality rate; 3) the maternal mortality ratio; 4) HIV prevalence in females; 5) the contraceptive prevalence rate; 6) the incidence of malaria; and 7) the incidence of tuberculosis. Detailed definitions of each of these indicators may be found in section 2.5.

[15] A total of 152 aid-recipient countries are considered (see Appendix 2.8), but due to missing data the maximum number of recipients included in the regression analysis is 127.

Table 8. Health-related MDGs: goals, targets, and indicators

Goals and targets	Indicators for monitoring progress
Goal 4: reduce child mortality	
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	13. Under-five mortality rate 14. Infant mortality rate 15. Proportion of one-year-old children immunized against measles
Goal 5: Improve maternal health	
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio	16. Maternal mortality ratio 17. Proportion of births attended by skilled health personnel
Goal 6: Combat HIV/AIDS, malaria, and other diseases	
Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS	18. HIV prevalence among 15-to-24-year-old pregnant women 19. Condom use rate of the contraceptive prevalence rate 19A. Condom use at last high-risk sexual encounter 19B. Percentage of population aged 15-24 with comprehensive correct knowledge of HIV/AIDS 19C. Contraceptive prevalence rate 20. Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14
Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	21. Prevalence and death rates associated with malaria 22. Proportion of population in malaria-risk areas using effective prevention and treatment measures 23. Prevalence and death rates associated with tuberculosis 24. Proportion of tuberculosis cases detected and cured under directly observed treatment short course (DOTS)

Source: United Nations (2003, p. 10).

The MDGs, expected to be accomplished by 2015, were approved in 2000. However, the baseline year established to assess progress was not 2000, but 1990. For that reason, this study has chosen 1990-2015 as the period of reference to evaluate the effectiveness of health ODA. In this regard, it is common in the literature on aid effectiveness to formulate questions such as 'Does aid have an impact?', or 'Is aid effective?' The use of the present tense in these sentences invokes its potential alternative meanings of 'at all times' or 'at no particular time'. However, the effectiveness of aid cannot be empirically assessed outside of a set of specific space-time coordinates. In fact, another concern in the literature on aid effectiveness is the use of fairly different time periods as a reference, ranging from

the early 1970s to the 2010s, which also complicates the comparison of studies and makes it harder to reach definitive conclusions. The effectiveness of aid is likely to vary not only across countries but also over time, given that the cooperation system, world societies, and economies have themselves gone through many changes since the 1970s. Faced with this difficulty, the 'MDG era' (1990-2015) provides a meaningful time period to be analyzed, with a set of defined targets and official indicators to assess progress.

Furthermore, the evaluation of aid effectiveness in the era of the MDGs is likely to lead to valuable findings for the future. Regarding the case of health ODA, it is noteworthy that MDGs 4-6, related to health, have been considered a single goal within the 2030 Agenda. Indeed, the first three targets included within SDG 3, 'ensure healthy lives and promote well-being for all at all ages', are equivalent to former MDGs 4-6, with child and maternal mortality and epidemics of AIDS, tuberculosis, malaria, and other diseases being the key issues to be addressed (United Nations, 2017). Therefore, knowledge on the effectiveness of aid in these sectors in the MDG era may prove useful to better addressing the many challenges set by the 2030 Agenda — including SDG 1 to eradicate extreme poverty, as 'ill health and high health care expenses constitute the biggest single reason for descents into poverty' (Krishna, 2010, p. 369).

These challenges are far from overcome. If child health has dramatically improved since 1990 throughout the world, the burden of disease during childhood is now more uneven than it was a generation ago (Kassebaum, 2017). The standard deviation of national U5 rates relative to the mean, which was 0.95 in 1990, increased slightly to 0.99 in 2015. As for U1 rates, the relative standard deviation increased from 0.82 to 0.90. Therefore, although important improvements have been made, it is necessary to keep pursuing these targets if no one is to be left behind. As for maternal and reproductive health, this remains a key cause of disease burden in adolescent females, especially in lower-income countries, not to mention the challenge posed by HIV/AIDS, which showed no improvement during the MDG era. Even if, as noted by Gillanders (2016, p. 340), a panel study like this 'should only be used with great caution to inform policy advice for a particular country, the question "does aid work on average?" is still one of interest for policy makers and one that has a long academic history.' Sound evidence on the effectiveness of aid is needed, not only in order to know the past, but to face the future.

2.3. Review of the literature

Little was known about the effects of foreign aid on the social dimensions until the early 2000s. Some progress has been made since then, although, as pointed out by Ziesemer (2016, p. 1359), 'the literature on effects of aid on education and health is as contradictory in terms of results as that of aid and growth.' More specifically, 'systematic evidence on how aid affects health outcomes in particular is surprisingly scarce' (Kotsadam et al. 2018, p. 60).

A first wave of literature tried to assess whether overall aid had an impact on under-one mortality rates (Boone, 1996; Burnside and Dollar, 2000; Gomanee et al., 2005a; Gomanee et al., 2005b; Bhaumik, 2005; Masud and Yontcheva, 2005; Fielding, Mark and Sebastian, 2006). These authors evaluated the impact of aid in different periods ranging from 1970 to the early 2000s. By and large, they tended to find a negative impact of aid on infant mortality, although most of them considered samples of a limited number of poor countries. Gomanee et al. (2005a), in a quantile regression, found the negative effect of aid on mortality to be stronger and more significant for poorer countries. The results of Masud and Yontcheva (2005) were mixed: they found no impact of bilateral aid, but found some evidence of impact of the aid from non-governmental organizations (NGOs).

Bhaumik (2005), in his study on 37 African countries, was the only one to also consider under-five mortality as dependent variable and found impact on U1 but not on U5. Boone (1996) and Gomanee et al. (2005b), who included in their samples a higher number of countries and used similar methods, came to different conclusions. While the former found no impact, the latter concluded that a 10% increase in aid appeared to be associated with a 4% reduction in infant mortality. Burnside and Dollar (2000) argued that overall aid might reduce infant mortality only if the recipient country has an optimal institutional framework.

Until the study by Wolf (2007), researchers had generally analyzed the impact of overall aid on infant mortality, but none used aid specifically targeted to the health sector. She was the first to study the relation between earmarked ODA for health and child mortality rates. In her models, two aid variables are used simultaneously: the share of aid for health, and overall aid as a share of gross national income. Overall aid shows a counterintuitive positive impact, meaning that aid seems to worsen health outcomes, whereas the share of ODA for health shows a negative impact on U5, and no impact on U1. This latter result was also found by Williamson (2008), who used the largest sample found in the literature. In fact, her results might be related to the fact that many of the 208 countries included in the analysis are developed countries, where the evolution of the U1 probably responds to different determinants compared to low- and middle-income countries. The heterogeneity of the sample could make it harder to find a generally valid relation between ODA and infant mortality.

Since Wolf's and Williamson's studies, most authors have used data on earmarked aid for the health sector instead of overall aid, except for Arndt et al. (2011). Gyimah-Brempong and Asiedu (2008) find favorable effects of health aid on U1. Mishra and Newhouse (2009) also find a reduction in U1 through health aid, but no such effect of overall aid. However, Wilson (2011) finds no effect of health ODA on U1 or U5. This analysis is the first to estimate the effectiveness of the various components of health ODA, such as spending on infectious diseases. Although it does not find evidence of impact of health ODA as a whole, it shows some evidence that spending on HIV/AIDS, other infectious disease, and family planning have had statistically significant (but very small) effects on mortality. Burguet and Soto (2012) provide additional evidence that supports the finding by Wilson (2011). They evaluate only the impact of infectious disease aid and

conclude that it reduces U5, mainly through malaria and STD/HIV control but also due to other components of infectious disease aid. Arndt et al. (2011), who return to the use of overall aid as explanatory variable of interest, find a negative impact of aggregate aid per capita on U1 only when using inverse probability weighted least squares (IPWLS) estimators, and they do not find any impact on U5 regardless of the estimation method.

Chauvet, Gubert and Mesplé-Somps (2013) analyze the impact of health aid on child mortality using panel and cross-country quintile-level data on 84 and 46 developing countries, respectively. While the impact of health aid is found to be significant in their cross-country regressions, this result vanishes when cross-country quintile-level data are used. Mukherjee and Kizhakethalackal (2013), in a fairly recent study using data for the latter decades of the past century (1978-2001), find that the impact of health aid depended on the educational level: this would have helped reduce infant mortality only where and when primary school completion rates were above 38% (which is outside the lowest quintile in their sample). This seems to happen mostly through nutritional aid and perhaps prenatal care.

The studies by Yogo and Mallaye (2015) and Gyimagh-Brempong (2015) focus on a limited sample of sub-Saharan African countries and analyze data for a period that largely overlaps with the MDG era. Both find that health ODA reduced under-five mortality. In addition, Yogo and Mallaye (2015) also find a negative impact on HIV prevalence, while Gyimagh-Brempong (2015) finds a negative impact on maternal mortality. Gyimagh-Brempong (2015) uses data on health aid from the Financing Global Health project of the Institute for Health Metrics and Evaluation, while most researchers use the Creditor Reporting System (CRS) of the OECD as their source of information.

As can be seen, most existing studies on the effectiveness of health ODA have focused on its impact on child mortality rates, and especially under-one mortality. This may be due to the fact that U1 is generally regarded as an important national indicator of health because it is particularly sensitive to general structural factors, like socioeconomic development and basic living conditions (Reidpath and Allotey, 2003). Fewer analyses have considered under-five mortality as their dependent variable (Wolf, 2007; Wilson, 2011; Arndt, Jones and Tarp, 2011; Burguet and Soto, 2012; Yogo and Mallaye, 2015), even though MDG 4 established U5 as its main objective variable, with U1 playing a subsidiary role.

Other indicators that were also established by the MDGs as official targets have received much less attention. One of these under-considered indicators in the study of the effectiveness of aid at the aggregate level is the maternal mortality ratio, which has only recently been evaluated by Gyimagh-Brempong (2015) and Pickbourn and Ndikumana (2016) to conclude that health ODA seems to have been effective in reducing this indicator. Yogo and Mallaye (2015) find that health aid has decreased the prevalence of HIV in Africa.

Table 9. Key aspects of existing literature on the impact of ODA on health-related indicators

Study	Dep. Var.	Methodology	Countries	Period	Impact
Boone (1996)	U1	OLS, IV, FELS	96	1970-1990	None
Burnside and Dollar (2000)	U1	2SLS	56	1970-1993	Negative
Gomanee et al. (2005a)	U1	OLS, quantile	38	1980-1998	Negative
Gomanee et al. (2005b)	U1	FELS	104	1980-2000	Negative
Bhaumik (2005)	U1, U5	FELS	37	1995-2002	Mixed
Masud and Yontcheva (2005)	U1	FE, RE	49-58	1990-2001	Mixed
Fielding et al. (2006)	U1	Sim. Eq. Sys	48	-	Negative
Wolf (2007)	U1, U5	OLS	41-109	1980-2002	Mixed
Williamson (2008)	U1	FE, IV	208	1973-2004	None
Gyimah-Brempong and Asiedu (2008)	U1	Difference GMM	90	1990-2004	Negative
Mishra and Newhouse (2009)	U1	System GMM	118	1973-2004	Mixed
Wilson (2011)	U1, U5	Difference GMM	84	1975-2005	Mixed
Arndt et al. (2011)	U1, U5	IPWLS (multi-eq. cross sec. model)	58	1970-2007	Mixed
Burguet and Soto (2012)	U5	2SLS	130	2000-2010	Negative
Chauvet et al. (2013)	U1, U5	FE, 2SLS	84	1991-2005	Mixed
Mukherjee and Kizhakethalckal (2013)	U1	Semiparametric	110	1978-2001	Mixed
Gyimah-Brempong (2015)	U5, MMR	System GMM	48	1990-2012	Negative
Yogo and Mallaye (2015)	U5, HIV	FE, GMM	34	1990-2012	Negative
Pickbourn and Ndikumana (2016)	MMR	OLS, IRLS, FE, GMM	75	1975-2010	Negative

Note: only references with dependent variables in common with this study have been included.
Source: own work.

While some MDGs indicators have not received much attention from researchers on aid effectiveness, other variables not included in the MDGs as targets have been commonly considered by scholars in the literature on the impact of aid. In this regard, Yogo and Mallaye (2015, p. 1179) have noted: 'One of the major concerns in this literature is the wide variety of health indicators used [...]. This complicates the comparison of studies.' One of these indicators is the UNDP health index, whose response to health ODA was explored by Pickbourn and Ndikumana (2013), with mixed results. However, among those indicators studied by the scholarly literature but not considered as direct targets by the MDGs, life expectancy at birth stands out. This variable was chosen by Gillanders (2016) and Ziesemer (2016), both reporting positive impacts of aid on the growth rate of life expectancy, but also by Wilson (2011), who found no effect. For the same variable, Arndt et al. (2011) obtained mixed results depending on the estimation method. Yogo and Mallaye (2015) also studied the effect of health aid on life expectancy, but found it not to be significantly robust across specifications, while they found a negative impact on HIV prevalence and under-five mortality. More specifically, Pickbourn and Ndikumana (2019) found health aid to have a negative impact on under-five mortality from diarrhea. These health outcomes are indeed more likely to reflect the effects of aid in the short to medium term than other measures such as life expectancy, which reflects combined effects over long periods.

2.4. Methodology

2.4.1. Theoretical framework

One of the main weaknesses of the literature on aid effectiveness is the lack of sound theoretical grounds on which empirical studies can be supported. While target variables of health aid such as HIV/AIDS or malaria have been repeatedly considered 'diseases of poverty' (WHO, 2004), the causal links leading from poverty to sickness are not always fully understood. In this study, the 'proximate determinants framework' developed by Mosley and Chen (1984) and adapted by Sartorius and Sartorius (2014) has been adopted as a conceptual guide for the identification of causal pathways between foreign aid and target variables. The framework is based on the premise that all *socioeconomic determinants* of morbidity and mortality necessarily operate through a common set of biological mechanisms, or *proximate determinants*, which in turn influence the risk of disease and the outcome of disease processes.

Socioeconomic determinants operate through proximate determinants to influence the level of morbidity and mortality. Six socioeconomic determinants are grouped into three broad categories of variables: 1) community-level variables, 2) household-level variables, and 3) individual-level variables.

Community-level variables include: 1) ecological setting, 2) political economy, and 3) health system. Among *household-level variables*, only income/wealth is considered. *Individual-level variables* include: 1) individual productivity (fathers, mothers), and 2) traditions/norms/attitudes.

In order to affect sickness and death, all socioeconomic determinants must operate through a set of proximate determinants that directly influence the risk of morbidity and mortality. Proximate determinants are limited to fourteen specific factors grouped into five broad categories.

First, *environmental contamination* includes factors that may cause infection and sickness classified by means of contagion: 1) air; 2) food/water/fingers, through the mouth and the digestive system; 3) skin/soil/inanimate objects; and 4) insect vectors. Thus, socioeconomic determinants such as the ecological setting (community level) or income/wealth (household level) could affect sickness and death through the availability of a safe water supply and the ability to pay for this service, hence reducing the probability of environmental contagion through contaminated water.

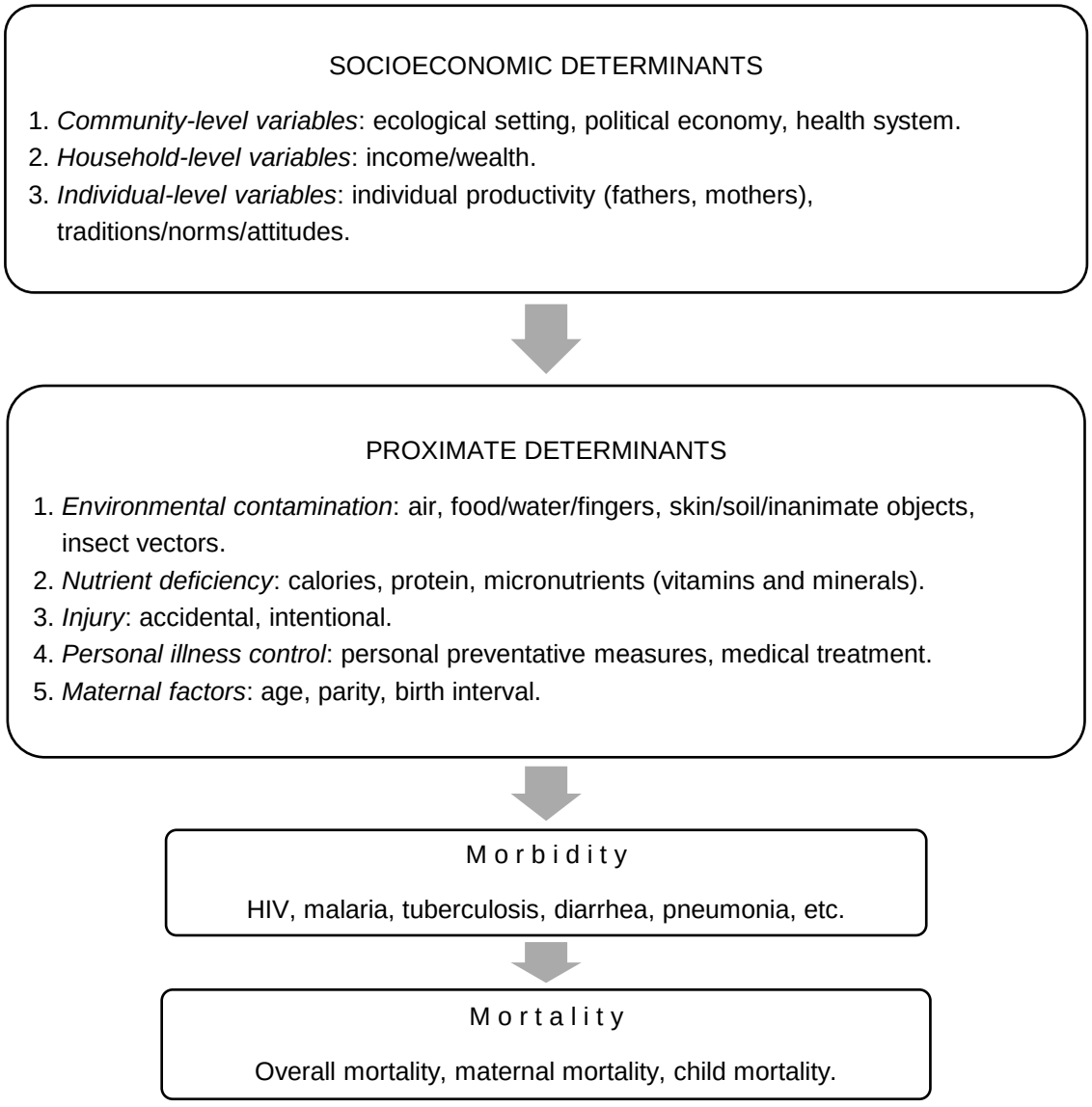
Second, *nutrient deficiency* includes: 1) calories, 2) protein, and 3) micronutrients (vitamins and minerals). Socioeconomic determinants such as political economy (community level) and income/wealth (household level) could affect morbidity and mortality via higher financial resources, sufficient to buy food that provides the necessary nutrients.

Third, the category *injury* includes two possible types: 1) accidental, and 2) intentional. Socioeconomic determinants such as political economy or health system could affect

sickness and death via regulation to avoid workplace accidents, or via medical care to heal the physical damage suffered.

Fourth, *personal illness control* factors include: 1) personal preventative measures, and 2) medical treatment. While all proximate determinates in the other groups influence the rate of shift of healthy individuals towards sickness, the *personal illness control* factors influence both the rate of illness (through prevention) and the rate of recovery (through treatment). Socioeconomic determinants such as the health system can only prevent morbidity and mortality if the individual seeks medical treatment when needed.

Figure 1. The proximate determinants framework for the study of morbidity and mortality



Source: adapted from Mosley and Chen (1984) and Sartorius and Sartorius (2014).

Fifth, for the specific case of maternal and infant mortality, *maternal factors* include: 1) age, 2) parity, and 3) birth interval. Socioeconomic determinants such as political economy (community level) or traditions/norms/attitudes (individual level) may affect maternal and child mortality through differentiated roles for men and women, hence promoting adolescence pregnancy, which is associated with higher risks of miscarriage and other complications.

From this theoretical framework, some causal pathways linking foreign aid and health outcomes (morbidity and mortality) may be identified.

As an example, aid targeted to sexually transmitted disease control may affect socioeconomic determinants at the individual level such as traditions/norms/attitudes regarding the use of contraceptive methods, hence having an impact on proximate determinants such as personal illness control (personal preventative measures). Thus, the incidence of HIV can be reduced. Inasmuch as immunodeficiency is associated with higher rates of incidence of malaria (WHO, 2004) and tuberculosis (Corbett et al., 2003), these variables can also be affected. Finally, since all these diseases, separately but also in combination, are associated with higher risks during pregnancy and delivery (McIntyre, 2005; Mofenson and Laughon, 2007; Menéndez et al., 2008; Ezechi, Petterson and Byamugisha, 2012; McGready et al., 2012; Thompson et al., 2020), maternal and infant mortality can be reduced as well.

2.4.2. Empirical strategy

The aim of this work is to find out whether health ODA has had, on average, an impact on several health-related indicators in developing countries as a group throughout the MDG era, meaning the period between 1990 and 2015. The objective variables are: 1) the under-five mortality rate; 2) the under-one mortality rate; 3) the maternal mortality ratio; 4) HIV prevalence in females; 5) contraception; 6) incidence of malaria; and 7) incidence of tuberculosis. The nature of the endeavor, which comprises a wide range of 'individuals' to be observed and a fair number of time periods, entails the use of panel data models as an empirical strategy.

The dependent variables employed in this study in a cross-country setting may be affected by various measurable factors that change over time, but also by factors that do not change over time (or that change at a rather slow pace) and are difficult to measure. This latter type of factor constitutes what has been called 'unobserved heterogeneity' and may include, among others, institutional frameworks as well as cultural systems, which usually have deep historical roots and notoriously differ among nations across the globe. In order to account for these factors and prevent them from interfering with the measurement of the relationships of interest to this study, the following equations are estimated:

$$Y_{k,t} = \delta_k + \gamma_t + \boldsymbol{\beta X}_{k,t} + u_{k,t} \quad (1)$$

Where $Y_{k,t}$ is the health-related indicator in country k at time t, δ_k is the 'unobserved heterogeneity' or 'fixed effect' of country k, γ_t is a time fixed effect that accounts for factors that vary over time but equally affect all countries, $\boldsymbol{X}_{k,t}$ is a matrix of variables that may affect the mortality rate in country k at time t, and $u_{k,t}$ is the error term. $\boldsymbol{\beta}$ is a vector of parameters to be estimated.

Seven explanatory variables have been included in the matrix $\boldsymbol{X}_{k,t}$. Two of these are the explanatory variables of interest. First, *health ODA*, which includes disbursements targeted to medical services, basic nutrition, infectious disease control, and reproductive health, among other topics (see Table 10 for a detailed description). Effective prevention and control of childhood diseases and improved health care programs, such as immunization and provision of vitamin supplementation, are regarded as key factors in the decline of child mortality (Abir et al., 2015). As these services are among those financed by *health ODA*, a negative relation with child mortality rates is expected. A negative impact is also expected on the maternal mortality ratio, since *health ODA* includes prenatal and postnatal care to address complications of pregnancy and childbirth, which are the leading causes of death and disability among women of reproductive age in developing countries (Mayor, 2004). A negative impact of this type of ODA is also expected on the incidence of malaria, since programs for control and prevention of this disease are also included in this category.

The second explanatory variable of interest is *STD ODA*, which is allocated to sexually transmitted disease (STD) control programs and is expected to have different effects than health ODA, depending on the objective variable considered in each model. In particular, there may be reasons to expect a modest impact of *STD ODA* on child mortality rates in the short to medium term, even if the overall effect on the population is sizable. Most children with HIV acquire the virus from their mothers during pregnancy or delivery, or through breastfeeding. More than in other cases, success in these areas may depend on strengthening the general health system, and maternal, neonatal, and child health services in particular (c-section, prophylactic breastfeeding, etc.). As these concepts are included within *health ODA*, this variable is expected to have a greater impact on child mortality than will *STD ODA*.

By contrast, *STD ODA* is expected to have a positive impact on the practice of modern methods of contraception and a negative one on female HIV prevalence. As for the impact of ODA on the incidence of tuberculosis (TB), in principle a negative sign is expected from both types of ODA, although the magnitude of their impacts is likely to be different. Incidence can change as a result of changes in transmission (the rate at which people become infected) or changes in the rate at which infected people develop the disease. Because TB can develop in people who became infected many years prior, new cases may be arising in spite of good control in the current moment, due to poor control in the past. Thus, TB control programs financed by foreign aid, which are included within the CRS code 12263 and therefore within the variable *health ODA* of this study, may not show a significant impact in the short term. Conversely, *STD ODA* may play a more important role in reducing the incidence of TB, even though this is not a sexually

transmitted disease. This is due to the long-established fact that the development of TB is closely associated with HIV infection, to the extent that both diseases have been defined as a 'syndemic', meaning 'the convergence of two or more diseases that act synergistically to magnify the burden of disease' (Kwan and Ernst, 2011).

It is common in the literature to measure ODA as the average of a number of past time periods in order to soften some portion of the volatility of ODA and possible errors of measurement (Williamson, 2008). In this study, two different models have been estimated, one of them containing yearly data and another with the variable expressed as the average of the past five years (in which case the regressions have been run taking into account only the years 1995, 2000, 2005, 2010 and 2015). Both are estimated by making use of ordinary least squares (OLS) and both yield similar results (see section 2.6).

Apart from volatility, another source of concern when evaluating the impact of aid is the possible existence of endogeneity or reverse causality. This is because, just as health aid is expected to have an impact on mortality rates, it is also expected to respond to these indicators by flowing in a greater magnitude to those countries that need it most (i.e., that present higher mortality rates). In order to avoid this issue, an approach based on the use of instrumental variables has been followed. Thus, a third model has been estimated by making use of two-stages least squares (2SLS) where the aid variables have been instrumented with their first lags. Lagged aid is a strong predictor of current aid, and lags of aid are unlikely to be driven by or exert a strong impact on current health outcomes. The instrumental variables are strongly correlated with current aid ($\rho = 0.69$ for health ODA, and $\rho = 0.86$ for STD ODA). Various test statistics for the instrumental variable estimation (under-identification and weak-identification tests) are reported in Appendix 2.8.2. Both OLS and 2SLS yield similar results. All statistical analysis was performed using Stata 15. Fixed-effects OLS estimations were performed using the Stata command 'xtreg', while 2SLS estimations were performed using the command 'xtivreg'.

As health indicators are expected to be related to the general level of development, other common variables have been included in the model as control variables. These are: 1) GDP per capita; 2) mean years of education; 3) rate of access to improved water supply; 4) rate of access to improved sanitation services; 5) share of urban population; and 6) an index of corruption.

GDP per capita has been included in the model as a broad indicator on the general level of development. It is expected to show a negative impact on child mortality rates and the maternal mortality ratio, inasmuch as health care and sanitary conditions are expected to improve as the economy grows and more resources become available. Here the relationship is double. On the supply side, a higher GDP per capita provides more resources for creating health infrastructures and improving health services at both primary and specialized levels. On the demand side, people with higher income live in healthier environments and are more demanding of high-quality health services. In this regard, it has been found that household wealth is negatively related to under-five mortality (Yaya et al., 2018), as it fosters personal illness control through the demand for medical

treatment when needed. However, the relation of GDP per capita with disease indicators is less clear.

Mean years of education is also expected to have a negative impact on child mortality, and maybe on the maternal mortality ratio and HIV prevalence in females, whereas a positive effect might be expected on contraception. The seminal paper by Caldwell (1979) argued that education, and particularly maternal education, played an important role in determining child survival even after control for a number of other factors. Caldwell suggested several pathways whereby a mother's education might enhance child survival. In increasing probable order of importance, these were: 1) a shift from 'fatalistic' acceptance of health outcomes towards implementation of simple health knowledge; 2) an increased capability to manipulate the modern world, including interaction with medical personnel; and 3) a shift in the familial power structures, permitting the educated woman to exert greater control over health choices for her children. Since then, empirical studies have repeatedly pointed at education as an important determinant of child health (Hobcraft, 1993; Yaya et al., 2018; Andriano and Monden, 2019). Recent studies observe that children of mothers with up to six years of education are about 20% more likely to survive until their fifth year, compared to children of mothers who have not been to school (Bado and Susuman, 2016); and even if evidence points to a reduction in these differences in mortality over the past decades, recent research shows that they have not yet disappeared altogether (Yaya et al., 2019).

The *rates of access to improved water and sanitation* have also been identified by numerous researchers as closely related not only to child mortality (see section 3.1.1) but also to maternal mortality (Cheng et al., 2012; Pickbourn and Ndikumana, 2016). Children bear the brunt of WS-related impacts. Their health, nutrition, growth, education, and life opportunities suffer as a result of inadequate water supply and sanitation. Access to improved WS determines hygiene practices and allows the use of treated water, which reduces gastrointestinal diseases. Since these are the main causes of death in children (along with respiratory diseases), a negative sign is expected for these variables in relation to U1 and U5. A negative relation is also expected with the MMR, as safe delivery requires clean water, both women and infants being at particular risk for infection and other complications (WHO/UNICEF, Water, sanitation and hygiene in health care facilites, 2015). In this regard, Campbell et al. (2015) have identified up to 77 risk mechanisms (67 chemical or biological factors and 10 complex behavioral factors) linking water, sanitation and hygiene to maternal and perinatal health outcomes. Recent research has also shed light on the link between the lack of access to improved WS and the spread of malaria in some African countries (Ayele, Zewotir and Mwambi, 2012, 2013; Kinuthia et al., 2012; Yang et al., 2020). As a potential transmission channel, Kinuthia et al. (2012) point to the use of unimproved rainwater collection facilities, which fill up with water during the rainy seasons, hence creating appropriate breeding sites for the mosquitoes that transmit the disease.

The *share of urban population* was also included as a variable that may affect health indicators. The existence of an urban-rural gap in health is firmly established by a body

of literature covering various geographical areas (see section 4.1). This gap is usually explained by differences in the distribution of factors such as health facilities, safe sources of drinking water, household and community sanitation, etc. Indeed, many public goods related to health are provided in cities but not in rural regions. Economies of scale explain why – for instance, hospital infrastructure requires a critical mass of patients demanding treatments. Hence there tends to be a concentration of health and medical resources in the cities, and this facilitates public health interventions, as compared to the countryside. Thus, urban dwellers have better access to health care, and illnesses are more likely to receive timely and appropriate treatment. Similarly, the fixed costs associated to community-level water supply and sanitation systems are fairly high, so these services can only be provided at affordable tariffs once the population to be covered has reached a certain level (Hope et al., 2020). Because of the well-documented existence of this urban-rural gap in health, a negative relation with the dependent variables is expected, even if the possibility of an 'urban penalty' in rapidly growing cities cannot be ruled out (section 4.4.1).

Finally, health indicators can also be affected by institutional factors such as *corruption*: this may lead to increased prices or reduced supply of health-care services for a given level of development as measured by the GDP per capita. In regard to this, the study by Friedman (2018) on a panel of sub-Saharan African countries concluded that corruption reduces the impact of a given quantity of antiretroviral drug imports on the number of AIDS deaths; and based on a case-study analysis of the Kenyan experience, corruption is flagged as a potential mechanism through the fact that clinics disproportionately begin distributing drugs in areas that are predominantly represented by the leader's ethnic group. To account for these kinds of institutional quality factors that may affect health indicators, an index of corruption was included in the model (see section 2.5 for a detailed description of this variable).

Four of the control variables have been included in the models as logarithms instead of in their original units. These are GDP per capita, mean years of education, and access to water and sanitation. This specification has proved able to maximize the explanatory capacity of the models. Moreover, it permits a straightforward economic interpretation. Child mortality is expected to decrease mainly at lower-middle levels of development, whereas once a certain level of GDP per capita is attained, it will have already fallen to lower levels, and progress will slow. Education is also expected to have a greater effect when basic knowledge on health care is yet to be acquired. After that, additional education may have a lower impact on indicators such as child or maternal mortality. Finally, the same can be said of access to water and sanitation. Once a certain level of provision is secured, further improvements may continue to reduce mortality, but this decrease tends to be of a lower magnitude than when a significant share of the population remains to be covered by these services, with greater risks associated to the spread of diseases related to water.

2.5. Data

Data for the seven objective variables have been sourced from the World Development Indicators database of the World Bank, which in turn collects its information from other sources. The *under-five mortality rate* (indicator code SH.DYN.MORT) is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year. The *under-one mortality rate* (indicator code SP.DYN.IMRT.IN) is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.

As complete vital registration systems are fairly uncommon in developing countries, annual estimates must be obtained from sample surveys or derived by applying indirect estimation techniques to registration, census, or survey data. Estimates are developed by the United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME). To reconcile differences between data sources and take better account of the systematic biases associated with the several types of data inputs, an estimation method is used to fit a smoothed trend curve to a set of U5 observations and to extrapolate that estimated U5 trend to a defined time point. This model is known as the Bayesian B-splines Bias-adjusted model, or B3 (Alkema and New, 2014). For countries with high-quality data (covering a sufficient period and deemed to have high levels of completeness and coverage), the B3 model is also used to estimate the U1. For the remaining countries, the U1 is derived from the U5 using model life tables and other statistical techniques (UN IGME, 2019).[16] As a consequence of these estimation methods, the figures on U5 and U1 cannot be assumed to provide an exact measure of real child mortality. Some disturbance is expected to exist, which could make it difficult to assess the true impact of the explanatory variables on child mortality rates.

The *maternal mortality ratio* (indicator code SH.STA.MMRT in the WDI) is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births. The ratios cannot be assumed to provide an exact estimate of maternal mortality, as its measurement is subject to many types of errors. Household surveys such as Demographic and Health Surveys attempt to measure maternal mortality by asking respondents about survivorship of sisters, but the estimates produced by this method pertain to any time within the past few years before the survey, making them unsuitable for some purposes such as monitoring short-term changes or observing the impact of interventions at the micro level. Even in high-income countries with reliable vital registration systems, misclassification of maternal deaths has been found to lead to underestimation. The national estimates of maternal mortality ratios are based on national surveys, vital registration records, and surveillance data or are derived from community and hospital records. They are only available for a limited number of years, so yearly data are estimated by the Maternal Mortality Estimation Inter-Agency Group (MMEIG), which consists of World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the World Bank, and the United Nations Population

[16] For a detailed explanation of UN IGME estimation methods, see WDI (2018).

Fund (UNFPA). For countries with incomplete or no data, maternal mortality is estimated with a regression model using available national maternal mortality data and socioeconomic information such as fertility, birth attendants, and GDP. Thus, data reliability is limited and is expected to vary between countries, as it is also in the case of other health indicators. Further details on the methodology can be found in MMEIG (2015).

Female HIV prevalence (indicator code SH.HIV.1524.FE.ZS) is the percentage of females between 15 and 24 years of age who are infected with HIV. Original data are provided by the Joint United Nations Programme on HIV/AIDS (UNAIDS). Yearly estimates are computed from information in HIV prevalence trends from surveillance data as well as survey data, tracking the course of HIV epidemics and their impact.

The *contraceptive prevalence rate* (SP.DYN.CONM.ZS) is the percentage of women who are practicing, or whose sexual partners are practicing, at least one modern method of contraception. It is usually measured for women ages 15-49 who are married or in union. Modern methods of contraception include female and male sterilization, oral hormonal pills, the intra-uterine device (IUD), the male condom, injectables, the implant (including Norplant), vaginal barrier methods, the female condom, and emergency contraception. Original data come from household surveys, including Demographic and Health Surveys and Multiple Indicator Cluster Surveys, largely compiled by the United Nations Population Division.

The *incidence of malaria* (SH.MLR.INCD.P3) is the number of new cases of malaria in a year per 1,000 population at risk. Population at risk is defined as population living in areas where malaria transmission occurs. Complete data on malaria cases reported through surveillance systems are rarely available for large populations. Reported data on malaria cases generally need to be corrected for extent of health service use, incompleteness of reporting, and lack of case confirmation. For that reason, the World Health Organization elaborates the estimates that are included in the WDI database. WHO compiles data on reported confirmed cases of malaria, submitted by national malaria control programs, and it estimates the extent of underreporting. In high-transmission areas with limited health service data but with good data on parasite prevalence, the number of cases is estimated from parasite prevalence surveys. The denominator (population at risk) is estimated using risk mapping and population data.

The *incidence of tuberculosis* (SH.TBS.INCD) is the estimated number of new and relapse tuberculosis (TB) cases arising in a given year, expressed as the rate per 100,000 population. All forms of tuberculosis are taken into account, including cases in people living with HIV. Estimates of TB incidence are produced through a consultative and analytical process led by the WHO and published in the Global Tuberculosis Report. These estimates are based on annual case notifications, assessments of the quality and coverage of TB notification data, national surveys of the prevalence of TB disease, and information from vital registration systems. Depending on the available data, estimates of incidence for each country are derived using one or more of the following approaches: 1) incidence = case notifications / estimated proportion of cases detected; 2) incidence =

prevalence / duration of condition; 3) incidence = deaths / proportion of incident cases that die. Where the proportion of cases treated and notified to WHO is consistent over time (even if it is low), trends in incidence can be judged from trends in notified cases. Where TB control efforts change over time, it is difficult to differentiate between changes in incidence and changes in the proportion of cases notified.

As can be seen from the definitions of the above indicators, the limited availability of data on health status is a major constraint in assessing the health situation in developing countries. Surveillance data are lacking for many major public health concerns. Estimates of prevalence and incidence are available for some diseases but are often unreliable and incomplete. National health authorities differ widely in capacity and willingness to collect or report information. For those reasons, the results obtained from the analysis of these data must be taken with caution. Even if changes in procedures and assumptions for estimating the data and better coordination with countries have resulted in improved estimates in recent decades, further improvements will allow the performance of more reliable empirical studies in the future.

As for the explanatory variables of interest, *health ODA* and *STD ODA* per capita, data were sourced from the Creditor Reporting System (CRS) of the OECD.

At present, two large databases on development aid flows at the project level are available: the CRS and AidData (Tierney et al., 2011). There are two main differences between them: 1) AidData includes flows from more donors, whereas the CRS provides only data on aid from OECD countries; and 2) AidData allows the same project to have more than one activity code, whereas CRS assigns just one purpose code to each project (Tierney et al., 2011). This being the case, AidData seems to be, *a priori*, a better source for research purposes due to its comprehensiveness and flexibility. However, data from emerging donors are still scarce and unreliable, a vast number of projects are not activity coded (39.8% in the 3.0 Research Release for 2016) and, more importantly for the purposes of this article, data on actual disbursements are not provided.

In this regard, previous literature has shown that 'disbursement data lead mostly to statistically significant expected results, whereas commitment data do not.' This is a meaningful finding, since 'undisbursed payments can hardly have any effect on health' (Ziesemer, 2016, p. 1375). For these reasons, the CRS is used in this study as the source of information on health ODA flows, as most previous researchers on the topic have done, except for Wilson (2011).

Data were sourced from the project-level files (18 January 2019 version), years 1990-2015, and aggregated at the national level. A total of 152 aid-recipient countries are considered (see Appendix 2.8.1), but due to missing data the maximum number of recipients included in the regression analysis is 127. The coverage of the data for a specific recipient or sector varies over time according to the donors and types of assistance involved. When analyzing data for the last three decades, the main issue to take into consideration is the progressive improvement in donors' reporting. The completeness of CRS disbursements for DAC members improved from 60% in 2002 to

nearly 100% in 2007 (OECD, 2020). As the existence of under-reporting comes from the donor's side, this is expected to be a problem of more importance for studies on aid allocation than for studies on aid effectiveness. Moreover, the use of a large panel of countries is likely to reduce the influence of particular cases of rapid changes in reporting. Nonetheless, this is another source of concern that must be taken into account when assessing the validity of the results.

In the classification provided by the CRS, the types of ODA most related to health may be found in DAC codes 120 and 130 (see Table 10 for a detailed description). Both have been considered together in this study. However, component 13040, intended for STD control (including HIV/AIDS), is expected to have different effects than the rest, depending on the objective variable. As the share of this component in the total sum of disbursements allocated to codes 120 and 130 is significant — US$ 54,196 out of US$ 173,435 (2015 dollars) for the whole period 1990-2015, which makes up 31.2% of the total — the results are likely to be influenced by the differentiated impacts of this type of ODA if it is included with the rest in the same variable. That being the case, two separate ODA variables have been included in the models: 1) *health ODA*, which equals the sum of DAC codes 120 and 130, excluding component 13040; and 2) *STD ODA*, which equals component 13040 for STD control.

Gross disbursements of ODA through all channels (public sector, NGOs, public-private partnerships, etc.) are taken into account. All amounts are expressed in real terms, the unit of measurement being 2015 US dollars per capita. In order to compute disbursements per inhabitant, population data were sourced from the World Development Indicators (WDI) of the World Bank (indicator code SP.POP.TOTL).

As for the remaining explanatory variables, the WDI database is the source of information for *GDP per capita* expressed in constant (2011) international dollars (PPP) per capita (indicator code NY.GDP.PCAP.PP.KD), the *rates of access to improved water and sanitation* in percentage points (indicator code SH.H2O.SAFE.ZS for access to improved water sources and SH.STA.ACSN for access to improved sanitation facilities), and the *share of urban population*, also in percentage points (indicator code SP.URB.TOTL.IN.ZS).

The variable *mean years of education* is defined as the average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level. Data were sourced from the Human Development Report 2018 Statistical Update by the UNDP (2018).

The *corruption index* employed in this study is an aggregate index which includes corrupt legislature activities, corrupt judicial decisions, corrupt public sector exchanges, public sector theft, executive bribery and corrupt exchanges, and executive embezzlement and theft. The index ranges from 0 to 1, with higher levels representing more corruption. Data were sourced from the Varieties of Democracy Project (indicator v2x_corr), version 8.

Summary statistics of both objective and explanatory variables are presented in Table 11.

Table 10. Components of health-related official development assistance (DAC codes 120, 130)

Code	Description	Clarifications
120	HEALTH	
121	HEALTH, GENERAL	
12110	Health policy and administrative management	Health sector policy, planning and programs; aid to health ministries, public health administration; institution capacity-building and advice; medical insurance programs.
12181	Medical education/training	Medical education and training for tertiary level services.
12182	Medical research	General medical research.
12191	Medical services	Laboratories, specialized clinics and hospitals (including equipment and supplies); ambulances; dental services; mental health care; medical rehabilitation; control of non-infectious diseases; drug and substance abuse control.
122	BASIC HEALTH	
12220	Basic health care	Basic and primary health care programs; paramedical and nursing care programs; supply of drugs, medicines and vaccines related to basic health care.
12230	Basic health infrastructure	District-level hospitals, clinics and dispensaries and related medical equipment.
12240	Basic nutrition	Direct feeding programs; determination of micro-nutrient deficiencies; provision of vitamin A, iodine, iron etc.; monitoring of nutritional status; nutrition and food hygiene education; household food security.
12250	Infectious disease control	Immunization; prevention and control of infectious and parasite diseases, except malaria (12262), tuberculosis (12263), and HIV/AIDS and other STDs (13040). It includes diarrheal diseases, among others.
12261	Health education	Information, education and training of the population for improving health knowledge and practices; public health and awareness campaigns; promotion of improved personal hygiene practices, including use of sanitation facilities and handwashing with soap.
12262	Malaria control	Prevention and control of malaria.
12263	Tuberculosis control	Immunization, prevention and control of tuberculosis.
12281	Health personnel development	Training of health staff for basic health care services.
130	POPULATION POLICIES/ PROGRAMS AND REPRODUCTIVE HEALTH	
13010	Population policy and administrative management	Population/development policies; census work, vital registration; migration data; demographic research/analysis; reproductive health research; unspecified population activities.
13020	Reproductive health care	Promotion of reproductive health; prenatal and postnatal care including delivery; prevention and treatment of infertility; prevention and management of consequences of abortion; safe motherhood activities.
13030	Family planning	Family planning services including counselling; information, education and communication (IEC) activities; delivery of contraceptives; capacity-building and training.
13040	STD control including HIV/AIDS	All activities related to sexually transmitted diseases and HIV/AIDS control; e.g. information, education and communication; testing; prevention; treatment, care.
13081	Personnel development for population and reproductive health	Education and training of health staff for population and reproductive health care services.

Source: OECD (2016). *DAC and CRS code lists*.

Table 11. Summary statistics for regression variables

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
Under-five mortality rate (‰)	65.4	56.0	2.4	328.9	3,848
Under-one mortality rate (‰)	45.3	32.7	1.9	173.1	3,484
Maternal mortality ratio (per 100,000 births)	324.4	380.3	4.0	2900	3,640
Female HIV prevalence, 15-24 years (%)	1.6	3.7	0.1	32.1	2,964
Contraceptive prevalence (%)	35.6	21.3	1.0	86.2	671
Malaria incidence (per 1,000 pop. at risk)	140.6	187.4	0.0	1741	1,741
Tuberculosis incidence (per 100,000 pop.)	172.4	205.3	0.0	1280	2,393
Health ODA pc	5.85	24.61	0	638.32	3,688
STD ODA pc	0.47	1.09	0	24.61	3,688
GDP pc	7846.58	8463.89	247.44	53595.24	3,645
Mean years of education	6.3	2.8	0.3	12.7	3,319
Rate of access to improved water (%)	79.3	18.6	13.2	100	3,717
Rate of access to improved sanitation (%)	60.2	30.2	2.6	100	3,689
Share of urban population (%)	46.8	21.6	5.4	100	3,922
Corruption index	0.64	0.23	0.04	0.98	3,431

Sources: CRS (2018), UNDP (2018) and WDI (2018). Sample: recipients of Health ODA or STD ODA.

If the variables that we are introducing in the models turn out to be strongly correlated, the coefficients associated to them could not be interpreted in terms of partial correlation with the dependent variable, and they would not be capturing the authentic relationship between each explanatory variable and the objective variable. Table 12 shows the matrix of correlations of all the variables that we are using. Since the variables of interest are health ODA and STD ODA per capita, their correlations with the rest of the variables are the most important for the purposes of this chapter. None are greater than 0.33 within panels, which is a fairly low level of correlation and allows interpretation of the coefficient as the genuine partial relationship between aid and mortality rates.

Only the rates of access to water and sanitation show a within-panel correlation above 0.70 (usually the rule-of-thumb flag for a critical value from which correlation becomes a serious issue). While this correlation can affect to some extent the interpretation of the estimated coefficients (which may give some insight when interpreting the results presented in section 2.6), it does not constitute a major problem since these variables are included only as control variables, and the specific values of their coefficients are not of great significance for the purposes of this chapter.

Table 12. Matrix of correlations for explanatory variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Health ODA pc	1	0.16	0.22	0.32	0.33	0.29	0.30	0.02
(2) STD ODA pc	0.12	1	0.19	0.22	0.24	0.18	0.22	0.03
(3) Ln GDP pc	-0.19	-0.02	1	0.52	0.48	0.49	0.54	-0.10
(4) Ln Mean years educ.	-0.03	0.05	0.66	1	0.56	0.61	0.66	0.03
(5) Ln Access to water	-0.02	0.01	0.66	0.62	1	0.73	0.52	0.02
(6) Ln Access to sanitation	-0.12	-0.05	0.74	0.69	0.73	1	0.59	0.00
(7) Urban population	-0.08	-0.10	0.67	0.51	0.55	0.54	1	-0.07
(8) Corruption	-0.11	-0.12	-0.38	-0.26	-0.35	-0.29	-0.25	1

Note: Overall correlations below the diagonal, within-panel correlations above the diagonal.
Sources: CRS (2018), UNDP (2018) and WDI (2018). Sample: recipients of health ODA or STD ODA.

2.6. Results

Table 13 shows the results obtained after estimating the models presented in section 2.4 for the dependent variables U1 and U5. The explanatory capacity of the models, as measured by the R-squared, is fairly high. On average, they account for about two-thirds of within-country variability in child mortality rates, with 0.64 being the lowest value and 0.73 the highest. Regarding the explanatory variable of interest, health ODA per capita shows in every specification a negative effect on both U5 and U1.

Table 13. The impact of health ODA on child mortality rates

	Dependent variable (estimation method in parentheses)					
	U5 (OLS)	U5 (2SLS)	U5 (OLS)	U1 (OLS)	U1 (2SLS)	U1 (OLS)
Health ODA pc	-0.715**	-1.602***		-0.380**	-0.848***	
	(0.330)	(0.541)		(0.186)	(0.301)	
STD ODA pc	-0.027	-0.065		0.022	0.023	
	(0.216)	(0.240)		(0.110)	(0.122)	
Health ODA pc (5-year avg.)			-0.926**			-0.482*
			(0.457)			(0.255)
STD ODA pc (5-year avg.)			-0.234			-0.051
			(0.264)			(0.132)
Ln GDP pc	-5.581	-7.075	-7.559	-7.642**	-8.414**	-8.568**
	(6.668)	(6.799)	(7.523)	(3.315)	(3.358)	(3.814)
Ln Mean years of education	-43.044***	-43.454***	-54.011***	-21.617***	-21.466***	-26.345***
	(11.362)	(11.472)	(14.177)	(6.362)	(6.341)	(7.136)
Ln Access to water	-68.591***	-64.311**	-84.030***	-27.385**	-25.555**	-36.208***
	(25.137)	(25.626)	(25.987)	(12.753)	(12.843)	(12.988)
Ln Access to sanitation	-18.940	-16.498	-6.879	-12.180**	-10.969*	-6.069
	(12.453)	(12.939)	(14.692)	(5.725)	(5.966)	(6.793)
Urban population	0.330	0.190	0.151	0.180	0.114	0.076
	(0.462)	(0.460)	(0.513)	(0.223)	(0.218)	(0.231)
Corruption	-1.774	0.103	10.475	-1.665	-0.555	5.063
	(12.835)	(12.238)	(14.767)	(7.078)	(6.752)	(7.225)
Year	-0.448	-0.277	-0.166	-0.394*	-0.310	-0.241
	(0.391)	(0.415)	(0.474)	(0.209)	(0.218)	(0.229)
Constant	1440.6*	1092.2	933.2	1095.2***	925.4**	819.1*
	(742.9)	(793.2)	(905.2)	(394.8)	(412.7)	(433.4)
Observations	2,742	2,660	546	2,742	2,660	546
Number of countries	127	127	126	127	127	126
R-Squared (within)	0.66	0.64	0.65	0.72	0.70	0.73

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The impact on U5 is observed to be larger than the impact on U1. Considering the full range of estimated coefficients provided by the three models, a one-dollar increase in health ODA per capita is associated with a reduction of between 0.036 and 2.663 per thousand points in U5 with a confidence of 95%, and with a reduction of between 0.059 and 1.343 per mil points in U1 with a confidence of 90%. As the mean amount of health

ODA perceived by each recipient country over the period 1990-2015 was $5.85 per inhabitant, it may be expected to have reduced national U5 rates, on average, from 5.85 × 0.036 = 0.211 to 5.85 × 2.663 = 15.579 per mil points. Because the decline in the U5 cross-country mean was 41 per mil points, from 72.4 in 1990 to 31.4 in 2015 (see section 2.1), the impact of health ODA would be equivalent to 0.5–38% of the reduction observed in U5 national figures in the MDG era. The confidence interval is large but reveals that aid has been generally effective in reducing under-five mortality in recipient countries, with some cases in which aid might account for up to a third of the improvement. Regarding the impact on national U1 rates, aid may be expected to have reduced these, on average, from 5.85 × 0.059 = 0.345 to 5.85 × 1.343 = 7.857 per mil points. Because the decline in the U1 cross-country mean was 25.9 per mil points, from 49.4 in 1990 to 23.5 in 2015, the effect of health ODA would amount to 1.3–30.3% of this decrease, with a confidence of 90%. Thus, the effect of health ODA on U1 is somewhat less clear in statistical terms but fairly comparable in magnitude to that on U5, provided that both impacts are considered in relative terms to the actual evolution of their respective rates.

Among the control variables, two stand out as consistently linked to child mortality rates. The first one is 'mean years of education', which reveals itself as more important than GDP per capita when it comes to explaining child mortality rates. A one-percent increase in the mean years of education is associated with a reduction of between 13.3 and 91.1 per mil points in U5, and with a reduction of between 5 and 45 per mil points in U1, with a confidence of 99%. This result is consistent with the long-established line of literature that emphasizes the role that maternal education may play in reducing children's probability of dying (see section 2.4).

The second control variable most associated with reduced child mortality rates is the rate of the population with access to improved water supply. The rate of access to sanitation seems to have a weaker effect and only appears as significant in two models where the dependent variable is U1. Nonetheless, as discussed in section 2.5, the close relationship between access to water and access to sanitation can make it difficult to disentangle the separate effects of each. In any case, the relationship between access to water and sanitation and reduced child mortality has long been corroborated and is more thoroughly considered in section 3.1.1. Based on this evidence, it is interesting to test whether ODA other than that included in DAC codes 120 and 130 may have an impact, if indirect, on child mortality rates. In particular, there is another category (code 140) devoted to water and sanitation, which may help improve child health through increased rates of access to improved water and sanitation services. Chapter 3 deals with the study of such questions.

Table 14 shows the results regarding the impact of health ODA on the MMR. Among the explanatory variables of interest, health ODA per capita shows in every specification a negative and statistically significant effect on the MMR. A one-dollar increase in health ODA per capita is associated with a reduction of between 0.271 and 17.020 per mil points in the MMR, with a confidence of 95%. As the mean amount of health ODA perceived by each recipient country over the period 1990-2015 was $5.85 per inhabitant, it may be

expected to have reduced national MMRs, on average, from 5.85 × 0.271 = 1.585 to 5.85 × 17.020 = 99.567 per mil points. Because the decline in the MMR cross-country mean was 170.9 per mil points, from 339.6 in 1990 to 168.7 in 2015 (see section 2.1), the impact of health ODA would be equivalent, on average, to 0.9–10% of the reductions observed in MMR national figures in the MDG era. Thus, the results point to a positive but modest impact of health ODA on the MMR: most of the decrease observed in national MMRs over the period 1990-2015 would have been driven by other factors, while no more than 10% can be attributed to health ODA, with a confidence of 95%. These results support those obtained by Pickbourn and Ndikumana (2016) in a smaller sample consisting of 75 countries, thus adding evidence in favor of the existence of an impact of health ODA on the MMR in developing countries. The aid for STD shows no relationship.

Table 14. The impact of health ODA on the maternal mortality ratio

	Estimation method		
	OLS	2SLS	OLS
Health ODA pc	-5.034**	-10.910***	
	(2.117)	(3.117)	
STD ODA pc	-0.862	-0.953	
	(1.041)	(1.092)	
Health ODA pc (5-year avg.)			-6.325**
			(3.059)
STD ODA pc (5-year avg.)			-1.519
			(1.253)
Ln GDP pc	-48.377	-57.409*	-70.480
	(32.726)	(32.709)	(44.506)
Ln Mean years of education	-202.770***	-199.093***	-236.524***
	(76.033)	(73.756)	(82.708)
Ln Access to water	-311.893**	-285.355*	-370.654**
	(146.837)	(150.187)	(179.318)
Ln Access to sanitation	-104.798	-96.305	-61.777
	(69.838)	(73.301)	(91.466)
Urban population	1.169	0.732	1.700
	(2.436)	(2.311)	(2.427)
Corruption	10.642	12.930	6.915
	(61.635)	(58.187)	(73.439)
Year	1.803	2.794	2.439
	(2.137)	(2.188)	(2.389)
Constant	-835.262	-2857.080	-1799.561
	(3978.884)	(4098.716)	(4512.696)
Observations	2,726	2,644	542
Number of countries	126	126	125
R-Squared (within)	0.50	0.46	0.50

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

Among the control variables, the *mean years of education* and the *rate of population with access to improved water supply* are those that prove to be most consistently linked to the

MMR, as is the case with child mortality rates. A one-percent increase in the mean years of education is associated with a reduction of between 3.887 and 452.893 per mil points in the MMR, with a confidence of 99%. The confidence interval is large but shows strong evidence in favor of a positive effect of this variable on the MMR. If a confidence of 90% is considered sufficient, the interval may be narrowed to an estimated decrease in the MMR of between 76.773 and 373.591 per mil points. The fact that the MMR responds in levels to percentage changes in the mean years of education suggests that it is basic education that contributes the most to reduced MMRs. These results fit well with the strand of literature initiated by Caldwell (1979), who based on evidence from Nigeria emphasized the role of 'education as a factor in mortality decline'. He argued that education, and particularly female education, played an important role in determining mortality through, among other pathways, a shift from 'fatalistic' acceptance of health outcomes towards implementation of simple health knowledge, and an increased capability to interact with medical personnel (see section 2.4). These abilities are most related to basic education, thus explaining the strong link between this explanatory variable in its logarithmic form and the objective variable.

The second control variable most associated with reduced the MMR is the *rate of the population with access to improved water supply*, which was also found to be closely related with reduced child mortality. This result is consistent with the fact that clean water supply is critical for safe delivery, so that both women and infants are particularly at risk for infection and other complications when it is not available (WHO/UNICEF, Water, sanitation and hygiene in health care facilites, 2015). Other authors have already noted the existence of this relation between access to water and maternal mortality (see section 2.4).

Table 15 shows the results regarding the impact of health-related ODA on female HIV prevalence and the prevalence of modern contraceptive practices. In this case, as expected, STD ODA shows a negative and statistically significant effect on both dependent variables, while mixed results are found for the impact of health ODA.

The effect of STD ODA on female HIV prevalence is found to be negative, with a confidence of 99%. In order to narrow the confidence interval while keeping a very high confidence, it can be concluded that a one-dollar increase in STD ODA per capita is associated with a reduction of between 0.056 and 0.194 percentage points in female HIV prevalence, with a confidence of 95%. As the mean amount of STD ODA perceived by each recipient country over the period 1990-2015 was $0.47 per inhabitant, it may be expected to have reduced national rates of female HIV prevalence, on average, from $0.47 \times 0.056 = 0.026$ to $0.47 \times 0.194 = 0.091$ percentage points. The cross-country mean of female HIV prevalence rose 0.12 percentage points between 1990 and 2015 (from 0.93 to 1.05), so it is clear that the estimated effect of STD ODA would not have been able to stop the rise in the prevalence of the disease. However, it can be argued that in absence of aid, female HIV prevalence rates would have increased, on average, by between 0.146 and 0.211 percentage points, instead of by 0.091 as they did. Thus, the actual increase in

female HIV prevalence was between 17.8% and 43.1% lower than it would have been in absence of aid targeted to the fight against STDs, with a confidence of 95%.

Table 15. The impact of health-related ODA on female HIV prevalence and modern contraception

	Dependent variable (estimation method in parentheses)					
	HIV (OLS)	HIV (2SLS)	HIV (OLS)	Contracep. (OLS)	Contracep. (2SLS)	Contracep. (OLS)
Health ODA pc	-0.030*	-0.031		0.113	0.542*	
	(0.017)	(0.023)		(0.114)	(0.298)	
STD ODA pc	-0.078***	-0.112***		0.201*	0.352**	
	(0.011)	(0.016)		(0.117)	(0.147)	
Health ODA pc (5-year avg.)			-0.011			0.297
			(0.026)			(0.422)
STD ODA pc (5-year avg.)			-0.145***			1.744***
			(0.025)			(0.204)
Ln GDP pc	0.681	0.916	1.513**	-1.513	0.131	-2.228
	(0.643)	(0.635)	(0.613)	(2.806)	(2.792)	(6.369)
Ln Mean years of education	-0.170	-0.207	-0.208	2.555	2.959	11.352
	(1.120)	(1.058)	(0.687)	(4.227)	(3.874)	(9.904)
Ln Access to water	0.730	0.608	-1.242	17.334**	10.762	-13.320
	(2.063)	(1.932)	(1.445)	(7.433)	(7.690)	(13.620)
Ln Access to sanitation	0.091	0.113	0.356	4.065	5.115*	18.564***
	(0.628)	(0.638)	(0.708)	(3.202)	(3.076)	(5.557)
Urban population	0.015	0.018	0.032	0.041	0.055	-0.309
	(0.025)	(0.025)	(0.029)	(0.167)	(0.158)	(0.346)
Corruption	0.262	0.285	0.324	1.431	1.631	-8.396
	(1.088)	(1.054)	(0.977)	(4.851)	(4.529)	(5.111)
Year	-0.038	-0.045	-0.070**	0.395**	0.264	0.214
	(0.043)	(0.041)	(0.035)	(0.186)	(0.177)	(0.332)
Constant	68.230	80.799	132.777**	-840.257**	-570.359*	-392.344
	(81.369)	(76.566)	(62.711)	(351.965)	(337.818)	(618.707)
Observations	2,479	2,401	487	576	568	135
Number of countries	110	110	109	121	121	77
R-Squared (within)	0.11	0.16	0.41	0.55	0.51	0.81

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The impact of STD ODA on the prevalence of modern contraceptive practices is found to be positive, as expected, in all models, with a confidence of 90%. The uncertainty about the impact on this variable is higher than for female HIV prevalence, but if a confidence of 90% is accepted as valid, its expected value is considerably larger. While a one-dollar increase in STD ODA per capita would be expected to reduce by 0.0596–0.1860 points the percentage of females aged 15-24 infected with HIV, that same increase in STD ODA would be expected to increase by 0.0080–2.0844 points the percentage of women aged 15-49 practicing modern methods of contraception. The impact on HIV prevalence can be measured with much more precision, but the expected effect on contraception is fairly higher, as long as it is assessed in terms of the percentage of women affected within the target age range.

As for the effects of health ODA, the signs of the coefficients are as expected but are statistically different from zero only in two models if a confidence of 90% applies. The magnitude of the impact also seems to be greater on contraception.

Table 16. The impact of health ODA on prevalence of malaria and tuberculosis

	Dependent variable (estimation method in parentheses)					
	Malaria (OLS)	Malaria (2SLS)	Malaria (OLS)	Tuberc. (OLS)	Tuberc. (2SLS)	Tuberc. (OLS)
Health ODA pc	-2.898**	-3.987**		-0.298	-0.744	
	(1.231)	(1.880)		(0.430)	(1.493)	
STD ODA pc	0.495	0.730		-1.914***	-4.217***	
	(1.115)	(1.022)		(0.506)	(0.784)	
Health ODA pc (5-year avg.)			-3.531**			-0.150
			(1.550)			(0.807)
STD ODA pc (5-year avg.)			0.789			-6.600***
			(1.012)			(1.217)
Ln GDP pc	-8.472	-13.594	-3.494	44.869	43.601	35.297
	(39.757)	(39.934)	(38.434)	(27.747)	(28.685)	(32.690)
Ln Mean years of education	-49.561	-44.735	-52.394	40.369	49.789	5.509
	(66.160)	(65.820)	(63.636)	(29.037)	(33.451)	(33.036)
Ln Access to water	-154.661	-150.153	-158.172	-46.857	-21.867	-12.902
	(119.462)	(119.366)	(120.313)	(73.155)	(72.475)	(81.521)
Ln Access to sanitation	2.697	6.826	8.316	-67.320	-77.745	-77.271
	(129.038)	(129.269)	(129.322)	(57.532)	(56.115)	(57.794)
Urban population	0.295	0.297	0.237	1.649	1.738	2.824*
	(2.800)	(2.807)	(2.795)	(1.765)	(1.633)	(1.624)
Corruption	-240.577	-240.517	-245.114	-9.137	-4.799	-10.118
	(186.380)	(185.877)	(185.291)	(48.041)	(46.936)	(52.632)
Year	-5.574**	-5.460**	-5.363**	-5.290***	-4.919**	-3.409*
	(2.111)	(2.139)	(2.201)	(2.016)	(1.997)	(2.003)
Constant	12304.3***	12080.4***	11841.9***	10765.9***	9948.6***	6970.3**
	(3942.9)	(4014.5)	(4184.5)	(3737.2)	(3700.3)	(3706.6)
Observations	361	361	360	1,868	1,863	462
Number of countries	95	95	95	125	125	126
R-Squared (within)	0.24	0.24	0.24	0.19	0.14	0.30

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

Finally, Table 16 shows the results regarding the impact of health-related ODA on the incidence of malaria and tuberculosis, which are included in MDG 6, target 8. In this case, health ODA is observed to contribute to reduced malaria incidence, while STD ODA is useful to addressing the incidence of tuberculosis. A one-dollar increase in health ODA per capita is expected to reduce the number of new cases of malaria in a year by 0.3–7.7 per 1,000 population at risk, with a confidence of 95%. The same increase in STD ODA per capita is expected to reduce the number of new and relapse cases of tuberculosis arising in a given year by 0.9–9.0 per 100,000 population, also with a confidence of 95%.

Inasmuch as programs for both malaria control (CRS 12262) and tuberculosis control (CRS 12263) are included within health ODA, this might seem a disconcerting result. However, as discussed in section 2.4, STD ODA is expected to play an important role in reducing the incidence of tuberculosis, even though this is not an STD, since the development of tuberculosis is closely associated with HIV infection. Tuberculosis control programs financed by health ODA, by contrast, might not show a significant impact on incidence in the short term because the disease can develop in people who became infected many years previously. These results highlight the importance of being aware of the distinct effects that each component of health-related ODA may have when trying to perform an assessment of its effectiveness, while, at the same time, considering health-related aid as a whole.

2.7. Conclusions

The objective of this chapter was to test whether health-related ODA had any impact on a set of health-related indicators during the period 1990-2015, taken as a reference by the MDGs. In order not to make a discretional choice among the numerous health indicators that can be used as dependent variables, which might influence the results of aid effectiveness evaluation, it was preferred to adhere to those indicators officially established as target variables by the MDGs: 1) the under-five mortality rate; 2) the under-one mortality rate; 3) the maternal mortality ratio; 4) the HIV prevalence in females; 5) the contraceptive prevalence rate; 6) the incidence of malaria; and 7) the incidence of tuberculosis. As different components of health-related ODA might have different impacts depending on the objective variable, two separate definitions of ODA have been used: health ODA, of a general character, and STD ODA, which is specifically targeted to the fight against sexually transmitted diseases. The impact on each objective variable has been estimated through three different model specifications and two estimation methods: fixed effects OLS and fixed effects 2SLS.

The results suggest that at least one of the two ODA variables had an impact with the expected sign on each of the objective indicators. The sign of the estimated impacts does not depend on model specification or estimation methods but changes according to causal pathways that can be easily interpreted. The estimations by 2SLS do not show a lower impact of aid in any of the models compared to those estimated by OLS, thus suggesting that the directionality of the observed relations between aid and the dependent variables follows the causal pathways considered in section 2.4.

According to the results, the impact of health ODA would amount to 0.5–38% of the reduction observed in national under-five mortality figures in the MDG era, with a confidence of 95%. Regarding the impact on national under-one mortality rates, aid might have been responsible for 1.3–30.3% of their decrease, with a confidence of 90%. Although the impact on U1 is somewhat less clear in statistical terms than the effect on U5, they are fairly comparable in magnitude.

Health ODA might also have been responsible, on average, for 0.9–10% of the reductions observed in national MMR figures in the MDG era. Regarding female HIV prevalence, even if aid was unable to stop its rise between 1990 and 2015, the results suggest that this increase was between 17.8% and 43.1% lower than it would have been in the absence of aid targeted to the fight against STDs. This type of ODA has also been found to have a positive impact on the prevalence of modern contraceptive practices, and to be effective in reducing the incidence of tuberculosis. The fight against malaria has been found to be supported by health ODA, with increases in aid associated to reduced incidence rates.

The results, then, point to the existence of a significant impact of health-related ODA on a comprehensive set of those indicators established by the MDGs to assess progress in international development from 1990 to 2015. Considering the full range of point estimates of these effects from all the models, the confidence intervals are large. This is no surprise given the wide range of local conditions in the body of aid recipients, which may influence the effectiveness of aid. However, the results reveal that, despite that variety of conditions, aid has been generally effective, with some cases in which it might account for up to a third of the improvements.

These results add evidence in favor of the hypothesis that ODA has had an impact on health-related indicators, thus contributing to a body of literature that has been largely inconclusive. Particularly, these results suggest that the findings of highly influential papers such as those by Boone (1996) and Williamson (2008), who concluded that neither overall ODA nor health-targeted ODA had any impact on infant mortality rates, might only be valid for the period before 1990. Indeed, it has already been noted that some factors that may influence effectiveness, such as allocation criteria, could have undergone significant changes since the end of the Cold War (McGillivray, 2003). Additionally, the remarkable consistency of the results of this study contrast with the mixed findings by Bhaumik (2005), Chauvet (2013) and Masud and Yontcheva (2005), who used similar methods but based their analyses on samples of smaller size.

Moreover, the conclusions of this study support recent research that has found ODA to have an impact on health indicators other than child mortality rates. Thus, the impact found by Pickbourn and Ndikumana (2016) on the maternal mortality ratio, or the effect observed by Yogo and Mallaye (2015) on HIV prevalence in sub-Saharan Africa, are both confirmed by this study and found to be generally valid as tested with a larger sample of developing countries across the world.

The conclusions of a panel study like this, however, should only be used with great caution to inform policy advice for a particular country. While these results provide evidence that health-targeted aid has been effective ‘on average’, and there is a low probability that it may have had no impact or even caused harm, these possibilities are not and cannot be completely ruled out. The estimated effect is just an average across a very heterogeneous set of countries. Local factors could greatly influence the impact of aid in very specific contexts, so they must be taken into account when designing and implementing local development programs.

Furthermore, the results of any empirical study on the effectiveness of health-related ODA critically depend on the quality of the data for health indicators. Although the collection and reporting of data have improved over recent decades, further improvement is needed in order to ensure the validity of empirical studies. This is all the more important considering that the literature on aid effectiveness largely lacks a sound theoretical framework to identify causal relations between the variables of interest, instead relying mostly on relations suggested by data analysis. In this regard, assessment of the effects of overall aid on aggregate socioeconomic indicators, such as economic growth or human development, turns out to be especially difficult, both theoretically and empirically. The evaluation of aid effectiveness at the sectoral level (health, education, etc.) make it easier to define cause-effect relationships, hence allowing for better model specifications and more meaningful results.

2.8. Appendix

2.8.1. Aid-recipient countries

Countries that received health ODA (DAC 120, 130) at some point between 1990 and 2015

1. Afghanistan	41. Ecuador	81. Malaysia	121. South Sudan
2. Albania	42. Egypt	82. Maldives	122. Sri Lanka
3. Algeria	43. El Salvador	83. Mali	123. St. Kitts and Nevis
4. Angola	44. Equatorial Guinea	84. Marshall Islands	124. St. Lucia
5. ATG	45. Eritrea	85. Mauritania	125. VCT
6. Argentina	46. Ethiopia	86. Mauritius	126. Sudan
7. Armenia	47. Fiji	87. Mexico	127. Suriname
8. Aruba	48. Gabon	88. Micronesia	128. Swaziland
9. Azerbaijan	49. Gambia	89. Moldova	129. Syria
10. Bahrain	50. Georgia	90. Mongolia	130. Tajikistan
11. Bangladesh	51. Ghana	91. Montenegro	131. Tanzania
12. Barbados	52. Grenada	92. Morocco	132. Thailand
13. Belarus	53. Guatemala	93. Mozambique	133. Timor-Leste
14. Belize	54. Guinea	94. Myanmar	134. Togo
15. Benin	55. Guinea-Bissau	95. Namibia	135. Tonga
16. Bhutan	56. Guyana	96. Nauru	136. Trinidad and Tobago
17. Bolivia	57. Haiti	97. Nepal	137. Tunisia
18. BIH	58. Honduras	98. Nicaragua	138. Turkey
19. Botswana	59. Hong Kong	99. Niger	139. Turkmenistan
20. Brazil	60. India	100. Nigeria	140. Turks and Caicos Islands
21. Burkina Faso	61. Indonesia	101. Oman	141. Tuvalu
22. Burundi	62. Iran	102. Pakistan	142. Uganda
23. Cabo Verde	63. Iraq	103. Palau	143. Ukraine
24. Cambodia	64. Jamaica	104. Panama	144. Uruguay
25. Cameroon	65. Jordan	105. PNG	145. Uzbekistan
26. CAF	66. Kazakhstan	106. Paraguay	146. Vanuatu
27. Chad	67. Kenya	107. Peru	147. Venezuela
28. Chile	68. Kiribati	108. Philippines	148. Vietnam
29. China	69. Korea, DPR	109. Rwanda	149. West Bank and Gaza
30. Colombia	70. Korea, Rep.	110. Samoa	150. Yemen
31. Comoros	71. Kosovo	111. STP	151. Zambia
32. Congo, Dem. Rep.	72. Kyrgyz Republic	112. Saudi Arabia	152. Zimbabwe
33. Congo, Rep.	73. Lao PDR	113. Senegal	
34. Costa Rica	74. Lebanon	114. Serbia	
35. Cote d'Ivoire	75. Lesotho	115. Seychelles	
36. Croatia	76. Liberia	116. Sierra Leone	
37. Cuba	77. Libya	117. Slovenia	
38. Djibouti	78. Macedonia, FYR	118. Solomon Islands	
39. Dominica	79. Madagascar	119. Somalia	
40. DOM	80. Malawi	120. South Africa	

ATG = Antigua and Barbuda. BIH = Bosnia and Herzegovina. CAF = Central African Republic.
DOM = Dominican Republic. PNG = Papua New Guinea. STP = Sao Tome and Principe.
VCT = St. Vincent and the Grenadines.
Source: CRS.

2.8.2. Tests for instrumental variables

Under-identification and weak-identification tests for instrumental variables

	Dependent variable						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Under-identification*							
Cragg-Donald J	18.88	18.88	18.62	16.28	6.12	7.14	13.08
Chi-sq p-value	0.000	0.000	0.000	0.000	0.013	0.008	0.000
2-step-GMM-based J	18.87	18.87	18.62	16.28	13.19	7.15	13.07
Chi-sq p-value	0.000	0.000	0.000	0.000	0.000	0.008	0.000
Windmeijer J2L	18.88	18.88	18.62	16.30	12.90	7.35	13.08
Chi-sq p-value	0.000	0.000	0.000	0.000	0.000	0.007	0.000
Windmeijer J2LR	18.88	18.88	18.62	16.30	12.82	7.37	13.08
Chi-sq p-value	0.000	0.000	0.000	0.000	0.000	0.007	0.000
Kleibergen-Paap J	18.88	18.88	18.62	16.30	12.99	7.37	13.08
Chi-sq p-value	0.000	0.000	0.000	0.000	0.000	0.007	0.000
Weak-identification**							
Anderson-Rubin	63.35	64.98	96.13	251.90	50.27	2.46	151.07
Chi-sq p-value	0.000	0.000	0.000	0.000	0.000	0.292	0.000
Wald	8.78	8.14	12.64	50.83	8.66	5.86	29.43
Chi-sq p-value	0.012	0.017	0.002	0.000	0.013	0.053	0.000

* H_0: The model is underidentified. Rejection indicates that the model is identified (the excluded instruments are relevant). ** H_0: The coefficients on the endogenous regressors are equal to zero.

Dependent variables: 1) under-age-five mortality rate; 2) under-age-one mortality rate; 3) maternal mortality ratio; 4) HIV prevalence among females; 5) rate of contraceptive prevalence; 6) incidence of malaria; 7) incidence of tuberculosis.

3. Water and sanitation for health: the role of foreign aid

3.1. Introduction

3.1.1. Water, sanitation, and health

The results obtained in section 2.6 when analyzing the impact of health ODA on child mortality rates point to a significant effect of access to improved water supply in child survival. This finding is consistent with abundant evidence at both micro and macro level relating to investments in water, sanitation, and hygiene as key determinants of child health.

More and better access to improved WS has been found to have beneficial effects on child nutrition (Cuesta and Maratou-Kolias, 2019) and is associated with lower risk of mild or severe stunting (Fink, Günther and Hill, 2011). Improved water sources are related with reductions in diarrhea incidence (Esrey et al., 1988; Gasana et al., 2002; Fewtrell et al., 2005; Cairncross et al., 2010; Novak, 2014; Manalew and Tennekoon, 2019) and in death rates from diarrhea (Pickbourn and Ndikumana, 2019) for children less than five years of age.

Access to basic sanitation has also been observed to reduce diarrheal morbidity (Fewtrell et al., 2005; Kumar and Vollmer, 2013; Manalew and Tennekoon, 2019) and to improve a range of children's health indicators such as mid-upper-arm circumference, height, and weight z-scores (Dickinson et al., 2015; Pickering et al., 2015; Hammer and Spears, 2016; Augsburg and Rodríguez-Lesmes, 2018; Spears, 2020). In the poorest regions of the world, unsafe water, sanitation, and hygiene have been found to be major contributors to loss of healthy life (Ezzati et al., 2002).

Regarding the dimension of these effects, the review by Esrey et al. (1991), based on 144 water and sanitation interventions conducted in various developing countries, showed that improved water supply and sanitation facilities resulted in substantial reductions in morbidity of diarrhea (26%), ascariasis (29%), guinea worm infection (78%), schistosomiasis (77%), and trachoma (27%). Moreover, accurate studies demonstrated a median reduction in diarrhea-specific mortality of 65% and 55% in general child mortality. The meta-analysis by Curtis and Cairncross (2003) concluded that the availability of a sufficient quantity of water for handwashing can reduce the risk of diarrheal diseases by 42–47%. Sartorius and Sartorius (2014), using data from 192 countries, concluded that the lack of access to water and sanitation is one of the most prominent attributable risk factors for infant mortality, along with maternal mortality and female education.

Not only child mortality but also maternal mortality have been found to decrease with access to improved WS (Cheng et al., 2012; Pickbourn and Ndikumana, 2016). More

generally, Pickbourn and Ndikumana (2013) have observed a positive relation with the human development index as well as with the aggregate health index used as a component of the former. Added to that, WS may have an impact not only on physical health, but also on mental health. Various studies suggest that water insecurity is associated with psychological distress and depression, with a higher probability of suffering symptoms such as headache, insomnia, chronic pain, weakness, tiredness, blurred vision, and dizziness (Ennis-McMillan, 2001; Wutich and Ragsdale, 2008; Stevenson et al., 2012; Tallman, 2019).

In addition to these impacts on short-term health outcomes, a number of studies have provided evidence of both short- and long-term impacts of WS on children's and youths' cognitive development as measured via motor development (Stewart et al., 2018; Tofail et al., 2018), literacy (Spears and Lamba, 2016), or analytic ability (Orgill-Meyer and Pattanayak, 2020). In a systematic review on this topic, Sclar et al. (2017) note that higher methodological quality is needed in future studies, although they show support for the possible existence of this relationship and propose lower rates of infection and illness as causal pathways that may directly lead to improved cognitive development and increase the ability to attend school.

The well-established link between access to improved WS and health outcomes is due to the existence of numerous diseases that are related to water. Following the widely used Bradley classification, these can be grouped into four categories: 1) waterborne diseases, 2) water-washed diseases, 3) water-based diseases, and 4) water-related diseases, the first three being the most clearly associated with lack of access to improved WS (White, Bradley and White, 1972).

Waterborne diseases are caused by pathogens that originate in fecal material and are transmitted by ingestion of contaminated water, which serves as the passive carrier of the infectious or chemical agent. The classic waterborne diseases are cholera and typhoid fever, but most of diarrheal diseases may also be caused by pathogens transmitted by contaminated drinking water. In the 2030 Agenda, SDG 3 ('ensure healthy lives and promote well-being for all at all ages') target 3 seeks to combat waterborne diseases among other communicable diseases (see Table 4).

Water-washed diseases are caused by organisms that are transmitted through contact due to poor hygiene and improper sanitation. In this case, the availability of a sufficient quantity of water for washing and bathing is generally considered more important than the quality of the water. Belong to this category are diseases that affect the eye and skin, as well as diarrheal illnesses. Respiratory diseases such as those caused by members of the coronavirus family — among which COVID-19 has recently turned particularly deadly — can also be included within this category, since without proven pharmaceutical intervention and no proven vaccine, frequent handwashing is listed at the top of prevention advice (Ray, 2020). Thus, it has been warned that 'water, sanitation and hygiene are a necessity to reduce the spread of COVID-19' (GWC, 2020); also, 'recognizing the importance of handwashing in preventing the spread of COVID-19,

concerns have arisen about the condition of millions of Africans who lack access to hygiene facilities and clean water services' (Okoi and Bwawa, 2020).

Water-based diseases are caused by pathogens that either spend all (or essential parts) of their life cycles in water or depend upon aquatic animals, and that come in direct contact with humans via water or by inhalation. Examples of such organisms are the parasitic helminth *Schistosoma* and the bacterium *Legionella*, which cause schistosomiasis and Legionnaires' disease, respectively.

Finally, *water-related diseases* such as yellow fever, dengue, or malaria are transmitted by insects that live or breed in water (like the mosquitoes that carry malaria) or that live near water. As a group, water-related diseases have not typically been considered to be associated with lack of access to improved WS. However, in recent times an emerging body of literature has shed light on the link between WS and malaria transmission. On a small scale, some studies have explored the effect of WS on malaria, considering the cases of Ethiopia (Ayele, Zewotir and Mwambi, 2012, 2013) and Kenya (Kinuthia et al., 2012). A study on a number of sub-Saharan African countries found that the odds of malaria infection in children under five years with access to improved WS conditions are lower than those in children with access to unimproved WS conditions (Yang et al., 2020). As a potential transmission channel, Kinuthia et al. (2012) flagged the use of unimproved rainwater collection facilities such as domestic dams in homesteads, which fill up with water during the rainy seasons, hence creating appropriate breeding sites for mosquitoes.

The classic waterborne diseases cholera and typhoid fever have frequently ravaged densely populated areas throughout human history. In the late 1870s, advanced economies still exhibited extraordinarily high rates of death from these diseases. In subsequent decades, however, a large decrease in deaths from these illnesses would ultimately result in their complete disappearance, allegedly due to the protection of water sources and to the treatment of contaminated water supplies. In fact, control of these classic diseases gave water supply treatment the reputation it enjoys today. While some historical studies carried out in the 1980s and 1990s yielded mixed results on the role played by the provision of WS as one of the drivers of this decades-long process of mortality reduction (van Poppel and van der Heijden, 1997), more recent research has provided renewed support for the idea that the provision of WS was indeed a key factor.

The pioneering and influential study by Cutler and Miller (2005) concluded that the development and application of water-purification technologies was responsible for roughly 40% of the decline in the mortality rate from 1900 to 1940 in the United States. Subsequent studies have also found improving effects of clean water in several countries: among other authors, Macassa, Ponce de León and Burström (2006) provide evidence for the case of Sweden; Jaadla and Puur (2016) for Estonia; Ogasawara, Shirota and Kobayashi (2016) for Japan; Chapman (2019) for the United Kingdom; Floris and Staub (2019) for Switzerland; and Peltola and Saaritsa (2019) for Finland. Nevertheless, it has also been noted that the magnitude of these effects has largely depended on local socioeconomic and institutional elements (Gallardo-Albarrán, 2020). Clean water is not considered to have helped reduce mortality rates from waterborne diseases alone, but also

from other diseases not directly related to water. These chain effects of WS are known as the 'Mills-Reincke phenomenon' (Inoue and Ogasawara, 2020).

3.1.2. Progress and efforts

Progress in access to water and sanitation

Modern WS services developed mainly in the period ranging from the second quarter of the 19th century to the middle years of the 20th century. After a long historical period of little progress from the Late Antiquity to the Age of Enlightenment, a new era of intense development in WS techniques began as a consequence of industrialization, urbanization, and globalization.[17] The outbreaks of cholera in highly populated European cities increased mortality dramatically, and hygiene became the key answer to that challenge. Large piped water supply and sewerage systems were built, most homes were connected to those networks, and chemical, mechanical and biological methods were developed to purify wastewater. It was then that public authorities took the leading role in the provision of water supply and sanitation services, hence establishing the basic elements of modern WS services that still persist in the developed world. In spite of the fact that access to WS has rarely been mentioned in the Constitutions of the historic democracies, in 2010 it was finally recognized as a human right by UN Human Rights Council Resolution 64/292 on the Right to Water (Greene Dobbins, 2019).

However, many developing countries still face a lack of access to clean water and safe sanitation. The paucity of these services in many world regions led to the first international efforts in the 1930s to provide access and monitor progress, under the auspices of the League of Nations Health Organization, predecessor of the World Health Organization. Since then, numerous efforts have been launched to improve both access to WS and the measurement of performance. In the 1960s, monitoring under the UN system began, compiling early reports from annual questionnaires sent by WHO to the Ministries of Health of monitored countries. These reports documented coverage of households with drinking water and sanitation technologies, using categories similar to those still used today (Bartram et al., 2014). A series of international targets were established through the second UN Development Decade (1970s), the International Drinking Water Supply and Sanitation Decade (1980s), and the World Summit for Children (1990), all in order to improve WS performance. Article 24 of the 1990 Convention on the Rights of the Child established monitoring of WS resources by UNICEF, in what would later become the Joint Monitoring Program (JMP) administered by both UNICEF and WHO.

Since the creation of the JMP, progress in access to water has been noteworthy worldwide: not only did the mean of the national rates of access increase from 80 to 89.4, but maybe more importantly, extremely low rates of access tended to disappear (Table

[17] A more detailed account of historical developments in water and sanitation services can be found in De Feo et al. (2014). For the case of modern Europe, see Abellán (2017).

17). Thus, even though in 2015 there were still certain countries where less than half the population had access to improved water (Papua New Guinea, 40%; Equatorial Guinea, 47.9%; Angola, 49%), these rates were considerably higher than those reported in 1990, when 29 countries showed rates below 50% (including Ethiopia at 13.2% and Cambodia at 23.4%). However, progress in access to sanitation proved much less marked than in access to water. The mean rate of access to sanitation at the national level rose from 66 to 73.9% between 1990 and 2015, but the minimum rate registered in 1990 (in Ethiopia, at 2.6%) was not far below the minimum in 2015 (South Sudan, 6.7%). Furthermore, while in 1990 there were 53 countries with a rate of access to sanitation below 50%, the number of countries in this same situation in 2015 was still as high as 46.

Table 17. Summary statistics for national rates of access to improved WS (1990, 2015)

Variable	Year	Mean	Std. Dev.	Min.	Max.	Obs.
Rate of access to improved water (%)	1990	80	21.5	13.2	100	171
	2015	89.4	14.3	40	100	191
Rate of access to improved sanitation (%)	1990	66	32.9	2.6	100	164
	2015	73.9	28.8	6.7	100	192

Source: WDI (2018).

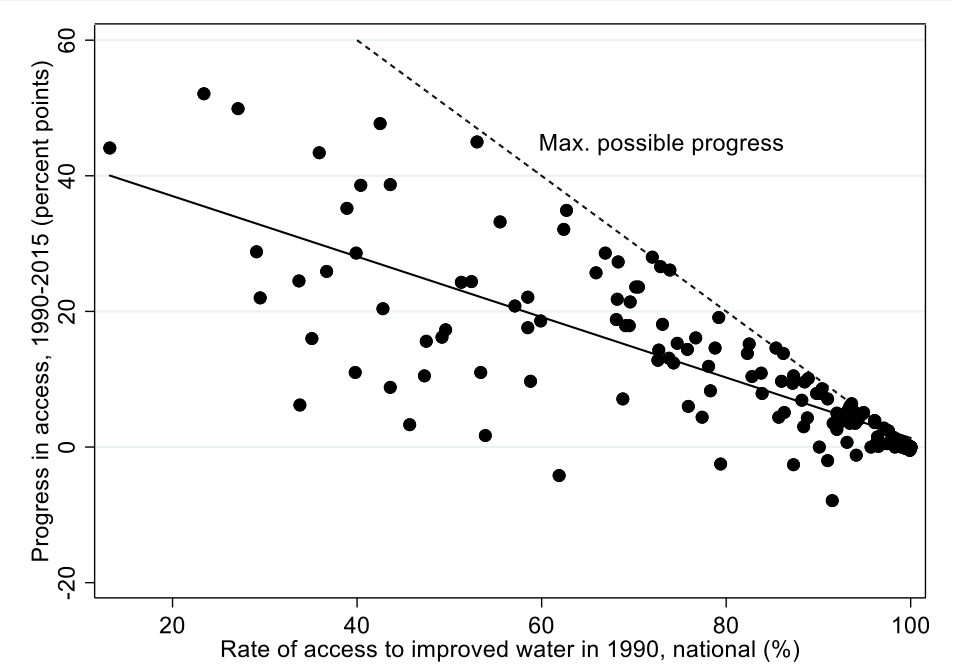
Thus progress has been fairly widespread, but also uneven. Low and low-middle income countries have shown little improvement, and some countries, despite economic growth over the past 25 years, have actually moved backward. Improvements have likewise been distributed unevenly in geographic terms: over three-quarters of countries with low levels of provision are located in sub-Saharan Africa. Uneven progress can also be observed by disaggregating the various categories included in the concept of 'improved' services.[18] In 2015, only about 58% of households around the world had access to a private water connection, which is considered to be the safest source of drinking water. The rest, most in developing countries, still relied on public water sources such as public taps and wells. For least-developed countries, where 42% of the population gained access to improved water sources, piped water coverage only increased from 7 to 12% (WHO/UNICEF, 2015).

As shown in Graph 5, a number of countries (12) saw their rates of access to improved water decrease between 1990 and 2015. Some of these are Algeria, with a drop of 7.9 percentage points, Haiti (-4.2), the Dominican Republic (-2.6), and Zimbabwe (-2.5). Despite this, generally speaking, those countries with lower rates of access in 1990 have improved the most, as indicated by the negative slope of the regression line. Each percentage point less in the rate of access to improved water in 1990 is associated with a 0.456 increase over the period 1990-2015 (Table 18). As for access to sanitation, a

[18] Improved drinking water sources include water piped into private premises (a household water connection located inside the user's dwelling, plot, or yard), public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection. Improved sanitation facilities include flush or pour/flush systems (piped to a sewer system, septic tank, or pit latrine), ventilated pit latrines, pit latrines with foundational slab, and composting toilets. For a detailed account of what 'improved' means, and the kinds of water sources and sanitation services included in this category, see section 3.6.

negative relation between the initial level and eventual progress can also be found, but this is considerably weaker: each percentage point less in the rate of access to improved sanitation in 1990 is associated with a 0.189 increase over the period 1990-2015.

Graph 5. Rate of access to improved water, variation against initial level (1990-2015)



Graph 6. Rate of access to improved sanitation, variation against initial level (1990-2015)

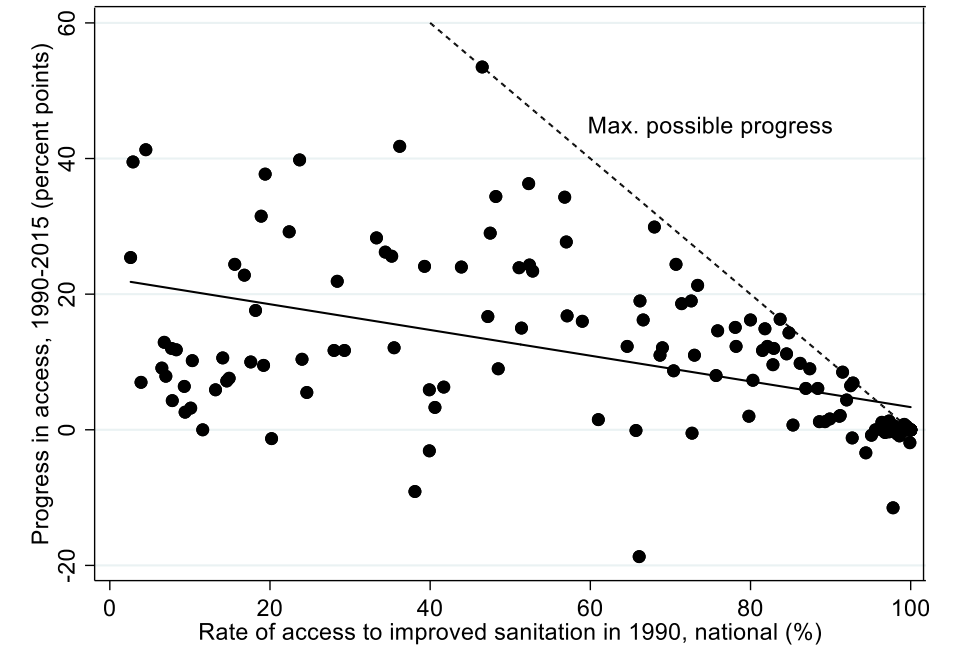


Table 18. The effect of initial levels in access to WS on variations, 1990-2015 (simple linear regression)

Dependent variable	β coefficient	SD	R^2	Obs.
Variation in access to improved water	-0.456***	0.026	0.65	165
Variation in access to improved sanitation	-0.189***	0.024	0.28	159

Note: Dependent variables are expressed as variations in percentage points. The β coefficient is that associated with the rate of access in 1990, measured as a percentage.
Source of data: WDI (2018).

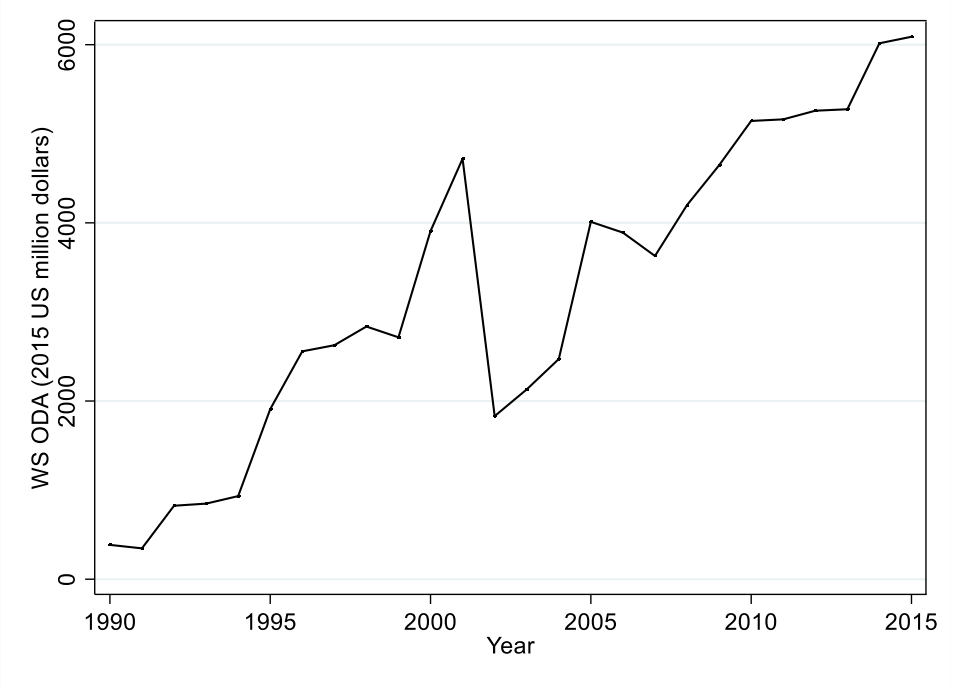
Indeed, much of the absolute convergence between countries in their rates of access to water and sanitation seem to be due to the fact that these rates, by definition, cannot keep increasing beyond a certain limit. Access rates have their maximum at 100%, so the better-off cannot keep improving once that limit is reached. This makes convergence easier to observe, even if progress is not clearly related with initial levels for a large subset of the sample. In fact, this can be observed for those countries with rates of access to sanitation lower than 40% in 1990. Within this group, very different paces of progress were achieved, with no apparent relation to their initial levels. Some such as Vietnam (from 36.2 to 78%), Nepal (from 4.5 to 45.8%), and Pakistan (from 23.7 to 63.5%) have improved remarkably. However, others have lost ground, including Nigeria (from 38.1 to 29%), Zimbabwe (from 39.9 to 36.8%), and Papua New Guinea (from 20.2 to 18.9%). A wide variety of different experiences ranges between these two extremes.

International efforts in the water and sanitation sector

The difficulties faced by many countries with a severe lack of access to improved WS have not gone unnoticed by the international community. Since the 1990 Convention on the Rights of the Child, a continuous rise in Official Development Assistance targeted for WS has been observed. Over this period, WS ODA disbursements per year multiplied by 15.8 in real terms, from US$ 386 million to US$ 6.088 billion (2015 dollars) (see Graph 7). At the same time, during the 1990s, WS ODA also increased as a share of total ODA, from 2.3% in 1990 to 6.3% in 2000, with its peak at 8% in 1997.

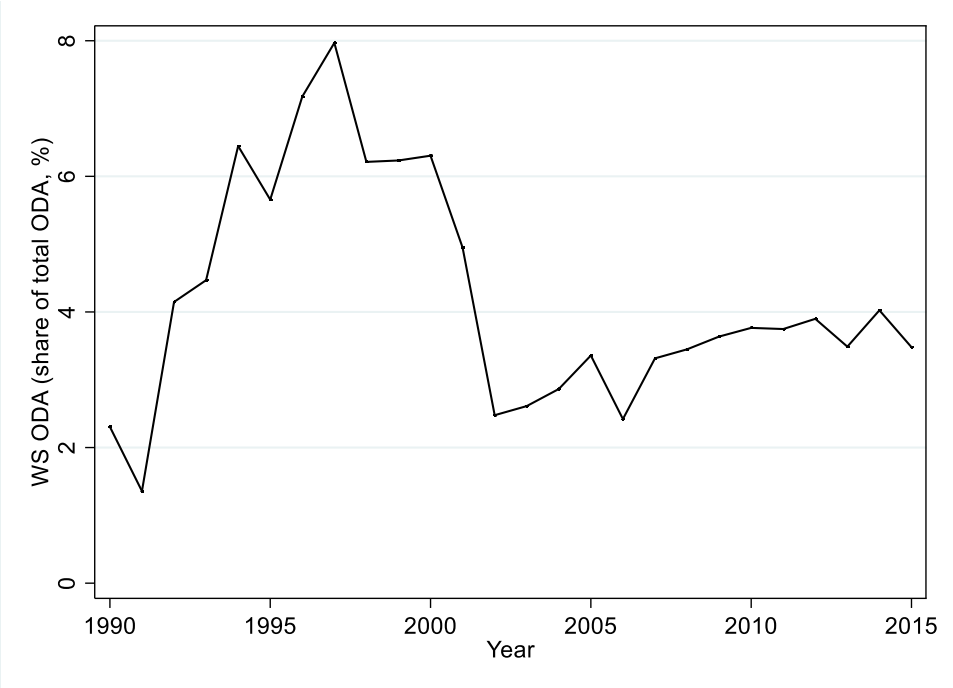
Nevertheless, in the first years of the new century its share dropped to the range of 3–4% and remained there until 2015. Thus, the approval of the MDGs in 2000 does not seem to have boosted investments in water, at least in relative terms. As already noted by Wolf (2009, p. 360), ‘the water and sanitation sector is especially heavily dependent on project funding with multiple fragmented donor projects, which makes planning at the sector level very difficult.’ With the approval of the MDGs, other sectors like health seemed to gain relevance as measured by their shares of total aid (see section 2.1), even though in real terms the amount of ODA targeted to the WS sector continued to grow throughout the MDG era.

Graph 7. The evolution of WS ODA (1990-2015)



Source: Creditor Reporting System (CRS).

Graph 8. The evolution of WS ODA as a share of total ODA (1990-2015)



Source: Creditor Reporting System (CRS).

Alongside the relative stagnation of WS ODA during most of the MDG era, another issue has been a source of concern. As can be seen in Graph 9, there is no clear relationship between the initial level of access to water in recipient countries and the amount of WS ODA received over the period 1990-2015 (similar results are obtained if access to sanitation is considered). Even if a negative and statistically significant relation may be found through a simple regression (Table 19), it is evident that this is due to three influential observations: Bahrain, Saudi Arabia, and Slovenia, all of which are high-income countries that (in exceptional circumstances) received very small amounts of WS ODA. If these three countries are dropped from the sample, the relation between the initial level and the amount of aid received disappears (Table 19). Thus, there does not seem to be a relationship between local needs and international efforts.

Graph 9. WS ODA per capita received and initial levels in access to water (1990-2015)

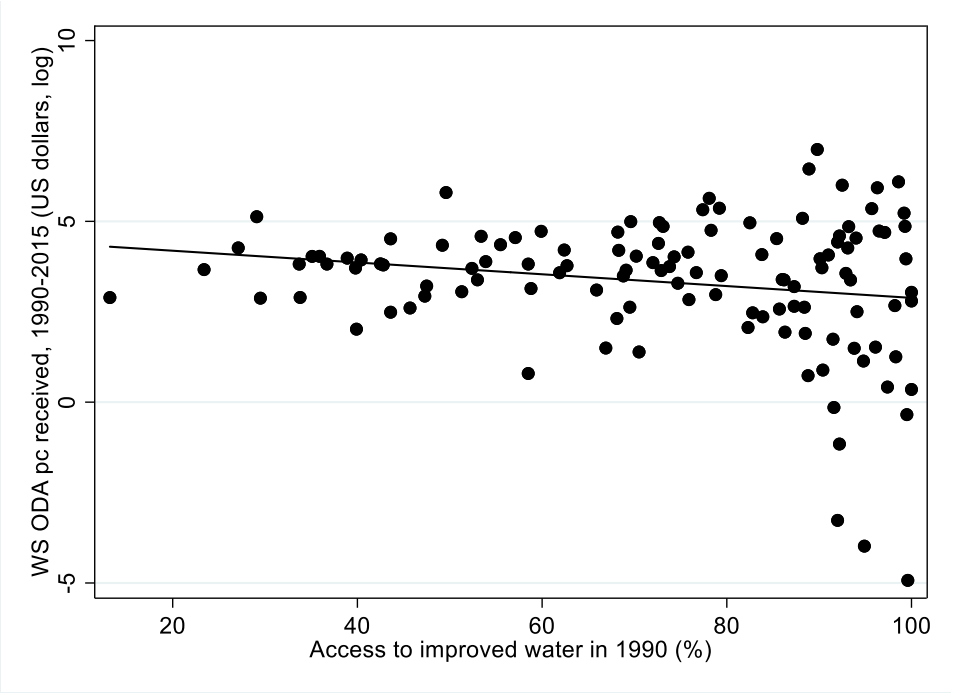


Table 19. The relation between the initial level in access to water and WS ODA received (1990-2015)

Dependent variable:	β coefficient	SD	R^2	Obs.
Sample: All recipients	-0.0162**	0.0078	0.04	120
Sample: All except Bahrain, Saudi Arabia, and Slovenia	-0.0074	0.0062	0.01	117

*** p < 0.01, ** p < 0.05, * p < 0.1. Simple linear regression.
Source: CRS (2018) and WDI (2018).

The uneven progress observed in national rates of access, along with the non-evident relation between need and aid, calls into question whether aid had any impact on this sector over the period 1990-2015. Did foreign aid play any role in providing people from developing countries with access to improved water and sanitation?

3.2. Objectives and relevance

This study seeks to test whether official development assistance (ODA) had any impact on the evolution of the rates of access to improved WS in developing countries during the period 1990-2015, which is the period set as a reference by the MDGs.

Target 10 of the MDGs —'halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation'— was not included within MDGs 4-6, which are those most related to health, but rather within MDG 7, 'ensure environmental sustainability.' Nonetheless, inasmuch as water and sanitation have proved to be closely related to the indicators for monitoring progress towards health-related MDGs 4-6 (see section 2.6), a comprehensive evaluation of the effectiveness of health-oriented ODA in the MDG era would not be complete without a careful consideration of progress towards MDG 7, target 10. After all, as noted by Martínez-Santos (2017, p. 517), the concept of 'safe drinking water' as worded in the MDGs is 'essentially a health concept', since 'by definition, safe water is that which is free of harmful microorganisms and other toxic substances'.

As discussed in section 3.1.2, there was progress in the rates of access to water and sanitation between 1990 and 2015. In fact, in the case of access to water, target 10 of the MDGs was met five years ahead of schedule: in 1990 the proportion of world population without access to improved water was 23.9%, while in 2010 it had declined by more than half to 11.6%. As for sanitation, however, the target was not met. The baseline ratio was 47.1% of people without access to improved sanitation, intended to be lowered to 23.6% by 2015; but in that year, 32.5% of the world population still did not have access to improved sanitation.

With the approval of the 2030 Agenda in 2015, the aforementioned targets became more ambitious, even if their more modest version in the MDGs had not been achieved in the case of sanitation. Moreover, the new agenda recognized the importance of this sector by recovering target 10 of the MDGs as a goal in its own right, in SDG 6, 'ensure availability and sustainable management of water and sanitation for all'. Providing a tenth of the world's population with access to water and a third with access to sanitation remains a great challenge, but the international community has shown its intention to achieve universal access. This is undoubtedly an urgent matter, as an estimated 17.5% of all deaths of children under the age of five worldwide are caused by insufficient weight or malnutrition associated with repeated diarrhea or intestinal nematode infections as a result of unsafe water, inadequate sanitation, or insufficient hygiene (Prüss-Üstün et al., 2008).

Access to improved WS is directly linked to health outcomes, especially for infants and children (section 3.1.1), but it also has important implications for the achievement of the other global goals. For instance, MGD 3 (now SGD 5), 'promote gender equality and empower women'. Pickbourn and Ndikumana (2016) have given evidence that access to improved WS is associated with a lower gender inequality index rating from the UNDP, explained by the fact that in many developing countries, women and girls are responsible for fetching water and caring for the sick. A study conducted in 24 sub-Saharan African

countries found adult females to be the primary collectors of water across all the countries included in the sample. In addition, female children were more likely to be responsible for water collection than male children (Graham, Hirai and Kim, 2016). Inadequate supply of water and of sanitation infrastructures not only increase the time it takes to fetch water, but by increasing the risk of illness of family members, they also increase the time that women spend on unpaid care. Moreover, limited access to water and sanitation increases the likelihood that girls will be withdrawn from school to help fetch water, and it reduces the time that women can allocate to paid market work. Moreover, as related to the gendered nature of household roles, ethnographic data suggest that household water insecurity could increase women's exposure to emotional and physical forms of intimate partner violence, as punishments for failures to complete socially expected household tasks that rely on water (like cooking and cleaning). Choudhary, Brewis and Wutich (2020), using nationally-representative data from Nepal and after controlling for women's empowerment and education, found that worse access to household water consistently elevates women's exposures to all forms of intimate partner violence. This suggests that improvements in household water access may have additional ramifications for reducing women's risk of exposure to emotional and physical violence, beyond currently recognized socioeconomic benefits.

Access to improved WS may also have far-reaching implications for the general economy, and for well-being. As noted by Ndikumana and Pickbourn (2017, p. 104), 'frequent occurrences of diarrhea and other diseases resulting from lack of access to water and sanitation undermine human capital formation and reduce the productivity of adults who fall sick or must care for the sick. Therefore, increasing access to water and sanitation can help to improve both health outcomes and human capital, thus contributing to greater overall productivity.' Furthermore, Devoto et al. (2012) and Mahasuweerachai and Pangjai (2018) have found that a piped water connection increases people's subjective well-being, this outcome being mostly explained by convenience, time saving, and the reduction in inter- and intra-household conflicts on water matters.

For all the aforementioned reasons, including health, gender equality, well-being, and productivity growth, progress in access to water and sanitation is urgently needed, as recognized by the 2030 Agenda. In order to achieve the goal of universal access, it is necessary to employ all the means available, among which ODA is expected to play an important role. But if the appropriate use of ODA is to be ensured, it is necessary to know whether it is generally effective or not (and in the case of its being effective, to identify the factors which determine ODA effectiveness). That is the objective of this chapter.

3.3. Review of the literature

While evaluation of the impact of health-care-oriented aid has received significant attention in the scholarly literature, less attention has been paid to that allocated to the provision of water and sanitation. This line of research emerged in the mid-2000s and, as

was recently noted by Gopalan and Rajan (2016, p. 96), 'despite the recognition of the importance of external financing such as aid flows to the WS sector, empirical studies focusing on assessing the impact of aid effectiveness in the WS sector are at a nascent stage.' Indeed, only a handful of studies have tried to measure the impact of foreign aid on access to improved WS, with conflicting results. Even so, two waves of literature can be distinguished within this short period.

The first-wave studies, ranging from 2006 to 2014, used cross-sectional regressions as their empirical strategy. Anand (2006) and Wolf (2007) made the first such attempts. Neither found any impact of WS-related ODA on access to WS at the national level. Botting et al. (2010) did find an impact on access to water, but not on access to sanitation. Thus this group of studies conjured a rather pessimistic image, concluding that WS ODA had no impact on access to WS.

Apart from a non-causal analysis of the relationship between aid and access to WS by Salami et al. (2014), who performed a descriptive evaluation comparing indicators of inputs and outcomes, the second wave of studies on the effectiveness of WS ODA has taken advantage of the availability of longer series of data, allowing them to employ panel data models in the estimates and to better deal with unobserved heterogeneity among countries.

A downside of this new wave of literature is that sanitation has been less studied than before. Bain et al. (2013) and Wayland (2013) focused on water only, leaving sanitation aside. Their results are contradictory, even though they employ similar statistical methods and sample size. Bain et al. (2013), who used aid disbursements to WS, found no evidence of a positive impact of aid on access to water supply. However, Wayland (2013), who used commitments, did find an impact.

Gopalan and Rajan (2016) added methodological improvements such as the estimation of dynamic models by GMM in addition to fixed effects models already used by Bain et al. (2013) and Wayland (2013). They found aid disbursements to produce a strong positive and significant effect on access to improved WS. They further found this result to be robust across multiple specifications and regression techniques. Similar findings are provided by Wayland (2018) and Ahmed (2020) – in this last case, regarding the impact on access to water only – whose studies are based on dynamic models. The results of these three papers contrast those by Bain et al. (2013), who relied exclusively on static models.

The still scarce literature on the impact of WS ODA on access to WS is, therefore, largely inconclusive. Three studies found no impact of aid on access to water or sanitation (Anand, 2006; Wolf, 2007; Bain, Luyendijk and Bartram, 2013). Only two studies found consistent evidence of the existence of a positive impact of aid on both access to water and access to sanitation (Gopalan and Rajan, 2016; Wayland, 2018). Finally, three studies that focused on water found different results: while Bain et al. (2013) did not observe any impact, Wayland (2013) did, and Ahmed (2020) only found impact when employing dynamic models.

Table 20. Key aspects of existing literature on the impact of WS ODA on access to improved WS

Study	Dep. Var.	Methodology	Countries	Period	Impact
Anand (2006)	Water	Cross-sectional OLS	37	2000	None
	Sanitation	"	51	"	None
Wolf (2007)	Water	Cross-sectional OLS	110	2002	None
	Sanitation	"	109	"	None
Botting et al. (2010)	Water	Cross-sectional logit	48	2002-2006	Positive
	Sanitation	"	"	"	None
Bain et al. (2013)	Water	FE	114	2000-2010	None
Wayland (2013)	Water	FE by GLS	133	1990-2009	Positive
Gopalan and Rajan (2016)	Water	FE, GMM	86	2002-2012	Positive
	Sanitation	"	106	"	Positive
Wayland (2018)	Water	GMM, 2SLS	125	1995-2014	Positive
	Sanitation	"	"	"	Positive
Ahmed (2020)	Water	RE, FE, GMM	87	2002-2015	Mixed

Source: own work.

This study adds to the growing empirical literature on aid effectiveness at the sectoral level in a number of ways. Firstly, it assumes a change in the theoretical approach, moving from growth theory (which most prior studies have been inspired by) towards consumer theory, in which demand factors (and not only supply factors) are considered. Secondly, and as a result of the perspective adopted, the estimates consider the effect that both aid for WS infrastructure and aid for health education have had on access to improved WS — health education can promote a change in personal hygiene practices and a more conscious demand for WS.[19] This has not been taken into account until now, maybe because health education is not officially categorized within WS ODA but instead within health ODA (see Table 10). Nonetheless, the interactions among various development goals have already been noted by previous researchers (Fernández Milán, 2017). Thirdly, on the empirical side, the use of panel vector autoregressive (PVAR) models has been introduced.

In addition, this study employs a comprehensive panel of countries across the globe, thus allowing conclusions to be drawn that can be considered of general validity and not limited to the specific sample of countries chosen. This is needed in the literature, to the extent that it has been recently stated that if the total number of studies on the topic is still low, 'studies specifically focused on assessments for a large panel of countries are even harder to find' (Gopalan and Rajan, 2016, p. 96). The largest panel found in the literature

[19] Health education includes 'information, education and training of the population for improving health knowledge and practices; public health and awareness campaigns; and promotion of improved personal hygiene practices, including use of sanitation facilities and handwashing with soap' (see Table 10).

is that of Wayland (2013), who focused on the impact of ODA on access to water only, leaving sanitation aside, using commitments instead of disbursements and without dynamic models. For this study, a sample of 155 aid-recipient countries is considered (see Appendix 3.9.1), although due to missing data the maximum number of recipients included in the regression analysis is 128.

3.4. Theoretical framework

Traditionally, the literature on aid effectiveness rests on approaches inspired by economic growth theory. While this may be justified when considering the relation between international aid and recipient countries' GDP, the link is not so clear when it is transplanted to other areas of analysis, the relation between ODA and WS among them. Historical evidence (and some case studies) suggest that the consumption of many kinds of services is not a mere mechanical result of investment in the infrastructure required to provide them. Building a school in a village does not guarantee that all children in the village will enroll; creating an infrastructure for water or sanitation does not guarantee that people will use it (En and Gan, 2011; Nganyanyuka et al., 2014). Factors from the demand side (related to people's preferences, culture, values and customs, as well as to perceived benefits and costs) are equally crucial.[20] This fact is well-known to organizations and individuals involved in sanitation promotion in developing countries, and it is one of the reasons behind the wide diffusion of the Community-Led Total Sanitation (CLTS) approach and its emphasis on behavior change (Zuin et al., 2019; Alzúa, Djebbari and Pickering, 2020). Such factors from the demand side, however, fall out of focus when a supply perspective is adopted (Díez and Ezquerra, 2018).

In order to overcome this gap, this study has tried to include some factors that condition personal demand of water and sanitation. More precisely, a demand perspective inspired by consumer theory is adopted in this work. In accordance with this approach, the variable of interest is not the supply of WS to a population (i.e., available infrastructure), but the use of such services by the population. This is the full meaning of the indicator called 'access' in the WDI (2018), since 'the coverage rates are based on information from service users on actual household use' and not merely on availability. The WDI explains that, 'while the estimates are based on "use", the Joint Monitoring Programme reports "use" as "access", because "access" is the term used in the Millennium Development Goal target for drinking water and sanitation' (World Bank, 2016). Consequently, both terms will be used indistinctly throughout this paper.

[20] An illustrative case is provided by Reis and Mollinga (2012) in a study on a microcredit program conducted in the Mekong Delta, Vietnam. They found that the demand for sanitation appliances offered within the program was concentrated on a specific model of latrine, which the locals often referred to as 'beautiful latrine', while other models were equally appropriate (and cheaper). The reason was that latrines were not being valued as sanitary facilities but rather as a status symbol in which only relatively better-off households showed interested.

The aim of development assistance for WS is to increase the use of these services, namely, to 'halve the proportion of people without sustainable access to safe drinking water and basic sanitation', according to the official target indicator established to evaluate progress in this area between 1990 and 2015, the period considered by the Millennium Declaration. This goal can easily be translated into its complement, that is, to increase the proportion of people that actually use improved WS. Let $R_k = A_k/N_k$ be the ratio of total number of people using improved WS (A_k) to total population (N_k) in country k. Assuming that development assistance for WS does not have among its objectives to influence demographic factors such as those represented by the denominator N_k, the actual target of this type of aid may be narrowed to the numerator A_k. This in turn can be expressed as the sum of the individual values of variable B_i for each inhabitant i of country k,

$$A_k = \sum_{i=1}^{N} B_i\,, \qquad i = 1, \dots, N, \tag{2}$$

where B_i is a binary variable which equals 1 if individual i uses improved WS and 0 otherwise. Thus, the aggregate goal can be disaggregated into a number of separate targets regarding individual consumption decisions in which improved WS are considered among other goods and services.

Now we turn to the question of how the value of variable B_i for each consumer i is determined. Following consumer theory, consumer i is considered to demonstrate well-behaved preferences (i.e., monotonic and convex preferences) and make decisions with the aim of maximizing his/her expected utility U_i that depends positively on the quantity of goods and services enjoyed by the individual. Consumer i faces an optimization problem with a budgetary constraint:

$$\begin{aligned} \max \quad & U_i(\mathbf{x}) \\ \text{subject to} \quad & \sum_{j=1}^{n} p_j x_{j,i} = R_i \end{aligned} \tag{3}$$

where $\mathbf{x} = (x_{1,i}, \dots, x_{n,i})$ is a vector of quantities of n goods and services, with $x_{j,i}$ being the quantity of the good or service j for $j = 1, \dots, n$, and where p_j is the price of x_j, and R_i is the consumer's budget.

Now let $x_{n,i}$ be the quantity of improved WS acquired by consumer i, with $x_{1,i}, \dots, x_{n-1,i}$ being the rest of goods and services, including unimproved WS. The fact that an important share of the world population is not using improved WS reveals that the constrained optimization problem faced by those consumers reaches a 'corner solution' where $x_{n,i}^* = 0$, and consequently $B_i = 0$. In order for development assistance to succeed in its goal, it

is necessary to increase the number of individuals whose optimization problem leads to a solution where $x^*_{n,i} > 0$ and therefore $B_i = 1$. The more individuals that make this transition from $B_i = 0$ to $B_i = 1$, the more the aggregate A_k increases, and so does the official MDG target variable $R_k = A_k/N_k$. This goal can be referred to as an 'extensive' rather than an 'intensive' one, meaning that the goal as officially formulated, in its microeconomic translation through variable B_i, is not to increase the amount of improved WS used by each consumer regardless their initial level (that is, to increase $x^*_{n,i,t}$ so that $x^*_{n,i,t+1} > x^*_{n,i,t}$), but to increase the amount used only by those who are initially at $x^*_{n,i,t} = 0$ so that $x^*_{n,i,t+1} > 0$. Therefore, the theoretical reasoning presented in this section always refers to the second aim, which is a specific case of the first one. Nevertheless, it can be applied to both.

The increase in the individual use of improved WS can be achieved in two ways: either by relaxing the consumer's budgetary constraint or by affecting the specific form of the consumer's utility function. The budgetary constraint can be modified, in turn, in three different ways. First, by increasing household income, which can be a general outcome of the aggregate ODA, but not likely as a consequence of the sectoral ODA on WS. Second, by pushing p_n down, although this price is established by local providers of improved WS, and it is not usually the aim of development assistance to alter this. Finally, by reducing the fixed costs associated to the use of improved WS, such as those needed for the installation of piped water supplies to households or on-site sanitation facilities, but also opportunity costs such as, for instance, the time spent travelling the distance to the nearest water source and the time spent waiting in line once there, both of which can be significant in a number of developing countries where in-house facilities are scarce (Sorenson, Morssink and Campos, 2011; Gross, Günther and Schipper, 2018).[21] These fixed costs can be formalized as a capitation tax T applied only when $x_{n,i} > 0$. Thus, T reflects the income that the consumer either devotes to installing a new facility or else stops earning in the labor market when he or she decides to spend a given amount of time carrying water home. Then, in the presence of these fixed costs, the constrained optimization problem actually faced by the consumer is:

$$\begin{aligned} \max \quad & U_i(\mathbf{x}) \\ \text{subject to} \quad & \begin{cases} \sum_{j=1}^{n} p_j x_{j,i} = R_i & \text{if} \quad x_{n,i} = 0 \\ \sum_{j=1}^{n} p_j x_{j,i} + T = R_i & \text{if} \quad x_{n,i} > 0 \end{cases} \end{aligned} \tag{4}$$

[21] Regarding this, research has suggested that if the time spent collecting water is between 3 and 30 minutes, the amount collected is fairly constant and suitable to meet basic needs, defined as between 15 and 25 litres per person per day. However, if the total time taken per round trip exceeds 30 minutes, households tend to collect less water, thus compromising their basic needs (WHO/UNICEF, 2008).

By reducing T, for example via the increase of the number of available water points, the budgetary constraint is modified and there is the possibility that a new equilibrium can be reached where $x_{n,i}^{*} > 0$, although that would depend on both the magnitude of such reduction and the actual shape of the utility function.

An alternative way of promoting the use of improved WS (that is, of pushing $x_{n,i}^{*}$ up) is to modify the specific form of the consumer's utility function U_i, namely by achieving an increment in $\partial U_i / \partial x_{n,i}$. Since the use of improved WS is thought to have health benefits for the consumer, a possible manner of increasing $\partial U_i / \partial x_n$ could be to provide the consumer with better information about these expected benefits. It is reasonable to think that health is considered desirable by the consumers themselves, so that if the individual knows about these benefits, his or her preferences may change in favor of improved WS, giving rise to the possibility of a new equilibrium with a consumption decision where $x_n^{*} > 0$.

3.5. Empirical strategy

The aim of this work is to find out whether development assistance had any impact on variable R_k during the period adopted as a reference by the MDGs. In a cross-country setting, R_k may be affected by various measurable factors that change over time, but also by factors that do not change over time (or that change at a rather slow pace) and are difficult to measure. These latter types of factors constitute what has been called 'unobserved heterogeneity' and include, among others, geographical factors such as climate, aridity, etc., as well as institutional or cultural factors. In order to account for these factors, the following equation is estimated as a baseline model:

$$R_{k,t} = \boldsymbol{\beta} \boldsymbol{X}_{k,t} + \delta_k + \gamma_t + u_{k,t} \qquad (5)$$

where $R_{k,t}$ is the rate of access to improved WS in country k at time t, δ_k is the country fixed effect, γ_t is a time fixed effect that accounts for factors that vary over time but equally affect all countries, $\boldsymbol{X}_{k,t}$ is a matrix of variables that may affect access in country k at time t, and $u_{k,t}$ is the error term. $\boldsymbol{\beta}$ is a vector of parameters to be estimated.

Regarding the variables to be included in the matrix $\boldsymbol{X}_{j,t}$, a guide can be found in consumer theory. As stated before, the opportunity costs represented by T may be reduced by an increase of supply of the service. This supply can be financed internally, as by local government expenditure, or externally, as by foreign aid. The latter is the explanatory variable of interest for this study, so it has been included in the matrix $\boldsymbol{X}_{j,t}$. ODA for both water supply and sanitation have been included as one variable, as is common in the literature. Separate information about each type of ODA is not available and, additionally, running separate regressions would be not appropriate because of the existence of narrow links between both sectors. ODA has been included in the model using logarithms instead

of the original series, as in Gopalan and Rajan (2016). This specification shows a higher explanatory capacity, meaning that the effect of ODA on access to WS seems to be non-linear. It is also common in the literature to measure ODA as the average of a number of past time periods, in order to soften a portion of the volatility that ODA is supposed to exert given its irregular nature but also due to possible errors of measurement. In this study two different models have been estimated, one of them containing yearly data and another with the variable expressed as the average of the past five years (in this last case, the regressions have been run taking into account only the years 1995, 2000, 2005, 2010 and 2015). Both are estimated by making use of ordinary least squares (OLS). Apart from volatility, another source of concern when evaluating the impact of aid is the possible existence of endogeneity or reverse causality. This is because, just as WS aid is expected to have an impact on access, it is also expected to respond to this indicator by flowing in a greater magnitude to those countries that need it most (i.e., that present lower rates of access). In order to avoid this issue, one possible estimation alternative is the use of instrumental variables. Thus, the model has also been estimated by making use of two-stages least squares (2SLS) where the aid variables have been instrumented with their first lags. The instrumental variables are strongly correlated with current aid ($\rho = 0.75$ for WS ODA, and $\rho = 0.69$ for health education ODA). Various test statistics for the instrumental variable estimation are reported in Appendix 3.9.3.

Apart from external financing, the supply of WS can also be financed internally. There is no single database with comprehensive panel data on local government expenditures on WS. Gopalan and Rajan (2016) managed to compile some sparse estimates on local government expenditures on WS from secondary reports, but only for a small number of countries and years. In accordance, the use of a reasonable proxy variable has been preferred for this study. *GDP per capita* has been included in the model as a broad indicator on the local capacity to provide the population with WS. It is expected to show a positive relation with access to WS.

The *share of urban population* was also included as a variable that may affect the costs of using WS. Since populations in urban contexts are more densely distributed, the same expenditure on WS can provide coverage to more people in urban settings than in rural areas. Therefore, better progress on access to WS is expected as the percentage of urban population grows. With the same philosophy, other authors such as Gopalan and Rajan (2016) preferred to include population density in their models instead of the share of urban population, assuming that a higher population density would reduce costs of access. However, the inclusion of population density in a fixed effects model could lead to misleading interpretations. These models are conceived to account for variations within panels and, since population density is a ratio with a denominator that is constant over time for a given panel, all the variability comes from its numerator, the absolute number of inhabitants. Thus, the variable turns into a measure of population growth, whose relation with geographical concentration of the population is not straightforward. For that reason, in this study the share of urban population has been preferred as an indicator of concentration. This variable was also taken into account in the studies by Wolf (2009), Bain et al. (2013) and Wayland (2013).

Supply of WS can also be affected by institutional factors such as corruption: this may lead to increased prices or reduced supply for a given level of expenditure. As noted by Herrera (2019, p. 107), 'Access to water is a problem of governance —and particularly local governance— rather than merely a problem of technology, infrastructure or financing'. For this reason, the *corruption index* provided by the Varieties of Democracy Project (version 8) was included in the model (for a detailed description of this variable, see section 2.5).

Following the suggested theoretical framework, the use of WS can also be promoted by increasing the marginal utility of WS, which can be achieved by providing the consumer with information about the health benefits derived from the use of these services. The better the existing information around the effects that improved water and sanitation have on human health, the higher the demand will be for WS. Therefore, basic education could increase the expected benefits of using WS. The use of the literacy rate as a measure of basic education is the strategy followed by Wolf (2009), but due to the great scarcity of data we preferred to use the logarithm of *mean years of education*. Higher levels of education are expected to be related with greater marginal utility of improved WS relative to other goods' marginal utilities. That is, the shape of indifference curves will tend to favor the consumption of WS in a greater magnitude as education increases.

In the same line, the demand for WS can be influenced by aid oriented to health education insofar as it can improve citizens' levels of information around the effects of the use of improved WS on health and may improve their knowledge on how to use them properly. In this sense, it has been remarked that the effect of limited water supply on health outcomes in rural areas derives from a lack of community-level infrastructure but also from the inability of some households to exploit it when available (van de Poel, O'Donnell and van Doorslaer, 2009). As a consequence, aid for health education, which had not been considered in prior studies, was included in the models.

The estimations based on static models from equation (5) prove to be of little use in explaining the impact of ODA on access to WS. This may be due to the 'static' nature of the model: objective and explanatory variables are assumed to be linked in levels, meaning that, as increases in ODA are expected to lead to increases in $R_{k,t}$, reductions in ODA would lead to reductions in $R_{k,t}$. This assumption may be reasonable when assessing the effectiveness of aid targeted mostly to the provision of services such as education or health. However, in the case of WS ODA, which is mostly allocated to financing projects of infrastructure rather than services, the outcome (built infrastructure) can hardly be expected to decrease as ODA does. Rather, a reduction in ODA could most probably lead to a reduction in the time variation of access, instead of in the level of access. To test this possibility, an alternative model has been estimated including the dependent variable as an interannual variation:

$$R_{k,t} - R_{k,t-1} = \boldsymbol{\beta X}_{k,t} + \delta_k + \gamma_t + u_{k,t} \quad (6)$$

The control variables have also been included in the models as variations, as they are expected to be related to the objective variable in levels.

The results obtained with this last estimation provide some evidence that the relation between ODA and access may in fact be dynamic in nature, instead of static. For that reason, a third specification has been employed where the lagged dependent variable is also included in the right side of the equation as an explanatory factor:

$$R_{k,t} = \alpha R_{k,t-1} + \boldsymbol{\beta X}_{k,t} + \delta_k + \gamma_t + u_{k,t}, \quad (7)$$

where the lagged dependent variable, $R_{k,t-1}$, captures the effects of aid in $t-1$, which are not expected to (completely) dissapear in t even if new aid falls to zero. Thus, the lagged dependent variable $R_{k,t-1}$, causes accumulation of aid effects over time. Note that both equation (5) and equation (6) are special cases of equation (7), with $\alpha = 0$ and $\alpha = 1$, respectively. Because the estimated values of α in equation (7) are close to 1 (see Tables 25 and 27), the β coefficients associated with aid in equation (7) can be interpreted as those in equation (6), that is, the impact of aid on the interannual variation in access.

To account for the possibility of endogeneity, an equation system has been employed instead of a single equation. Two additional equations relate the explanatory variables of interest (WS ODA and health education ODA) to $R_{k,t-1}$ and the rest of the independent variables. Applying fixed effects estimates to dynamic panels could potentially lead to significantly biased OLS coefficients. To overcome this issue, a panel data vector autoregressive model has been estimated through the GMM method.

All statistical analysis was performed using Stata 15. Fixed-effects OLS estimations were performed using the Stata command 'xtreg', while 2SLS estimations were performed using the command 'xtivreg'. To estimate PVAR models, the program 'pvar' developed by Abrigo and Love (2016) has been used.

3.6. Data

Data for the objective variables were sourced from WDI (indicator code SH.H2O.SAFE.ZS for the *share of population with access to improved water* and SH.STA.ACSN for the *share of population with access to improved sanitation*), which in turn takes its information from the WHO/UNICEF Joint Monitoring Programme (JMP).[22] This is the only available source of comprehensive and internationally comparable information on drinking water and sanitation coverage, and as such it served as the UN-recognized instrument for monitoring progress towards the MDG target.

These variables are computed according to the definition of 'improved' water and sanitation developed to assess progress towards the MDGs. Improved drinking water

[22] Once the MDGs were replaced by the SDGs, from 2015 onwards, the definition of the objective variables changed, and variables according to the old formulations are no longer computed. The last version of the WDI that included the MDG-oriented variables is that of April 2018. For that reason, all the variables that have been sourced from the WDI come from this version of the database.

sources include water piped into private premises (a household water connection located inside the user's dwelling, plot, or yard), public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection. Improved sanitation facilities include flush or pour/flush systems (piped to a sewer system, septic tank, or pit latrine), ventilated pit latrines, pit latrines with foundational slab, and composting toilets. The coverage rates for water and sanitation are based on information from service users on the facilities their households actually use rather than on information from service providers, which may include nonfunctioning systems. See Appendix 3.9.2 for a detailed account of the JMP categorization of water and sanitation coverage.

The concept of 'improved WS' was designed to allow for easy comparability across countries. Using simple metrics, such as counting taps and toilets, would provide clear signals in order to assist policymakers. Nonetheless, progress in access to WS, as measured by the JMP, has been criticized by many water experts for a variety of reasons.

The first critiques focused on the JMP's definitions of access to WS, which failed to account for quality. The JMP did not allow for an explicit assessment of clean, safe potability, relying instead on household survey respondents' judgments about whether their water was safe to drink. Since microbial contamination is not necessarily visible, we do not know how much water considered safe by JMP was actually contaminated. In this sense, Martínez-Santos (2017, p. 1) warns that 'indicators overemphasize improved water sources, disregarding the fact that many continue to be contaminated, unreliable or unaffordable.' A number of studies that used microbial water quality data to adjust the JMP estimates found that contamination is much higher than JMP figures suggest, and therefore the actual rate of the world's population with access to safe drinking water is lower than expected (Onda, LoBuglio and Bartram, 2012; Bain, Luyendijk and Bartram, 2013; Martínez-Santos, 2017). That being the case, it has been alleged that the indicators were only partially congruent with the objective, and so it can be said that having access to improved water sources is not necessarily the same as having access to safe drinking water. Even official reports recognized that 'it is likely that the number of people using safe water supplies has been over-estimated' (UNICEF/WHO, 2012). Therefore, access to drinking water from an improved source does not ensure that the water is safe or adequate, as these characteristics are not tested at the time of survey. Even so, improved drinking water technologies are more likely than those characterized as unimproved to provide safe drinking water and to prevent contact with human excreta. It must kept in mind that, while information on access to an improved water source is widely used, it is extremely subjective, and such terms as safe, improved, adequate, and reasonable may have different meanings in different countries despite official WHO definitions. Even in high-income countries, treated water may not always be safe to drink. Access to an improved water source is equated with connection to a supply system; it does not take into account variations in the quality and cost (broadly defined) of the service.

Similar definitional and measurement issues affected JMP assessment of sanitation access and wastewater management. Manalew and Tennekoon (2019) stress the heterogeneous

effects of the different types of water sources and sanitation facilities, thus suggesting that the traditional way of categorizing water sources and sanitation facilities into a dichotomous variable, 'improved' or 'unimproved', could be misleading. They find that some of the water sources traditionally considered as improved are not effective in reducing diarrhea. They also find that some unimproved water sources and sanitation facilities are less inferior than they are believed to be. Some of the improved sources are actually not different from the unimproved sources, or could even be inferior in terms of reducing diarrhea. Also Herrera (2019, p. 106) noted that 'over-aggregated indices of WS access [...] failed to capture much of the variation in service quality, quantity, ease of access, and sustainability of WS management.'

A second set of critiques emphasized shortcomings in the JMP's data collection and analysis strategies. The JMP measured WS progress through nationally-representative household surveys and national censuses (Bartram et al., 2014), but these are only available for a limited number of years. The JMP's modelling approach to estimating yearly data was to use linear regression, relying on coverage estimates to model progress through annual updates. This could plausibly reduce the within-country variability in the dependent variable and limit the ability of statistical models to disentangle its genuine relations with the explanatory variables of interest. Furthermore, studies have shown that WS trajectories are more likely to be 'S-shaped', with progress stalling at low levels of coverage, quickening at intermediate stages, and slowing again towards high levels. For that reason, researchers have emphasized the need to improve estimates of nonlinear trends (Fuller et al., 2016).

In spite of all these critiques, target 10 of the MDGs was established in terms of 'improved' access to WS as computed by the JMP, so this is the indicator employed in this study to assess progress to target 10 in the MDG era.

Regarding the explanatory variables in the model, those of interest are *WS ODA per capita* and *health education ODA per capita*, which were sourced from CRS (code 140 for WS ODA, and code 12261 for health education ODA). Most prior researchers on the topic also used this database, with the exception of Wayland (2013), who used AidData (for a discussion about their differences, see section 2.5). *Health education ODA* includes: 1) information, education and training of the population for improving health knowledge and practices; 2) public health and awareness campaigns; and 3) promotion of improved personal hygiene practices, including the use of sanitation facilities and handwashing with soap. As for *WS ODA*, almost half is allocated to the construction of large systems of water and sanitation such as potable water treatment plants, intake works, water supply pumping stations, distribution systems, large scale sewerage including trunk sewers and sewage pumping stations, and waste water treatment plants. About a fifth of total WS ODA is intended for basic infrastructure such as hand pumps, spring catchments, gravity-fed systems, rainwater collection and fog harvesting, storage tanks, small distribution systems, and local neighborhood networks. The rest is allocated to water sector policy and administrative management, water resources conservation, river basin development,

municipal and industrial solid waste management, and education and training for sector professionals and service providers (for a full description, see Table 21).

Table 21. Components of official development assistance for water and sanitation

Code	Description	Clarifications	Disbursed*
140	WATER AND SANITATION		91 020.39
14010	Water sector policy and administrative management	Water sector policy and governance, including legislation, regulation, planning and management as well as transboundary management of water; institutional capacity development; activities supporting the Integrated Water Resource Management approach.	15 895.67 (17.5%)
14015	Water resources conservation (including data collection)	Collection and usage of quantitative and qualitative data on water resources; creation and sharing of water knowledge; conservation and rehabilitation of inland surface waters (rivers, lakes, etc.), ground water and coastal waters; prevention of water contamination.	2 083.71 (2.3%)
14020	Water supply and sanitation - large systems	Programs where components according to water supply (14021), sanitation (14022), and hygiene (12261) cannot be identified.	37 589.53 (41.3%)
14021	Water supply - large systems	Potable water treatment plants; intake works; storage; water supply pumping stations; large scale transmission / conveyance and distribution systems.	4 323.14 (4.6%)
14022	Sanitation - large systems	Large scale sewerage including trunk sewers and sewage pumping stations; domestic and industrial waste water treatment plants.	2 290.16 (2.5%)
14030	Basic drinking water supply and basic sanitation	Programs where components according to water supply (14031), sanitation (14032), and hygiene (12261) cannot be identified.	17 404.36 (19.1%)
14031	Basic drinking water supply	Rural water supply schemes using handpumps, spring catchments, gravity-fed systems, rainwater collection and fog harvesting, storage tanks, small distribution systems typically with shared connections/points of use. Urban schemes using handpumps and local neighbourhood networks including those with shared connections.	2 005.98 (2.2%)
14032	Basic sanitation	Latrines, on-site disposal, and alternative sanitation systems, including the promotion of household and community investments in the construction of these facilities (activities promoting improved personal hygiene practices are coded in 12261).	855.98 (0.9%)
14040	River basin development	Infrastructure-focused integrated river basin projects and related institutional activities; river flow control; dams and reservoirs (excluding dams primarily for irrigation and hydropower and activities related to river transport).	4957.72 (5.4%)
14050	Waste management / disposal	Municipal and industrial solid waste management, including hazardous and toxic waste; collection, disposal and treatment; landfill areas; composting and reuse.	3255.02 (3.6%)
14081	Education and training in water supply and sanitation	Education and training for sector professionals and service providers.	450.14 (0.5%)

* Total disbursements from 1990 to 2015. Millions of 2015 US dollars.
Source: OECD (2016). *DAC and CRS code lists*. Figures from CRS database.

Data were sourced from the project-level files (18 January 2019 version), years 1990-2015, and aggregated at the national level. A total of 155 aid-recipient countries are considered (see Appendix 3.9.1), but due to missing data the maximum number of

recipients included in the regression analysis is 128. Any type of ODA (budget support, project-type interventions, technical assistance, etc.) is included. Gross disbursements of ODA through all channels (public sector, NGOs, public-private partnerships, etc.) are taken into account. All amounts are expressed in 2015 US dollars per capita. In order to compute disbursements per inhabitant, population data were sourced from WDI (indicator code SP.POP.TOTL).

Apart from the explanatory variables of interest, the following control variables were included in the model. Data for *GDP per capita* were sourced from WDI (indicator code NY.GDP.PCAP.PP.KD). Amounts are expressed in constant (2011) international dollars (PPP) per capita. Data for the *share of urban population* were sourced from WDI (indicator code SP.URB.TOTL.IN.ZS). Data for the *mean years of education* were sourced from the Human Development Data Bank (2018 version) of the UNDP (indicator code 103006). Finally, data for the c*orruption index* included in the model were drawn from the Varieties of Democracy Project (version 8) of the University of Gothenburg (index code v2x_corr). This is an aggregate index which provides an average measure of both 'petty' and 'grand' corruption, including corruption in the different areas of the polity realm: public sector, legislative, executive, and judicial. The directionality of this index runs from less corrupt (0) to more corrupt (1).

The sample period considered ranges from 1990 to 2015. A panel data set was compiled for 132 developing countries which received WS ODA at some point within the sample period.

Table 22. Summary statistics for regression variables

Variable	Mean	Std. Dev.	Min.	Max.
Rate of access to improved water (%)	77.9	17.6	25.8	100
Rate of access to improved sanitation (%)	56.8	29.5	3.9	100
WS ODA pc	2.76	5.32	0.00	97.73
Health education ODA pc	0.03	0.12	0.00	1.74
GDP pc	6909.66	6840.04	247.44	47702.4
Mean years of education	5.9	2.7	0.3	12.7
Urban population	45.9	20.6	5.4	95.3
Corruption	0.64	0.23	0.04	0.98

Note: summary statistics based on observations that have no missing data in any of the variables included in the baseline model.

Table 23. Matrix of correlations for explanatory variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Ln WS ODA pc	1	0.32	0.35	0.36	0.31	0.08
(2) Ln Health educ. ODA pc	0.35	1	0.42	0.55	0.49	0.05
(3) Ln GDP pc	-0.11	-0.15	1	0.50	0.53	-0.08
(4) Ln Mean years educ.	-0.03	0.02	0.66	1	0.66	0.05
(5) Urban population	-0.04	-0.11	0.66	0.50	1	-0.04
(6) Corruption	0.07	0.12	-0.32	-0.23	-0.20	1

Note: Overall correlations below the diagonal, within-panel correlations above the diagonal.
Sources: WDI (2018) and CRS (2018). Sample: recipients of WS ODA or health education ODA.

3.7. Results

Table 24 shows the results from the static models for the impact of ODA on access to improved water, where the dependent variable is measured in levels (columns 1-3) and in variations (columns 4-6). If the relation between ODA and access to WS is assumed to be in levels (1-3), the coefficients for WS ODA show a counterintuitive negative sign, meaning that greater amounts of ODA are related to lower levels of access. This sign is also found by Ndikumana and Pickbourn (2017) in a separate analysis of urban and rural areas (see chapter 4), although in their case the coefficients are not statistically different from zero at the usual confidence levels.

This striking result could be partly explained by the possible existence of endogeneity, if WS ODA disbursements are reduced as the recipient increases its level of access. However, as discussed in section 3.1.2, cross-country evidence points to no relationship between initial levels of access and subsequent WS ODA allocations. In this regard, reverse causality would be expected to affect the results to a lesser extent when the variable of aid expressed as a five-year average is used; due to the greater temporal distance, this definition of aid could hardly be influenced by the current values of access. Nonetheless, when using this five-year-average for aid, the expected value of the coefficient remains negative, even though it turns non-significantly different from zero at the usual confidence levels. The impact of health education ODA is expected to be positive in most of the model specifications.

Another possibility that could account for the negative expected value of the coefficient associated with WS ODA is that we are seeking to find a static relation between WS ODA and access when the relation is, in fact, dynamic. Some evidence in favor of this possibility is found in the results shown in columns 4-6, obtained when using first differences in the dependent variable. Here the signs of the coefficients turn positive and significantly different from zero in all cases, with a confidence of 99%. The explanatory capacity of models 4-6 as measured by the R-squared are lower than those of models 1-3, which comes as no surprise, since levels of access are easier to explain than short-time variations through control variables like the GDP. Still, when using five-year averages (column 6), which are expected to capture more variability, the model is able to explain 28% of the variability in five-year variations. This is also the model specification where the coefficient associated to WS ODA shows its highest expected value.

Considering the estimated coefficients provided by models 4-5, a one-percent increase in WS ODA per capita is associated with an interannual variation in the rate of access to water of between 0.0015 and 0.0066 percentage points higher, with a confidence of 95%. The greater expected value of the coefficient for WS ODA observed in model 6 was an expected result, as most of this type of ODA is allocated to infrastructure projects that may differ widely in dimension, so that their impacts are likely to be differently distributed over time.

Table 24. The impact of ODA on the rate of access to improved water (fixed effects)

	Dependent variable: rate of access to improved water					
	(1) Level (y_t) (OLS)	(2) Level (y_t) (2SLS)	(3) Level (y_t) (OLS)	(4) Dif. (y_t-y_{t-1}) (OLS)	(5) Dif. (y_t-y_{t-1}) (2SLS)	(6) Dif. (y_t-y_{t-5}) (OLS)
Ln WS ODA pc	-0.020**	-0.036*		0.0026***	0.0047***	
	(0.010)	(0.020)		(0.0005)	(0.0010)	
Ln HE ODA pc	0.018***	0.052***		0.0004**	0.0010	
	(0.005)	(0.0152)		(0.0002)	(0.0008)	
Ln WS ODA pc (5-year avg.)			-0.033			0.0210***
			(0.031)			(0.0058)
Ln HE ODA pc (5-year avg.)			0.015			0.0021
			(0.010)			(0.0024)
Ln GDP pc	3.621**	4.063**	5.841***			
	(1.632)	(1.654)	(2.216)			
Ln Mean years of education	0.541	0.474	3.588			
	(4.830)	(4.854)	(5.106)			
Urban population	0.085	0.063	0.044			
	(0.153)	(0.153)	(0.173)			
Corruption	0.834	0.312	0.011			
	(3.402)	(3.118)	(2.737)			
Δ_{t-1}^{t} Ln GDP pc				0.236*	0.204*	
				(0.130)	(0.121)	
Δ_{t-1}^{t} Ln Mean years of education				-0.296*	-0.283*	
				(0.169)	(0.170)	
Δ_{t-1}^{t} Urban pop.				0.296***	0.286***	
				(0.054)	(0.050)	
Δ_{t-1}^{t} Corruption				0.053	0.041	
				(0.134)	(0.135)	
Δ_{t-5}^{t} Ln GDP pc						0.894**
						(0.428)
Δ_{t-5}^{t} Ln Mean years of education						-0.924
						(0.654)
Δ_{t-5}^{t} Urban pop.						0.252***
						(0.065)
Δ_{t-5}^{t} Corruption						0.105
						(0.428)
Year	0.451***	0.380***	0.353***	-0.010***	-0.013***	-0.060***
	(0.126)	(0.134)	(0.122)	(0.001))	(0.002)	(0.009)
Constant	-860.99***	-720.29***	-686.56***	20.221***	26.899***	122.462***
	(240.16)	(255.78)	(232.64)	(2.637)	(4.005)	(18.023)
Observations	2,762	2,676	440	2,640	2,633	420
Number of countries	128	128	125	127	127	124
R-Squared (within)	0.57	0.55	0.58	0.14	0.12	0.28

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The five-year averages allow for softening these disparities in the WS ODA variable, and the five-year differences would allow for more variability in the dependent variable, hence making it easier to identify a greater impact of aid. Nevertheless, in spite of the

higher value of the coefficient, its translation into yearly contributions is not different from the results obtained in models 4-5. A one-percent increase in the average amount of yearly WS ODA received over the past five years is associated with a five-year variation in the rate of access of between 0.0096 and 0.0324 percentage points higher, with a confidence of 95%. If this contribution to five-year variation is assumed to be evenly distributed over time, the expected yearly contribution would be between 0.0096/5 = 0.0019 and 0.0324/5 = 0.0065 percentage points, which almost perfectly matches the range of 0.0015–0.0066 suggested by models 4-5.

If WS ODA is related to the variation in access instead of the level of access, it would mean that once a given disbursement of WS ODA is made, its effect persists for some time, hence preventing access from diminishing, even if ODA does so. Instead of a decrease in levels, a stagnation or a smaller increase is more likely to be observed (a decline in levels of access is also possible, but not a direct outcome of a decrease in aid, as would be the case in a static model). To better test the dynamic nature of the relation between ODA and access to WS while at the same time testing the possible existence of endogeneity, a panel vector autoregressive (PVAR) model has been estimated.

Table 25. The impact of ODA on the rate of access to improved water (PVAR)

	Dependent variables		
	(1) Access to water	(2) Ln WS ODA pc	(3) Ln HE ODA pc
Access to water $_{t-1}$	0.9613*** (0.0067)	0.9893 (0.6218)	2.2791** (1.0412)
Ln WS ODA pc $_{t-1}$	0.0019** (0.0008)	0.4583*** (0.1319)	0.0171 (0.0808)
Ln HE ODA pc $_{t-1}$	0.0016*** (0.0004)	0.0440 (0.0380)	0.2569*** (0.0567)
Δ_{t-1}^{t} Ln GDP pc	-0.0188 (0.4415)	59.3306 (62.6179)	6.0578 (66.8228)
Δ_{t-1}^{t} Ln Mean years of education	0.1160 (0.2223)	-12.8655 (22.9129)	16.0503 (30.4564)
Δ_{t-1}^{t} Urban population	0.6596 (0.9451)	-113.8685 (118.7432)	-27.9428 (144.1859)
Δ_{t-1}^{t} Corruption	0.2202 (0.1557)	5.8675 (15.1963)	5.1620 (21.5388)
Observations: 2,505.			
Number of countries: 127			
Final GMM criterion Q(b) = 0.000			

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The results contained in Table 25 point to a positive impact of both WS ODA and health education ODA on the rate of access to improved water one year later. The expected impacts of both types of ODA on access one year later are fairly similar per increase of one percent, with that of WS ODA (0.0019) being only 18.8% higher than that of health education ODA (0.0016). Regarding the coefficients of the control variables, none is

significantly different from zero. In this study, as has also been noted by previous authors on aid effectiveness, 'regressions with lagged dependent variables — in particular when using general method of moments (GMM) — tend to find a low number of significant regressors' (Ziesemer, 2016, p. 1363). As for both types of ODA as dependent variables, the level of access is found to increase the amount of health ODA received one year later, but it shows no effect on WS ODA.

PVAR model estimates, however, are of little interest by themselves. In a dynamic model with endogenous variables like this, what is truly interesting is the cumulative impact of exogenous changes in one variable on the rest, taking into account the intermediate impacts among all endogenous variables. In order to estimate the cumulative impact of exogenous changes in ODA variables on access to water over time, impulse-response functions (IRF) and forecast-error variance decompositions (FEVD) are estimated. The IRF confidence intervals are computed using 200 Monte Carlo draws based on the estimated model.

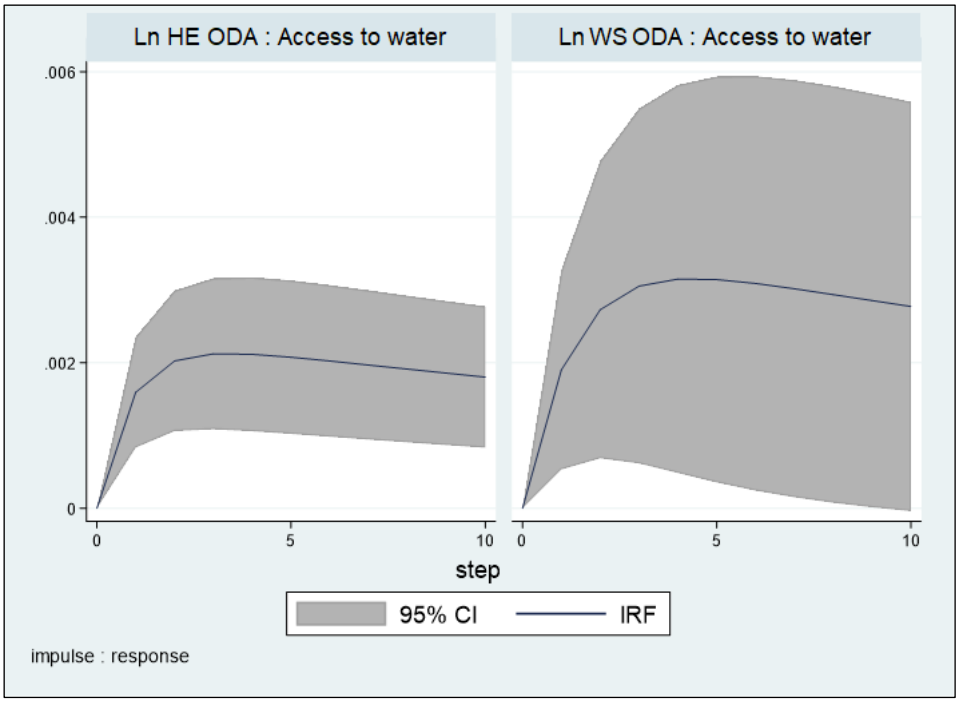
In terms of levels, the IRF shows that a positive shock on any type of ODA leads to an increased rate of access that is expected to be maintained for at least ten years (Graph 10). As already discussed from the estimated coefficients, the effect of a one-percent increase in WS ODA is expected to be similar to that of health education ODA one year later. However, it is expected to be higher with a longer time horizon. In the case of a one-percent increase in health education ODA, it is expected to increase the rate of access by about 0.002 percentage points permanently, or at least over a period of ten years. The effect of a positive shock of the same magnitude in WS ODA is expected to be about 0.003 percentage points from four years after the shock onward. This means that, even if both types of ODA may affect access in a similar way at a one-year horizon, the effects of WS ODA seem to exert a stronger effect in the long run.

Nonetheless, the effect of WS ODA, while expected to be somewhat higher, is also more uncertain. If the estimated contribution of health education ODA to the variation in the rate of access to water may range from about 0.0001 to 0.0003 percentage points with a confidence of 95%, the contribution of WS ODA may range from 0.0006 percentage points four or five years after the shock to the possibility of vanishing altogether ten years later. Based on the FEVD estimates, as much as 12% of variation in the rate of access to water can be explained by WS ODA in a forecast horizon of ten years (see Appendix 3.9.4). With the same forecast horizon, as much as 3.6% of variation in access can be explained by health education ODA. The rate of access, which has been found to positively affect the amount of health education ODA received in the next year, can only explain 1.8% of variation of health education with a forecast horizon of ten years. Therefore, although evidence of reverse causality is found, its effect is of small magnitude.

This finding that points to a positive but uncertain effect of WS ODA on access to water in the long run may be related with field experience that has already warned about the sustainability of WS infrastructures. In this regard, even if one of the outcomes of the International Drinking Water Supply and Sanitation Decade (1981-1990) was the

widespread installation of water supply infrastructures in developing countries, 'in the decades following, evidence showed that poor planning and implementation strategies left nearly a third of hand pumps non-functional' (Chintalapati, 2020, p. 1). More recently, it has been estimated that approximately one in four hand pumps in sub-Saharan Africa are non-functional at any point in time, which in 2015 was roughly equivalent to 175,000 inoperative water points (Foster, Furey and Banks, 2019).

Graph 10. The impact of ODA on the rate of access to improved water (IRFs)



Common factors that influence the sustainability of water service delivery are: 1) the capacity, accountability, and willingness of local governments to provide and finance post-construction support; 2) the willingness and ability of water users to pay tariffs, and the ability of local governments to enforce tariff collection; and 3) the availability of reliable maintenance resources, including spare parts and mechanics, which are often unfamiliar to the local population. All these factors might affect the sustainability of WS infrastructure provided by foreign aid, thus explaining why the impact of WS ODA, which is expected to be positive, becomes more uncertain as time passes.

As for access to sanitation, the static models do not identify any relation between WS ODA and access, while they do find a positive impact of health education ODA (see Table 26). If we measure the impact on interannual variations, WS ODA again turns to a positive sign in two of the specifications. The estimated values of the coefficients are, however, lower than in the case of water, and this relation disappears when using five-year averages. The explanatory capacity of the models as measured by the R-squared is also significantly lower.

Table 26. The impact of ODA on the rate of access to improved sanitation (fixed effects)

	Dependent variable: rate of access to improved sanitation					
	Level (y_t) (OLS)	Level (y_t) (2SLS)	Level (y_t) (OLS)	Dif. (y_t-y_{t-1}) (OLS)	Dif. (y_t-y_{t-1}) (2SLS)	Dif. (y_t-y_{t-5}) (OLS)
Ln WS ODA pc	-0.008	-0.019		0.0019***	0.0038***	
	(0.011)	(0.022)		(0.0006)	(0.0011)	
Ln HE ODA pc	0.014***	0.037***		0.0005	0.0011	
	(0.005)	(0.013)		(0.0004)	(0.0012)	
Ln WS ODA pc (5-year avg.)			0.006			0.0074
			(0.027)			(0.0066)
Ln HE ODA pc (5-year avg.)			0.016*			0.0055
			(0.009)			(0.0039)
Ln GDP pc	5.867***	6.286***	8.531***			
	(1.602)	(1.646)	(2.188)			
Ln Mean years of education	5.758**	5.714*	6.828**			
	(2.893)	(2.941)	(3.090)			
Urban population	0.404***	0.392***	0.336**			
	(0.136)	(0.135)	(0.164)			
Corruption	-1.220	-1.140	-3.032			
	(2.735)	(2.853)	(2.860)			
Δ_{t-1}^{t} Ln GDP pc				0.281***	0.278***	
				(0.103)	(0.1035)	
Δ_{t-1}^{t} Ln Mean years of education				-0.240	-0.226	
				(0.236)	(0.244)	
Δ_{t-1}^{t} Urban pop.				0.305***	0.297***	
				(0.059)	(0.061)	
Δ_{t-1}^{t} Corruption				-0.085	-0.105	
				(0.131)	(0.140)	
Δ_{t-5}^{t} Ln GDP pc						0.897*
						(0.533)
Δ_{t-5}^{t} Ln Mean years of education						-1.021
						(0.640)
Δ_{t-5}^{t} Urban pop.						0.276***
						(0.081)
Δ_{t-5}^{t} Corruption						-0.023
						(0.663)
Year	0.142	0.088	0.048	-0.009***	-0.013***	-0.061***
	(0.090)	(0.096)	(0.098)	(0.002)	(0.003)	(0.012)
Constant	-303.81*	-198.30	-136.19	18.985***	25.842***	125.266***
	(169.04)	(180.12)	(182.09)	(3.264)	(5.609)	(23.392)
Observations	2,767	2,683	442	2,645	2,637	419
Number of countries	128	128	126	128	128	126
R-Squared (within)	0.64	0.63	0.64	0.10	0.09	0.16

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The PVAR model finds the impact of health education to again be positive and persistent over time (see Table 27 and Graph 11). A one-percent increase in health ODA is expected to increase the rate of access to sanitation by 0.0020 percentage points one year later, and that effect persists for at least ten years. Based on the FEVD estimates, as much as 1.4%

of variation in the rate of access to sanitation can be explained by health education ODA at a forecast horizon of ten years (see Appendix 3.9.5), so the effect is persistent but of small relative importance. With the same forecast horizon, as much as 3.6% of variation in health education can be explained by the rate of access to sanitation. Thus, there is evidence of reverse causality, but its magnitude is also small.

Regarding WS ODA, the model fails to find a consistent relation with access to sanitation, in the same way that static models show worse results (in levels and in differences) than in the case of access to water. A likely explanation to this finding is the well-known emphasis that foreign aid placed on water over sanitation in the MDG era (Jiménez and Pérez Foguet, 2008). CRS data does not allow a full accounting for this bias, but those items that can be differentiated into water- and sanitation-oriented show a clear bias in favor of water. Thus, large systems of sanitation received US$ 2.29 billion of 2015 dollars between 1990 and 2015, which makes little more than 50% of the US$ 4.32 billion allocated to large systems of water supply. The same applies to basic sanitation, which received only US$ 855.98 million, or about 40% of the US$ 2.01 billion received by basic water supply (see Table 21).

Table 27. The impact of ODA on the rate of access to improved sanitation (PVAR)

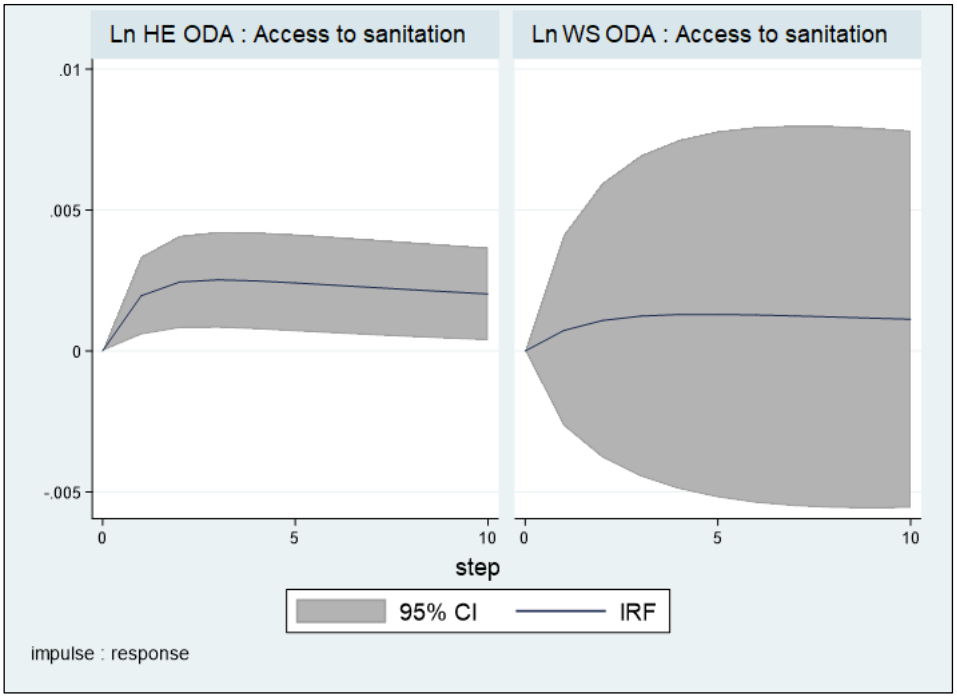
	Dependent variables		
	Access to sanitation	Ln WS ODA pc	LN HE ODA pc
Access to sanitation $_{t-1}$	0.9566***	1.0891	1.9533*
	(0.0104)	(0.8387)	(1.0880)
Ln WS ODA pc $_{t-1}$	0.0007	0.5037***	0.0101
	(0.0017)	(0.1872)	(0.1208)
Ln HE ODA pc $_{t-1}$	0.0020***	0.0423	0.2774***
	(0.0007)	(0.0607)	(0.0630)
Δ_{t-1}^{t} Ln GDP pc	-0.8368	67.4432	-8.9821
	(1.0567)	(98.3367)	(89.0944)
Δ_{t-1}^{t} Ln Mean years of education	0.2437	-23.3929	20.0507
	(0.3622)	(36.6536)	(39.8132)
Δ_{t-1}^{t} Urban population	2.5655	-191.1604	-12.4747
	(2.5038)	(234.9062)	(225.6054)
Δ_{t-1}^{t} Corruption	-0.0850	19.9299	5.4021
	(0.2327)	(24.0861)	(26.1587)
Observations: 2,508			
Number of countries: 128			
Final GMM criterion Q(b) = 0.000			

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The lack of investment does not necessarily translate into a lack of effectiveness, as small disbursements could be expected to lead to positive outcomes, even if these outcomes are also expected to be small in magnitude. However, as the lack of investment may ultimately reflect a lack of interest in this sector in comparison to water, such could also lead to relatively poor performance in interventions and thus to lower impacts.

The role played by local governments might also be of great importance. Most basic sanitation technologies are not expensive to implement, but those facing the problems of inadequate sanitation are rarely aware of either the origin of their ills, or the true costs of their deficit. As a result, it has been argued that 'in most of the developing countries those without sanitation are hard to convince of the need to invest scarce resources in sanitation facilities,' and local governments 'rarely give sanitation or hygiene improvements the priority that is needed in order to tackle the massive sanitation deficit faced by the developing world' (World Bank, 2020). As has been discussed regarding the sustainability of access to water, local involvement is crucial to secure the success of interventions. If sanitation is under-considered by the locals, as it seems to be under-considered by international donors, then it should come as no surprise that the impact of WS ODA is highly uncertain. This, in turn, might explain the positive and persistent impact of health education, which could be helping to change that state of mind.

Graph 11. The impact of ODA on the rate of access to improved sanitation (IRFs)



3.8. Conclusions

Global rates of access to improved water and sanitation increased over the period 1990-2015, but progress was uneven, and the role played by foreign aid in these trends has not been fully disentangled. This study has tried to shed light on this matter in a number of ways. Firstly, it provides an initial attempt to build a theoretical framework that opens a new way of addressing the interpretation of causal pathways in the evaluation of the impact of development assistance for the water and sanitation sector. Secondly, it applies

new empirical methods that are considered more suitable to the theoretical perspective that has been adopted. Several conclusions have been reached as a result.

First, the relation between ODA for water and sanitation infrastructure and the rates of access to water seems to be dynamic in nature, meaning that the impacts of disbursements accumulate over time and are expected to be persistent in the medium term. Nonetheless, it is necessary to pay closer attention to the maintenance of infrastructure already built, if the achievements of WS ODA are to be sustained permanently. Thus, sustainability proves an important factor to be addressed in the immediate future. As for the impact of ODA for infrastructure on access to sanitation, no general rule has been found. It is commonly known that this sector has been under-considered in comparison to water supply, which might account for that result. More careful consideration of sanitation is needed, especially given that progress in this sector has been observed as more uneven than in access to water.

Second, ODA for health education, which has not been taken into account in previous studies on aid effectiveness in the water and sanitation sector, seems to have a persistent, positive impact on the use of both water and sanitation services. This finding could have two possible interpretations that are not mutually exclusive. First, it can be concluded that, just as investment in infrastructure builds 'physical capital', investment in education builds 'human capital', both of which are difficult to destroy in the short term. Hence the persistence of the observed effects of health education ODA on access to water and sanitation (and the effects of WS ODA on access to water). Alternatively, the persistence effect of health education might be due to the positive reinforcement between this type of ODA and the levels of access due to the existence of co-causality, which does not exist for WS ODA. Therefore, these results should not be taken as a motive to divert funds from WS infrastructure to health education; rather, they may suggest that health education seems to take the baton from WS ODA when certain levels of access have already been reached, and it continues to improve on these levels by promoting the use of WS when the infrastructure is already available. Both sides of the coin, supply and demand, deserve careful consideration.

These results, however, should be tested in future research as better quality data becomes available. As also noted by Gopalan and Rajan (2016, p. 97), 'while we evaluate aid effectiveness on access to improved water sources and sanitation facilities separately, the results might be more conclusive if we can disentangle the component of aid to water and sanitation.' Such disaggregated data have been made available only recently, from 2010 onwards, and only partially, so this does not permit their use in evaluating the impact of aid in the MDG era. However, they will be crucial to evaluating the contribution of development cooperation to progress in terms of the new SDGs when the time comes.

Globally comparable data on local expenditures on WS are also needed, in order to be able to explore whether aid flows and local expenditures are complements or substitutes. One possible explanation for the lack of evidence regarding an impact of WS ODA on access to sanitation might be greater aid flows leading to a substitution of government

expenditures, which could reduce the net positive impact of aid on outcomes. As better quality data becomes available, this would be an interesting avenue for future research.

Not only empirical but also theoretical improvements are urgently needed. Even if this study has tried to set the basics for a theoretical understanding of the causal mechanisms between ODA and access to WS, further development is essential. Such would also provide some guidance for better monitoring as relevant intermediate variables are identified.

In the meantime, the evidence provided by this study with the available data and new statistical techniques suggests that aid has been effective in increasing the rates of access to improved water supply during the MDG era, although more careful consideration for both sustainability and sanitation are needed. Also, the role of promoting demand through health education has been observed to be significant, so it is suggested that this pathway from aid to access to WS be taken into account by policymakers and researchers on aid effectiveness alike in future design and evaluation.

3.9. Appendix

3.9.1. Aid-recipient countries

Countries that received WS ODA or health education ODA at some point between 1990 and 2015

1. Afghanistan	41. Ecuador	81. Malawi	121. Solomon Islands
2. Albania	42. Egypt, Arab Rep.	82. Malaysia	122. Somalia
3. Algeria	43. El Salvador	83. Maldives	123. South Africa
4. Angola	44. Equatorial Guinea	84. Mali	124. South Sudan
5. ATG	45. Eritrea	85. Marshall Islands	125. Sri Lanka
6. Argentina	46. Ethiopia	86. Mauritania	126. St. Kitts and Nevis
7. Armenia	47. Fiji	87. Mauritius	127. St. Lucia
8. Azerbaijan	48. French Polynesia	88. Mexico	128. VCT
9. Bahrain	49. Gabon	89. Micronesia	129. Sudan
10. Bangladesh	50. Gambia	90. Moldova	130. Suriname
11. Barbados	51. Georgia	91. Mongolia	131. Swaziland
12. Belarus	52. Ghana	92. Montenegro	132. Syria
13. Belize	53. Grenada	93. Morocco	133. Tajikistan
14. Benin	54. Guatemala	94. Mozambique	134. Tanzania
15. Bhutan	55. Guinea	95. Myanmar	135. Thailand
16. Bolivia	56. Guinea-Bissau	96. Namibia	136. Timor-Leste
17. BIH	57. Guyana	97. Nauru	137. Togo
18. Botswana	58. Haiti	98. Nepal	138. Tonga
19. Brazil	59. Honduras	99. New Caledonia	139. Trinidad and Tobago
20. British Virgin Islands	60. India	100. Nicaragua	140. Tunisia
21. Burkina Faso	61. Indonesia	101. Niger	141. Turkey
22. Burundi	62. Iran	102. Nigeria	142. Turkmenistan
23. Cabo Verde	63. Iraq	103. MNP	143. Turks and Caicos Islands
24. Cambodia	64. Israel	104. Oman	144. Tuvalu
25. Cameroon	65. Jamaica	105. Pakistan	145. Uganda
26. CAF	66. Jordan	106. Palau	146. Ukraine
27. Chad	67. Kazakhstan	107. Panama	147. Uruguay
28. Chile	68. Kenya	108. PNG	148. Uzbekistan
29. China	69. Kiribati	109. Paraguay	149. Vanuatu
30. Colombia	70. Korea, DPR	110. Peru	150. Venezuela
31. Comoros	71. Korea, Rep.	111. Philippines	151. Vietnam
32. Congo, Dem. Rep.	72. Kosovo	112. Rwanda	152. West Bank and Gaza
33. Congo, Rep.	73. Kyrgyz Republic	113. Samoa	153. Yemen, Rep.
34. Costa Rica	74. Lao PDR	114. STP	154. Zambia
35. Cote d'Ivoire	75. Lebanon	115. Saudi Arabia	155. Zimbabwe
36. Croatia	76. Lesotho	116. Senegal	
37. Cuba	77. Liberia	117. Serbia	
38. Djibouti	78. Libya	118. Seychelles	
39. Dominica	79. Macedonia, FYR	119. Sierra Leone	
40. DOM	80. Madagascar	120. Slovenia	

ATG = Antigua and Barbuda. BIH = Bosnia and Herzegovina. CAF = Central African Republic. DOM = Dominican Republic. MNP = Northern Mariana Islands. PNG = Papua New Guinea. STP = Sao Tome and Principe. VCT = St. Vincent and the Grenadines.
Source: CRS.

3.9.2. JMP categorization of water and sanitation coverage

Household surveys and censuses are conducted every year throughout the world to assess drinking water, sanitation, and hygiene-related practices at the household level. Because of variations in survey tools, attempts to compare the results of one survey with those of another have been fraught with difficulties. For this reason, the JMP developed a set of harmonized survey questions that helps to resolve the problems of comparability. The core harmonized questions presented here have been adopted by the Demographic and Health Surveys, the Multiple Indicator Cluster Survey, and the World Health Survey (WHO/UNICEF, 2006).

Table 28. JMP categorization of water coverage

Drinking water core questions:

(1) What is the main source of drinking water for members of your household?
(2) Where is that water source located?
(3) How long does it take to go there, get water, and come back?
(4) Who usually goes to this source to collect the water for your household?
(5) Do you do anything to the water to make it safer to drink? (introduced in 2005)
(6) What do you usually do to make the water safer to drink? (introduced in 2005)

Response to question (1)	**JMP Categorization**	**MDGs categorization**
- Surface water (river, dam, lake, pond, stream, canal, irrigation channel)	Collection of water from a surface water source	Not using an improved drinking water source
- Unprotected dug well - Unprotected spring - Cart with small tank or drum - Tanker truck[a] - Bottled water (where other water source is classified as unimproved)[b]	Other unimproved sources	
- Public tap or standpipe - Tubewell or borehole - Protected spring - Rainwater collection - Bottled water (where other water source is classified as improved)[b]	Other improved sources	Using an improved drinking water source
- Piped water into dwelling, yard or plot	Piped drinking water into dwelling, plot or yard	

[a] Water provided by tanker truck is considered adequate in the United Arab Emirates, Oman and Kuwait, as it is a service regulated by the drinking water authorities delivering water to nomadic populations and communities not connected to a piped network.
[b] Bottled/packaged water is considered improved only when the household uses drinking water from an improved source for cooking and personal hygiene. For countries with information about the secondary source, more than 80% of bottled water users report having water piped on the premises. Where information on the other source is not available, the household is categorized as using piped water.
Source: WHO/UNICEF (2006) and Bartram et al. (2014).

Table 29. JMP categorization of sanitation coverage

Sanitation core questions:

(1) What kind of toilet facility do members of your household usually use?
(2) Do you share this facility with others who are not members of your household?
(3) With how many households do you share this facility?
(4) The last time (Name of Child U5) passed stools, what was done to dispose of the stools?

Response to question (1)	**JMP Categorization**	**MDGs categorization**
- No facilities, bush or field, open water bodies (open defecation)	Open defecation	Not using improved sanitation
- Flush or pour-flush to elsewhere (that is, not to piped sewer system, septic tank or pit latrine) - Pit latrine without slab, or open pit - Bucket - Hanging toilet or hanging latrine	Unimproved	
- Facilities listed below where shared by more than one household (question 2)	Shared use of a facility otherwise classified as improved	
- Flush or pour-flush to piped sewer or septic tank or latrine pit - Ventilated improved pit (VIP) latrine - Pit latrine with slab - Composting toilet	Improved sanitation	Using improved sanitation

Source: WHO/UNICEF (2006) and Bartram et al. (2014).

3.9.3. Tests for instrumental variables

Under-identification and weak-identification tests for instrumental variables

	Dependent variable			
	Water access Level (y_t)	Water access Dif. (y_t-y_{t-1})	Sanitation access Level (y_t)	Sanitation access Dif. (y_t-y_{t-1})
Under-identification*				
Cragg-Donald J	53.03	54.34	52.65	54.18
Chi-sq p-value	0.000	0.000	0.000	0.000
2-step-GMM-based J	50.10	48.76	50.09	48.39
Chi-sq p-value	0.000	0.000	0.000	0.000
Windmeijer J2L	54.14	54.43	53.99	54.31
Chi-sq p-value	0.000	0.000	0.000	0.000
Windmeijer J2LR	53.91	54.38	53.75	54.25
Chi-sq p-value	0.000	0.000	0.000	0.000
Kleibergen-Paap J	54.25	54.38	54.11	54.29
Chi-sq p-value	0.000	0.000	0.000	0.000
Weak-identification**				
Anderson-Rubin	39.87	74.72	20.44	36.36
Chi-sq p-value	0.000	0.000	0.000	0.000
Wald	14.65	27.63	8.06	11.72
Chi-sq p-value	0.001	0.000	0.018	0.003

* H_0: The model is underidentified. Rejection indicates that the model is identified (the excluded instruments are relevant). ** H_0: The coefficients on the endogenous regressors are equal to zero.

3.9.4. PVAR postestimation. Dep. Var.: access to water

Granger causality Wald test

Equation	Excluded	chi2	df	Prob > chi2
Access to water	Ln WS ODA pc	6.297	1	0.012
	Ln HE ODA pc	19.108	1	0
	All	26.448	2	0
Ln WS ODA pc	Access to water	2.531	1	0.112
	Ln HE ODA pc	1.344	1	0.246
	All	2.74	2	0.254
Ln HE ODA pc	Access to water	4.791	1	0.029
	Ln WS ODA pc	0.045	1	0.832
	All	4.931	2	0.085

Ho: Excluded variable does not Granger-cause Equation variable
Ha: Excluded variable Granger-causes Equation variable

Eigenvalue stability condition

Eigen. Real	Eigen. Imaginary	Modulus
0.9707239	0	0.9707239
0.4562417	0	0.4562417
0.2495428	0	0.2495428

All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variable		
		Access to water	Ln WS ODA pc	Ln HE ODA pc
Access to water	0	0.0000	0.0000	0.0000
	1	1.0000	0.0000	0.0000
	2	0.9649	0.0248	0.0103
	3	0.9301	0.0511	0.0187
	4	0.9039	0.0718	0.0243
	5	0.8849	0.0870	0.0280
	6	0.8711	0.0983	0.0306
	7	0.8607	0.1067	0.0325
	8	0.8528	0.1132	0.0340
	9	0.8466	0.1183	0.0351
	10	0.8417	0.1224	0.0360
Ln WS ODA pc	0	0.0000	0.0000	0.0000
	1	0.0644	0.9356	0.0000
	2	0.0629	0.9358	0.0013
	3	0.0619	0.9361	0.0019
	4	0.0615	0.9363	0.0022
	5	0.0614	0.9363	0.0023
	6	0.0614	0.9363	0.0023
	7	0.0616	0.9361	0.0023
	8	0.0617	0.9359	0.0023
	9	0.0619	0.9358	0.0024
	10	0.0620	0.9356	0.0024
Ln HE ODA pc	0	0.0000	0.0000	0.0000
	1	0.0147	0.0641	0.9212
	2	0.0138	0.0664	0.9197
	3	0.0141	0.0672	0.9187
	4	0.0146	0.0675	0.9179
	5	0.0152	0.0677	0.9171
	6	0.0159	0.0678	0.9164
	7	0.0165	0.0679	0.9157
	8	0.0170	0.0679	0.9150
	9	0.0176	0.0680	0.9144
	10	0.0181	0.0681	0.9138

3.9.5. PVAR postestimation. Dep. Var.: access to sanitation

Granger causality Wald test

Equation	Excluded	chi2	df	Prob > chi2
Access to sanitation	Ln WS ODA pc	0.181	1	0.671
	Ln HE ODA pc	7.261	1	0.007
	All	8.475	2	0.014
Ln WS ODA pc	Access to sanitation	1.686	1	0.194
	Ln HE ODA pc	0.485	1	0.486
	All	1.937	2	0.38
Ln HE ODA pc	Access to sanitation	3.223	1	0.073
	Ln WS ODA pc	0.007	1	0.934
	All	3.394	2	0.183

Ho: Excluded variable does not Granger-cause Equation variable
Ha: Excluded variable Granger-causes Equation variable

Eigenvalue stability condition

Eigen. Real	Eigen. Imaginary	Modulus
0.9641432	0	0.9641432
0.5030754	0	0.5030754
0.2705057	0	0.2705057

All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variable		
		Access to sanitation	Ln WS ODA pc	Ln HE ODA pc
Access to sanitation	0	0.0000	0.0000	0.0000
	1	1.0000	0.0000	0.0000
	2	0.9952	0.0010	0.0039
	3	0.9908	0.0021	0.0071
	4	0.9876	0.0031	0.0093
	5	0.9853	0.0038	0.0109
	6	0.9836	0.0044	0.0120
	7	0.9823	0.0049	0.0128
	8	0.9813	0.0053	0.0134
	9	0.9805	0.0056	0.0139
	10	0.9799	0.0058	0.0143
Ln WS ODA pc	0	0.0000	0.0000	0.0000
	1	0.6442	0.3558	0.0000
	2	0.6405	0.3590	0.0005
	3	0.6380	0.3612	0.0008
	4	0.6366	0.3625	0.0009
	5	0.6359	0.3631	0.0010
	6	0.6357	0.3633	0.0010
	7	0.6356	0.3633	0.0011
	8	0.6357	0.3633	0.0011
	9	0.6358	0.3632	0.0011
	10	0.6359	0.3630	0.0011
Ln HE ODA pc	0	0.0000	0.0000	0.0000
	1	0.0245	0.0136	0.9619
	2	0.0229	0.0144	0.9628
	3	0.0236	0.0146	0.9619
	4	0.0252	0.0146	0.9602
	5	0.0271	0.0147	0.9583
	6	0.0290	0.0147	0.9564
	7	0.0308	0.0147	0.9545
	8	0.0325	0.0146	0.9528
	9	0.0341	0.0146	0.9512
	10	0.0356	0.0146	0.9497

4. Introducing inequality into the equation: the urban-rural gap

4.1. Introduction

4.1.1. The urban-rural gap in health

Chapters 2 and 3 were devoted to the assessment of aid effectiveness regarding its observed impact on health-related indicators and on access to water and sanitation at the national level. But while aid is expected to reduce the differences in health between countries by having an effect on national indicators in developing economies, it is equally important to know how this effect is distributed across social sectors and regions within countries. Fighting inequalities is part of the development endeavor, as the 2030 Agenda reveals. However, within-country differences in health are not usually considered when only aggregate indicators are employed to assess progress.

Alongside the well-documented existence of an urban-rural gap in income per capita (Wei, 2015), evidence of an urban-rural gap in health is also firmly established by a body of literature covering various geographical areas. Knöbel, Yang and Ho (1994) studied the case of Taiwan and observed the level of urbanization to be an important determinant of death rate, urban areas having much lower rates than rural ones. The highest rate was persistently observed in the rural areas where the aboriginal tribes reside, which is an important finding for many developing countries where ethnic diversity is closely related with the spatial distribution of the population. This differential rate between urban and rural areas was most prominent for the vaccine-preventable diseases, and authors point to education, health care, and environmental hygiene as key challenges to be addressed if the urban-rural gap is to be reduced.

Lalou and LeGrand (1997), in a study on a number of countries from the Sahel, also found that child mortality is substantially higher in the countryside than in the cities, even in the poorest urban districts. Sastry (1997) found child mortality rates to be substantially and significantly lower in urban areas of Brazil. Heaton and Forste (2003), taking the case of Bolivia, found that children in rural areas were twice as likely to die before the age of two than were children in large cities, and they concluded that expansion of health services and improvements in household and community sanitation are needed to overcome the rural disadvantage in child health. Even in the case of Colombia, that stands out among the Latin American countries that have done the most to ensure access to health care (Martínez and Sánchez-Ancochea, 2018), it has been warned that in rural areas, important problems remain that generate bottlenecks for the effective delivery of these services (Montenegro and Bernal, 2013).

Wang (2003), using data from 60 low-income countries, found not only that child mortality in rural areas was substantially higher than in urban ones, but also that the reduction in child mortality progressed much more slowly in rural settings, concluding that health interventions implemented in the previous decade might not have been as effective as intended. Cai and Chongsuvivatwong (2006) found the premature mortality burden to be 50% higher in the rural region of Kunming, China, compared to the urban and suburban regions in the same province. Yaya et al. (2018) and Yaya et al. (2019), based on data from sub-Saharan African countries, have also found that rural residence accounts for higher risk of death in children under age five, compared to urban residence.

Considering this wide variety of studies that point to the same conclusion, the urban-rural gap in health seems to be a well-established fact. Exploring the factors that explain that gap is an important task, insofar as it can help define sounder public policies oriented to reduce within-country inequalities.

4.1.2. The urban-rural gap in water and sanitation

In order to explain the urban-rural gap in health outcomes, a number of factors have been proposed. Among them, differences in the distribution of contextual factors such as the existence of a health facility within the community, a safe source of drinking water, household and community sanitation, electricity and quality of housing materials have been identified as the most important contributors (Heaton and Forste, 2003; van de Poel, O'Donnell and van Doorslaer, 2009). In particular, the economic challenge regarding water policy differs considerably between urban and rural areas in terms of scale, demand, institutions, and finance, hence the different levels of coverage between these settings (Hope et al., 2020). For instance, the estimated annual capital costs of delivering safely-managed drinking water in rural areas in Sub-Saharan Africa by 2030 is estimated at over US$ 5 billion per year, higher than costs for urban delivery in any other global region (Hutton and Varughese, 2016, p. 14). Given these differences in costs between urban and rural areas, it is no surprise that household connections — which are considered to be the safest source of drinking water — are most frequent in urban areas where economies of scale make this infrastructure affordable, while public hand pumps and standpipes are common in rural villages (Martínez-Santos, 2017, p. 517).

There is, then, an urban-rural gap in access to improved WS as well as a gap in health outcomes, and these seem to be related to each other, judging from the findings in the literature and the results obtained in previous chapters of this study. This opens a window for assessing whether foreign aid had any presumable impact on the urban-rural gap in health during the MDG era, in addition to the already observed impact on health-related indicators at the national level (section 2.6). The MDGs did not include reducing the urban-rural gap in health among their targets, and this may be partly the reason for the paucity of internationally comparable data on the decomposition of child mortality by urban-rural differences. However, even if target 10 of the MDGs was established to ‘halve, by 2015, the proportion of people without sustainable access to safe drinking water

and basic sanitation', without reference to urban and rural areas, the indicators finally approved to monitor progress towards target 10 explicitly consider these areas separately. They are indicator number 30, 'proportion of population with sustainable access to an improved water source, urban and rural', and indicator number 31, 'proportion of urban and rural population with access to improved sanitation' (United Nations, 2003, p. 10). The availability of data for these indicators allow us to empirically assess whether foreign aid had a differentiated impact on access to improved WS in rural and urban settings, thus making it possible to observe whether aid has had any effect on the urban-rural gap in WS. Should that be the case, it could be accepted as evidence that foreign aid has not only had an impact on health at the national level, but that it has also helped to reduce, albeit indirectly, the urban-rural gap in health.

While globally comparable data on the evolution of the urban-rural gap in health indicators are not generally available, we do have such information regarding the urban-rural gap in access to WS, which showed a downward trend during the period 1990-2015. Regarding access to improved water, in 1990 the proportion of the global urban population covered was 95.1%, while in the rural world this figure was 62.2%. Therefore, the urban-rural gap amounted to 32.9 percentage points. In 2015 this gap had narrowed to 11.9 pp, with 96.5% being the rate of urban access and 84.6% the rate of rural access. Rural water coverage increased considerably during this period, but growth in urban area access to improved water remained stagnant, virtually cancelled out by population growth. The urban-rural gap in access to sanitation also showed a downward trend, but much less pronounced, from the initial 44.6 percentage points (78.8–34.2%) to the still high 31.9 (82.2–50.3%). Again, progress in urban areas proves to be significantly lower than in rural ones.

Table 30. Summary statistics for access variables, at urban and rural level (1990, 2015)

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
Urban rate of access to improved water in 1990	91.9	11.7	33.8	100	182
Urban rate of access to improved water in 2015	95.1	8.1	50.7	100	195
Rural rate of access to improved water in 1990	72.4	26	3	100	169
Rural rate of access to improved water in 2015	84.6	18.7	28.2	100	187
Urban-rural gap in access to improved water in 1990	19.0	19.3	-3.7	80.8	169
Urban-rural gap in access to improved water in 2015	10.3	14.4	-30.8	55.8	187
Urban rate of access to improved sanitation in 1990	76.2	26	6.3	100	174
Urban rate of access to improved sanitation in 2015	79.7	23.9	16.4	100	193
Rural rate of access to improved sanitation in 1990	57.9	36.6	0	100	163
Rural rate of access to improved sanitation in 2015	68	32.7	2.9	100	188
Urban-rural gap in access to improved sanitation in 1990	16.6	18.1	-11.2	61.3	160
Urban-rural gap in access to improved sanitation in 2015	11.5	14.8	-8.6	66.4	188

Source: WDI (2018).

It is necessary to take a look to data at the national level to realize that these global figures obscure wide disparities regarding the dimension of the urban-rural gap in different countries across the world. The mean of national figures for the urban-rural gap in access to water descended from 19 to 10.3 percentage points in the period 1990-2015, a decrease

of lower magnitude than that of the global figure, thus suggesting that the reduction at the world level has been greatly influenced by the evolution of the gap in some populous countries. The mean gap in access to sanitation decreased modestly from 16.6 to 11.5 percentage points. The standard deviations of the mean gaps in access are higher than their respective means, thus reflecting the very different dimensions of these gaps depending on the particular case of each country. In this sense, while the maximum gap in access to water descended from the 80.8 percentage points observed in Ethiopia in 1990 to the still high 55.8 of Congo in 2015, the maximum gap in access to sanitation increased slightly, from the 61.3 of Pakistan in 1990 to the 66.4 of the Solomon Islands in 2015.[23]

Inasmuch as urban-rural gaps in access to WS tended to decline in the period 1990-2015, they are expected to have contributed to decreased urban-rural gaps in health as well. The question of interest here is, did foreign aid play some role in the reduction of these gaps during the MDG era?

4.2. Objectives and relevance

The aim of this chapter is to find out whether development assistance has affected rural and urban areas differently, thus having an impact on inequality in access to WS services between rural and urban areas during the period 1990-2015, adopted as a reference by the MDGs. Even if target 10 of the MDGs was established to 'halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation,' without making any reference to urban and rural areas, the indicators finally approved to monitor progress explicitly consider these areas separately. This implies that the existence of a clear gap in access to WS, not only between countries but between urban and rural areas, was already seen as a key element of the nature of WS services to be taken into account by global development policymakers.

In fact, the 2030 Agenda explicitly set within-country inequality as an issue to be tackled in SDG 10, in part due to the fact that a number of developing countries have experienced rapid economic growth while maintaining large pockets of poverty. As a result, most poverty (almost two-thirds) is currently located in MICs, and not in LICs as previously (Edward and Summer, 2013). Therefore, aggregate variables at the national level are less representative of the situation faced by the majority of the population, and variables at the sub-national level acquire more relevance as indicators to be monitored if social cohesion is to be preserved. In other words: 'Disaggregating data to subnational levels

[23] There are also a few negative gaps (i.e., a greater level of access in rural areas than in the cities), but most of these are of negligible magnitude and are observed in middle- or high-income countries, where both rates of access have reached levels well above 90%. Regarding the gap in access to water, the exception is the West Bank and Gaza (-30.8), whose figures are undoubtedly influenced by its peculiar political conditions. As for access to sanitation, Burundi (-11.2) and Sri Lanka (-8.6) show the minimum values in the sample for the years 1990 and 2015, respectively.

can highlight "hotspots" where inequalities are most acute' (United Nations, 2018, p. 111).

In the specific case of WS, it has been argued that 'the inequalities that prevent the rights to water and sanitation of marginalized communities and disadvantaged groups from being satisfied must be addressed in accordance with the international human rights framework,' and 'disaggregated data play a vital role in supporting these efforts, to enable policymakers to identify disadvantaged groups and to tailor support to their specific needs and priorities' (United Nations, 2018, p. 181). Furthermore, the geographical dimension of such inequalities has been recognized inasmuch as 'the characteristics of urban water/sanitation and rural water/sanitation differ considerably in terms of their constituencies and the roles of state and private actors, and therefore attract varying degrees of political attention, suggesting diverse strategies to improve performance' (World Bank, 2017, p. 15). The scholarly literature has also warned that 'national water policy makers should recognize urban-rural inequalities in access and tailor their monitoring and evaluation plans and strategies to the appropriate context' (Adams and Smiley, 2018, p. 224).

For these reasons, in addition to the analysis at the national level performed in chapter 3 of this study, more careful attention is now given to possibly differentiated impacts of aid depending on specific geographical contexts, thereby bringing within-country inequality into the picture. While this has usually been outside the scope of researchers on aid effectiveness, Gopalan and Rajan (2016, p. 94) have observed that 'the capacity of institutions in urban and rural areas could be very different, which consequently might affect the effectiveness of aid flows to WS sector.' In order to test this hypothesis, two different empirical strategies are followed. First, the impact of aid is assessed taking separately as dependent variables the rates of access in urban areas and the rates of access in rural areas. Next, the observed impacts of a given increase in ODA on the rates of access in each of these areas are compared. If the impact in rural areas is observed to be greater than that in urban areas, it can be concluded that aid is a useful instrument to reduce the urban-rural gap in access to water and sanitation. The second strategy consists of testing the impact that aid has had directly on the urban-rural gap, taking as a dependent variable the variation in the urban-rural gap.

4.3. Review of the literature

The existence of an urban-rural gap in health has been well established by numerous studies based on data from a single country, or else a limited number of countries (Knöbel, Yang and Ho, 1994; Lalou and LeGrand, 1997; Sastry, 1997; Heaton and Forste, 2003; Wang, 2003; Cai and Chongsuvivatwong, 2006; Yaya et al., 2019). The explanation of this gap is less clear, but a number of factors have been repeatedly proposed and the urban-rural gap in access to safe water and basic sanitation is usually included among them (Heaton and Forste, 2003; van de Poel, O'Donnell and van Doorslaer, 2009).

Given the lack of internationally comparable data on the urban-rural gap in health, the evaluation of the role that foreign aid might play in reducing these disparities is difficult to carry out. As an indirect approach, the study of the impact of aid on the urban-rural gap in access to water and sanitation has been undertaken by some researchers. However, as Gopalan and Rajan (2016, p. 96) were recently able to conclude, 'empirical studies focusing on assessing the impact of aid effectiveness in the WS sector are at a nascent stage,' and this is even more true for the case of urban-rural gaps. Only a few studies on aid effectiveness have considered the differentiated role that ODA may have played on the evolution of the rates of access to improved WS at the urban and rural levels.

Table 31. Key aspects of existing literature on the impact of WS ODA on access to improved water and sanitation services at the urban and rural levels

Study	Context	Service	Methodology	Countries	Period	Impact
Wolf (2009)	Urban	Water	FE	98	1995-2004	None
		Sanitation	"	96	"	Positive
	Rural	Water	"	96	"	None
		Sanitation	"	93	"	None
Hopewell and Graham (2014)	Urban	Water	Cross-sectional OLS	20[a]	2000-2012	None
		Sanitation	"	"	"	None
Gopalan and Rajan (2016)	Urban	Water	FE	86	2002-2012	None
		Sanitation	"	107	"	Mixed*
	Rural	Water	"	86	"	Positive
		Sanitation	"	106	"	Positive
Ndikumana and Pickbourn (2017)	Urban	Water	FE, GMM	29	1990-2010	Mixed**
		Sanitation	"	"	"	Mixed**
	Rural	Water	"	"	"	Mixed**
		Sanitation	"	"	"	Positive

[a] The study is limited to a sample of 31 cities from 20 sub-Saharan African countries.
* Depending on the definition of the ODA variable. ** Depending on estimation method.
Source: own work.

An early study by Wolf (2009) on the impact of WS ODA distinguished for the first time between access in urban and rural areas. Her analysis based on panel data and fixed effects models found an impact of WS ODA as a share of GNI only in terms of access to sanitation in urban settings. On the other hand, Hopewell and Graham (2014), in a study at the city level on a limited sample of 31 large cities in low or lower-middle income countries from sub-Saharan Africa, found no impact of ODA allocated to WS (large systems). The main focus of the statistical analysis relied on descriptive statistics, although multivariate regression analysis was also conducted to control for different independent variables.

The results obtained by Gopalan and Rajan (2016) conflicted with those of the study by Wolf (2009). While Gopalan and Rajan (2016) find evidence of a highly statistically and economically significant positive impact of aid on access to both water and sanitation in rural areas, Wolf (2009) found no such evidence; and in the opposite sense, Gopalan and Rajan (2016) find no impact of aid on access to WS in urban settlements, while Wolf (2009) observed a positive impact on access to urban sanitation.

Finally, Ndikumana and Pickbourn (2017) take a regional perspective and focus on the impact of aid on access to improved WS in 29 sub-Saharan African countries. They are the first researchers to use dynamic models and GMM estimation techniques to assess the effectiveness of ODA on urban and rural access to WS. When using a fixed-effects method of estimation, they find only a positive impact of aid on access to sanitation in rural areas. On the other hand, when using the generalized method of moments (two-step system GMM), they find a positive impact of aid on access to water, in both urban and rural contexts, and on access to sanitation only in rural areas. This is the only study that also examines the direct impact of aid for WS on the urban-rural gap in access to these services. The urban-rural gap is measured by the ratio of the percentage of the urban population with access to water and sanitation to the percentage of the rural population with access. When using GMM, they find a negative impact of aid on both gaps in water and sanitation. When using fixed effects, they only find a negative impact on the urban-rural gap in access to sanitation. They use CRS data on WS-targeted aid disbursements and introduce this variable in their models as a percentage of the recipient's GDP.

Thus, the results obtained by previous literature are mixed and inconclusive. Results have proved to be dependent on model specifications and estimation methods. Notably, while the results presented in chapter 3 of this study have found WS ODA to be linked to access in a dynamic way, most previous studies on the impact of WS ODA in urban and rural areas employed static models. Those who used both static and dynamic models (Ndikumana and Pickbourn, 2017) found mixed results. Most recent studies tend to find a greater impact of aid on rural than on urban access (Gopalan and Rajan, 2016; Ndikumana and Pickbourn, 2017), but more evidence is needed.

This analysis of the impact of ODA on the urban-rural gap in access to WS contributes in a number of ways to the existing literature on the topic, which is still scarce and with rather ambiguous results (section 4.3). Firstly, inspired by the theoretical model discussed in section 3.4, supply factors as well as demand factors are here considered. As a result of the perspective adopted, the estimates consider the effect that both aid for WS infrastructure and aid for health education have had on access to improved WS — health education can promote a change in personal hygiene practices and a more conscious demand for WS. Secondly, on the empirical side, the use of panel vector autoregressive (PVAR) models has been introduced into a literature that has almost exclusively employed static models thus far. Finally, not only has the differentiated impact of ODA on access in urban/rural areas been tested, but also its direct impact on the urban-rural gap.

4.4. Methodology

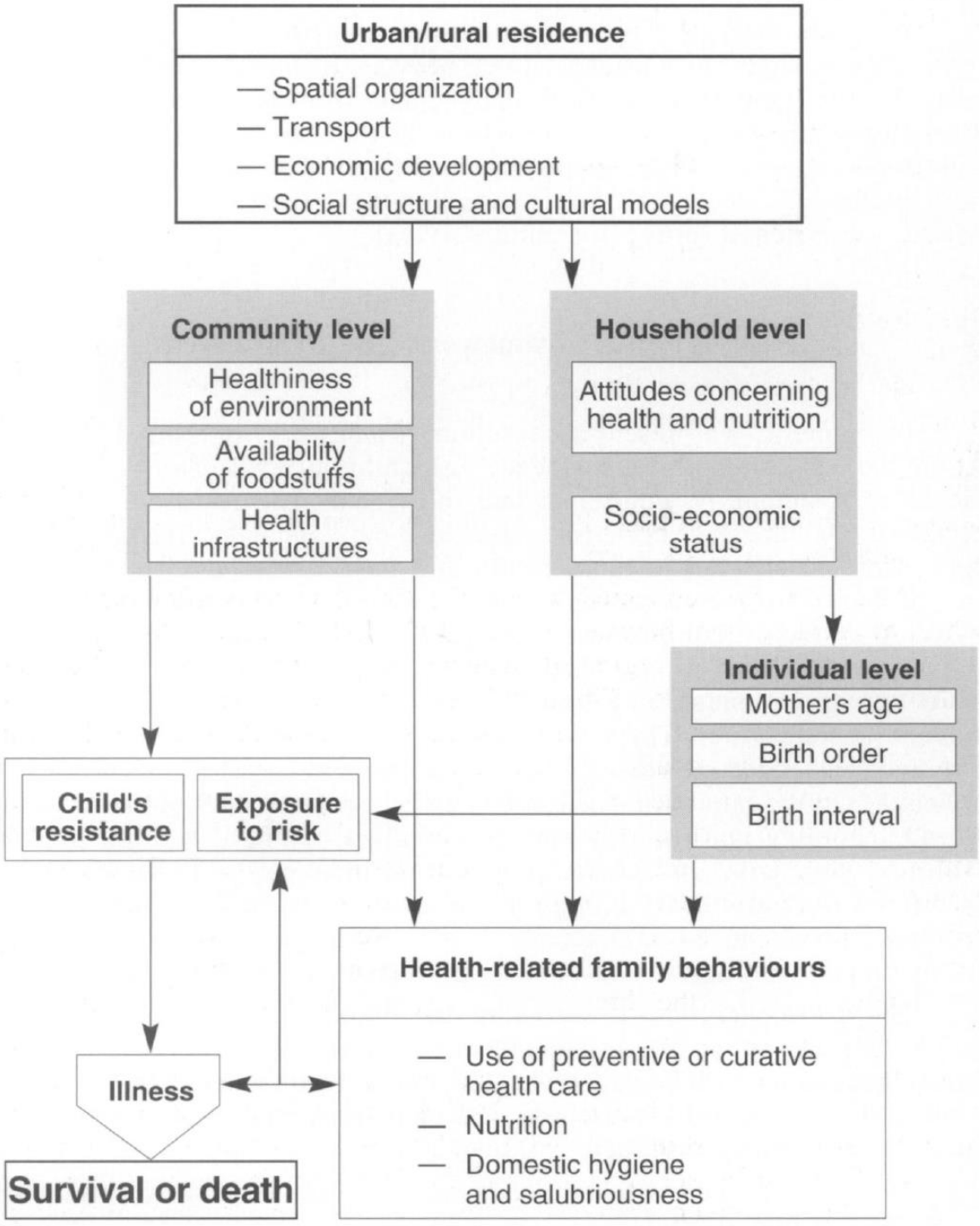
4.4.1. Theoretical framework

Following the conceptual framework developed by Lalou and LeGrand (1997) for relations between urban/rural residence and child survival, which is commonly used as a key health indicator, the residence factor may be expressed through characteristics specific to three levels: 1) community, 2) household, and 3) individual (see Figure 2).

First, regarding the community level, the urban/rural opposition is reflected in more health and medical facilities in the cities, and probably by better environmental management, at least in the areas serviced. Economies of scale explain why many public goods are provided in cities and not rural regions. As an example, hospital infrastructure requires a critical mass of patients demanding treatments. The concentration of health and medical resources in the cities compared to the countryside facilitates public health interventions, such as campaigns to control epidemic diseases, vaccination, and maternal-and-child health programs. Thus, urban dwellers have better access to health care facilities, and so illnesses are more likely to receive timely and appropriate treatment. The same can be said of community-level water supply and sanitation systems. The scale at which rural water delivery has been executed has been largely at community level, with a few hundred people served by one water point, in contrast to the networks of piped urban systems serving many thousands of people. The fixed costs associated with these systems are fairly high and can only be provided at affordable tariffs once the population to be covered has reached a certain level (Hope et al., 2020). In this perspective, the advantages of life in the city essentially include greater access to health-related infrastructure, better provision of specialized health services, and more effective control of the disease environment. Also, the availability and diversity of foodstuffs is generally greater and ensured year round in the cities due to the development of road and rail links, which ensure that urban populations receive a fairly regular and abundant supply.

Second, the residence factor may be expressed through characteristics specific to households. The place of residence differentiates households by two factors: 1) socio-economic level, which defines economic access to health care; and 2) attitudes and knowledge concerning hygiene and nutrition, which expresses a cultural and social distance relative to healthy habits. On the latter point, the urban effect operates through more widespread schooling and the diffusion of so-called ‘modern’ cultural model. The conceptual framework developed by Caldwell (1979) on the effect that female education is expected to have on maternal health practices has already been mentioned (see section 2.4). However, attachment to traditions and habits with respect to health matters, much like systematically resorting to modern medicine, are attitudes which are generated, adopted, or refused by the group before they become individualized. When education is widespread, as is more often the case in cities, it can transform group norms, opening the door to modern health practices.

Figure 2. Conceptual framework for the relations between place of residence and child health



Source: Lalou and LeGrand (1997, p. 150).

Lastly, the residence factor may be expressed through characteristics specific to the individual, through the medium of the household and its socio-economic level and cultural features. In the case of child survival, these are essentially biological and demographic characteristics of the mother (Caldwell, 1979). These three groups of variables act either directly on exposure to health risks and on the physiological capacity to resist, or indirectly through family behavior with regard to health. These factors

determine how capable and how willing a household will be to seek medical treatment, and thus the probability that their children may die.

Considering all these levels through which the residence factor may play a role in the explanation of health outcomes, children living in rural settings are expected to stand greater risks of dying than in urban settings. The shortage of health programs (immunization, maternal and child health care) and health infrastructures in the countryside would increase exposure to the risks of infectious disease and make the children more vulnerable to severe health problems. In cities, the environment is (generally speaking) healthier and more salubrious, and there is greater medical protection than in rural areas.

Arguably, the advantages of living in a medically protected environment are qualified by socio-economic status: the abundance of modern health facilities, good housing conditions (water supply, electricity, etc.) and a plentiful supply of foodstuffs can only be fully exploited by those households that have access to them, and in many developing countries the health care system is often beyond the reach of poorer segments of the population, even in urban settings. In this regard, according to recent estimates, the urban poor are two to three times less likely to access any type of improved sanitation than their better-off neighbors (World Bank, 2017). More specifically, the existence of an 'urban penalty' in rapidly growing cities cannot be ruled out (Brockerhoff, 1995; Gould, 1998). The presumed health advantages of urban areas may fade with accelerated urban population growth if it is not matched by an adequate expansion of safe water supply, sanitation, and health care. In absence of these services, greater crowding in underprivileged districts may favor the spread of contagious diseases and the prevalence of diarrhea, malaria, and respiratory problems. Residents of informal settlements or slums, typified by congestion and poor access to vital resources such as WS, often see health outcomes that are much worse than those of non-slum dwelling urban residents or even rural inhabitants (Ramin, 2009). For all these reasons, an intra-urban gap among households is also expected to exist.

However, that does not diminish the importance of the community level in explaining health outcomes. Compared to the countryside, health and medical infrastructures offer urban citizens a wider range of health care alternatives and modify their perceptions of health risks, thus bringing about a change in economic and health options and in cultural behaviors. The urban environment creates group dynamics (widespread schooling, greater access to information...) which, in health matters, modify the traditional cultural and social norms and transform individual behaviors. In the countryside, however, the dearth of medical and health facilities sometimes fails to allow even wealthy and educated families to escape the ill effects of their 'unhealthy' environment.

Regarding this, from their study on a number of African countries, Lalou and LeGrand (1997, p.164) concluded: 'In the countryside, the effect of "residence zone" is greater than any of the individual or household characteristics.' Sastry (1997, p. 989), with evidence from Brazil, also concluded that 'the urban advantage does not simply reflect underlying differences in socioeconomic and behavioral characteristics at the individual

and household levels; rather, community variables appear to play an independent and important role.' In this regard, recent evidence from the developed world suggests that about half of the geographic variation in health care utilization is attributable to demand-side factors, including preferences, while the other half is due to place-specific supply factors (Finkelstein, Gentzkow and Williams, 2016).

The role of foreign aid in diminishing the urban-rural gap in access to WS, and indirectly in health, may take several forms. Firstly, it may soften the disparities in the availability of community-level water supply and sanitation systems by financing public works that would not be affordable for local governments in rural areas. It can also serve as a transmission channel for innovative solutions to provide clean water at affordable costs to low-densely populated areas, which otherwise would not be available because of the technology gap between donors and recipient countries. Technical and managerial skills tend to be extremely scarce in rural areas from developing countries, and their marginal products are therefore likely to be high. Secondly, foreign aid may also contribute to changing attitudes and knowledge concerning hygiene and nutrition through health education projects, replacing the urban effect that operates through more widespread schooling and the diffusion of new cultural models. Thus, it can open the door to modern health practices. These effects may be expressed through two types of characeristics. First, through characteristics specific to households, via family behavior with regard to health. Second, through characteristics specific to the individual, acting on exposure to health risks related to the use of unimproved WS.

For all these reasons, it is sensible to expect a stronger impact of foreign aid on access to WS in rural than in urban areas, since the former are starting from a lower base in many respects and therefore the improvement would be more feasible and more visible. By contrast, urban areas are closer to 'saturation' so it may be harder for aid to achieve improvements in these settings.

4.4.2. Empirical strategy

The aim of this work is to find out whether development assistance had any impact on inequality in access to improved WS between rural and urban areas during the period adopted as a reference by the MDGs. Two different empirical strategies have been followed to achieve this, each of them having advantages and disadvantages.

First, the impact of aid has been assessed taking separately as dependent variables the rates of access in urban areas and the rates of access in rural areas. Next, the observed impacts of a given increase in ODA on the rates of access in each of these areas have been compared. If the impact in rural areas is observed to be greater than that in urban areas, it can be concluded that aid is a useful instrument to reduce the urban-rural gap in access to water and sanitation. That, however, does not necessarily mean that ODA has actually decreased the urban-rural gaps, as the total effect would depend not only on the impact

per monetary unit, but also on the amount of aid disbursed in each area. Unfortunately, information on the allocation of aid to urban or rural areas is not available (see section 4.5). This is the main drawback of this strategy, which is why a second strategy has also been followed.

The second strategy consists of testing the impact that aid has had directly on the urban-rural gap. This strategy takes as a dependent variable the variation in the urban-rural gap. If the impact of aid is found to be negative, it can be concluded that aid has contributed to reduce the urban-rural gaps in access to water and sanitation. The advantage of this strategy is that the dependent variable included in the models is itself the variable of interest, so that no additional assumptions are needed to establish a causal path. The main drawback of this strategy, however, is that there is no reasonable theoretical framework to guide the specification of the model supposed to explain the urban-rural gaps in access. Thus, estimations with scarce explanatory capacity are likely to be obtained — as already observed by Ndikumana and Pickbourn (2017) in an exercise of this type — due to the lack of meaningful control variables to be included in the models. In any case, even if much of the variability in the gaps cannot be explained, this approach might be useful, in combination with the one previously outlined, for capturing some information about the relationship between aid and inequality in access to WS, if one exists.

As for the first strategy, several models have been specified where the rates of access at the urban level and the rates of access at the rural level are included separately as dependent variables. Let $R_{k,t}$ be the rate of access (urban or rural) to improved WS in country k at time t. In a cross-country setting, R_k may be affected by various measurable factors that change over time, but also by factors that do not change over time (or that change at a rather slow pace) and are difficult to measure. These latter types of factors constitute what has been called 'unobserved heterogeneity' and include, among others, geographical factors such as climate, aridity, etc., as well as institutional or cultural factors. In order to account for these factors, a fixed effects estimation has been applied to the baseline model. As discussed in chapter 3, the relation between ODA and access to WS has been observed to be dynamic in nature. That being the case, the first model specification for the rates of urban and rural access has been estimated including the dependent variable as an interannual variation:

$$R_{k,t} - R_{k,t-1} = \boldsymbol{\beta} \boldsymbol{X}_{k,t} + \delta_k + \gamma_t + u_{k,t} \quad (8)$$

Where δ_k is the country fixed effect, γ_t is a time fixed effect that accounts for factors that vary over time but affect all countries equally, $\boldsymbol{X}_{k,t}$ is a matrix of variables that may affect access in country k at time t, and $u_{k,t}$ is the error term. $\boldsymbol{\beta}$ is a vector of parameters to be estimated.

Regarding the variables to be included in the matrix $\boldsymbol{X}_{j,t}$, the same set as that employed when seeking to explain the rates of access at the national level has been used here (see section 3.5). They are the explanatory variables of interest *WS ODA per capita* and *health*

education ODA per capita, and, as control variables, the *GDP per capita*, the *mean years of education*, and the *corruption index* by the Varieties of Democracy Project (for a detailed description of these variables, see section 2.5). As for this last variable, if it is expected to affect access to WS at the national level, it is even more important to account for when addressing within-country inequality. Indeed, it has been warned that political corruption may drive the allocation of more resources to urban areas to pacify the urban elite while depriving the rural areas of development programs (Konadu-Agyemang and Shabaya, 2005). The *share of urban population* is not needed when considering the impact of ODA on urban and rural areas separately, but it has been included in the models explaining the urban-rural gap. All the control variables have been included in the models as variations.

Two different models have been estimated, one of them containing yearly ODA data and another with these variables expressed as the average of the past five years (in this latter case, the regressions have been run taking into account only the years 1995, 2000, 2005, 2010 and 2015). Both are estimated by making use of ordinary least squares (OLS). In order to avoid the possibility of endogeneity, instrumental variables have been employed as an estimation alternative. This model has been estimated by making use of two-stages least squares (2SLS) where the aid variables have been instrumented with their first lags. Various test statistics for the instrumental variable estimation are reported in Appendix 4.8.2.

To better test the existence of a dynamic relation between ODA and access to water and sanitation at the urban and at the rural level, and to test at the same time the existence of a co-causality effect, a third specification has been employed where the lagged dependent variable is also included in the right side of the equation as an explanatory factor:

$$R_{k,t} = \alpha R_{k,t-1} + \boldsymbol{\beta X}_{k,t} + \delta_k + \gamma_t + u_{k,t} \tag{9}$$

An equation system has been employed instead of a single equation. Two additional equations relate the explanatory variables of interest (WS ODA and health education ODA) to $R_{k,t-1}$ and the rest of the independent variables. A PVAR model has been estimated making use of GMM.

As a second strategy, a fixed effects model is estimated where the direct relation between ODA and the variation in the urban-rural gap is tested. Two different measures of the urban-rural gap have been used. First is the absolute difference between urban access and rural access, in percentage points. Thus, the following model has been estimated:

$$(UR - RU)_{k,t} - (UR - RU)_{k,t-1} = \boldsymbol{\beta X}_{k,t} + \delta_k + \gamma_t + u_{k,t}, \tag{10}$$

where UR is the urban rate of access and RU is the rural rate of access.

As an alternative, the same model has been estimated using as a measure of the urban-rural gap the ratio of the urban rate of access to the rural rate of access:

$$(UR/RU)_{k,t} - (UR/RU)_{k,t-1} = \boldsymbol{\beta X}_{k,t} + \delta_k + \gamma_t + u_{k,t}, \quad (11)$$

This is the measure of the urban-rural gap used by Ndikumana and Pickbourn (2017), so it has also been included in order to reach comparable results.

All statistical analysis was performed using Stata 15. Fixed-effects OLS estimations were performed using the Stata command 'xtreg', while 2SLS estimations were performed using the command 'xtivreg'. To estimate PVAR models, the program 'pvar' developed by Abrigo and Love (2016) has been used.

4.5. Data

Data for the dependent variables are drawn from the WDI. There are four dependent variables: 1) the *rate of access to improved water in urban areas* (indicator code SH.H2O.SAFE.UR.ZS) referring to the percentage of the urban population using an improved drinking water source; 2) the *rate of access to improved water in rural areas* (SH.H2O.SAFE.RU.ZS) referring to the percentage of the rural population using an improved drinking water source; 3) the *rate of access to improved sanitation in urban areas* (SH.STA.ACSN.UR); and 4) *access to improved sanitation in rural areas* (SH.STA.ACSN.RU) referring to the percentage of the rural population using improved sanitation facilities. The data are derived by the Joint Monitoring Programme of the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) based on national censuses and nationally representative household surveys. Further details can be found in section 3.6.

Improved drinking water sources include piped water on premises (piped household water connection located inside the user's dwelling, plot, or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection). The concept of improved sources of water include a wide range of different sources that can be found in urban as well as in rural areas. For instance, household connections are most frequent in urban areas, while public hand pumps and standpipes are common in rural villages (Martínez-Santos, 2017). Improved sanitation facilities are those likely to ensure hygienic separation of human excreta from human contact. These include flush/pour flush (to a piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet.

The concept of access to improved WS, as already noted is section 3.6, does not take into account variations in the quality and cost (broadly defined) of the service. This is

particularly relevant with regard to the urban-rural gap in access to WS. As discussed in section 3.4, among the costs of access to water supply are those associated with the time taken to collect water, and research has suggested that if the time spent per round trip exceeds 30 minutes, households tend to collect less water than is necessary to meet basic needs. An urban-rural gap also exists in this respect: while an estimated 12.9% of the urban population in sub-Saharan Africa is using improved water sources over 30 minutes away, that rate increases to 19.3% for the rural population (see Appendix 4.8.1). Thus, if there is an urban-rural gap in access to improved water sources, the gap between the rates of urban and rural populations that are actually using enough water to meet their basic needs is still higher. Nonetheless, the MDG indicators do not include a measure for time taken to collect water.[24]

As for the explanatory variables of interest, *WS ODA* and *health education ODA* per capita, data were sourced from the Creditor Reporting System (CRS) of the OECD. Data from the project-level files (18 January 2019 version), years 1990-2015, were aggregated to obtain total disbursements at the national level. Any type of ODA (budget support, project-type interventions, technical assistance, etc.) was considered. Gross disbursements of ODA through all channels (public sector, NGOs, public-private partnerships, etc.) are taken into account. All amounts are expressed in real terms, the unit of measurement being 2015 US dollars per capita. In order to compute disbursements per inhabitant, population data were sourced from WDI (indicator code SP.POP.TOTL).

Health education ODA includes: 1) information, education and training of the population for improving health knowledge and practices; 2) public health and awareness campaigns; and 3) promotion of improved personal hygiene practices, including use of sanitation facilities and handwashing with soap.

Regarding *WS ODA*, almost half is allocated to the construction of large systems of water and sanitation, such as potable water treatment plants, intake works, water supply pumping stations, distribution systems, large scale sewerage including trunk sewers and sewage pumping stations, and waste water treatment plants. About a fifth of total WS ODA is intended for basic infrastructure, such as hand pumps, spring catchments, gravity-fed systems, rainwater collection and fog harvesting, storage tanks, small distribution systems, and local neighborhood networks. The rest is allocated to water sector policy and administrative management, water resources conservation, river basin development, municipal and industrial solid waste management, and education and training for sector professionals and service providers (for a full description, see Table 21).

An important limitation of the available data on ODA for the purposes of this chapter must be highlighted. While separate indicators for urban and rural access to water and sanitation are available, this disaggregation is not possible in the case of ODA variables. These are defined at the national level, and there is no possibility of distinguishing how much of that aid has been allocated to urban or rural areas. That being the case, to accept

[24] In the new conceptual framework and monitoring system of the SDGs, this aspect has been taken into account. Now, if the improved drinking water source is located further away than 30 minutes per round trip, including queuing, the service is categorized as 'limited' (WHO/UNICEF, 2017).

as valid the relationships between ODA and urban/rural access brought up by the estimated coefficients of the models presented in section 4.4.2, a crucial assumption must be made: the relative share of ODA received by urban/rural settings has not significantly changed over time within each country. If that assumption applies, changes in aggregate ODA directly translate into changes of the same relative magnitude in the allocations to urban settings and rural settings alike. Thus, the true impact of ODA can be assessed when comparing the evolution of disbursements and the evolution of urban/rural rates of access. Otherwise, changes in the relative share received by each geographic context might be influencing the results. This assumption has been made, even if not explicitly, by all previous authors on the subject, as it is necessarily imposed by the available data.

4.6. Results

4.6.1. Foreign aid and the urban-rural gap in water

Table 32 shows the results from fixed-effects estimations where the rates of urban/rural access to improved water are included as first-differences or five-year differences. Most specifications and estimation methods show a positive effect of both WS ODA and health education ODA on access to water in urban and rural areas. However, the estimated values of the coefficients significantly different from zero are consistently higher for the case of rural access than for urban access.

With a confidence of 95%, and considering the full range of coefficients significantly different from zero provided by models 1-6, the contribution of a one-percent increase in WS ODA to the interannual variation in the urban rate of access to water is expected to be between 0.0002 and 0.0028 percentage points, whereas its contribution to the interannual variation in the rural rate of access to water would be between 0.0019 and 0.0112.[25] With a confidence of 90%, the contribution of a one-percent increase in health education ODA to the interannual variation in the urban rate of access to water is expected to be between 0.0000 and 0.0019 percentage points, whereas its contribution to the interannual variation in the rural rate of access to water would be between 0.0003 and 0.0042. Therefore, the expected impact of both types of ODA on access to water seems to be greater in rural than in urban areas, thus suggesting that ODA has contributed, to some extent, to reducing the urban-rural gap in access to water.

If there is a dynamic relation between ODA and access, as has been suggested by the results obtained in previous chapters, a better option to test that relation is to estimate dynamic models such as the PVARs, the results of which are shown in Table 33. Access to water and ODA are assumed to be endogenous, so the three variables appear as dependent variables. In these models, WS ODA shows a positive impact on rural access

[25] The upper limit being equal to the upper limit of the coefficient 0.0362 in column 6 with a confidence of 95%, divided by 5 years (0.0562/5=0.0112).

to water, while it has no impact on urban access. In contrast, health education ODA shows a positive impact on both urban and rural access to water, but the impact on rural access is greater than that on urban access. Therefore, the results obtained by the PVAR model also suggest that aid had a differentiated effect on each of these settings and may have contributed to the reduction observed in the urban-rural gap in access to water over the period 1990-2015.

Table 32. The impact of ODA on the rate of access to improved water, urban and rural (fixed effects)

	Dependent variable: rate of access to improved water					
	Urban			Rural		
	(1) Dif. (y_t-y_{t-1}) (OLS)	(2) Dif. (y_t-y_{t-1}) (2SLS)	(3) Dif. (y_t-y_{t-5}) (OLS)	(4) Dif. (y_t-y_{t-1}) (OLS)	(5) Dif. (y_t-y_{t-1}) (2SLS)	(6) Dif. (y_t-y_{t-5}) (OLS)
Ln WS ODA pc	0.0008***	0.0015**		0.0036***	0.0066***	
	(0.0003)	(0.0007)		(0.0009)	(0.0015)	
Ln HE ODA pc	0.0004**	0.0010*		0.0009***	0.0023**	
	(0.0002)	(0.0006)		(0.0003)	(0.0011)	
Ln WS ODA pc (5-year avg.)			0.0037			0.0362***
			(0.0035)			(0.0101)
Ln HE ODA pc (5-year avg.)			0.0027			0.0048
			(0.0019)			(0.0033)
Δ_{t-1}^{t} Ln GDP pc	0.060	0.045		0.397**	0.338**	
	(0.089)	(0.092)		(0.172)	(0.166)	
Δ_{t-1}^{t} Ln Mean years of education	-0.126	-0.126		-0.364*	-0.349*	
	(0.187)	(0.187)		(0.193)	(0.192)	
Δ_{t-1}^{t} Corruption	0.077	0.079		0.085	0.082	
	(0.084)	(0.085)		(0.176)	(0.180)	
Δ_{t-5}^{t} Ln GDP pc			0.689**			1.379**
			(0.342)			(0.666)
Δ_{t-5}^{t} Ln Mean years of education			-0.593			-0.918
			(0.613)			(0.650)
Δ_{t-5}^{t} Corruption			0.387			0.105
			(0.321)			(0.565)
Year	-0.004***	-0.007***	-0.030***	-0.006***	-0.013***	-0.051***
	(0.001)	(0.002)	(0.007)	(0.002)	(0.003)	(0.012)
Constant	9.151***	13.283***	61.564***	13.622***	26.435***	105.614***
	(2.052)	(3.086)	(14.839)	(3.401)	(6.188)	(24.928)
Observations	2,672	2,664	427	2,651	2,644	422
Number of countries	130	130	128	129	129	126
R-Squared (within)	0.02	0.01	0.09	0.05	0.01	0.21

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

Based on the FEVD estimates, on average, as much as 5.3% of variation in the rate of rural access to water can be explained by WS ODA in a forecast horizon of ten years (see Appendix 4.8.3), while this type of ODA would have had virtually no impact on urban access according to its estimated coefficient. With the same forecast horizon, as much as 4.7% of variation in rural access can be explained by health education ODA, while this

type of ODA only can explain as much as 1.2% of variation in urban access. It should not come as a surprise that the average impact of ODA is rather small in all cases, since international cooperation can only be expected to play a subsidiary role in local development outcomes. Nonetheless, for the purpose of this chapter, the important thing to note is that the impact on rural access, even if small, is observed to be greater than the impact on urban access.

Table 33. The impact of ODA on the rate of access to improved water, urban and rural (PVAR)

	Dependent variables					
	Urban			Rural		
	Access to water	Ln WS ODA pc	Ln HE ODA pc	Access to water	Ln WS ODA pc	Ln HE ODA pc
Access to water $_{t-1}$	0.9454***	3.4085***	6.7567***	0.9648***	0.8666***	1.7107**
	(0.0146)	(1.259)	(2.8745)	(0.0068)	(0.3734)	(0.8522)
Ln WS ODA pc $_{t-1}$	0.0003	0.4056***	0.0040	0.0035***	0.4037***	0.0004
	(0.0004)	(0.1010)	(0.0481)	(0.0009)	(0.1010)	(0.0497)
Ln HE ODA pc $_{t-1}$	0.0007***	0.05401*	0.2565***	0.0024***	0.0512*	0.2618***
	(0.0003)	(0.0294)	(0.0551)	(0.0005)	(0.0308)	(0.0572)
Δ_{t-1}^{t} Ln GDP pc	0.1852***	4.7619	-8.4828	0.1892*	7.1473	-6.7990
	(0.0601)	(9.5906)	(13.0641)	(0.0968)	(9.2570)	(12.9393)
Δ_{t-1}^{t} Ln Mean years of education	0.1251	-4.8394	13.9662	0.0770	-0.2783	25.2846
	(0.1529)	(15.2235)	(24.9850)	(0.2409)	(16.2699)	(25.1538)
Δ_{t-1}^{t} Corruption	0.1169	9.4784	4.3683	0.3031*	-0.9600	4.2683
	(0.0814)	(11.9741)	(19.5321)	(0.1754)	(10.6430)	(19.8066)
Observations		2,533			2,514	
Number of countries		130			129	

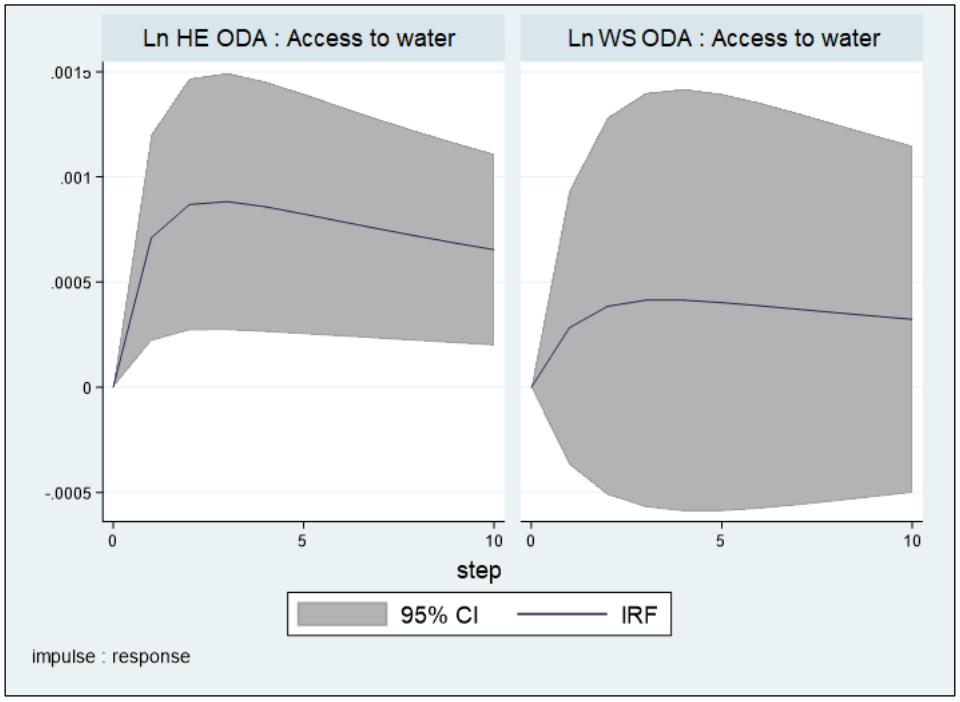
Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

Both types of ODA are observed to have a greater impact on rural access than in urban access to water. Also, one of them seems to have more impact than the other depending on the geographic context: in urban settings, health education ODA shows a greater impact than WS ODA. In rural areas, by contrast, the impact of WS ODA seems to be greater than that of health education. As observed at the national level, the confidence intervals for the impact of WS ODA are wider than those for health education, but its expected impact is higher in value.

Regarding the issue of endogeneity, both types of ODA show a clear positive response to shocks in access to urban and rural water, thus suggesting that aid has not been allocated to those countries that are experiencing difficulties in this sector, but rather 'follow success' inasmuch as increases in access attract new allocations of ODA. This finding might explain why the PVAR models do not show an impact of WS ODA on urban access to water while fixed effects models do. The positive relation found in fixed effects models could be due to the reverse causality observed in the PVAR models. Once this is accounted for, the impact of WS ODA on access disappears. However, the observed

impact of WS ODA on rural access remains, thus giving evidence in favor of co-causality rather than unidirectional reverse causality from access to ODA.

Graph 12. The impact of ODA on the urban rate of access to improved water (IRFs)



Graph 13. The impact of ODA on the rural rate of access to improved water (IRFs)

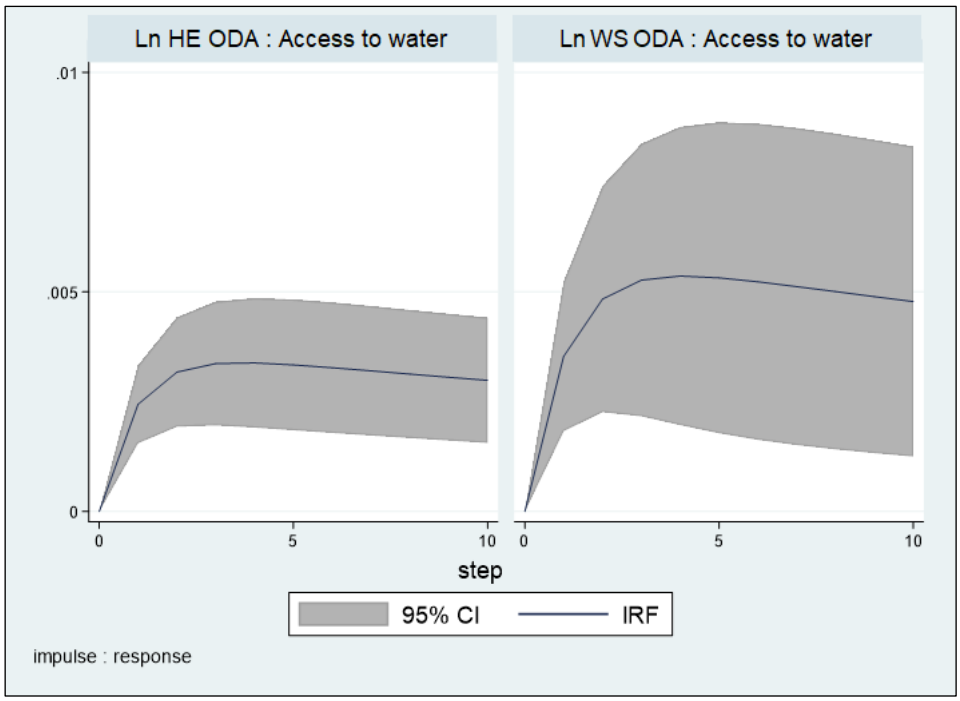


Table 34. The impact of ODA on the urban-rural gap in access to improved water (fixed effects)

	Dependent variables			
	(1) Δ_{t-1}^{t} Abs. Gap	(2) Δ_{t-5}^{t} Abs. Gap	(3) Δ_{t-1}^{t} Rel. Gap	(4) Δ_{t-5}^{t} Rel. Gap
Ln WS ODA pc	-0.0028***		-0.0001**	
	(0.0009)		(0.0000)	
Ln HE ODA pc	-0.0004		0.0000	
	(0.0003)		(0.0000)	
Ln WS ODA pc (5-year avg.)		-0.0175***		-0.0009***
		(0.0060)		(0.0002)
Ln HE ODA pc (5-year avg.)		-0.0025*		0.0002
		(0.0013)		(0.0001)
Δ_{t-1}^{t} Ln GDP pc	-0.3203*		-0.0044	
	(0.1640)		(0.0097)	
Δ_{t-1}^{t} Ln Mean years of education	0.2740		0.0347	
	(0.1795)		(0.0242)	
Δ_{t-1}^{t} Urban pop.	-0.0631		0.0032	
	(0.0653)		(0.0058)	
Δ_{t-1}^{t} Corruption	-0.0471		-0.0052	
	(0.1427)		(0.0118)	
Δ_{t-5}^{t} Ln GDP pc		-0.3942*		0.0237
		(0.2284)		(0.0230)
Δ_{t-5}^{t} Ln Mean years of education		0.4033		0.1376
		(0.3176)		(0.0898)
Δ_{t-5}^{t} Urban pop.		-0.1076		0.0073
		(0.0665)		(0.0092)
Δ_{t-5}^{t} Corruption		0.0303		-0.0258
		(0.2610)		(0.0438)
Year	0.0019	0.0067	0.0010***	0.0049***
	(0.0016)	(0.0046)	(0.0002)	(0.0009)
Constant	-4.2808	-16.1057	-1.9237***	-9.8909***
	(3.2397)	(9.2403)	(0.4423)	(1.8583)
Observations	2,651	2,137	2,651	2,137
Number of countries	129	128	129	128
R-Squared (within)	0.04	0.12	0.09	0.19

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

As a last test for the hypothesis that foreign aid has had an impact on the evolution of the urban-rural gap in access to water, a fixed effects model is estimated where the direct relation between ODA and the variation in the urban-rural gap is tested. Table 34 shows the results. The models in columns 1-2 have as a dependent variable the variation in the absolute urban-rural gap measured in percentage points, whereas the models in columns 3-4 have as a dependent variable the variation in the urban-rural gap measured as the ratio of the rate of urban access to the rate of rural access.

As expected, the overall explanatory capacity of the models is low. This is not surprising inasmuch as there is not a clear set of control variables that could be expected to fully explain short-term variations in the urban-rural gap. However, the effect of WS ODA on

the variation in the urban-rural gap is shown to be negative in all the models. Considering the combined range of estimated coefficients provided by models 1-2, a one-percent increase in WS ODA is expected to reduce the interannual variation in the absolute urban-rural gap by between 0.0010 and 0.0059 percentage points, with a confidence of 95%. If the gap is measured in relative terms (urban access/rural access, columns 3-4), the same increase in WS ODA is expected to reduce the interannual variation in the gap by between 0.0000 and 0.0003 percentage points. As testified by the low explanatory capacity of the models as measured by the R-squared, these impacts can only account for a very small part of short-term variations in the urban-rural gap. However, these impacts are observed to exist, meaning that WS ODA has contributed, if in a limited way, to reducing the gap between urban and rural areas in access to improved water.

The results concerning the impact of health education ODA are mixed. Only model 2 finds a negative impact on the interannual variation of the absolute urban-rural gap, which would be expected to be between 0.0001 and 0.0009 percentage points, with a confidence of 90%. If a higher confidence is required, the impact cannot be expected to be different from zero. The rest of the models find no relationship.

The finding that WS ODA helps to lower the urban-rural gap suggests that WS ODA has had a stronger impact on rural access to water than on urban access to water. That is also the conclusion that can be drawn from the results in Tables 32-33 and Graphs 12-13. The impact of health education ODA, however, was also found to be stronger in rural areas, while its impact on the evolution of the urban-rural gap is less clear.

All in all, putting together the results obtained by different models and estimation methods, the findings suggest that WS ODA had a greater impact in rural and urban areas and contributed to the reduction of the urban-rural gaps in access to water in the period 1990-2015. These results support and generalize those of Ndikumana and Pickbourn (2017), who reached the same conclusion in a study based on a relatively small sample of 29 sub-Saharan African countries. Nonetheless, the contribution of WS ODA is expected to be small, with other factors (which have yet to be studied) probably representing the main determinants of the evolution of the urban-rural gap in access to water.

4.6.2. Foreign aid and the urban-rural gap in sanitation

As for sanitation, Table 35 shows the results from fixed-effects estimations where the rates of urban/rural access to improved sanitation are included as first-differences or five-year differences. Regarding the differentiated impact of ODA on access at the urban/rural levels, the results in the case of sanitation are more mixed than in the case of access to water.

As for the impact of WS ODA on rural access to sanitation, two out of three models show a positive impact, with a confidence of 90%, whereas regarding its impact on urban

access, all the models (three out of three) show a positive impact with the same confidence. However, the expected values of the impacts on urban access are lower than those on rural access. This suggests that the impact of WS ODA on access to sanitation is expected to be higher on average, but also more uncertain (even zero or negative in some cases) in rural areas, whereas in urban settings its impact is expected to be lower but certainly positive.

As for the impact of health education ODA on access to sanitation, it is generally expected to be positive in urban areas, with a confidence of 90%. Once again, the expected values of the coefficients are higher for rural areas, but they are not significantly different from zero, with a confidence of 90%.

Table 35. The impact of ODA on the rate of access to improved sanitation, urban and rural (fixed effects)

	Dependent variable: rate of access to improved sanitation					
	Urban			Rural		
	(1) Dif. (y_t-y_{t-1}) (OLS)	(2) Dif. (y_t-y_{t-1}) (2SLS)	(3) Dif. (y_t-y_{t-5}) (OLS)	(4) Dif. (y_t-y_{t-1}) (OLS)	(5) Dif. (y_t-y_{t-1}) (2SLS)	(6) Dif. (y_t-y_{t-5}) (OLS)
Ln WS ODA pc	0.0011***	0.0024***		0.0027***	0.0051***	
	(0.0004)	(0.0008)		(0.0009)	(0.0016)	
Ln HE ODA pc	0.0005*	0.0012		0.0008	0.0024	
	(0.0003)	(0.0009)		(0.0005)	(0.0016)	
Ln WS ODA pc (5-year avg.)			0.0048*			0.0112
			(0.0026)			(0.0079)
Ln HE ODA pc (5-year avg.)			0.0059**			0.0072
			(0.0023)			(0.0058)
Δ^{t}_{t-1} Ln GDP pc	0.212**	0.215**		0.382***	0.367***	
	(0.087)	(0.092)		(0.125)	(0.125)	
Δ^{t}_{t-1} Ln Mean years of education	-0.211	-0.202		-0.171	-0.156	
	(0.246)	(0.251)		(0.277)	(0.287)	
Δ^{t}_{t-1} Corruption	0.097	0.083		-0.161	-0.167	
	(0.074)	(0.074)		(0.201)	(0.217)	
Δ^{t}_{t-5} Ln GDP pc			0.853**			0.914
			(0.382)			(0.567)
Δ^{t}_{t-5} Ln Mean years of education			-0.831			-0.847
			(0.704)			(0.736)
Δ^{t}_{t-5} Corruption			0.484			-0.712
			(0.316)			(1.041)
Year	-0.005***	-0.008***	-0.036***	-0.008***	-0.014***	-0.055***
	(0.001)	(0.002)	(0.008)	(0.002)	(0.004)	(0.016)
Constant	9.851***	15.829***	74.763***	16.553***	28.838***	113.753***
	(1.925)	(3.800)	(15.595)	(4.239)	(7.662)	(31.706)
Observations	2,666	2,656	423	2,660	2,652	422
Number of countries	131	131	129	130	130	128
R-Squared (within)	0.02	0.01	0.10	0.03	0.01	0.05

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

The results, then, indicate a relatively high uncertainty about the effects of aid on access to sanitation in rural areas, even if they are generally expected to be positive. By contrast, although these effects are expected to be lower in magnitude in the cities, they are more likely to be positive. Therefore, unlike in the case of water, there is no clear expectation on the contribution that aid might have on the urban-rural gap in access to sanitation.

The estimates from PVAR models may help clarify the inconclusive results of fixed-effects estimations. These are shown in Table 36. In these models, both WS ODA and health education ODA show a positive impact on rural access as well as on urban access to sanitation. Their impacts within the same geographic context are fairly similar, so there is no evidence that one type of ODA is more effective than the other in a specific context.

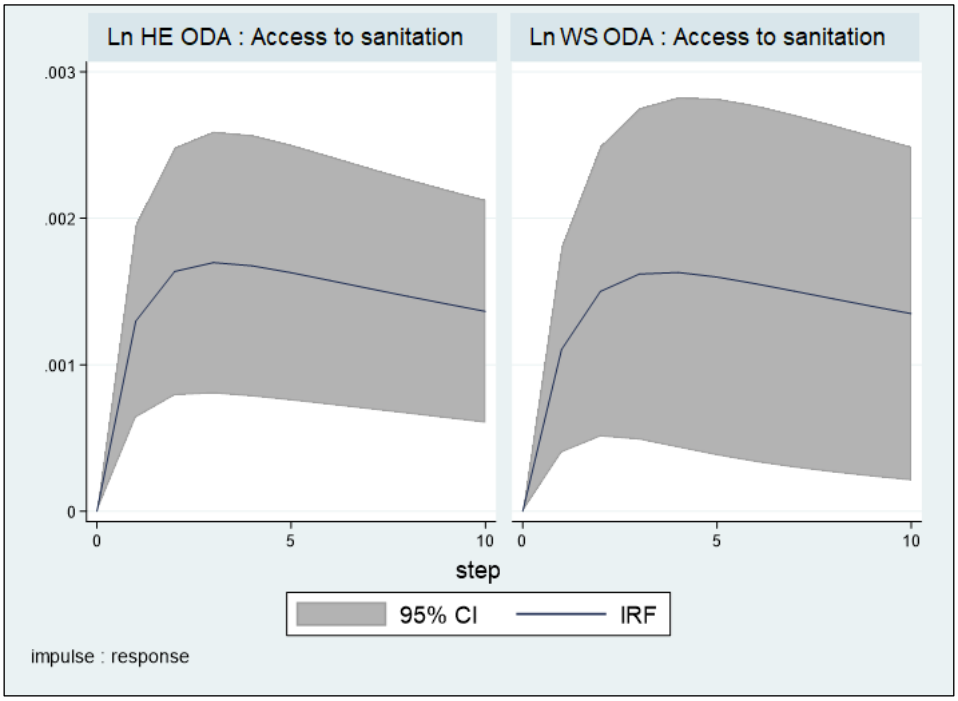
More importantly for the purposes of this chapter, in this case the estimated coefficients for both types of ODA are higher for rural access than for urban access. A one-percent shock in WS ODA is expected to increase the rate of urban access to sanitation by 0.0011 percentage points one year later, whereas the same shock is expected to increase the rate of rural access by 0.0025 percentage points. Similarly, a one-percent shock in health education ODA is expected to increase the rate of urban access to sanitation by 0.0013 percentage points one year later, whereas the same shock is expected to increase the rate of rural access by 0.0028 percentage points. Thus, these results suggest that aid had a differentiated effect on urban/rural settings and may have contributed to the reduction observed in the urban-rural gaps in access to sanitation over the period 1990-2015.

Table 36. The impact of ODA on the rate of access to improved sanitation, urban and rural (PVAR)

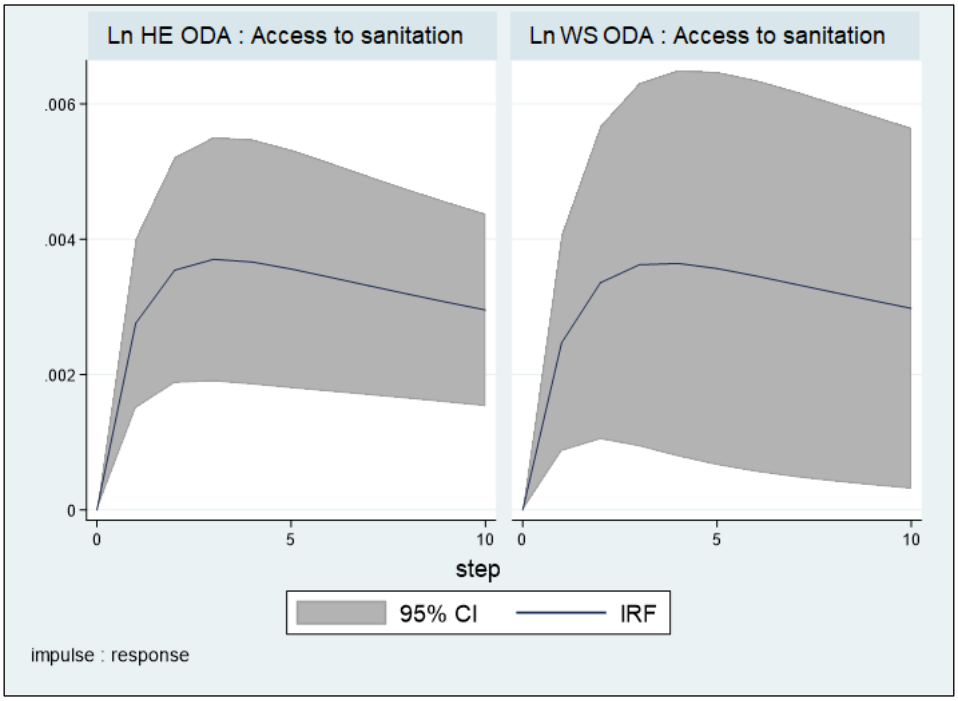
	Dependent variables					
	Urban			Rural		
	Access to sanitation	Ln WS ODA pc	Ln HE ODA pc	Access to sanitation	Ln WS ODA pc	Ln HE ODA pc
Access to sanitation $_{t-1}$	0.9524***	2.1830**	3.8025*	0.9511***	1.0727*	1.4475
	(0.0107)	(0.9596)	(1.9458)	(0.0096)	(0.5973)	(1.0477)
Ln WS ODA pc $_{t-1}$	0.0011***	0.4043***	0.0017	0.0025***	0.4057***	0.0030
	(0.0004)	(0.1006)	(0.0499)	(0.0008)	(0.0991)	(0.0513)
Ln HE ODA pc $_{t-1}$	0.0013***	0.0485	0.2675***	0.0028***	0.0463	0.2920***
	(0.0003)	(0.0324)	(0.0576)	(0.0006)	(0.0380)	(0.0649)
Δ_{t-1}^{t} Ln GDP pc	0.1866*	-8.4089	-14.7614	0.2537**	-8.6495	-12.1969
	(0.0962)	(13.7214)	(13.2667)	(0.1050)	(14.4066)	(13.6006)
Δ_{t-1}^{t} Ln Mean years of education	-0.0476	-11.0435	12.7069	0.2721	-6.0359	30.1819
	(0.1585)	(18.6551)	(27.9373)	(0.2687)	(20.0691)	(29.2435)
Δ_{t-1}^{t} Corruption	0.0912	4.2552	3.2990	0.2300*	5.2790	4.9625
	(0.0844)	(11.5457)	(20.0276)	(0.1211)	(11.5887)	(20.2960)
Observations		2,524			2,521	
Number of countries		131			130	

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

Graph 14. The impact of ODA on the urban rate of access to improved sanitation (IRFs)



Graph 15. The impact of ODA on the rural rate of access to improved sanitation (IRFs)



The magnitudes of these effects, however, are expected to be relatively small. Based on the FEVD estimates (see Appendix 4.8.4), WS ODA can explain only as much as 2.1% of variation in the rate of urban access to sanitation at a forecast horizon of ten years, and as much as 2.2% of variation in rural access. With the same forecast horizon, as much as 3.2% of variation in urban access can be explained by health education ODA, while this type of ODA can explain as much as 4.5% of variation in rural access. According to the IRFs (Graphs 14-15), the highest impact of a one-percent positive shock in any of the ODA variables is expected to be observed three or four years later, but most of it still remains ten years after the shock, with a rate of urban access to sanitation about 0.0015 percentage points higher, and a rate of rural access to sanitation about 0.0030 percentage points higher than before the shock.

As a last test for the hypothesis that foreign aid has had an impact on the evolution of the urban-rural gap in access to sanitation, a fixed effects model is estimated where the direct relation between ODA and the variation in the urban-rural gap is tested. Table 37 shows the results. The models in columns 1-2 have as a dependent variable the variation in the absolute urban-rural gap measured in percentage points, whereas the models in columns 3-4 have as a dependent variable the variation in the urban-rural gap measured as the ratio of the rate of urban access to the rate of rural access.

As for the effect of WS ODA on the variation in the urban-rural gap, all the models show a negative impact, although one of them is not significantly different from zero, with a confidence of 90%. The results, then, depend to some extent on the way that the urban-rural gap is defined as a dependent variable. However, by and large, the models give evidence in favor of a negative contribution of WS ODA to the variation in the urban-rural gap in access to sanitation.

The results concerning the impact of health education ODA are mixed, as was the case with its impact on the gap in access to water. If the urban-rural gap is measured in absolute terms, the coefficients are not significantly different from zero. By contrast, if the gap is measured as the ratio of urban access to rural access, then a positive impact of health education ODA is found, meaning that this type of ODA would contribute to the differences observed between urban and rural areas. This result contrasts with the findings of the PVAR models, which conclude that health education ODA would have been more effective in rural than in urban areas but could be explained by the findings of fixed effects models (Table 35) which show that, even if the expected effects of health education in cities are lower on average than in the countryside, they are more likely to be positive.

Putting together the results obtained by different models and estimation methods, the evidence generally suggests that WS ODA had a greater impact in rural and urban areas, thus contributing to the reduction of the urban-rural gaps in access to sanitation in the period 1990-2015. In contrast, the evidence regarding the impact of health education ODA is mixed: according to the PVAR models, its impact has been greater in rural areas, but the static models on the levels of access (Table 35) and on the urban-rural gap (Table 37) seem to suggest that health education ODA would not have had any effect, or could even have contributed to increased urban-rural gaps in access to sanitation.

Table 37. The impact of ODA on the urban-rural gap in access to improved sanitation (fixed effects)

	Dependent variables			
	(1) Δ_{t-1}^{t} Abs. Gap	(2) Δ_{t-5}^{t} Abs. Gap	(3) Δ_{t-1}^{t} Rel. Gap	(4) Δ_{t-5}^{t} Rel. Gap
Ln WS ODA pc	-0.0016**		-0.0011	
	(0.0007)		(0.0007)	
Ln HE ODA pc	-0.0002		0.0010*	
	(0.0004)		(0.0005)	
Ln WS ODA pc (5-year avg.)		-0.0114**		-0.0066***
		(0.0049)		(0.0021)
Ln HE ODA pc (5-year avg.)		-0.0021		0.0031*
		(0.0020)		(0.0018)
Δ_{t-1}^{t} Ln GDP pc	-0.1545		0.0122	
	(0.1385)		(0.0504)	
Δ_{t-1}^{t} Ln Mean years of education	-0.0141		-0.1987	
	(0.2533)		(0.2124)	
Δ_{t-1}^{t} Urban pop.	-0.0605		-0.0739	
	(0.0528)		(0.0575)	
Δ_{t-1}^{t} Corruption	0.2498		0.2048	
	(0.1923)		(0.1856)	
Δ_{t-5}^{t} Ln GDP pc		-0.2282		0.1161
		(0.3488)		(0.1533)
Δ_{t-5}^{t} Ln Mean years of education		0.2389		-0.6380
		(0.4728)		(0.8055)
Δ_{t-5}^{t} Urban pop.		-0.0557		-0.0433
		(0.0634)		(0.0442)
Δ_{t-5}^{t} Corruption		0.6244		0.3032
		(0.4939)		(0.2747)
Year	0.0031*	0.0164**	0.0078***	0.0298***
	(0.0019)	(0.0082)	(0.0027)	(0.0093)
Constant	-6.5675*	-34.4750**	-15.5911***	-59.8997***
	(3.7177)	(16.5139)	(5.4474)	(18.7290)
Observations	2,656	2,137	2,656	2,137
Number of countries	130	129	130	129
R-Squared (within)	0.01	0.03	0.02	0.07

Note: robust standard errors clustered for countries in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

4.7. Conclusions

The existence of an urban-rural gap in health has been well established by numerous studies. The explanation of this gap is less clear, but a number of factors have been repeatedly proposed, and the urban-rural gap in access to safe water and basic sanitation is usually included among them (Heaton and Forste, 2003; van de Poel, O'Donnell and van Doorslaer, 2009). This study sought to discover whether development assistance allocated to the WS sector affected rural and urban areas differently, thus having an

impact on inequality in access to WS services between rural and urban areas during the period 1990-2015, adopted as a reference by the MDGs.

All in all, putting together the results obtained by different models and estimation methods, the findings suggest that WS ODA had a greater impact in rural than in urban areas and contributed to the reduction of the urban-rural gaps in access to water and sanitation. Nonetheless, the contribution of WS ODA is expected to be small, with other factors (which have yet to be studied) probably representing the main determinants of the evolution of the urban-rural gap in access to water.

These results support and generalize those of Ndikumana and Pickbourn (2017), who reached the same conclusion in a study based on a smaller sample of 29 sub-Saharan African countries. Also, Gopalan and Rajan (2016), who used fixed effects models as an empirical strategy, found the significance of aid in rural regressions to be more statistically and economically important than the corresponding coefficients in urban regressions. The results from the PVAR models provided by this study add evidence that supports their findings. A possible explanation, as proposed by Gopalan and Rajan (2016, p. 96), is that 'since the need for improving access to both water and sanitation is greater in rural areas compared to urban areas, greater aid flows tend to show relatively more significant results in rural areas in terms of effectiveness compared to urban areas, i.e., the marginal contribution of aid is greater in rural than urban areas.'

The evidence regarding the impact of health education ODA on inequality in access to WS services between rural and urban areas is mixed: according to the PVAR models, its impact has been greater in rural areas, but the static models on the levels of access (Table 35) and on the urban-rural gap (Table 37) seem to suggest that health education ODA would not have had any effect, or even could have contributed to increased urban-rural gaps in access to sanitation. One possible explanation to the absence of impact of health education ODA on the urban-rural gap (while showing higher effectiveness in rural areas) might be related to the relative importance of health education ODA in absolute terms. Even if the marginal contribution of health education is greater in rural than urban areas, it could hardly be expected to affect the urban-rural gap if disbursements in the countryside do not reach a minimum required.

In this regard, an important limitation of this study must be highlighted: while separate indicators for urban and rural access to WS are available, there is no possibility of distinguishing how much aid has been allocated to urban or rural areas. To accept the results of this study as valid, a crucial assumption must be made: the relative share of ODA received by urban/rural settings has not significantly changed over time within each country. If changes in the relative share received by each geographic context are actually occurring, this would influence the results. With the available data, this is a necessary assumption that all authors on this topic have been forced to make. Better data on ODA disaggregated by urban/rural areas are needed in order to perform future evaluations of the role played by ODA in the evolution on spatial inequalities in access to water and sanitation.

4.8. Appendix

4.8.1. Improved water sources over 30 minutes away

Table 38. Percentage of population using improved water sources over 30 minutes away (round-trip)

Country	Total	Urban	Rural	Rural-Urban	Rural/Urban
Uganda	41	28	43	15	1.5
Burundi	36	13	38	25	2.9
Burkina Faso	35	35	36	1	1.0
Malawi	33	55	35	-20	0.6
Mauritania	30	36	26	-10	0.7
Rwanda	28	23	29	6	1.3
Mauritius	26	0	45	45	-
Lesotho	23	12	25	13	2.1
Central African Republic	22	22	22	0	1.0
Gambia	21	15	23	8	1.5
Namibia	20	5	27	22	5.4
Zimbabwe	19	0	28	28	-
Nigeria	19	22	13	-9	0.6
Cameroon	18	15	18	3	1.2
Tanzania	18	14	20	6	1.4
Chad	18	4	22	18	5.5
Ethiopia	18	12	15	3	1.3
Ghana	15	8	19	11	2.4
Congo	15	16	13	-3	0.8
Kenya	14	2	17	15	8.5
Swaziland	13	4	15	11	3.8
Sao Tome and Principe	11	11	12	1	1.1
Côte d'Ivoire	11	2	17	15	8.5
Guinea	11	14	9	-5	0.6
Togo	11	8	12	4	1.5
Guinea-Bissau	11	8	12	4	1.5
South Africa	10	7	15	8	2.1
Senegal	10	4	16	12	4.0
Madagascar	10	13	8	-5	0.6
Niger	10	7	10	3	1.4
Zambia	9	4	12	8	3.0
Mali	7	3	8	5	2.7
Sierra Leone	7	16	3	-13	0.2
Somalia	7	9	6	-3	0.7
Comoros	5	5	5	0	1.0
Average	17.5	12.9	19.3	6.3	2.2

Source: WHO/UNICEF (2008)

4.8.2. Tests for instrumental variables

Under-identification and weak-identification tests for instrumental variables

	Dependent variable			
	Water access Urban	Water access Rural	Sanitation access Urban	Sanitation access Rural
Under-identification*				
Cragg-Donald J	56.80	55.94	55.83	55.74
Chi-sq p-value	0.000	0.000	0.000	0.000
2-step-GMM-based J	49.82	48.54	48.40	48.46
Chi-sq p-value	0.000	0.000	0.000	0.000
Windmeijer J2L	56.89	56.20	56.17	56.12
Chi-sq p-value	0.000	0.000	0.000	0.000
Windmeijer J2LR	56.85	56.12	56.08	56.03
Chi-sq p-value	0.000	0.000	0.000	0.000
Kleibergen-Paap J	56.81	56.15	56.15	56.11
Chi-sq p-value	0.000	0.000	0.000	0.000
Weak-identification**				
Anderson-Rubin	13.73	83.41	25.77	38.79
Chi-sq p-value	0.001	0.000	0.000	0.000
Wald	7.26	23.93	11.26	12.03
Chi-sq p-value	0.027	0.000	0.004	0.002

* H_0: The model is underidentified. Rejection indicates that the model is identified (the excluded instruments are relevant). ** H_0: The coefficients on the endogenous regressors are equal to zero.

4.8.3. PVAR postestimation. Dep. Var.: access to water

Dependent variable: urban access to water

Granger causality Wald test

Equation	Excluded	chi2	df	Prob > chi2
Access to water	Ln WS ODA pc	0.619	1	0.431
	Ln HE ODA pc	7.761	1	0.005
	All	7.923	2	0.019
Ln WS ODA pc	Access to water	7.326	1	0.007
	Ln HE ODA pc	3.366	1	0.067
	All	7.437	2	0.024
Ln HE ODA pc	Access to water	5.525	1	0.019
	Ln WS ODA pc	0.007	1	0.934
	All	6.127	2	0.047

Ho: Excluded variable does not Granger-cause Equation variable
Ha: Excluded variable Granger-causes Equation variable

Eigenvalue stability condition

Eigen. Real	Eigen. Imaginary	Modulus
0.9543023	0	0.9543023
0.4039283	0	0.4039283
0.2492071	0	0.2492071

All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variable		
		Access to water	Ln WS ODA pc	Ln HE ODA pc
Access to water	0	0.0000	0.0000	0.0000
	1	1.0000	0.0000	0.0000
	2	0.9946	0.0017	0.0037
	3	0.9903	0.0032	0.0066
	4	0.9873	0.0042	0.0085
	5	0.9853	0.0050	0.0097
	6	0.9839	0.0055	0.0106
	7	0.9829	0.0059	0.0112
	8	0.9821	0.0062	0.0117
	9	0.9815	0.0064	0.0121
	10	0.9811	0.0066	0.0124
Ln WS ODA pc	0	0.0000	0.0000	0.0000
	1	0.2000	0.8000	0.0000
	2	0.1940	0.8010	0.0050
	3	0.1899	0.8028	0.0073
	4	0.1891	0.8027	0.0081
	5	0.1904	0.8012	0.0084
	6	0.1923	0.7992	0.0085
	7	0.1945	0.7970	0.0086
	8	0.1966	0.7948	0.0086
	9	0.1985	0.7928	0.0086
	10	0.2003	0.7910	0.0086
Ln HE ODA pc	0	0.0000	0.0000	0.0000
	1	0.1804	0.1295	0.6901
	2	0.1740	0.1309	0.6952
	3	0.1739	0.1310	0.6951
	4	0.1756	0.1307	0.6937
	5	0.1776	0.1304	0.6920
	6	0.1795	0.1302	0.6904
	7	0.1813	0.1299	0.6889
	8	0.1829	0.1296	0.6875
	9	0.1843	0.1294	0.6863
	10	0.1856	0.1292	0.6851

Dependent variable: rural access to water

Granger causality Wald test

Equation	Excluded	chi2	df	Prob > chi2
Access to water	Ln WS ODA pc	16.118	1	0
	Ln HE ODA pc	26.531	1	0
	All	32.09	2	0
Ln WS ODA pc	Access to water	5.386	1	0.02
	Ln HE ODA pc	2.763	1	0.096
	All	6.51	2	0.039
Ln HE ODA pc	Access to water	4.03	1	0.045
	Ln WS ODA pc	0	1	0.994
	All	4.592	2	0.101

Ho: Excluded variable does not Granger-cause Equation variable
Ha: Excluded variable Granger-causes Equation variable

Eigenvalue stability condition

Eigen. Real	Eigen. Imaginary	Modulus
0.9767328	0	0.9767328
0.3948766	0	0.3948766
0.2586546	0	0.2586546

All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variable		
		Access to water	Ln WS ODA pc	Ln HE ODA pc
Access to water	0	0.0000	0.0000	0.0000
	1	1.0000	0.0000	0.0000
	2	0.9739	0.0129	0.0132
	3	0.9508	0.0250	0.0242
	4	0.9347	0.0337	0.0316
	5	0.9237	0.0398	0.0365
	6	0.9159	0.0441	0.0400
	7	0.9102	0.0473	0.0425
	8	0.9059	0.0497	0.0443
	9	0.9026	0.0516	0.0458
	10	0.8999	0.0531	0.0470
Ln WS ODA pc	0	0.0000	0.0000	0.0000
	1	0.0114	0.9886	0.0000
	2	0.0103	0.9839	0.0059
	3	0.0101	0.9813	0.0086
	4	0.0106	0.9799	0.0095
	5	0.0114	0.9788	0.0098
	6	0.0123	0.9777	0.0100
	7	0.0133	0.9767	0.0100
	8	0.0142	0.9757	0.0101
	9	0.0151	0.9747	0.0102
	10	0.0159	0.9738	0.0102
Ln HE ODA pc	0	0.0000	0.0000	0.0000
	1	0.0020	0.0097	0.9882
	2	0.0021	0.0097	0.9882
	3	0.0028	0.0098	0.9874
	4	0.0037	0.0098	0.9864
	5	0.0046	0.0099	0.9855
	6	0.0054	0.0100	0.9846
	7	0.0063	0.0100	0.9837
	8	0.0070	0.0101	0.9829
	9	0.0078	0.0101	0.9821
	10	0.0085	0.0102	0.9814

4.8.4. PVAR Postestimation. Dep. Var. access to sanitation

Dependent variable: urban access to sanitation

Granger causality Wald test

Equation	Excluded	chi2	df	Prob > chi2
Access to sanitation	Ln WS ODA pc	8.284	1	0.004
	Ln HE ODA pc	15.67	1	0
	All	20.245	2	0
Ln WS ODA pc	Access to sanitation	5.175	1	0.023
	Ln HE ODA pc	2.243	1	0.134
	All	6.697	2	0.035
Ln HE ODA pc	Access to sanitation	3.819	1	0.051
	Ln WS ODA pc	0.001	1	0.974
	All	4.371	2	0.112

Ho: Excluded variable does not Granger-cause Equation variable
Ha: Excluded variable Granger-causes Equation variable

Eigenvalue stability condition

Eigen. Real	Eigen. Imaginary	Modulus
0.9643638	0	0.9643638
0.3981449	0	0.3981449
0.2617603	0	0.2617603

All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variable		
		Access to sanitation	Ln WS ODA pc	Ln HE ODA pc
Access to sanitation	0	0.0000	0.0000	0.0000
	1	1.0000	0.0000	0.0000
	2	0.9862	0.0048	0.0090
	3	0.9742	0.0095	0.0164
	4	0.9658	0.0129	0.0213
	5	0.9600	0.0153	0.0247
	6	0.9560	0.0170	0.0270
	7	0.9530	0.0183	0.0287
	8	0.9507	0.0192	0.0300
	9	0.9490	0.0200	0.0310
	10	0.9476	0.0206	0.0318
Ln WS ODA pc	0	0.0000	0.0000	0.0000
	1	0.0815	0.9185	0.0000
	2	0.0770	0.9183	0.0047
	3	0.0750	0.9180	0.0070
	4	0.0752	0.9170	0.0079
	5	0.0764	0.9154	0.0082
	6	0.0780	0.9136	0.0084
	7	0.0797	0.9118	0.0085
	8	0.0813	0.9101	0.0086
	9	0.0829	0.9085	0.0086
	10	0.0843	0.9070	0.0087
Ln HE ODA pc	0	0.0000	0.0000	0.0000
	1	0.0323	0.0384	0.9293
	2	0.0303	0.0386	0.9311
	3	0.0309	0.0387	0.9304
	4	0.0323	0.0387	0.9290
	5	0.0338	0.0387	0.9275
	6	0.0353	0.0387	0.9261
	7	0.0366	0.0386	0.9247
	8	0.0378	0.0386	0.9235
	9	0.0390	0.0386	0.9224
	10	0.0401	0.0386	0.9213

Dependent variable: rural access to sanitation

Granger causality Wald test

Equation	Excluded	chi2	df	Prob > chi2
Access to sanitation	Ln WS ODA pc	9.104	1	0.003
	Ln HE ODA pc	22.343	1	0
	All	27.865	2	0
Ln WS ODA pc	Access to sanitation	3.225	1	0.073
	Ln HE ODA pc	1.485	1	0.223
	All	6.103	2	0.047
Ln HE ODA pc	Access to sanitation	1.909	1	0.167
	Ln WS ODA pc	0.004	1	0.953
	All	2.378	2	0.305

Ho: Excluded variable does not Granger-cause Equation variable
Ha: Excluded variable Granger-causes Equation variable

Eigenvalue stability condition

Eigen. Real	Eigen. Imaginary	Modulus
0.9622816	0	0.9622816
0.3997211	0	0.3997211
0.2868556	0	0.2868556

All the eigenvalues lie inside the unit circle. PVAR satisfies stability condition.

Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variable		
		Access to sanitation	Ln WS ODA pc	Ln HE ODA pc
Access to sanitation	0	0.0000	0.0000	0.0000
	1	1.0000	0.0000	0.0000
	2	0.9824	0.0052	0.0124
	3	0.9670	0.0101	0.0229
	4	0.9563	0.0137	0.0299
	5	0.9491	0.0163	0.0347
	6	0.9439	0.0181	0.0379
	7	0.9402	0.0195	0.0403
	8	0.9374	0.0205	0.0421
	9	0.9352	0.0213	0.0435
	10	0.9335	0.0219	0.0446
Ln WS ODA pc	0	0.0000	0.0000	0.0000
	1	0.0335	0.9665	0.0000
	2	0.0304	0.9650	0.0046
	3	0.0297	0.9633	0.0071
	4	0.0304	0.9615	0.0080
	5	0.0318	0.9598	0.0084
	6	0.0333	0.9580	0.0087
	7	0.0348	0.9564	0.0088
	8	0.0363	0.9548	0.0089
	9	0.0376	0.9534	0.0090
	10	0.0389	0.9521	0.0091
Ln HE ODA pc	0	0.0000	0.0000	0.0000
	1	0.0007	0.0079	0.9915
	2	0.0009	0.0080	0.9911
	3	0.0017	0.0080	0.9903
	4	0.0026	0.0081	0.9894
	5	0.0035	0.0081	0.9885
	6	0.0043	0.0081	0.9876
	7	0.0050	0.0081	0.9868
	8	0.0058	0.0081	0.9861
	9	0.0064	0.0082	0.9854
	10	0.0070	0.0082	0.9848

5. General conclusions

5.1. The impact of foreign aid on health, water, and sanitation

This study pursued three main objectives that in combination make up a comprehensive assessment of both direct and indirect effects that ODA might have had during the period 1990-2015 on a series of indicators related to health in a large set of developing countries. The first aim was to assess the impact of ODA on a set of indicators relevant to health-related MDGs, namely: 1) the under-five mortality rate; 2) the under-one mortality rate; 3) the maternal mortality ratio; 4) HIV prevalence in females; 5) the contraceptive prevalence rate; 6) the incidence of malaria; and 7) the incidence of tuberculosis. Second, as access to safe drinking water and basic sanitation has been found to be closely related to some of the aforementioned indicators (particularly child and maternal mortality), the second aim of this study was to test whether ODA had, on average, any impact on the evolution of the rates of access to water and sanitation in developing countries as a group. Finally, inasmuch as an important consideration for global development is the reduction of inequality within and among countries, and an essential manifestation of within-country inequality is the existence of an urban-rural gap in access to water and sanitation (section 4.1.2), the third and final aim of this study was to test whether foreign aid had a differentiated impact on access to water and sanitation in rural and urban settings.

Regarding the first aim, and according to the results from fixed effects panel data models, the average impact of health-targeted ODA would amount to a reduction in national under-five mortality (U5) figures equivalent to 0.5–38% of the actual reduction observed in the MDG era, with a confidence of 95%. A similar impact (1.3–30.3%) is found on under-one mortality (U1) rates, with a confidence of 90%. Although the impact on U1 is somewhat less clear in statistical terms than the effect on U5, they are fairly comparable in magnitude.

ODA might also have been responsible, on average, for 0.9–10% of the reductions observed in national maternal mortality ratios in the MDG era. Regarding female HIV prevalence, even if aid was unable to stop its rise between 1990 and 2015, the results suggest that this increase was lower than it would have been in the absence of aid targeted to the fight against sexually transmitted diseases. This type of ODA has also been found to have a positive impact on the prevalence of modern contraceptive practices, and to be effective in reducing the incidence of tuberculosis. The fight against malaria seems also supported by health-targeted ODA, with increases in aid associated to reduced incidence rates.

As for the relation of ODA with access to water and sanitation, this has been found to be of a dynamic nature, meaning that the impacts of aid accumulate over time and are expected to be persistent in the medium term. The findings from PVAR models suggest that both ODA for water and sanitation infrastructure and ODA for the promotion of

hygienic practices seem to have a positive and persistent impact on the use of safe water supply services. Nonetheless, evidence has been found that it is necessary to pay closer attention to the maintenance of infrastructures already built if the achievements are to be sustained permanently. Thus, sustainability proves an important factor to be addressed in the immediate future. As for the impact of ODA for infrastructure on access to sanitation, no general rule has been found. It is commonly known that this sector has been under-considered in comparison to water supply, which might account for that result.

Finally, regarding the third and last aim of this study, the findings suggest that ODA for water and sanitation infrastructure had a greater impact in rural than in urban areas and contributed to the reduction of the urban-rural gaps in access to water and sanitation. Nonetheless, this contribution is expected to have been small, with other factors (which have yet to be studied) being the likely main determinants in the evolution of the urban-rural gap in access to water.

All in all, then, the findings of this study suggest that both aid targeted to the health sector and aid targeted to the water and sanitation sector had, on average, an impact on the evolution of their respective target variables in a large set of developing countries during the period 1990-2015. Thus, these would have contributed, at least to some extent, to the progress observed during the MDG era. Moreover, regarding the impact of ODA on access to water and sanitation, not only does aid seem to have contributed to reducing inequalities among countries, but also within-country inequalities between urban and rural areas. As the fight against inequalities has been given a central role in the 2030 Agenda, efforts in the water and sanitation sector may be crucial if the SDGs are to be achieved.

In conclusion, the results presented here provide evidence in favor of a positive role of ODA in achieving the goals related to health and access to water and sanitation set by the global development agenda. Some issues must certainly be addressed. However, ODA is observed as generally effective in reducing child and maternal mortality, HIV prevalence, and the incidence of malaria and tuberculosis, and in promoting modern contraceptive practices and access to water and sanitation. Even though the conclusions of a panel study like this should be used only with great caution to inform policy advice for a particular country, the results provide evidence that ODA has indeed been effective on average, and the probability that it may have had no impact (or even caused harm, as some studies have suggested) is low. While it is true that the estimated effects of ODA are generally found to be small, the confidence intervals are large, accounting for up to a third of improvements in some cases. That should not be ignored when faced with a development agenda that will require the use of all available means. In this context, the role of ODA in promoting development should not be underestimated.

5.2. Public policy evaluation and foreign aid

The results provided by this study add evidence to the idea that foreign aid can contribute to achieving the goals established in the global development agenda. The ability of aid to assist in this regard has been questioned since its very inception, but criticisms have not always come as a result of careful evaluation. This study has been carried out from the conviction that the improvement of foreign aid, as with other public policies, is possible only through evidence-based policy making, and that evaluation is a key component of that process.

Evaluation is a fundamental phase of the public policy management cycle. Since the outputs of public policies are not exchanged in the market, prices cannot be expected to transmit any information on the contribution of public policies to social welfare. For this reason, these policies must be subject to evaluation if accountability is to be ensured. And while this is true of any public policy, it is even more important in the case of foreign aid, which represents a particular case of imperfect information: the recipients lack the ability to demand accountability from the donor, and taxpayers from the donor country (the principal) are rarely aware of the outcomes of disbursements made abroad by development agencies (the agents). Furthermore, evaluation encourages learning, insofar as it allows subsequent decisions to be based on empirical evidence. This is also crucial for development projects, inasmuch as the acquisition of knowledge around local realities is often a prerequisite for success (Alonso, 2012).

The evaluation of foreign aid's impact at the macro level is long established, and the scholarly literature on the subject has made significant progress since its beginnings in the 1970s. Theoretical grounds as well as statistical methods have been refined, and different lines of research have been explored, sometimes leading to dead ends. Among the lessons learned is that aid has many different objectives, and hence its effects are also expected to be heterogeneous. This thesis contributes to the field by pursuing a path which focuses on the impact that specific components of aid are intended to have on their respective target variables. In this way, causal pathways are easier to detect, and the results are easier to interpret. Although there is still a long way to go, the results provided by this thesis suggest that this line of research can be fruitful and can lead to findings that are more meaningful for policymakers and development agencies.

5.3. Limitations and future research

Every study on aid effectiveness must face a series of difficulties that inevitably limit the reliability of its results. As an example, it is commonly known that national capacities for reporting and registering data differ widely among developing countries, which compromises the accuracy of data. Thus, although the collection and reporting of data have improved over the past decades, information on health-related indicators is often

unreliable in developing countries, and further improvement is needed in order to ensure the validity of empirical studies. Better data from donors on ODA disaggregated by urban/rural areas are also needed in order to perform future evaluations of the role played by ODA in the evolution of spatial inequalities in access to water and sanitation. While the fight against inequality 'within and among countries' (SDG 10) is one of the key policy challenges of our time, data that permit to address developmental questions related to inequality are particularly scarce. This issue must be dealt with swiftly if effective delivery of the 2030 Agenda is to be achieved.

Not only empirical but also theoretical improvements are urgently needed. The literature on aid effectiveness largely lacks a sound theoretical framework to identify causal relations between the variables of interest. In this regard, the evaluation of aid effectiveness at the sectoral level (health, education, etc.) makes it easier to define cause-effect relationships than is the case vis-à-vis the effects of overall aid on aggregate socioeconomic indicators, such as economic growth. However, even if this study has sought to set the basics for a theoretical understanding of the causal mechanisms between ODA and access to water and sanitation, further development is essential. Factors related to people's preferences, culture, values, and customs, must be better incorporated into the explanatory models of use of basic services. This will require further commitment to multidisciplinary studies where economics and other social sciences such as sociology, politology, and anthropology, converge. As socio-economic, political, and cultural factors vary across countries and regions, qualitative case and area studies will also be needed in order to gain a contextually sensitive understanding of the local factors that could influence the use of basic services and the impact of aid. Finally, comparative studies should be done to find out the extent to which local factors differ across a range of contexts, thus possibly leading to different outcomes. This is critical in order to inform policy advice for a particular region or country.

Both empirical and theoretical advancements will allow to extend improved research on aid effectiveness to the post-2015 era as the implementation of the current 2030 Agenda progresses. Although the SDGs are generally considered to be better designed than their predecessors, their definition was not carried out without criticism, and careful evaluation will remain essential if the new goals are to be achieved.

6. Bibliography

Abellán, J. (2017). Water supply and sanitation services in modern Europe: developments in 19th-20th centuries. *XII International Congress of the Spanish Association of Economic History*. Salamanca. Retrieved from https://www.aehe.es/wp-content/uploads/2016/01/Javier-Abell%E2%80%A0n.pdf

Abir, T., Agho, K. E., Page, A. N., Milton, A. H., and Dibley, M. J. (2015). Risk factors for under-5 mortality: evidence from Bangladesh Demographic and Health Survey, 2004–2011. *BMJ Open, 5*(8), e006722. doi:10.1136/bmjopen-2014-006722

Abrigo, M. R., and Love, I. (2016). Estimation of panel vector autoregression in Stata. *The Stata Journal, 16*(3), 778-804.

Adams, E. A., and Smiley, S. L. (2018). Urban-rural water access inequalities in Malawi: implications for monitoring the Sustainable Development Goals. *Natural Resources Forum, 42*(4), 217-226. doi:10.1111/1477-8947.12150

Addison, T., and Baliamoune-Lutz, M. (2017). Aid, the real exchange rate and why policy matters: the cases of Morocco and Tunisia. *Journal of Development Studies, 53*(7), 1104-1121. doi:10.1080/00220388.2017.1303673

Addison, T., Morrissey, O., and Tarp, F. (2017). The macroeconomics of aid: overview. *Journal of Development Studies, 53*(7), 987-997. doi:10.1080/00220388.2017.1303669

Ahmed, M. (2020). Does state capacity matter for foreign aid effectiveness? Panel data evidence on water from 87 countries. *Water International, 45*(5), 479-496. doi:10.1080/02508060.2020.1774317

Alkema, L., and New, J. R. (2014). Global estimation of child mortality using a Bayesian B-spline Bias-reduction model. *The Annals of Applied Statistics, 8*(4), 2122-2149. doi:10.1214/14-AOAS768

Alonso, J. A. (2012). From aid to global development policy. *DESA Working Papers, 121*.

Alonso, J. A. (2012). La evaluación en la cooperación internacional para el desarrollo. *Presupuesto y Gasto Público, 68*, 239-255.

Alonso, J. A. (2014). Eficacia agregada de la ayuda: incidencia sobre el crecimiento del receptor. *Revista de Evaluación de Programas y Políticas Públicas, 3*, 154-188.

Alonso, J. A., and Garcimartín, C. (2011). El impacto de la ayuda internacional sobre la calidad de las instituciones. *Ekonomiaz, 77*, 155-175.

Alonso, J. A., and Ocampo, J. A. (2015). *Global governance and rules for the post-2015 era.* London: Bloomsbury Academic. doi:10.5040/9781472580740

Alzúa, M. L., Djebbari, H., and Pickering, A. J. (2020). A community-based program promotes sanitation. *Economic Development and Cultural Change, 68*(2), 357-390. doi:10.1086/701214

Amin, S. (2006). The Millennium Development Goals: a critique from the South. *Monthly Review, 57*(10), 1-15. doi:10.14452/MR-057-10-2006-03_1

Anand, P. B. (2006). Millenium development goal 7: an assessment of progress with respect to water and sanitation: legacy, synergy, complacency or policy? *UNU-WIDER Research Papers, 2006/01*. Helsinki: UNU-WIDER. Retrieved from https://www.wider.unu.edu/sites/default/files/rp2006-01.pdf

Andriano, L., and Monden, C. W. (2019). The causal effect of maternal education on child mortality: evidence from a quasi-experiment in Malawi and Uganda. *Demography, 56*, 1765-1790. doi:10.1007/s13524-019-00812-3

Annan, K. A. (2000). *We the people: the role of the United Nations in the 21st century.* New York: United Nations. Retrieved from https://www.un.org/en/events/pastevents/pdfs/We_The_Peoples.pdf

Arellano, C., Bulir, A., Lane, T., and Lipschitz, L. (2009). The dynamic implications of foreign aid and its variability. *Journal of Development Economics, 88*, 87-102.

Arndt, C. H., Jones, S., and Tarp, F. (2009). Aid and growth. Have we come full circle? *Discussion Papers, 2009/05*. Helsinki: UNU-WIDER.

Arndt, C., Jones, S., and Tarp, F. (2011). *Aid effectiveness: opening the black box.* Helsinki: UNU-WIDER Working Papers, 2011/44.

Arndt, C., Jones, S., and Tarp, F. (2015). Assessing foreign aid's long-run contribution to growth and development. *World Development, 69*, 6-18. doi:10.1016/j.worlddev.2013.12.016

Arndt, C., Jones, S., and Tarp, F. (2016). What is the aggregate economic rate of return to foreign aid? *World Bank Economic Review, 30*(3), 446–474. doi:https://doi.org/10.1093/wber/lhv033

Augsburg, B., and Rodríguez-Lesmes, P. A. (2018). Sanitation and child health in India. *World Development, 107*, 22-39. doi:10.1016/j.worlddev.2018.02.005

Ayele, D. G., Zewotir, T. T., and Mwambi, H. G. (2012). Prevalence and risk factors of malaria in Ethiopia. *Malaria Journal, 11*, 195. doi:10.1186/1475-2875-11-195

Ayele, D. G., Zewotir, T. T., and Mwambi, H. G. (2013). Spatial distribution of malaria problem in three regions of Ethiopia. *Malaria Journal, 12*, 207. doi:10.1186/1475-2875-12-207

Bado, A. R., and Susuman, A. S. (2016). Women's education and health inequalities in under-five mortality in selected sub-Saharan African countries, 1990–2015. *PLoS ONE, 11*(7), e0159186. doi:10.1371/journal.pone.0159186

Bain, R., Luyendijk, R., and Bartram, J. (2013). Universal access to drinking water: the role of aid. *WIDER Working Papers, 2013/88.* Helsinki: UNU-WIDER.

Bartram, J., Brocklehurst, C., Fisher, M. B., Luyendijk, R., Hossain, R., Wardlaw, T., and Gordon, B. (2014). Global monitoring of water supply and sanitation: history, methods and future challenges. *International Journal of Environmental Research and Public Health, 11,* 8137-8165. doi:10.3390/ijerph110808137

Bhaumik, S. K. (2005). Does the World Bank have any impact on human development of the poorest countries? Some preliminary evidence from Africa. *Economic systems, 29,* 422-432.

Birchler, K., and Michaelowa, K. (2013). Making aid work for education in developing countries. *WIDER Working Papers, 2013/021.* Helsinki: UNU-WIDER.

Bird, G., and Choi, Y. (2020). The effects of remittances, foreign direct investment, and foreign aid on economic growth: an empirical analysis. *Review of Development Economics, 24*(1), 1-30. doi:10.1111/rode.12630

Boone, P. (1996). Politics and the effectiveness of foreign aid. *European Economic Review, 40*(2), 289-329. doi:10.1016/0014-2921(95)00127-1

Botting, M. J., Porbeni, E. O., Joffres, M. R., Johnston, B. C., Black, R. E., and Mills, E. J. (2010). Water and sanitation infrastructure for health: the impact of foreign aid. *Globalization and health, 6,* 12. doi:10.1186/1744-8603-6-12

Bourguignon, F., and Sundberg, M. (2007). Aid effectiveness: opening the black box. *American Economic Review, 97*(2), 316-321. doi:10.1257/aer.97.2.316

Brabin, B. J. (1991). *The risk and severity of malaria in pregnant women: applied field research in malaria reports.* Geneva: UNDP/World Bank/WHO.

Brockerhoff, M. (1995). Child survival in big cities: the disadvantages of migrants. *Social Science and Medicine, 40*(10), 1371-1383. doi:10.1016/0277-9536(94)00268-X

Burguet, R., and Soto, M. (2012). Measuring the child mortality impact of official aid for fighting infectious diseases, 2000-2010. *Barcelona GSE Working Paper Series, 616.*

Burnside, C., and Dollar, D. (2000). Aid, growth, the incentive regime, and poverty reduction. In C. L. Gilbert, and D. Vines, *The World Bank: structure and policies* (pp. 210-227). Cambridge, UK: Cambridge University Press.

Burnside, C., and Dollar, D. (2000a). Aid, policies and growth. *American Economic Review, 90*(4), 847-868.

Burnside, C., and Dollar, D. (2004). Aid, policies, and growth: revisiting evidence. *Policy Research Papers, 2834.* Washington DC: World Bank.

Cai, L., and Chongsuvivatwong. (2006). Rural-urban differentials of premature mortality burden in south-west China. *International Journal for Equity in Health, 5*(13). doi:10.1186/1475-9276-5-13

Cairncross, S., Hunt, C., Boisson, S., Bostoen, K., Curtis, V., Fung, I. C., and Schmidt, W.-P. (2010). Water, sanitation and hygiene for the prevention of diarrhoea. *International Journal of Epidemiology, 39*(S1), i193–i205. doi:10.1093/ije/dyq035

Caldwell, J. C. (1979). Education as a factor in mortality decline: an examination of Nigerian data. *Population Studies, 33*(3), 395-413.

Campbell, O. M., Benova, L., Gon, G., Afsana, K., and Cumming, O. (2015). Getting the basic rights – the role of water, sanitation and hygiene in maternal and reproductive health: a conceptual framework. *Tropical Medicine and International Health, 20*(3), 252–267. doi:10.1111/tmi.12439

Chapman, J. (2019). The contribution of infrastructure investment to Britain's urban mortality decline, 1861-1900. *Economic History Review, 72*(1), 233-259.

Chauvet, L., Gubert, F., and Mesplé-Somps, S. (2013). Aid, remittances, medical brain drain and child mortality: evidence using inter and intra-country data. *Journal of Development Studies, 49*(6), 801-818. doi:10.1080/00220388.2012.742508

Chen, S., and Ravallion, M. (2012). More relatively-poor people in a less absolutely-poor world. *Policy Research Working Papers, 6114.* Washington DC: World Bank.

Cheng, J. J., Schuster-Wallace, C. J., Watt, S., Newbold, B. K., and Mente, A. (2012). An ecological quantification of the relationships between water, sanitation and infant, child, and maternal mortality. *Environmental health, 11*, 4. doi:10.1186/1476-069X-11-4

Chintalapati, P. (2020). *Maintenance approaches to improve the sustainability of rural water supplies.* Sustainable WASH Systems Learning Partnership. Retrieved from https://files.globalwaters.org/water-links-files/Maintenance%20Approaches%20to%20Improve%20the%20Sustainability%20of%20Rural%20Water%20Supplies.pdf

Choudhary, N., Brewis, A., and Wutich, A. U. (2020). Sub-optimal household water access is associated with greater risk of intimate partner violence against women: evidence from Nepal. *Water and health, 18*(4), 579–594. doi:10.2166/wh.2020.024

Clemens, M. A., Radelet, S., Bhavnani, R. R., and Bazzi, S. (2012). Counting chickens when they hatch: timing and the effects of aid on growth. *The Economic Journal, 122*(561), 590-617. doi:10.1111/j.1468-0297.2011.02482.x

Collier, P., and Dehn, J. (2001). Aid, shocks, and growth. *Working Papers, 2688.* Washington DC: World Bank.

Collier, P., and Hoeffler, A. (2004). Aid, policy and growth in post-conflict societies. *European Economic Review, 48*, 1124-1145.

Corbett, E. L., Watt, C. J., Walker, N., Maher, D., Williams, B. G., Raviglione, M. C., and Dye, C. (2003). The growing burden of tuberculosis global trends and interactions with the HIV epidemic. *Archives of Internal Medicine, 163*, 1009-2021. doi:10.1001/archinte.163.9.1009

CRS. (2018). *Technical Guide to terms and data in the Creditor Reporting System (CRS) Aid Activities database*. Retrieved from https://www.oecd.org/dac/stats/crsguide.htm

Cuesta, J., and Maratou-Kolias, L. (2019). WASH and nutrition synergies: the case of Tunisia. *The Journal of Development Studies, 55*(9), 2024-2045. doi:10.1080/00220388.2018.1516870

Curtis, V., and Cairncross, S. (2003). Effect of washing hands with soap on diarrhoea risk in the community: a systematic review . *The Lancet Infectious Diseases, 3*(5), 275-281. doi:10.1016/s1473-3099(03)00606-6

Cutler, D., and Miller, G. (2005). The role of public health improvements in health advances: the twentieth-century United States. *Demography, 42*, 1-22.

DAC. (1995). *Summary of the Thirty-Third High Level Meeting, held on 3-4 May 1995 at the Chateau de la Muette, Paris. DCD/DAC/M(95)4/PROV.* Paris: OECD.

DAC. (1996). *Shaping the 21st century: the contribution of development cooperation.* OECD. Retrieved from https://www.oecd.org/dac/2508761.pdf

D'Aiglepierre, R., and Wagner, L. (2010). Aid and universal primary education. *CERDI Etudes et Documents, E2010.22.* Clermont-Ferrand.

Dalgaard, C.-J., Hansen, H., and Tarp, F. (2004). On the empirics of foreign aid and growth. *The Economic Journal, 114*(496), 191-216.

Dang, H.-A., Knack, S., and Rogers, H. (2010). International aid and financial crises in donor countries. *Policy Research Working Papers, 5162.*

De Feo, G., Antoniou, G., Fardin, H., El-Gohary, F., Zheng, X., Reklaityte, I., . . . Angelakis, A. N. (2014). The historical development of sewers worldwide. *Sustainability, 6*, 3936-3974.

Devoto, F., Duflo, E., Dupas, P., Parienté, W., and Pons, V. (2012). Happiness on tap: piped water adoption in urban Morocco. *American Economic Journal: Economic Policy, 4*(4), 68-99. doi:10.1257/pol.4.4.68

Dickinson, K. L., Patil, S. R., Pattanayak, S. K., Poulos, C., and Yang, J.-H. (2015). Nature's call: impacts of sanitation choices in Orissa, India. *Economic Development and Cultural Change, 64*(1), 1-29.

Díez, M., and Ezquerra, I. (2018). Un recorrido por la dimensión cultural del agua. Consejos para futuras intervenciones de cooperación al desarrollo. *DisTecD. Diseño y Tecnología para el Desarrollo, 5*, 5-19. Retrieved from http://polired.upm.es/index.php/distecd/article/view/3739/3825

Djankov, S., García-Montalvo, J., and Reynal-Querol, M. (2008). The curse of aid. *Journal of Economic Growth, 13*, 169-194.

Doucouliagos, H., and Paldam, M. (2008). Aid effectiveness on growth: a meta study. *European Journal of Political Economy, 24*(1), 1-24.

Dreher, A., Eichenauer, V. Z., and Gehring, K. (2013). Geopolitics, aid and growth. *CESifo Working Paper Series, 4299.*

Dreher, A., P., N., and Thiele, R. (2008). Does aid for education educate children? Evidence from panel data. *World Bank Economic Review, 22*, 291-314.

Easterly, W. (2006). *The white man's burden: why the West's efforts to aid the rest have done so much ill and so little good.* Oxford: Oxford University Press.

Easterly, W., Levine, R., and Roodman, D. (2004). New data, new doubts: a comment on Burnside and Dollars 'Aid, policies and growth'. *American Economic Review, 94*(3), 774-780.

Economides, G., Kalyvitis, S., and Philppopoulos, A. (2008). Does foreign aid distort incentives and hurt growth? Theory and evidence from 75 aid-recipient countries. *Public Choice, 134*(3), 463-488.

Edward, P., and Summer, A. (2013). Estimating the scale and geography of global poverty now and in the future: how much difference do method and assumptions make? *World Development, 58*, 67-82.

Emmerij, L., Jolly, R., and Weiss, T. G. (2001). *Ahead of the curve? UN ideas and global challenges.* Bloomington, IN: Indiana University Press.

En, W. L., and Gan, G. L. (2011). Factors associated with use of improved water sources and sanitation among rural primary schoolchildren in Pursat Province, Cambodia . *Southeast Asian Journal of Tropical Medicine and Public Health, 42*(4), 1022-1031. Retrieved from https://pubmed.ncbi.nlm.nih.gov/22299486/

Ennis-McMillan, M. C. (2001). Suffering from water: social origins of bodily distress in a Mexican community. *Medical Anthropology Quarterly, 15*(3), 368-390. doi:10.1525/maq.2001.15.3.368

Esrey, S. A., Habicht, J.-P., Latham, M. C., Sisler, D. G., and Casella, G. (1988). Drinking water source, diarrheal morbidity, and child growth in villages with both traditional and improved water supplies in rural Lesotho, Southern Africa. *American Journal of Public Health, 78*(11), 1451-1455. doi:10.2105/AJPH.78.11.1451

Esrey, S. A., Potash, J. B., Roberts, L., and Shiff, C. (1991). Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma . *Bulletin of the World Health Organization, 69*(5), 609-621.

Eyben, R. (2006). The road not taken: international aid's choice of Copenhagen over Beijing. *Third World Quarterly, 27*(4), 595-608.

Ezechi, O., Petterson, K. O., and Byamugisha, J. (2012). HIV/AIDS, tuberculosis, and malaria in pregnancy. *Journal of Pregnancy, 2012*, 140826. doi:10.1155/2012/140826

Ezzati, M., Lopez, A. D., Rodgers, A., Hoorn, S. V., and Murray, C. J. (2002). Selected major risk factors and global and regional burden of disease. *Lancet, 2*(360), 1347-1360. doi:10.1016/S0140-6736(02)11403-6

Fehling, M., Nelson, B. D., and Venkatapuram, S. (2013). Limitations of the Millennium Development Goals: a literature review. *Global Public Health, 8*(10), 1109-1122. doi:10.1080/17441692.2013.845676

Fernández Milán, B. (2017). Clean water and sanitation for all: interactions with other sustainable development goals. *Sustainable Water Resources Management, 3*, 479–489. doi:10.1007/s40899-017-0117-4

Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, L., and Colford, J. M. (2005). Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases, 5*(1), 42-52. doi:10.1016/S1473-3099(04)01253-8

Fielding, D. (2010). Aid and Dutch disease in the South Pacific and in other small island states. *Journal of Development Studies, 46*(5), 918-940. doi:10.1080/00220381003623855

Fielding, D., Mark, M., and Sebastian, T. (2006). A wider approach to aid effectiveness: correlated impacts on health, wealth, fertility and education. *UNU-WIDER Research Papers, 2006/23.* Retrieved from http://hdl.handle.net/10419/63372

Fink, G., Günther, I., and Hill, K. (2011). The effect of water and sanitation on child health: evidence from the demographic and health surveys 1986-2007. *International Journal of Epidemiology, 40*(5), 1196-1204. doi:10.1093/ije/dyr102

Finkelstein, A., Gentzkow, M., and Williams, H. (2016). Sources of geographic variation in health care: evidence from patient migration. *Quarterly Journal of Economics, 131*(4), 1681-1726. doi:10.1093/qje/qjw023

Floris, J., and Staub, K. (2019). Water, sanitation and mortality in Swiss towns in the context of urban renewal in the late nineteenth century. *The History of the Family, 24*(2), 249-276. doi:10.1080/1081602X.2019.1598460

Foster, T., Furey, S., and Banks, B. W. (2019). Functionality of handpump water supplies: a review of data from sub-Saharan Africa and the Asia-Pacific region. *International Journal of Water Resources Development*. doi:10.1080/07900627.2018.1543117

Friedman, W. (2018). Corruption and averting AIDS deaths. *World Development, 110*, 13-25. doi:10.1016/j.worlddev.2018.05.015

Fuller, J. A., Goldstick, J., Bartram, J., and Eisenberg, J. N. (2016). Tracking progress towards global drinking water and sanitation targets: a within and among country analysis. *Science of the Total Environment, 541*(15), 857-864. doi:10.1016/j.scitotenv.2015.09.130

Galiani, S., Knack, S., Xu, L. C., and Zou, B. (2017). The effect of aid on growth: evidence from a quasi-experiment. *Journal of Economic Growth, 22*, 1-33. doi:10.1007/s10887-016-9137-4

Gallardo-Albarrán, D. (2020). Sanitary infrastructures and the decline of mortality in Germany, 1877-1913. *Economic History Review, 73*(3), 730-757. doi:10.1111/ehr.12942

Gasana, J., Morin, J., Ndikuyeze, A., and Kamoso, P. (2002). Impact of water supply and sanitation on diarrheal morbidity among young children in the socioeconomic and cultural context of Rwanda (Africa). *Environmental Research, 90*(2), 76-88. doi:10.1006/enrs.2002.4394

Gerba, C. P., and Pepper, I. L. (2006). Microbial contaminants. In *Environmental and pollution science* (pp. 144-169). Elsevier Science.

Gillanders, R. (2016). The effects of foreign aid in sub-Saharan Africa. *The Economic and Social Review, 47*(3), 339-360.

Gomanee, K., Girma, S., and Morrissey, O. (2005a). Aid, public spending and human welfare: evidence from quantile regressions. *Journal of International Development, 17*, 299-309. doi:10.1002/jid.1163

Gomanee, K., Morrissey, O., Mosley, P., and Verschoor, A. (2005b). Aid, government expenditure, and aggregate welfare. *World Development, 33*(3), 355-370. doi:10.1016/j.worlddev.2004.09.005

Gopalan, S., and Rajan, R. S. (2016). Has foreign aid been effective in the water supply and sanitation sector? Evidence from panel data. *World Development, 85*, 84-104. doi:10.1016/j.worlddev.2016.04.010

Gould, W. T. (1998). African mortality and the new 'urban penalty'. *Health and Place, 4*(2), 171-181. doi:10.1016/S1353-8292(98)00009-4

Graham, J. P., Hirai, M., and Kim, S.-S. (2016). An analysis of water collection labor among women and children in 24 sub-Saharan African countries. *PLoS ONE, 11*(6), e0155981. doi:10.1371/journal.pone.0155981

Granja, A. C., Machungo, F., Gomes, A., Bergström, S., and Brabin, B. (1998). Malaria-related maternal mortality in urban Mozambique. *Annals of Tropical Medicine and Parasitology, 92*(3), 257-263. doi:10.1080/00034983.1998.11813288

Greene Dobbins, E. (2019). Human rights, sanitation, and sewers. *Azafea: Revista de Filosofía, 21*, 129-157. doi:10.14201/azafea201921129157

Gross, E., Günther, I., and Schipper, Y. (2018). Women are walking and waiting for water: the time value of public water supply. *Economic Development and Cultural Change, 66*(3), 489-517. doi:10.1086/696531

Guillaumont, P., and Chauvet, L. (2001). Aid performance: a reassessment. *Journal of Development Studies, 37*(6), 66-92.

GWC. (2020). *COVID-19 and WASH: mitigating the socio-economic impacts on the water, sanitation and hygiene (WASH) sector.* Retrieved from https://www.sanitationandwaterforall.org/sites/default/files/2020-06/COVID%2019%20WASH%20Advocacy_Final-GWC-SWA.pdf

Gyimah-Brempong. (2015). Do African countries get health from health aid? *Journal of African Development, 17*(2), 83-114.

Gyimah-Brempong, K., and Asiedu, E. (2008). Aid and human capital formation: some evidence. *African Development Bank/United Nations Economic Commission for Africa Conference on Globalization, Institutions and Economic Development in Africa.* Tunis.

Hallet, M. (2009). Economic cycles and development aid: what is the evidence from the past? *ECFIN Economic Briefs, 5.*

Hammer, J., and Spears, D. (2016). Village sanitation and child health: effects and external validity in a randomized field experiment in rural India. *Journal of Health Economics, 48*, 135-148. doi:10.1016/j.jhealeco.2016.03.003

Hammerich, A., Campbell, O. M., and Chandramohan, D. (2002). Unstable malaria transmission and maternal mortality: experiences from Rwanda. *Tropical Medicine and International Health, 7*(7), 573-576. doi:10.1046/j.1365-3156.2002.00898.x

Hansen, H., and Tarp, F. (2000). Aid effectiveness disputed. In F. Tarp (Ed.), *Foreign aid and development.* London: Routledge.

Hansen, H., and Tarp, F. (2001). Aid and growth regressions. *Journal of Development Economics, 64*, 547-570.

Heaton, T. B., and Forste, R. (2003). Rural/urban differences in child growth and survival in Bolivia. *Rural Sociology, 68*(3), 410-433. doi:10.1111/j.1549-0831.2003.tb00144.x

Herrera, V. (2019). Reconciling global aspirations and local realities: challenges facing the Sustainable Development Goals for water and sanitation. *World Development, 118,* 106-117. doi:10.1016/j.worlddev.2019.02.009

Herzer, D., and Oliver, M. (2009). The long-run effect of aid on domestic output. *CREDIT Research Papers, 09/01.* University of Nottingham.

Hobcraft, J. (1993). Women's education, child welfare and child survival: a review of the evidence. *Health Transition Review, 3*(2), 159-175.

Hope, R., Thomson, P., Koehler, J., and Foster, T. (2020). Rethinking the economics of rural water in Africa. *Oxford Review of Economic Policy, 36*(1), 171-190.

Hopewell, M. R., and Graham, J. P. (2014). Trends in access to water supply and sanitation in 31 major sub-Saharan African cities: an analysis of DHS data from 2000 to 2012. *BMC Public Health, 14,* 208. doi:10.1186/1471-2458-14-208

Hubbard, R. G., and Duggan, W. (2009). *The aid trap: hard truths about ending poverty*. New York: Columbia Business School Publishing.

Hudson, J. (2015). Consequences of aid volatility for macroeconomic management and aid effectiveness. *World Development, 69,* 62-74. doi:10.1016/j.worlddev.2013.12.010

Hulme, D. (2009). The Millennium Development Goals (MDGs): a short history of the world's biggest promise. *Brooks World Poverty Institute Working Papers, 100.* University of Manchester. Retrieved from http://hummedia.manchester.ac.uk/institutes/gdi/publications/workingpapers/bwpi/bwpi-wp-10009.pdf

Hutton, G., and Varughese, M. (2016). *The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene. Water and Sanitation Program (WSP).* Washington DC: World Bank.

IMF, OECD, UN, and Bank, W. (2000). *A better world for all: progress toward the International Development Goals.* Washington DC: Communications Development/Grundy and Northedge. Retrieved from https://www.imf.org/external/pubs/ft/jointpub/world/2000/eng/bwae.pdf

Inoue, T., and Ogasawara, K. (2020). Chain effects of clean water: The Mills–Reincke phenomenon in early 20th-century Japan. *Economics and Human Biology, 36,* 100822. doi:10.1016/j.ehb.2019.100822

Jaadla, H., and Puur, A. (2016). The impact of water supply and sanitation on infant mortality: individual-level evidence from Tartu, Estonia, 1897-1900. *Population Studies, 70*(2), 163-179. doi:10.1080/00324728.2016.1176237

Jain, P., and Jain, P. (2020). Are the Sustainable Development Goals really sustainable? A policy perspective. *Sustainable Development*. doi:10.1002/sd.2112

Jiménez, A., and Pérez Foguet, A. (2008). International investments in the water sector: last decade evolution and way forward towards MDG. *IWRA World Water Congress. "13th IWRA World Water Congress 2008"*. Montpellier.

Johnson, P., and Papageorgiou, C. (2020). What remains of cross-country convergence? *Journal of Economic Literature, 58*(1), 129-175. doi:10.1257/jel.20181207

Juselius, K., Møller, N. F., and Tarp, F. (2014). The long-run impact of foreign aid in 36 African countries: insights from multivariate time series analysis. *Oxford Bulletin of Economics and Statistics, 76*(2), 153-184. doi:10.1111/obes.12012

Kassebaum, N. J. (2017). Child and adolescent health from 1990 to 2015. *JAMA Pediatrics, 171*(6), 573-592. doi:10.1001/jamapediatrics.2017.0250

Kilby, C., and Dreher, A. (2010). The impact of aid on growth revisited: do donors motives matter? *Economics Letters, 107*(3), 338-340. doi:10.1016/j.econlet.2010.02.015

Kinuthia, G. K., Gicheru, M. M., Ngure, P. K., and Kabiru, E. W. (2012). Lifestyles and practices that enhance malaria and typhoid fever in Njoro District, Kenya. *Journal of Community Health, 37*, 224–233. doi:10.1007/s10900-011-9440-0

Knöbel, H. H., Yang, W.-S., and Ho, M.-S. (1994). Urban-rural and regional differences in infant mortality in Taiwan. *Social Science and Medicine, 39*(6), 815-822. doi:10.1016/0277-9536(94)90043-4

Konadu-Agyemang, K., and Shabaya, J. (2005). What has corruption got to do with it? Understanding the persistence of rural-urban and inter-regional inequalities in Ghana and Zimbabwe. *GeoJournal, 62*(1/2), 129-146. Retrieved from https://www.jstor.org/stable/41147983

Kothari, A., Salleh, A., Escobar, A., Demaria, F., and Acosta, A. (2019). Finding pluriversal paths. In A. Kothari, A. Salleh, A. Escobar, F. Demaria, and A. Acosta, *Pluriverse: a post-development dictionary* (pp. XXI-XL). New Delhi, India: Tulika Books.

Kotsadam, A., Ostby, G., Rustad, S. A., Tollefsen, A. F., and Urdal, H. (2018). Development aid and infant mortality. Micro-level evidence from Nigeria. *World Development, 105*, 59-69. doi:10.1016/j.worlddev.2017.12.022

Krishna, A. (2010). Who became poor, who escaped poverty, and why? Developing and using a retrospective methodology in five countries. *Journal of Policy Analysis and Management, 29*(2), 351-372. doi:10.1002/pam.20495

Kumar, S., and Vollmer, S. (2013). Does access to improved sanitation reduce childhood diarrhea in rural India? *Health Economics, 22*(4), 410-427.

Kwan, C. K., and Ernst, J. D. (2011). HIV and tuberculosis: a deadly human syndemic. *Clinical Microbiology Reviews, 24*(2), 351-376. doi:10.1128/CMR.00042-10

Lalou, R., and LeGrand, T. K. (1997). Child mortality in the urban and rural Sahel. *Population: An English Selection, 9*, 147-168.

Lensink, R., and Morrissey, O. (2000). Aid instability as a measure of uncertainty and the positive impact of aid on growth. *Journal of Development Studies, 36*(3), 30-48.

Lensink, R., and White, H. (2001). Are there negative returns to aid? *Journal of Development Studies, 37*(6), 42-65.

Macassa, G., Ponce de León, A., and Burström, B. (2006). The impact of water supply and sanitation on area differentials in the decline of diarrhoeal disease mortality among infants in Stockholm 1878-1925. *Scandinavian Journal of Public Health, 34*(5), 526-533. doi:10.1080/14034940600551137

Mahasuweerachai, P., and Pangjai, S. (2018). Does piped water improve happiness? A case from Asian rural communities. *Journal of Happiness Studies, 19*, 1329-1346. doi:10.1007/s10902-017-9875-9

Manalew, W. S., and Tennekoon, V. S. (2019). Dirty hands on troubled waters: sanitation, access to water and child health in Ethiopia. *Review of Development Economics, 23*(4), 1800-1817. doi:10.1111/rode.12604

Martínez, J., and Sánchez-Ancochea, D. (2018). Undoing segmentation? Latin American health care policy during the economic boom. *Social Policy and Administration, 52*(6), 1181-1200. doi:10.1111/spol.12434

Martínez-Santos, P. (2017). Does 91 % of the world's population really have 'sustainable access to safe drinking water'? *International Journal of Water Resources Development, 33*(4), 514-533. doi:10.1080/07900627.2017.1298517

Masud, N., and Yontcheva, B. (2005). Does foreign aid reduce poverty? Empirical evidence from nongovernmental and bilateral aid. *IMF Working Papers, WP/05/100.*

Mayor, S. (2004). Pregnancy and childbirth are leading causes of death in teenage girls in developing countries. *BMJ, 328*(7449), 1152. doi:10.1136/bmj.328.7449.1152-a

McGillivray, M. (2003). Modelling aid allocation: issues, approaches and results. *Journal of Economic Development, 28*(1), 171-188.

McGready, R., Boel, M. R., Ashley, E. A., Cho, T., Moo, O. P., Pimanpanarak, M., . . . van Vugt, M. (2012). Effect of early detection and treatment on malaria related maternal mortality on the North-Western Border of Thailand 1986-2010. *PLoS ONE, 7*(7), e40244. doi:10.1371/journal.pone.0040244

McIntyre, J. (2003). Mothers infected with HIV: Reducing maternal death and disability during pregnancy . *British Medical Bulletin, 67*(1), 127–135. doi:10.1093/bmb/ldg012

McIntyre, J. (2005). Maternal health and HIV. *Reproductive Health Matters, 13*(25), 129-135. doi:10.1016/S0968-8080(05)25184-4

Mekasha, T. J., and Tarp, F. (2013). Aid and growth: what meta-analysis reveals. *Journal of Development Studies, 49*(4), 564-583. doi:10.1080/00220388.2012.709621

Menéndez, C., Romagosa, C., Ismail, M. R., Saute, F., Osman, N., Machungo, F., . . . Ordi, j. (2008). An autopsy study of maternal mortality in Mozambique: the contribution of infectious diseases . *PLoS Med, 5*(2), e44. doi:10.1371/journal.pmed.0050044

Michaelowa, K. (2004). Aid effectiveness reconsidered: panel data evidence for the education sector. *HWWA Discussion Papers, 264.* Hamburg.

Minoiu, C., and Reddy, S. G. (2009). Development aid and economic growth: a positive long-run relation. *IMF Working Papers, 09/118.* Washington DC: International Monetary Fund.

MIP. (2014). *The contribution of malaria control to maternal and newborn health.* Geneva: World Health Organization. Retrieved from https://www.mmv.org/sites/default/files/uploads/docs/publications/The_contribution_of_malaria_control_to_maternal_and_newborn_health_3.pdf

Mishra, P., and Newhouse, D. (2009). Does health aid matter? *Journal of Health Economics, 28*(4), 855-872. doi:10.1016/j.jhealeco.2009.05.004

MMEIG. (2015). *Trends in maternal mortality: 1990 to 2015.* Geneva: World Health Organization.

Mofenson, L. M., and Laughon, B. E. (2007). Human Immunodeficiency Virus, Mycobacterium Tuberculosis, and Pregnancy: A Deadly Combination. *Clinical Infectious Diseases, 45*(2), 250-253. doi:10.1086/518975

Mold, A., and Prizzon, A. (2012). The economic crisis and aid. In Alonso, J. Antonio, and J. A. Ocampo (Eds.), *Development cooperation in times of crisis.* New York: Columbia University Press.

Montenegro, F., and Bernal, Ó. (2013). Colombia case study: the subsidized regime of Colombia's National Health Insurance System. *UNICO Studies Series No. 15.* Washington, DC: World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/13285

Mosley, P. (1986). Aid-effectiveness: the micro-macro paradox. *IDS Bulletin, 17*(2), 22-27. doi:10.1111/j.1759-5436.1986.mp17002004.x

Mosley, P. (1987). *Foreign aid: its defense and reform.* Lexington, KY: University Press of Kentucky.

Mosley, W. H., and Chen, L. C. (1984). An analytical framework for the study of child survival in developing countries. *Population and Development Review, 10*(Suppl.), 25-45.

Moyo, D. (2009). *Dead aid. Why aid is not working and how there is a better way for Africa.* New York: Farrat, Straus and Giroux.

Mukherjee, D., and Kizhakethalackal, E. T. (2013). Empirics of health-aid, education and infant mortality: a semiparametric study. *Applied Economics, 45*(22), 3137-3150. doi:10.1080/00036846.2012.699186

Ndikumana, L., and Pickbourn, L. (2017). The impact of foreign aid allocation on access to social services in sub-Saharan Africa: the case of water and sanitation. *World Development, 90*, 104-114. doi:10.1016/j.worlddev.2016.09.001

Nganyanyuka, K., Martínez, J., Wesselink, A., Lungo, J. H., and Georgiadou, Y. (2014). Accessing water services in Dar es Salaam: are we counting what counts? *Habitat International, 44*, 358-366. doi:10.1016/j.habitatint.2014.07.003

Novak, L. (2014). The impact of access to water on child health in Senegal. *Review of Development Economics, 18*(3), 431-444. doi:10.1111/rode.12094

Nowak-Lehmann, F., Dreher, A., Herzer, D., and Klasen, S. (2012). Does foreign aid really raise per capita income? A time series perspective . *Canadian Journal of Economics, 45*(1), 288-313. doi:10.1111/j.1540-5982.2011.01696.x

OECD. (2011). *Aid effectiveness 2005-2010: progress in implementing the Paris Declaration.* Paris: OECD.

OECD. (2016, July 12). *DAC and CRS code lists*. Retrieved from http://www.oecd.org/development/financing-sustainable-development/development-finance-standards/dacandcrscodelists.htm

OECD. (2020). *Technical Guide to terms and data in the Creditor Reporting System (CRS) Aid Activities database* . Retrieved from http://www.oecd.org/dac/stats/crsguide.htm

Ogasawara, K., Shirota, S., and Kobayashi, G. (2016). Public health improvements and mortality in interwar Tokyo: a Bayesian disease mapping approach. *Cliometrica*, 1-31.

Okoi, O., and Bwawa, T. (2020). How health inequality affect responses to the COVID-19 pandemic in Sub-Saharan Africa. *World Development, 135*, 105067. doi:10.1016/j.worlddev.2020.105067

Onda, K., LoBuglio, J., and Bartram, J. (2012). Global access to safe water: accounting for water quality and the resulting impact on MDG progress. *International Journal of Environmental Research and Public Health*, 880-894.

Orgill-Meyer, J., and Pattanayak, S. K. (2020). Improved sanitation increases long-term cognitive test scores. *World Development, 132*, 104975. doi:10.1016/j.worlddev.2020.104975

Pallage, S., and Robe, M. A. (2001). Foreign aid and the business cycle. *Review of International Economics, 9*(4), 641-672.

Peltola, J., and Saaritsa, S. (2019). Later, smaller, better? Water infrastructure and infant mortality in Finnish cities and towns, 1870-1938. *The History of the Family, 24*(2), 277-306. doi:10.1080/1081602X.2019.1598462

Pickbourn, L., and Ndikumana, L. (2013). *Impact of sectoral allocation of foreign aid on gender equity and human development.* UNU-WIDER Working Papers, 2013/066.

Pickbourn, L., and Ndikumana, L. (2013). Impact of sectoral allocation of foreign aid on gender equity and human development. *WIDER Working Papers, 2013/066.* Helsinki: UNU-WIDER.

Pickbourn, L., and Ndikumana, L. (2016). The impact of the sectorial allocation of foreign aid on gender inequality. *Journal of International Development, 28,* 396-411. doi:10.1002/jid.3213

Pickbourn, L., and Ndikumana, L. (2019). Does health aid reduce infant and child mortality from diarrhoea in sub-Saharan Africa? *Journal of Development Studies, 55*(10), 2212-2231. doi:10.1080/00220388.2018.1536264

Pickering, A., Djebbari, H., López, C., Coulibaly, M., and Alzúa, M. L. (2015). Effect of a community-led sanitation intervention on child diarrhoea and child growth in rural Mali: a cluster-randomised controlled trial. *The Lancet Global Health, 3*(11), 701-711. doi:10.1016/S2214-109X(15)00144-8

Prüss-Üstün, A., Bos, R., Gore, F., and Bartram, J. (2008). *Safe water, better health: costs, benefits and sustainability of interventions to protect and promote health.* Geneva: World Health Organization.

Qian, N. (2015). Making progress on foreign aid. *Annual Review of Economics, 7*, 277-308. doi:10.1146/annurev-economics-080614-115553

Rajan, R. G., and Subramanian, A. (2005). What undermines aid's impact on growth? *IMF Working Papers, 05/126.* Washington DC: International Monetary Fund.

Rajan, R. G., and Subramanian, A. (2008). Aid and growth: what does the cross-country evidence really show? *Review of Economics and Statistics, 90*(4).

Rajan, R. G., and Subramanian, A. (2009a). Aid, Dutch disease, and manufacturing growth. *CGD Working Papers, 196.* Washington DC: Center for Global Development.

Rajan, R. G., and Subramanian, A. (2009b). Does aid affect governance? *American Economic Review, 97*(2), 322-327.

Ramin, B. (2009). Slums, climate change and human health in sub-Saharan Africa. *Bulletin of World Health Organization, 87*, 886.

Raviglione, M., and Sulis, G. (2016). Tuberculosis 2015: burden, challenges and strategy for control and elimination. *Infectious Disease Reports, 8*(2), 6570. doi:10.4081/idr.2016.6570

Ray, I. (2020). Handwashing and COVID-19: simple, right there...? *World Development, 135*, 105086. doi:10.1016/j.worlddev.2020.105086

Reidpath, D., and Allotey, P. (2003). Infant mortality rate as an indicator of population health. *Journal of Epidemiology and Community Health, 57*(5), 344–346. doi:10.1136/jech.57.5.344

Reis, N., and Mollinga, P. P. (2012). Water supply or 'beautiful latrines'? Microcredit for rural water supply and sanitation in the Mekong Delta, Vietnam. *ASEAS - Austrian Journal of South-East Asian Studies, 5*(1), 10-29.

Robeyns, I. (2005). The capability approach: a theoretical survey. *Journal of Human Development, 6*(1), 93-114. doi:10.1080/146498805200034266

Roodman, D. (2007a). The anarchy of numbers: aid, development, and cross-country empirics. *CGD Working Papers, 32.* Washington DC: Center for Global Development.

Roodman, D. (2007b). Macro aid effectiveness research: a guide for the perplexed. *CGD Working Papers 134.* Washington DC: Center for Global Development.

Round, J. I., and Odedokun, M. (2004). Aid effort and its determinants. *International Review of Economics and Finance, 13*, 293-309.

Rueda, F., and Gozalo, M. (2015). Ayuda para el comercio en América Latina: adecuación de los donantes a los principios de la Declaración de París. *Boletín Económico de ICE*(3060), 51-60.

Salami, A. O., Stampini, M., Kamara, A. B., Sullivan, C. A., and Namara, R. (2014). Development aid and access to water and sanitation in Sub-Saharan Africa. *Water International, 39*(3), 294-314. doi:10.1080/02508060.2013.876570

Sarbib, J.-L., and Baudouy, J. (2004). Foreword. In A. Wagstaff, and M. Claeson, *Rising to the challenges: the Millennium Development Goals for health* (p. 9). Washington DC: World Bank. Retrieved from http://hdl.handle.net/10986/14954

Sartorius, B. K., and Sartorius, K. (2014). Global infant mortality trends and attributable determinants: an ecological study using data from 192 countries for the period 1990-2011. *Population Health Metrics, 12*, 29. doi:10.1186/s12963-014-0029-6

Sastry, N. (1997). What explains rural-urban differentials in child mortality in Brazil? *Social Science and Medicine, 44*(7), 989-1002. doi:10.1016/S0277-9536(96)00224-9

Schantz-Dunn, J., and Nour, N. M. (2009). Malaria and pregnancy: a global health perspective. *Obstetrics and gynecology, 2*(3), 186-192. Retrieved from https://pubmed.ncbi.nlm.nih.gov/19826576/

Schechter, M. G. (2005). *United Nations Global Conferences.* London: Routledge.

Sclar, G. D., Garn, J. V., Penakalapati, G., Alexander, K. T., Krauss, J., Freeman, M. C., . . . Clasen, T. (2017). Effects of sanitation on cognitive development and school absence: a systematic review. *220*, 917-927. doi:10.1016/j.ijheh.2017.06.010

Selaya, P., and Thiele, R. (2010). Aid and sectoral growth: evidence from panel data. *Journal of Development Studies, 46*(10), 1749-1766. doi:10.1080/00220388.2010.492856

Sen, A. (2002). Why health equity? *Health Economics, 11*(8), 659-666. doi:10.1002/hec.762

Sorenson, S. B., Morssink, C., and Campos, P. A. (2011). Safe access to safe water in low income countries:Water fetching in current times. *Social Science and Medicine, 72*(9), 1522-1526. doi:10.1016/j.socscimed.2011.03.010

Spears, D. (2020). Exposure to open defecation can account for the Indian enigma of child height. *Journal of Development Economics, 146*, 102277. doi:10.1016/j.jdeveco.2018.08.003

Spears, D., and Lamba, S. (2016). Effects of early-life exposure to sanitation on childhood cognitive skills: evidence from India's Total Sanitation Campaign. *Journal of Human Resources, 51*(2), 298-327. doi:10.3368/jhr.51.2.0712-5051R1

Stevenson, E. G., Greene, L. E., Maes, K. C., Ambelu, A., Tesfaye, Y. A., Rheingans, R., and Hadley, C. (2012). Water insecurity in 3 dimensions: an anthropological perspective on water and women's psychosocial distress in Ethiopia. *75*(2), 392-400. doi:10.1016/j.socscimed.2012.03.022

Stewart, C. P., Kariger, P., Fernald, L., Pickering, A. J., Arnold, C. D., Arnold, B. F., . . . Null, C. (2018). Effects of water quality, sanitation, handwashing, and nutritional interventions on child development in rural Kenya (WASH Benefits Kenya): a cluster-randomised controlled trial. *The Lancet Child and Adolescent Health, 2*(4), 269-280. doi:10.1016/S2352-4642(18)30025-7

Svensson, J. (1999). Aid, growth and democracy. *Economics and Politics, 11*(3), 275-297.

Tallman, P. S. (2019). Water insecurity and mental health in the Amazon: economic and ecological drivers of distress. *Economic Anthropology, 6*(2), 304-316. doi:10.1002/sea2.12144

Taylor, E. M., Hayman, R., Crawford, F., Patricia, J., and Smith, J. (2013). The impact of official development aid on maternal and reproductive health outcomes: a systematic review. *PLoS ONE, 8*(2), e56271. doi:10.1371/journal.pone.0056271

Thompson, J. M., Eick, S. M., Dailey, C., Dale, A. P., Mehta, M., Nair, A., . . . Welton, M. (2020). Relationship between pregnancy-assocaited malaria and adverse pregnancy outcomes: a systematic review and meta-analysis. *Journal of Tropical Pediatrics, 66*(3), 327-338. doi:10.1093/tropej/fmz068

Tierney, M. J., Nielson, D. L., Hawkins, D. G., Roberts, J. T., Findley, M. G., Powers, R. M., . . . Hicks, R. L. (2011). More dollars than sense: refining our knowledge of development finance using AidData. *World Development, 39*(11), 1891-1906. doi:10.1016/j.worlddev.2011.07.029

Tofail, F., Fernald, L. C., Das, K. K., Rahman, M., Ahmed, T., Jannat, K. K., . . . Luby, S. P. (2018). Effect of water quality, sanitation, hand washing, and nutritional interventions on child development in rural Bangladesh (WASH Benefits Bangladesh): a cluster-randomised controlled trial. *The Lancet Child and Adolescent Health, 2*(4), 255-268. doi:10.1016/S2352-4642(18)30031-2

UN IGME. (2019). *Explanatory notes: child mortality trend series to 2018.* UN IGME. Retrieved from https://childmortality.org/wp-content/uploads/2019/09/UNIGME-Explanatory-Notes_ENGLISH.pdf

UNDP. (1990). *Human Development Report 1990.* New York: Oxford University Press.

UNDP. (1997). *Human Development Report 1997: human development to eradicate poverty.* Oxford: Oxford University Press.

UNDP. (2015). *The Millennium Development Goals Report.* United Nations. Retrieved from https://www.undp.org/content/undp/en/home/librarypage/mdg/the-millennium-development-goals-report-2015.html

UNDP. (2018). *Human development indices and indicators. 2018 statistical update.* New York: United Nations. Retrieved from http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf

UNICEF/WHO. (2012). *Progress on drinking water and sanitation: 2012 update.* New York: UNICEF and WHO.

United Nations. (1948). *Universal Declaration of Human Rights.* United Nations. Retrieved from https://digitallibrary.un.org/record/666853

United Nations. (2001). *Road map towards the implementation of the United Nations Millennium Declaration.* United Nations General Assembly. Retrieved from https://digitallibrary.un.org/record/448375

United Nations. (2003). *Indicators for monitoring the Millenium Development Goals: definitions, rationale, concepts, and sources.* New York: United Nations.

United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development.* United Nations General Assembly. Retrieved from https://digitallibrary.un.org/record/808134

United Nations. (2016). *The Sustainable Development Goals Report 2016.* United Nations. Retrieved from https://unstats.un.org/sdgs/report/2016/

United Nations. (2017). *Resolution adopted by the General Assembly on 6 July 2017. 71/313. Work of the Statistical Commission pertaining to the 2030 Agenda for Sustainable Development.* United Nations.

United Nations. (2018). *Sustainable Development Goal 6: synthesis report on water and sanitation 2018.* New York: United Nations. Retrieved from https://sustainabledevelopment.un.org/content/documents/19901SDG6_SR2018_web_3.pdf

van de Poel, E., O'Donnell, O., and van Doorslaer, E. (2009). What explains the rural-urban gap in infant mortality: household or community characteristics? *Demography, 46*(4), 827-850. doi:10.1353/dem.0.0074

van Poppel, F., and van der Heijden, C. (1997). The effects of water supply on infant and childhood mortality: a review of historical evidence. *Health Transition Review, 7*, 113-148.

Wackernagel, M., Hanscom, L., and Lin, D. (2017). Making the Sustainable Development Goals consistent with sustainability. *Frontiers in Energy Research, 5*(18). doi:10.3389/fenrg.2017.00018

Wang, L. (2003). Determinants of child mortality in LDCs: empirical findings from demographic and health surveys. *Health Policy, 65*(3), 277-299. doi:10.1016/s0168-8510(03)00039-3

Wayland, J. (2013). *A drop in the bucket? The effectiveness of foreign aid in the water, sanitation, and hygiene (WASH) sector.* Washington DC: American University.

Wayland, J. (2018). Constraints on foreign aid effectiveness in the water, sanitation, and hygiene (WaSH) sector. *Journal of Water, Sanitation and Hygiene for Development, 8*(1), 44-52. doi:10.2166/washdev.2017.095

WDI. (2018, April). *World Development Indicators*, April 2018. Retrieved from https://datatopics.worldbank.org/world-development-indicators/wdi-archives.html

Wei, Y. D. (2015). Spatiality of regional inequality. *Applied Geography, 61*, 1-10. doi:10.1016/j.apgeog.2015.03.013

White, G., Bradley, D., and White, A. (1972). *Drawers of water: domestic water use in East Africa.* Chicago: University of Chicago Press.

White, H. (1992). The macroeconomic impact of development aid: a critical survey. *Journal of Development Studies, 28*(2), 163-240 . doi:10.1080/00220389208422230

WHO. (2004). *Malaria and HIV/AIDS: interactions and implications.* Geneva: World Health Organization. Retrieved from https://www.who.int/malaria/publications/atoz/who_hiv_2004_08/en/

WHO/UNICEF. (2006). *Core questions on drinking water and sanitation for household surveys.* Geneva: World Health Organization. Retrieved from https://www.who.int/water_sanitation_health/monitoring/oms_brochure_core_questionsfinal24608.pdf

WHO/UNICEF. (2008). *Progress on drinking water and sanitation: special focus on sanitation.* WHO/UNICEF. Retrieved from https://www.who.int/water_sanitation_health/monitoring/jmp_report_7_10_lores.pdf

WHO/UNICEF. (2015). *Progress on sanitation and drinking water: 2015 update and MDG assessment.* WHO/UNICEF. Retrieved from https://www.who.int/water_sanitation_health/publications/jmp-2015-update/en/

WHO/UNICEF. (2015). *Water, sanitation and hygiene in health care facilites.* Geneva: World Health Organization. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/154588/9789241508476_eng.pdf;jsessionid=D3BF85E26670C7A06EF62691778E153D?sequence=1

WHO/UNICEF. (2017). *Progress on drinking water, sanitation and hygiene, 2017: update and SDG baselines.* Geneva: World Health Organization. Retrieved from https://www.who.int/mediacentre/news/releases/2017/launch-version-report-jmp-water-sanitation-hygiene.pdf

Williamson, C. R. (2008). Foreign aid and human development: the impact of foreign aid to the health sector. *Southern Economic Journal, 75*(1), 188-207.

Wilson, S. E. (2011). Chasing success: health sector aid and mortality. *World Development, 39*(11), 2032-2043. doi:10.1016/j.worlddev.2011.07.021

Wolf, S. (2007). Does aid improve public service delivery? *Review of World Economics, 143*, 650-672. doi:10.1007/s10290-007-0126-8

Wolf, S. (2009). Water and sanitation for all? Rural versus urban provision. *International Journal of Services, Economics and Management, 1*(4), 358-370.

World Bank. (2016). *WDI Archives*. Retrieved from https://datatopics.worldbank.org/world-development-indicators/wdi-archives.html

World Bank. (2017). *Reducing inequalities in water supply, sanitation, and hygiene in the era of the sustainable development goals.* Washington DC: World Bank. Retrieved from https://openknowledge.worldbank.org/

bitstream/handle/10986/27831/W17075.pdf

World Bank. (2020). *World Development Indicators: people using at least basic sanitation services*. Retrieved from https://databank.worldbank.org/metadataglossary/world-development-indicators/series/SH.STA.BASS.UR.ZS

Wutich, A., and Ragsdale, K. (2008). Water insecurity and emotional distress: coping with supply, access, and seasonal variability of water in a Bolivian squatter settlement. *Social Science and Medicine, 67*(12), 2116-2125. doi:10.1016/j.socscimed.2008.09.042

Yang, D., He, Y., Wu, B., Deng, Y., Li, M., Yang, Q., . . . Liu, Y. (2020). Drinking water and sanitation conditions are associated with the risk of malaria among children under five years old in sub-Saharan Africa: a logistic regression model analysis of national survey data. *Journal of Advanced Research, 21*, 1-13. doi:10.1016/j.jare.2019.09.001

Yaya, S., Bishwajit, G., Okonofua, F., and Uthman, O. A. (2018). Under five mortality patterns and associated maternal risk factors in sub-Saharan Africa: a multi-country analysis. *PLoS ONE, 13*(10), e0205977. doi:10.1371/journal.pone.0205977

Yaya, S., Uthman, O. A., Okonofua, F., and Bishwajit, G. (2019). Decomposing the rural-urban gap in the factors of under-five mortality in sub-Saharan Africa? Evidence from 35 countries. *BMC Public Health, 19*, 616. doi:10.1186/s12889-019-6940-9

Yogo, U. T., and Mallaye, D. (2015). Health aid and health improvement in sub-Saharan Africa: accounting for the heterogeneity between stable states and post-conflict states. *Journal of International Development, 27*, 1178-1196. doi:10.1002/jid.3034

Ziesemer, T. (2016). The impact of development aid on education and health: survey and new evidence for low-income countries from dynamic models. *Journal of International Development, 28*, 1358-1380. doi:10.1002/jid.3223

Zuin, V., Delaire, C., Peletz, R., Cock-Esteb, A., Khush, R., and Albert, J. (2019). Policy diffusion in the rural sanitation sector: lessons from Community-Led Total Sanitation (CLTS). *World Development, 124*, 104643. doi:10.1016/j.worlddev.2019.104643

7. Tables

8. Graphs

9. Figures

10. Acronyms

CRS: Creditor Reporting System

DAC: Development Assistance Committee

FWCW: Fourth World Conference on Women

HE: health education

HIV: human immunodeficiency virus

IDA: International Development Association

IMF: International Monetary Fund

JMP: Joint Monitoring Programme

LIC: low-income country

MDGs: Millennium Development Goals

MIC: middle-income country

MMEIG: Maternal Mortality Estimation Inter-Agency Group

ODA: official development assistance

OECD: Organisation for Economic Cooperation and Development

SDGs: Sustainable Development Goals

STD: sexually transmitted disease

TB: tuberculosis

UN: United Nations

UN IGME: United Nations Inter-Agency Group for Child Mortality Estimation

UNCTAD: United Nations Conference on Trade and Development

UNDP: United Nations Development Programme

UNICEF: United Nations International Children's Emergency Fund

UNFPA: United Nations Population Fund

WDI: World Development Indicators

WHO: World Health Organization

WS: water and sanitation

WSC: World Summit for Children

WSSD: World Summit on Social Development