

## Health and Development : A Circular Causality

Jean-Claude Berthélemy, Josselin Thuilliez

In **Revue d'économie du développement** Volume 21, Issue 2, 2013, pages 119 to 147

ISSN 1245-4060

ISBN 9782804183424

DOI 10.3917/edd.272.0119

Available online at:

-----  
<https://www.cairn-int.info/journal-revue-d-economie-du-developpement-2013-2-page-119.htm>  
-----

How to cite this article:

Jean-Claude Berthélemy, Josselin Thuilliez, «Health and Development : A Circular Causality», *Revue d'économie du développement* 2013/2 (Vol. 21) , p. 119-147

Electronic distribution by Cairn on behalf of De Boeck Supérieur.

© De Boeck Supérieur. All rights reserved for all countries.

Reproducing this article (including by photocopying) is only authorized in accordance with the general terms and conditions of use for the website, or with the general terms and conditions of the license held by your institution, where applicable. Any other reproduction, in full or in part, or storage in a database, in any form and by any means whatsoever is strictly prohibited without the prior written consent of the publisher, except where permitted under French law.

# Health and Development: A Circular Causality

Jean-Claude Berthélemy<sup>1\*</sup>

Josselin Thuilliez<sup>1</sup>

Historically population health improvements and economic development are closely interrelated. The theme “Health and Development” poses indeed a large number of both theoretical and empirical questions, and social policy issues in this area are obvious. The issue of bidirectional causality between health and development has contributed to one of the most lively debates in the last two decades in development economics, with an alternation of mainstreams rather than a real dialogue. We offer four pathways to overcome these limitations, some of which are not new but have not been integrated together: (i) reconcile the microeconomic and macroeconomic analyses, (ii) explore the channels of influence to better resolve the ambiguity of the relationship, (iii) establish a dialogue with the epidemiology and biomedical sciences – the definition of a good or bad health is not neutral in this debate, neither are the health indicators used, (iv) develop a supply side analysis, while so far the demand side has received more attention.

Key words : Health, epidemiology, economic growth, poverty, inequality.

JEL Classification : I15.

## 1 INTRODUCTION

In historical terms, there is a close relationship between improvements in a population’s state of health and economic development. Robert Fogel, who was awarded a Nobel Prize in economics in 1993, points out that since 1700,

---

<sup>1</sup> CES-CNRS, Université Paris 1, Panthéon-Sorbonne, Centre d’économie de la Sorbonne, Maison des Sciences Economiques, 106-112 Boulevard de l’Hôpital, 75013 Paris.

FERDI, Fondation pour les Études et la Recherche sur le Développement International.  
E-mail addresses: jean-claude.berthelemy@univ-paris1.fr; Josselin.Thuilliez@univ-paris1.fr

\* Corresponding author.

we have seen an unprecedented decline in mortality rates and historic economic growth in industrialised countries (Fogel, 1990, 2004, ). Simultaneous technological and physiological advances seem to have resulted in a positive spiral between the “thermodynamic” and “physiological” aspects of economic growth. According to Fogel, the combination of these two effects – namely improving food and increasing the efficiency with which food energy is converted into productive labour – makes it possible to explain 50% of British economic growth since 1790. The explanation he puts forward is relatively simple. An exogenous technological shock in the agricultural sector is thought to have enabled an increase in initial food production, which in turn increased human production capacity based on a thermodynamic effect; this also prompted a decrease in childhood malnutrition and consequently, lower prevalence of chronic illnesses, an increase in levels of basic education and an improvement in public health. These last three factors then combined to improve labour productivity and drive other innovations. The main issue with this theory is identifying the conditions that would have triggered the emergence of the initial exogenous shock. Moreover, Fogel leaves this question open, when he explains a significant proportion of the decline in mortality before 1870 based on nutritional factors or elements linked to agricultural progress (Fogel, 1994). The thesis that health has an influence on economic development is therefore not unambiguous, because of the intrinsic endogeneity of progress in health.

More recently, Birchenall (2007), showed the causal relationship between economic development and mortality since the 18th century, in both developed and developing or emerging countries. The first observation is that at the end of the 20th century, even countries with the lowest levels of life expectancy had mortality rates well below those found in countries in western Europe in the 18th century. The second is that in both developed and developing or emerging countries, the age group which is the most vulnerable (young children, who are more vulnerable to problems of malnutrition and contextual aspects) and under working age is the one where the decline in mortality is the fastest and contributes to the general decline in mortality in statistical terms. The final significant result emphasises the fact that economic development could explain between 30 and 50% of the recent decline in mortality, in line with findings by Preston (1980) or Easterly (1999). Medical progress unquestionably remains important at an individual level (Preston, 1975) but is thought to have only a marginal effect overall, particularly given the fact that most medical discoveries took place in the second half of the 19th century (except for the smallpox vaccine; Easterlin, 2004), therefore providing little or no explanation for the decline in mortality before this period in western European countries or the United States. The major exogenous

shocks in public health since the end of the 19th century would also appear to have primarily benefited an urban population, although substantial progress can also be observed in rural areas prior to such events (Birchenall, 2007; Fogel, 1997).

The question of bidirectional causality between health and development has contributed to one of the liveliest debates in development economics in the last two decades. Interventionists support the thesis of the predominantly negative effect of health on economic growth and recommend an exogenous “big push” to get people out of poverty traps. Sceptics, on the other hand, consider that the inability of a country to deal with health problems is the result of ineffective action arising from institutional problems rather than poverty traps, and that it is development that leads to progress in health rather than the opposite. Finally, there is a third category of economists who could be characterised as empiricists as they rely almost exclusively on social experiments in the field to provide answers to these questions in a particular microeconomic context and at a particular time. Note that many of the examples used in this article are borrowed from the economic literature on malaria. This bias is easily justified on the basis that malaria has acted as a catalyst for the debate for around ten years, but it would be restrictive to limit health to this purely vertical view.

In the rest of this article, we intend to demonstrate that it is necessary to overcome the biases in these approaches to move the debate forwards, because of the circular nature of the causality that lies at its heart. Defining good or poor health is not a neutral element in this debate, any more than the health indicators used are. We propose four pathways for overcoming these limitations, which are not new in themselves but which have not previously been brought together in an integrated approach: (i) exploring various channels to arrive at a better understanding of the contradictory nature of the relationship; (ii) reconciling microeconomic and macroeconomic results; (iii) establishing a dialogue with epidemiology. Without a dialogue of this kind, it will not be possible to resolve the econometric problems of identifying relationships. Moreover, economic analysis will have only limited practical involvement in defining policy priorities and applying them in terms of improving health and economic conditions; (iv) developing supply-side analyses in light of the greater attention previously paid to demand.

Prior to this, there are several additional context-related reasons to explain the renewed interest in the subject of “health and development”.

## 2 A RENEWED INTEREST IN THE SUBJECT OF “HEALTH AND DEVELOPMENT”

### 2.1 The Millennium Development Goals

The Millennium Development Goals<sup>2</sup> and the work of the Commission on Macroeconomics and Health<sup>3</sup> have contributed to bringing health back to the centre of the development debate. Indeed, three of the eight Millennium Development Goals are directly related to health (MDG 4: reduce child mortality; MDG 5: improve maternal health and MDG 6: combat HIV/AIDS, malaria and other diseases). To some extent, MDG 1 (eradicate extreme poverty and hunger) can be seen as being connected to the health and nutritional status of individuals.

Health is also a central ingredient in development insofar as it can be seen as an investment in human capital, which plays an important role in both endogenous growth models and neoclassical theories as applied to health (Schultz, 1961; Becker, 1962; Grossman, 1972a). More fundamentally, health is a precious tool for improving the economic and social future of a population by improving not only individuals' aspirations but also their “capacities” (Sen, 1980, 1988; Sen and Nussbaum 1993). At the same time, health contributes to the well-being of individuals, which has been reflected in the inclusion of life expectancy in calculating the human development index. Finally, sources of deficiency in the healthcare market as described by Arrow (1963) mean that the social optimum is not achieved and that intervention in the healthcare market becomes necessary. The necessity of implementing public policies in the healthcare field is a justification in itself for the significant weight given to support for health in development aid policies. The barriers to access to healthcare also highlighted in recent literature on health behaviours in developing countries (Dupas, 2011) join several arguments by Arrow (1963) on deficiencies in the healthcare market resulting from (i) external factors, (ii) a shortage of high-quality information aimed at a well-targeted audience, (iii) uncertainty in the face of risk and questions of coherence in temporal terms, (iv) demand which is, in reality, driven by supply, cutting across institutional or organisational questions.

<sup>2</sup> <http://www.un.org/fr/millenniumgoals/>, June 2013.

<sup>3</sup> [http://apps.who.int/gb/archive/pdf\\_files/WHA55/fa555.pdf](http://apps.who.int/gb/archive/pdf_files/WHA55/fa555.pdf), June 2013.

## 2.2 Increasing support for health in developing countries

Aid for health has increased significantly in absolute terms since the beginning of the 21<sup>st</sup> century. This is explained in part, by a recovery in publicly funded development aid over the past decade, but first and foremost by the increase in the proportion of development aid allocated to health, which doubled over this period to account for around 13% in 2011.<sup>4</sup> Moreover, it is important not to ignore the increasing contribution made by private-sector aid, funded primarily through large private foundations. In overall terms, the most comprehensive data source in this area, produced by the Institute for Health Metrics and Evaluation,<sup>5</sup> estimates total international aid for health at around \$28 billion in 2011, of which \$20 billion are accounted for by development aid from the OECD DAC countries. The proactive approach of a number of major donors, notably the United States, and the philanthropy of the main foundations, have thus contributed to a significant improvement in the volume of aid allocated to health. The driver for this increase was the development of vertical programmes (either public-sector initiatives such as the PEPFAR in the United States, or initiatives funded fully or partially by the private sector, such as the GAVI and the Global Fund).

Macroeconomic studies comparing spending on health with improvements in the state of health remain, however, less than convincing on the positive impact of aid. It is difficult to identify the effects of public spending on health, in particular because of problems of endogeneity. Both Filmer and Pritchett (1999) and Wagstaff et al. (2004a, 2004b), taking these problems into account, found non-significant results in respect of the elasticity of health indicators (child mortality and maternal mortality) compared with public spending on health. Bokhari et al. (2007) find significant elasticity when they control for official development assistance received in the health sector, but in their regressions the variable associated with official development assistance is not significant. Their result may, however, be marred by a new endogeneity bias insofar as the aid variable is not instrumented in this study.

One of the conclusions that emerges from the literature is that trying to identify a mechanical link between health spending and the state of health of a population would be a futile exercise. First and foremost, resources need to be allocated fairly and efficiently if the Millennium Development Goals are to be achieved. Problems associated with the efficiency of allocation become

<sup>4</sup> This observation is valid according to data from the DAC or CRS databases and contradicts Moatti and Ventelou (2009), who found that the proportion had remained stable since 2000.

<sup>5</sup> <http://www.healthmetricsandevaluation.org>, June 2013.

clear when we see significant leakages in health budgets, which only reach end users to a very limited extent (see, for example, Gauthier and Wane, 2008). As a result, the increase in aid for health has logically involved the development of vertical programmes, with an increase in measures based on performance-related payment and evaluation of results, although these concepts are not systematically interpreted in the same way (Eldridge et al., 2009; Carlson et al., 2010). The kinds of subsidy advocated by economic theory have therefore found fertile ground in the development of these specific funds. One telling example is the establishment of the AMFm (*Affordable Medicines Facility – malaria*) following the work carried out by the Institute of Medicine of the National Academy of Sciences in the US, led by K. Arrow (Arrow et al., 2004) which produced controversial results in the most remote areas. Medico-economic evaluations whose efficiency measures are focused on a specific health problem probably accentuate this phenomenon, since it is much simpler to evaluate correctly in a specific area for well-defined diseases than for cross-cutting problems. Finally, the appearance of diseases that are transmitted from south to north, such as HIV/AIDS, has unquestionably contributed to legitimising aid for health as a global public good.<sup>6</sup>

### 2.3 A renewed theoretical and empirical interest in health?

The renewed interest in methodologies derived from biomedical sciences and a multidisciplinary openness have probably contributed to the development of the discipline since the first research carried out by Arrow (1963), and have in turn fuelled the debate. Numerous behavioural questions, in particular, have been the subject of particular attention, considering not only that these behaviours represented a hindrance to the effectiveness of interventions (and therefore a waste of resources) but also given the impasse to which empirical models for analysing the determinants of high-risk behaviours, belief models for health and models inspired by social learning theories led (Moatti et al., 1993). Indeed, the risk of falling into a “disciplinary bias” is high (as each has a tendency to insist on a particular type of variable) in empirical models. Furthermore, all these models often result in tautological results that effectively lead to impasses. Rational choice models came to dominate in the 1990s, to explain the persistence of high-risk behaviours relating to diseases that are transmitted between humans (mainly HIV/AIDS) and to some extent provided a way out of the impasse. The most well-known concept is prevalence-elasticity, which

<sup>6</sup> A comprehensive discussion of new paradigms in health economics in developing countries can be found in Moatti and Ventelou (2009).

has been developed in economic epidemiology since Geoffard and Philipson (1996). A positive prevalence-elasticity implies that when the risk of illness decreases, it prompts a decline in prevention or treatment behaviours, leading in turn to a fresh increase in risk and consequently so-called “rational” epidemics. When prevalence-elasticity is low and incidence declines, the reduction in prevention or treatment is less than proportional, thus increasing the chances of success of an exogenous treatment for eradication objectives (such as a universal vaccination campaign, for example). We should note, however, that eradicating an illness is not always possible and eradication is sometimes not the objective public-health decision makers are seeking or even want to achieve. Furthermore, low elasticity limits, conversely, the positive effects of prevention behaviours on restricting an increasing incidence.

Experimental analyses based on the randomised trials popularised by Fisher in the 1920s (Box, 1980) and applied to the field of development economics more recently by Kremer and Duflo (see, for example, Miguel and Kremer, 2004; Duflo and Kremer, 2005; Duflo et al., 2007 ; Banerjee and Duflo, 2008; Kremer and Glennerster, 2011), represent a real contribution to the identification of a link between health and development through the understanding they provide of exogenous interventions in experimental conditions in a specific context. They also support health and development programmes by providing a rigorous simultaneous evaluation in the field. Quasi-experimental models (discontinuous models, instrumental variables and differences in differences) help cover the gaps in randomised field trials and supplement these models, helping to identify a causal effect. They also help to reach more reliable conclusions, after applying filters derived from econometric mechanisms to retrospective data in real and non-experimental conditions.

These analyses do not, however, fully resolve the problem posed by Fogel of the emergence of shocks in natural conditions. Bleakley (2010b), who is interested in the economic effects of malaria, uses for example, medical progress (in this case the discovery of the parasite by C. L. A. Lavéran and the malaria vector by R. Ross at the end of the 19th century). Although apparently exogenous, however<sup>7</sup>, it is still difficult to totally exclude other, more societal factors for the progress made at the time. For example, Reiter et al. (2003) conclude in an article on dengue fever that in spite of similar knowledge about this vector-borne disease in different parts of the world and ecological conditions in Texas favourable to the emergence of epidemics, lifestyles provide a more persuasive explanation for the low prevalence of dengue fever in the United

<sup>7</sup> This discovery and those that followed on from it having accelerated the identification of cases and their systematic and scientific monitoring



States compared with other countries. The article by Bleakley (2010b), of course, takes rigorous account of these aspects in its analysis and contributes in a remarkable fashion to the renewed interest in development economics as applied to health, by identifying empirically, within the confines of the available data, the effects of an improvement in the state of health on income.

The central question nevertheless remains: can progress or economic and social change be reduced to a mechanical growth or decrease of scales (Marshall, 1898)? In other words, are we asking the right questions by focusing all our attention on identifying a causal effect when the relationship is probably bidirectional, given the difficult transition from experiments to public policy and the difficulty of transposing experimental results?

Epidemiology, for example, is less dogmatically attached to identifying causality in this way, not because of a lack of appropriate tools but undoubtedly because of a more realistic and more systemic view of questions of circular causality as applied to the health field.

Moreover, as with the empirical models referred to previously, the risk of reaching an impasse remains, with each having a tendency to insist on a particular type of treatment. This risk is probably greater in social experiments than in analyses of the societal impacts of clinical trials (the impact of medical interventions on socio-economic factors). Finally, there remains a difference between identifying the impact of a treatment (prompting an improvement in the state of health) on economic variables and identifying the effects of a poor state of health on these same variables. Both questions remain fundamentally different, as a treatment can affect these variables through channels different from the health problem it is designed to eliminate or at least mitigate. Whilst it is possible to compile evidence showing that a medical treatment has a beneficial effect on economic variables, it is undoubtedly more difficult to show that a poor state of health has negative effects.

## 2.4 What healthcare systems exist in developing countries?

Finally, it is impossible to address the question of health in developing countries without reminding ourselves of the institutional context in which the main decisions are taken. We will only touch on a few aspects here, as these issues have been dealt with more comprehensively by Moatti and Ventelou (2009).

At an organisational level, healthcare systems in the poorest countries are primarily characterised by their heterogeneity, a pyramidal structure designed to support local medical care and a strategy focused on primary health

care as defined at the Alma Ata conference in 1978 and relaunched by the Bamako Initiative in 1987.<sup>8</sup>

Firstly, in terms of providing insurance, existing systems are closer to a Bismarckian-type system in the sense that universal welfare remains limited. Cost recovery has been replaced by the introduction of prepayment mechanisms and insurance to cover the risk of ill health (Moatti and Ventelou, 2009).

Secondly, in respect of planning and overall visibility objectives, analysis of national strategic plans is increasing in order to identify barriers to achieving the Millennium Development Goals at an organisational level (Travis et al., 2004; Backman et al., 2008;)<sup>9</sup> and organise the development of more homogenous healthcare systems.

Thirdly, healthcare systems in developing countries must content with a human resource crisis. Many medical personnel emigrate, partly because of the working and health and safety conditions they are faced with and partly because both developed and emerging countries (such as South Africa) attract expatriate medical staff because of the strong growth in demand for medical care and the shortage of training for qualified personnel in some cases. Bhargava and Docquier (2008) have shown that the HIV/AIDS crisis provides an explanation for the emigration of medical personnel to some extent, alongside more traditional factors such as medical doctors' relative salaries, and that emigration in turn worsens the medical situation in the countries concerned. Bhargava, Docquier and Moullan (2011), moreover, have shown that the existence of some form of compensation for the loss of medical personnel by greater incentives to train in the sector (according to the so-called "brain gain" theory) is illusory.

Finally, areas of concern include the fact that the transition the world is experiencing between transmissible and non-transmissible diseases risks having a particularly significant effect on developing countries in the near future (Monteiro et al., 2001; Cavalli et al., 2010).

<sup>8</sup> A detailed analysis of the establishment of the Bamako Initiative and its effects can be found in the report by Ridde, 2004: <http://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1095698140167/BamakoInitiativeReview.pdf>

<sup>9</sup> See also the One Health Tool initiative: <http://www.internationalhealthpartnership.net/en/tools/one-health-tool/>, June 2013.

### 3 HEALTH AS A FACTOR IN ECONOMIC GROWTH?

#### 3.1 Controversial results at a macroeconomic level.

Various pieces of research have suggested that the poor health of a population could be a cause of its backwardness in terms of economic development<sup>10</sup>. The most “dramatic” version of this approach is represented by the calculations done by Gallup and Sachs (2001) showing the strong negative impact of malaria on growth at a macroeconomic level. The approach taken by Gallup and Sachs (2001), focusing on malaria, is undoubtedly caricatural but has the merit of having highlighted at the time a problem that had previously been ignored. According to Gallup and Sachs (2001), annual growth in GDP per capita in countries with a high incidence of malaria is 1.3% lower. A 10% decrease in malaria should result in a 0.3% increase in growth. The literature on growth has shown that this kind of result was often not very robust, mainly because of recognised problems of endogeneity and the quality of the macroeconomic data used, and therefore calls for a more cautious approach. Sachs’ approach, based on cross-sectional estimates, is not the only one, however, and follows on from numerous other pieces of research based on transverse or panel data using similar methods (amongst others Barro and Lee 1994; Barro and Sala-I-Martin 1995). Note that these empirical estimates have often been produced based on different samples with similar results.

This approach has, however, drawn criticism because of the fact that it results in a blind belief that it is sufficient to increase international aid for health to get out of the trap of under-development and because considerable amounts of aid have probably been invested with no requirements in terms of performance. As far as malaria is concerned, we nonetheless need to recognise that this is a disease that imposes high costs on developing countries. Malaria is essentially found in the world’s poverty belt. Almost 41% of the global population (around 3.3 billion people) live in areas where malaria is transmitted (Centers for Disease Control and Prevention – CDC). The number of clinical cases is estimated at 219 million per year (World Malaria Report 2012).<sup>11</sup> The number of deaths is around 660,000 per year, 75% of which are children in Africa (CDC). Although criticisms of Sachs’ approach may be well-founded, they probably go too far if they deny that diseases such as malaria play any part in worsening poverty in Africa.

<sup>10</sup> See Audibert and Drabo (2011) for a very comprehensive review of the literature on this topic: <http://halshs.archives-ouvertes.fr/docs/00/55/17/70/PDF/2010.36.pdf>, June 2013.

<sup>11</sup> [http://www.who.int/malaria/publications/world\\_malaria\\_report\\_2012/en/](http://www.who.int/malaria/publications/world_malaria_report_2012/en/), June 2013.

Moreover, numerous other pieces of recent research have shown the role of health in growth. Bhargava et al. (2001) is a good example. The authors reveal the impact of health on growth, particularly in poor countries. Bloom, Canning and Sevilla (2004) also show the positive effect of health on total factor productivity, using a production function approach. We will return to this later.

Some authors challenge these results, however, in particular Acemoglu and Johnson (2007), although they use similar methods to Sachs' approach (Packard, 2009). The authors use historical data on the change in life expectancy (from the 1940s to the 2000s) to produce an estimate of instrumental variables designed to control endogeneity bias. The instrumental method exploits the epidemiological transition of the 1940s, with instruments being developed based on mortality rate data observed in 1940 for around 15 infectious diseases and on the dates from when actions were taken to control the diseases concerned. Acemoglu and Johnson (2007) use this approach to show that the effects of health on growth per inhabitant are not significant and may even be negative because of a very positive effect on demography and a very limited effect on GDP. The structure of the procedure used, however, excludes poor countries and in particular, all African countries, for which we have no historical observations to develop instruments.

Berthélemy (2011) suggested that the effect of health on growth was not linear, as it was associated with the notion of under-development traps and multiple equilibria. This approach makes the results obtained by Bhargava et al. (2001) compatible with those of Acemoglu and Johnson (2007). The point is that it is difficult to generalise results observed locally: for countries caught in an under-development trap, health may not seem to have an impact on development, however improving the level of health could contribute to these countries escaping a low equilibrium of this kind. Restricting the analysis to a set of relatively developed countries, as Acemoglu and Johnson (2007) do, inevitably leads to this effect being hidden. Conversely, it is fair to say that testing under-development traps involves working on an extensive sample of countries for which the available data restrict the possibilities of instrumentation. The main result of the approach in terms of the under-development trap, however, is its highlighting of the non-linear relationship between initial health and future development, whilst endogeneity biases are based on a linear relationship between these two variables. Identifying the theory behind an under-development trap related to health therefore relies on testing for a highly non-linear specification rather than on any kind of instrumentation.

Similarly, Bonds et al. (2010) show that a dynamic interaction between health and the incidence of poverty can lead to under-development traps. This approach is largely based on macroeconomic indicators (DALY for health and GDP per inhabitant as a development measurement) and highlights the mechanisms by which health and poverty interact and which can result in multiple equilibria, even if in this case, the authors only demonstrate the possibility that such multiple equilibria may exist, without really testing their existence.

Overall, current econometric research on the effect of health on economic development based on internationally comparable macroeconomic data offers few conclusive results that can be generally applied in one or other direction.

### 3.2 More intelligible results at a microeconomic level

It is easier to take account of endogeneity problems at a microeconomic level (Strauss, 1986; Strauss and Thomas, 1998; Thomas et al., 2002; Strauss and Thomas, 2008).

In respect of the effects of health on income, either directly or indirectly, Strauss and Thomas (1998) establish a clear relationship between nutrition, health and income. The traditional indirect channels of the impact of health on income at a microeconomic level are: participation in the labour market, labour productivity, technical efficiency and expenditure on consumption and investment. In particular, Strauss (1986) highlights the impact of caloric intake on productivity, with a decreasing but still positive marginal effect for high intakes. Research carried out by Audibert et al. (1986, 1993, 2003a, 2003b) has contributed to research on the effect of health on agricultural productivity. Audibert et al. (2009) show, however, in the case of the impact of malaria on coffee and cocoa production in the forested region of Ivory Coast, that the prevalence of malaria does not always have a significant effect on agricultural production. This result is in line with other analyses by the same authors and suggests the necessity of a highly detailed epidemiological analysis if one wants to show the impact of morbidity on productivity. In this instance, the prevalence of malaria is measured imperfectly, because of its often asymptomatic nature in areas of high transmission, and it would be necessary to be able to observe highly invalidating malarial episodes to obtain significant results. Bartel and Taubman (1979), in an analysis that is non-targeted on developing countries, shows that the effects of health on the labour supply and salaries are positive but vary depending on the diseases analysed. This study offers a somewhat unusual advantage for the time, namely using

clinical measurements of health (rather than subjective measurements) and taking account of the effects of selection or simultaneity. A recent study by Levinsohn et al. (2013) shows, having resolved these problems of simultaneity (primarily via poverty) the very significant impact of HIV/AIDS on participation in the labour market in South Africa. Booyesen and Arntz (2003), however, show in the case of HIV/AIDS that the multiplicity of study frameworks and of methods used and the disciplines concerned make comparisons difficult. The same remark could apply to other diseases, hence the need for dialogue to increase harmonisation.

On the demand side (the inverse relationship of income and prices on demand), one of the central questions is the price elasticity of demand, which lies at the centre of the debate on cost recovery. Bates et al. (2012) review the main randomised analyses carried out between 2006 and 2010. The authors show that even a slight increase in prices prompts a dramatic decline in the demand for healthcare products whilst generating limited income for healthcare providers. The high elasticity of demand to prices, however, remains difficult to explain from a theoretical point of view. One explanation could come from the possibility of health traps, along the same lines as the research by Bonds et al. (2010) on macroeconomic data. Berthélemy et al. (2013) show that based on a traditional epidemiological model of malaria, it is possible to arrive at health traps of this kind, by including endogenous rational behaviours in the model. The implication of this model is that for the free distribution of preventive measures to be effective, it is important to subsidise not only access to such measures but also their use. This model therefore explains certain results found in randomised studies (Banerjee et al., 2010).

The effect of income on demand for healthcare products is also well documented (Grossman, 1972b) as is the very high elasticity of demand in relation to the quality, reliability and accessibility of healthcare (see, for example, Lavy et al., 1996).

#### 4 HEALTH AND INEQUALITIES

The notion of economic development encompasses not only the interactions between income, productivity, health and education but also the distribution of these variables within a population (Marmot et al., 2008). Inequalities in relation to health are mainly driven by social inequalities. This is certainly the case in relation to income inequalities. By way of example, in Glasgow (Scotland) the difference in life expectancy between the richest and the

poorest is 28 years. On average, the poorest inhabitants of Glasgow have a life expectancy of eight years less than the average for Indians (around 60 years) although 76% of Indians live on less than \$2 a day (Commission on Social Determinants of Health<sup>12</sup>). Numerous other social determinants are also involved, however, including living conditions, access to public services such as the provision of drinking water, and working conditions.

As a result of the high incidence of social inequalities on disparities in access to health, there is a risk of falling into a health-related poverty trap at an individual level, as a poor state of health can in turn have a long-term effect on an individual's capacity to get out of poverty. This is a vicious circle, which can only be broken by implementing policies aimed at restoring health equity. Such policies should address the social determinants of health problems.

Numerous pieces of research have developed concepts and measurements of health equity over the last two decades to analyse and design such policies. Health equity is defined either on the basis of a vertical or horizontal approach (Rochaix and Tubeuf, 2009). Both concepts are central in discussions on health inequalities and poverty in developing countries.

One important trend in the literature on development economics has been to measure the incidence of benefits received by different socioeconomic groups from public spending, such as spending on healthcare. By testing whether the poorest have more or less access than the richest to the benefits of public spending, this research is similar to the discussions on vertical equity, which requires that people seen as unequal on the basis of a characteristic deemed relevant for the allocation of healthcare are treated differently to correct the inequality.

Numerous pieces of research on analysing the incidence of benefits associated with public spending on health show that these policies are vertically inequitable, insofar as it is generally the case that the richest categories of the population benefit more from public spending on health than the poorest categories.<sup>13</sup> This often comes from the fact that primary healthcare services, which are the only ones widely accessible to poor people, are insufficiently developed. This is particularly true in Africa, where a still large rural population has no access to healthcare centres.

Aspects of horizontal equity in access to healthcare have been analysed by Wagstaff (1991, 2002a, 2002b). The idea is that two people with the same

<sup>12</sup> [http://www.who.int/social\\_determinants/en/](http://www.who.int/social_determinants/en/), June 2013.

<sup>13</sup> See Berthélemy and Seban, 2009, for a general overview.

needs should have access to the same care. Here again, empirical research highlights horizontal inequity in relation to health in developing countries. Research on the subject is too extensive to be summarised here, but often follows the same line: there is significant horizontal inequity in access to care in developing countries, which can be explained both by the weakness of public infrastructure in the health sector and by the limited resources available to set up health insurance systems.

A recent contribution on Senegal (Mané, 2013), for example, shows that the poor access rarely, and the rich access often, to public hospitals, where disabling conditions are treated.

In China, Zhou et al. (2013) have shown that, between 1993 and 2008, the use of outpatient and hospitalisation services was inequitably split in favour of the rich, with the exception of outpatient services in 2008. In recent years, however, the introduction of a new health insurance system has helped to reduce inequality in access to outpatient services.

Similarly, when governments implement policies designed to support the supply of healthcare services aimed at socially disadvantaged groups, there is an improvement in health equity. This was the case in Brazil, for example, between 1998 and 2009 (Macinko and Lima-Costa, 2012).

Sources of horizontal inequity should not be sought only in income distribution, particularly given that Deaton (2003) has shown that there is no clear direct link between income inequality and health problems. Berthélemy and Seban (2009), for example, have shown that the concentration of access to a certain number of maternal and child healthcare services (immunisation cover, treatment of fever, treatment of respiratory infections, treatment of diarrhoea, prenatal examinations and assisted childbirth) is very significantly associated with the concentration in mothers' education and much less with the concentration of wealth. Furthermore, access to maternal and child healthcare services in public facilities is more equitably distributed, all other things being equal, in countries with good governance. This suggests that the institutional organisation of the supply of healthcare services may also be an important determinant of social conditions of access to healthcare.

Other public policies may have a very significant impact on health equity. This is the case with policies relating to the provision of drinking water and sanitation services (Commission on the social determinants of health). The problems that arise in this respect are related to both funding for infrastructure and pricing. Free access is socially inequitable if the poorest sections of society do not have access to the public network.



## 5 CIRCULAR CAUSALITY: AN IMPASSE?

### 5.1 Reconciling macroeconomics and microeconomics in the health field

Bloom and Canning (2005) combine the microeconomic effects of health on salaries and macroeconomic simulations of the effects of health on income and find similar microeconomic and macroeconomic effects. Similarly, Weil (2007) explores general equilibrium effects using a similar approach and calibrates macroeconomic production functions based on microeconomic measurements. The authors find significant effects for health on GDP per inhabitant. These estimates, however, give lower results than the cross-sectional results presented previously. Eastwood (2012) gives a detailed description of the various models used up till now to reconcile the two levels of analysis and the difficulties associated with each approach. Amongst these are simple cost extrapolation models (a simple aggregate of analyses of microeconomic costs), computable general equilibrium models (CGE; Barlow, 1967), macro-simulation models calibrated on microeconomic data (Young, 2005 and his controversial article on the positive economic effects of AIDS; Weil, 2007). The latter two approaches (CGE and simulations) probably help to overcome the constraints inherent in panel or cross-sectional data related to the poor quality of macroeconomic health data in numerous developing countries. In the case of CGE, however, one of the main difficulties is being able to carry out plausible sensitivity studies on the chosen multisectoral structure because of the multiplicity of parameters. In the case of macroeconomic simulations, the high level of dependency on the microeconomic data that feed into the model can lead to very heterogeneous results. A final difficulty common to these models in terms of recommendations is that health effects tend to be more medium or long term in these approaches. This makes these models relatively unattractive from the point of view of recommendations but potentially leaves room for more innovative short term models.

### 5.2 Examining impact channels and their classification in greater depth

As we suggested in the introduction, identifying indirect channels would help to overcome the limitations of the debate to some extent. One of the disciplinary biases in this approach to development economics consists of starting with the assumption that all relationships are endogenous and that economic science is better placed than other disciplines to respond to questions of

causality. This a priori suspicion leads on the one hand, to a bias in favour of establishing causal relationships (as evidenced by a significantly higher proportion of articles demonstrating the existence rather than the absence of relationships) and secondly, viewing as inadequate indicators that support causality used by other disciplines (the link with other independent studies, the biological plausibility of a hypothesis, the temporal sequence between cause and effect, the link between the intensity of infection or treatment and the scale of the effect). Changing the initial assumption would not, however, necessarily prevent testing the robustness of results by using the most widespread econometric techniques in the discipline. Potentially, there are relationships that by definition are not endogenous and which can supplement the analysis of questions of endogeneity that exist at other analytical levels. These relationships are undoubtedly very specific but examining them and their classifications in more detail and exploring areas that have previously been ignored will, in the long term, undoubtedly help to achieve a simplified vision that is relatively closely modelled on reality: in some sense a map of economic development.

Among the impact channels already explored in the literature, one of the most intuitive is the one that links health and education. Education (primarily education for mothers) is an important element, as has been shown by Berthélemy and Seban (2009) or Breierova and Duflo (2004) and Duflo et al. (2006). As far as the effects of illness on education are concerned, however, these depend on the illnesses studied, with effects that seem to be somewhat significant for nutrition, HIV/AIDS (Gachuhi, 1999; Odiwuor, 2000) and malaria (Thuilliez, 2009, at the macroeconomic level, Thuilliez et al., 2010; Thuilliez, 2010, at the microeconomic level) and less clear effects of certain helminthiasis (Miguel and Kremer, 2004). The aim here is simply to recall some of the principal channels and not to examine them in detail. Let us just note that the effects of health on education also vary according to age (from the foetal stage to adulthood and therefore both within the teaching profession and amongst pupils or students), in conjunction with the specifics of the illnesses studied. In this respect, external factors such as those referred to by Miguel and Kremer (2004) are important to analyse in calculating the beneficial effect of a treatment and its cost-effectiveness. From the point of view of the effects of biomarkers on cognitive variables, the variable biases omitted are probably of primary importance in the treatment of endogeneity compared with problems of inverse causality or measurement errors (once, of course, the temporal sequence between cause and effect has been adequately defined in research protocols). Education may then affect other, more traditional channels via its effects on future activity, salaries and productivity (Leibowitz, 1974).

The effects of health on accumulating savings have been explored by Ram and Schultz (1979), and Zhang and Zhang (2005). The underlying theoretical argument is that life expectancy affects intertemporal choices but also that longevity mechanically increases savings and consequently investments.

The demographic dividends produced by a decline in child mortality (modifying the age structure of a population) translate into lower investments to meet the needs of the youngest groups whilst adults are relatively more numerous in the working population, thus generating an opportunity for temporary growth (Bloom et al., 2003). An epidemiological transition may accompany this phenomenon in more qualitative terms and have a fundamental effect on healthcare systems (Frenk, 1989).

As we have already referred to the institutional aspects above, let us note simply that Bleaney and Dimico (2010) show that geographical questions (which encompass certain health problems) can have indirect effects on growth through their effects on the quality of institutions. Kudamatsu et al. (2012), for example, analyse the relationship between environmental factors such as climate and child mortality in Africa and find significant effects.

Cultural questions, gender differences, household structure and negotiation within the household (Beegle 2001; Maitra, 2005) represent undoubtedly less intuitive channels, which in some respects are related to the problems of inequality and equity discussed previously and require detailed theoretical approaches (notably on the unitary household models challenged by cooperative models such as the one put forward by Chiappori, 1992 amongst many others).

### 5.3 Opening up economic sciences to epidemiological approaches

Numerous pieces of epidemiological research are already being enhanced by econometric methods as evidenced by some examples published in major biomedical or epidemiological journals (McClellan et al., 1994; Rassen et al., 2009a; 2009b; Craig et al., 2012). From an epistemological point of view, combining an epidemiological understanding of health problems and an economic approach makes it possible to reconcile a conception of well-being based on utility with more objective measures of health.

Taking individual behaviours into account in epidemiological models, along with a better awareness of the epidemiological characteristics of epidemics analysed in economic models, also helps to produce more targeted

research protocols based on a firmer theoretical foundation and consequently, more reliable estimates. They should also make it easier to incorporate more complex phenomena such as co-morbidities, of which economic analyses generally take little account, as a result of the lack of precise knowledge about such aspects.

Combining them in this way should also result in better measurement of health indicators, whilst not ignoring the multi-dimensional nature of health. At this level, it is particularly surprising to observe that questions of measurement are neglected in favour of econometric issues in numerous empirical studies, including at a microeconomic level. Yet correct measurement of the state of health lies at the heart of questions of causality and should be the starting point for any analysis, before trying to correct measurement errors econometrically. Given the policy implications of economic analyses, the question of measurement should be taken more seriously. As far as malaria is concerned, the historical measurements used in quasi-experimental studies are generally questionable and above all it is difficult or even impossible to assess their quality (Lucas, 2010; Bleakley, 2010; Venkataramani, 2012). The same applies to mortality indicators in colonies or other historical indicators used in Acemoglu's or Sachs' approaches. Other analyses often limit health to nutrition<sup>14</sup> or confuse health and other specific indicators of health. Subjective indicators are also more likely to be subject to risks of non-systematic errors, correlated to income (Strauss and Thomas, 1998) or to access to care rather than more objective indicators such as biomarkers. Note that the efforts made in this direction by research institutes such as ORC Macro (demographic and health surveys) are remarkable and are now providing high-quality biomarkers on a large scale. Questions of measurement, however, are constrained by inadequacies in surveillance systems (particularly in Africa) and by health indicators that are sometimes highly variable (even over short timescales, as for palustrine parasitemia or blood pressure).

Overall, this interdisciplinary combination has direct implications for measuring the impact channels of health on economic development and vice versa, resulting in more rigorous analyses at a biomedical level and more precise public policy recommendations, regardless of the empirical approach chosen (experimental or not). This combination has already been suggested by Heckman (2005) in his critique of statistical or epidemiological experimental approaches, provided there is a thorough understanding from a theoretical point of view of the sources of potential causality.

<sup>14</sup> See, for example, Behrman et al., (1988) for a discussion on health and nutrition.

## 5.4 Developing studies on supply

In terms of supply and demand, an important debate emerged at the time Cohen and Dupas (2010) published their article on the use of mosquito nets, with malaria once more serving as a pretext for a wider debate. Researchers such as Mead Over protested against an overinterpretation of the results obtained from the literature in this area, whilst others confined themselves to disputing the interest of randomised studies in terms of public policy recommendations.

As a result, the question of quality of supply and in particular, of health-care services remains central and requires the development of new assessment methods focused on supply in order to really understand the impact of cost recovery, for example, on the distribution of healthcare measures.<sup>15</sup> Some research carried out in China or Africa therefore does attempt to focus on supply. Experiments have, for example, been carried out on a large scale in China, in order to assess the effect of a change of payment mechanisms on the quality of care, the practices of key healthcare players (in particular, systematic prescription of care that is not essential for the patient), and the overall change in costs for the system (Wang et al., 2011; Yip et al., 2010; Yip et al., 2012). Still looking at China, Audibert et al. (2013) also provide an interesting response to a well-known stylised fact: access to curative measures and spending on treatments are generally significantly higher than spending on prevention. By showing that the technical efficiency of healthcare services is significantly higher in the case of curative rather than preventive care, the authors suggest that part of the explanation could be found on the supply side.

Audibert et al. (2000), in Mauritania, take a qualified view of the supposed negative effects of cost recovery. The authors show that there is no lack of willingness to pay when the quality of services is adequate. Much greater consistency in the structure of published prices for care, however, is necessary to make these strategies more effective. Seban et al. (2013) arrive at an unexpected conclusion in their analysis of the problem of the failure to use prevention in the Democratic Republic of the Congo. The low level of availability of mosquito nets in households is thought to be due principally to the incapacity of healthcare centres to distribute tools to prevent malaria where they are most needed. In other words, and subject to confirmation of the results, the most vulnerable centres are those that are least well supplied, in spite of demand from the population.

<sup>15</sup> [http://international.cgdev.org/doc/events/1.09.08/User\\_fees\\_can\\_sometimes\\_help\\_2008.pdf](http://international.cgdev.org/doc/events/1.09.08/User_fees_can_sometimes_help_2008.pdf), June 2013.

## 6 CONCLUSION

Overall, the impasse into which the circular causality between health and development leads is, in reality, only apparent and there are several options for overcoming it, whilst accepting the bidirectional character of the relationship and the difficulty of identifying the conditions for the emergence of an initial exogenous shock. The various contrasting currents of thought are highly complementary in terms of the understanding of the relationship they provide from different angles. Nonetheless, there is a risk of getting caught up in a purely academic debate, where one strand of thinking simply replaces another. This article does not claim to resolve the entire debate on analysing health problems in developing countries. It simply provides a few keys to understanding the problems with which the discipline is faced. “Health and development” topics raise a large number of both theoretical and empirical questions in terms of understanding the interactions between economics and health. The social challenges around policies in this area are clear. Bidisciplinary cooperation between economic sciences and biomedical sciences overall is therefore promising, but requires a clear understanding of the two academic cultures. On the one hand, health professionals are becoming increasingly familiar with medico-economic concepts as a way of helping to optimise their capacity for intervention. On the other hand, access to healthcare information, understanding it and using it need specific skills that are difficult to acquire, given the complexity of medical practices and the fact that they are permanently changing. There is no shortage of areas to observe, however, and this is a fruitful period in terms of the international efforts being made to improve health and combat poverty.

## REFERENCES

- ACEMOGLU, D., JOHNSON, S., ROBINSON, J. (2003). Disease and development in historical perspective. *Journal of the European Economic Association* 1, 397–405.
- ACEMOGLU, D., JOHNSON, S. (2007). Disease and development: the effect of life expectancy on economic growth. *Journal of Political Economy* 115, 925–965.
- AGHION, P., HOWITT, P., MURTIN, F. (2010). The relationship between health and growth: when Lucas meets Nelson-Phelps. *National Bureau of Economic Research*.
- ARROW, K.J. (1963). Uncertainty and the welfare economics of medical care. *The American Economic Review* 53, 941–973.
- ARROW, K. J., PANOSIAN, C., GELBAND, H. (2004). Comité on the Economics of Antimalarial Drugs (Ed.), *Saving lives, buying time: Economics of malaria*

- drugs in an age of resistance*. (Institute of Medicine of the National Academies ed.). Washington, D.C.: National Academy Press.
- AUDIBERT, M. (1986). Agricultural non-wage production and health status: A case study in a tropical environment. *Journal of Development Economics* 24(2), 275-291.
- AUDIBERT, M. (1993). Invalidité temporaire et production agricole: Les effets de la dracunculose dans une agriculture de subsistance. *Revue d'Economie du Développement* 1, 23-36.
- AUDIBERT, M., MATHONNAT, J. (2000). Cost recovery in Mauritania: Initial lessons. *Health Policy and Planning* 15(1), 66-75.
- AUDIBERT, M., MATHONNAT, J., HENRY, M.C. (2003a). Malaria and property accumulation in rice production systems in the savannah zone of Côte d'Ivoire. *Tropical Medicine & International Health* 8(5), 471.
- AUDIBERT, M., ETARD, J. F. (2003b). Productive benefits after investment in health in Mali. *Economic Development and Cultural Change* 51(3), 769-782.
- AUDIBERT, M., BRUN, J.F., MATHONNAT J., HENRY, M.C. (2009). Effets économiques du paludisme sur les cultures de rente : l'exemple du café et du cacao en Côte d'Ivoire, *Revue d'Economie du Développement* 1-2, 145-166.
- AUDIBERT M., J. MATHONNAT, A. PELISSIER, X. XIAN HUANG, A. MA (2013). "Health Insurance Reform and Efficiency of Township Hospitals in Rural China: An Analysis from Survey Data." *China Economic Review*. Accessed October 21, doi:10.1016/j.chieco.2013.01.004.
- BACKMAN, G., P. HUNT, R. KHOSLA, C. JARAMILLO-STROUSS, Belachew Mekuria Fikre, C. RUMBLE, D. PEVALIN, D. ACURIO PÁEZ, M. ARMIJOS PINEDA, A. FRISANCHO (2008). "Health Systems and the Right to Health: An Assessment of 194 Countries." *The Lancet* 372, no. 9655 : 2047-2085.
- BARLOW, R. (1967). The economic effects of malaria eradication. *The American Economic Review* 57(2), 130-148.
- BANERJEE, A., DEATON, A., DUFLO, E. (2004). Health care delivery in rural Rajasthan. *Economic and Political Weekly*, 944-949.
- BANERJEE, A. V., DUFLO, E. (2008). The experimental approach to development economics. *National Bureau of Economic Research*.
- BANERJEE, A. V., E. DUFLO, R. GLENNERSTER, D. KOTHARI (2010). "Improving Immunisation Coverage in Rural India: Clustered Randomised Controlled Evaluation of Immunisation Campaigns with and Without Incentives." *BMJ: British Medical Journal* 340. <http://www.ncbi.nlm.nih.gov/pmc/articles/pmc2871989/>.
- BARTEL, A., P. TAUBMAN (1979). "Health and Labor Market Success: The Role of Various Diseases", *The Review of Economics and Statistics* 61, 1.
- BARRO, R. (1991). "Economic Growth in a Cross-Section of Countries." *Quarterly Journal of Economics* 106(2): 407-43.
- BATES, M A., R. GLENNERSTER, K. GUMEDE, E. DUFLO (2012). "The Price Is Wrong." *Field Actions Science Reports. The Journal of Field Actions*, no. Special Issue 4 (June 12). <http://factsreports.revues.org/1554>.
- BECKER, G. S. "Investment in Human Capital: A Theoretical Analysis." *The Journal of Political Economy*, 1962, 9-49.

- BEEGLE, K., E. FRANKENBERG, D. THOMAS (2001). "Bargaining Power Within Couples and Use of Prenatal and Delivery Care in Indonesia." *Studies in Family Planning*, 32, 2 (June 1): 130–146.
- BEHRMAN, J.R., DEOLALIKAR, A.B. (1988). Chapter 14, *Health and nutrition*, in H. Chenery and T.N. Srinivasan (Ed.), *Handbook of Development Economics*. Elsevier, 631–711.
- BERTHELEMY, J.-C., SEBAN, J. (2009). Dépenses de santé et équité dans l'accès aux services de santé dans les pays en développement. *Revue d'Economie du Développement* 1-2, 33-71.
- BERTHELEMY, J.-C. (2011). Health, Education and Emergence from the Development Trap, *African Development Review* 23, 300–312.
- BERTHELEMY, J.-C., J. THUILLIEZ, O. DOUMBO, J. GAUDART (2013). "Malaria and Protective Behaviours: Is There a Malaria Trap?" *Malaria Journal* 12, no. 1 (June 13): 200. doi:10.1186/1475-2875-12-200.
- BHARGAVA, A. (2001). Nutrition, health, and economic development: some policy priorities. *Food & Nutrition Bulletin* 22, 173–177.
- BHARGAVA, A., JAMISON, D.T., LAU, L.J., MURRAY, C.J. (2001). Modeling the effects of health on economic growth. *Journal of Health Economics* 20, 423–440.
- BHARGAVA, A., DOCQUIER F., MOULLAN, Y. (2011). Modeling the Effects of Physician Emigration on Human Development, *Economics and Human Biology* 9, 172-183.
- BHARGAVA, A., DOCQUIER F. (2008). HIV Pandemic, Medical Brain Drain, and Economic Development in Sub-Saharan Africa, *World Bank Economic Review* 22, 345-366.
- BHATTACHARYYA, S. (2009). Root causes of African underdevelopment. *Journal of African Economies* 18, 745–780.
- BIRCHENALL, J.A. (2007). Economic development and the escape from high mortality. *World Development* 35, 543–568.
- BLEAKLEY, H. (2003). Disease and development: Evidence from the American South. *Journal of the European Economic Association* 1, 376–386.
- BLEAKLEY, H. (2010a). Health, human capital, and development. *Annu. Rev. Econ.* 2, 283–310.
- BLEAKLEY, H. (2010b). Malaria eradication in the Americas: A retrospective analysis of childhood exposure. *American Economic Journal: Applied Economics* 1–45.
- BLEANEY, M., Arcangelo DIMICO (2010). "Geographical Influences on Long-run Development." *Journal of African Economies* 19, no. 5: 635–656.
- BLOOM, D.E., CANNING, D., SEVILLA, J. (2003). *The demographic dividend: A new perspective on the economic consequences of population change*. Vol. 5. 1274. Rand Corporation.
- BLOOM, D.E., CANNING, D., SEVILLA, J. (2004). The effect of health on economic growth: a production function approach. *World Development* 32, 1–13.
- BOKHARI, F.A.S, Y. GAI, P. GOTTTRET (2007). « Government health expenditures and health outcomes ». *Health Economics* 16 (3): 257–273.



- BOOYSEN, F. le R., T. ARNTZ (2003). « The methodology of HIV/AIDS impact studies: a review of current practices ». *Social Science & Medicine* 56 (12): 2391–2405.
- BONDS, M.H., KEENAN, D.C., ROHANI, P., SACHS, J.D. (2010). Poverty trap formed by the ecology of infectious diseases. *Proceedings of the Royal Society B: Biological Sciences* 277, 1185–1192.
- BOX, J. FISHER (1980). « R.A. Fisher and the design of experiments, 1922–1926 ». *The American Statistician* 34 (1): 1–7.
- BREIEROVA, L., E. DUFLO (2004). *The impact of education on fertility and child mortality: Do fathers really matter less than mothers?* National Bureau of Economic Research.
- BRUNET-JAILLY, J. (1997). *Innover dans les systèmes de santé: expériences d’Afrique de l’Ouest*. Ed. Karthala.
- COHEN J. , DUPAS P. (2010). Free Distribution of Cost-Sharing? Evidence from a Randomized Malaria Prevention Experiment, *Quarterly Journal of Economics* 125(1), pp. 1-45.
- CARLSON, J. J., S. D. SULLIVAN, L. P. GARRISON, P. J. NEUMANN, D. L. VEENSTRA (2010). Linking payment to health outcomes: a taxonomy and examination of performance-based reimbursement schemes between healthcare payers and manufacturers. *Health Policy* 96 (3): 179–190.
- CARSTENSEN, K., GUNDLACH, E. (2006). The primacy of institutions reconsidered: Direct income effects of malaria prevalence. *The World Bank Economic Review* 20, 309–339.
- CAVALLI, A., Sory I. BAMBA, M.N. TRAORE, M. BOELAERT, Y. COULIBALY, K. POLMAN, M. PIRARD, M. VAN DORMAEL (2010). « Interactions between global health initiatives and country health systems: the case of a neglected tropical diseases control program in Mali ». *PLoS neglected tropical diseases* 4, 8: 798.
- CHIMA, R.I., GOODMAN, C.A., MILLS, A. (2003). The economic impact of malaria in Africa: a critical review of the evidence. *Health policy* 63, 17–36.
- CHIAPPORI, P.A. (1992). Collective labour supply and welfare. *Journal of Political Economy* 100 (3), 437-467.
- CRAIG, P., C. COOPER, D. GUNNELL, S. HAW, K. LAWSON, S. MACINTYRE, D. OGILVIE, M. PETTICREW, B. REEVES, M. SUTTON (2012). « Using natural experiments to evaluate population health interventions: new Medical Research Council guidance ». *Journal of epidemiology and community health* 66, 12: 1182–1186.
- DEATON, A. (2003). Health, Inequality, and Economic Development. *Journal of Economic Literature* 41: 113-158.
- DUFLO, E., M. KREMER (2005). « Use of randomization in the evaluation of development effectiveness ». *Evaluating Development Effectiveness* 7 : 205–231.
- DUFLO, E., P. DUPAS, M. KREMER, S. SINEI (2006). « Education and HIV/AIDS prevention: evidence from a randomized evaluation in Western Kenya ». *World Bank Policy Research Working Paper*, n° 4024.
- DUFLO, E., R. GLENNERSTER, M. KREMER (2007). « Using randomization in development economics research: A toolkit ». *Handbook of development economics* 4: 3895–3962.

- DUPAS, P. (2011). "Health Behavior in Developing Countries." *Annu. Rev. Econ.* 3, no. 1: 425–449.
- EASTWOOD, R. (2012). Macroeconomic approaches to identifying the effects of health on output, growth and poverty. *African Development Review* 24, 279–290
- EASTERLY, W. (1999). Life during growth. *Journal of Economic Growth*, 4, 239–275.
- EASTERLIN, R. A. (2004). The reluctant economist: Perspectives on economics, economic history, and demography. Cambridge University Press.
- ELDRIDGE, C., N. PALMER (2009). Performance-based payment: some reflections on the discourse, evidence and unanswered questions. *Health policy and planning* 24 (3): 160–166.
- FILMER, D., L. PRITCHETT (1999). The impact of public spending on health: does money matter? *Social science & medicine* 49 (10): 1309–1323.
- FOGEL, R.W. (1990). *The conquest of high mortality and hunger in Europe and America: Timing and mechanisms*. National Bureau of Economic Research Cambridge, Mass., USA.
- FOGEL, R. W. (1994). Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy. *American Economic Review* 83(3): 369–95.
- FOGEL, R. W. (1997). *New Findings on Secular Trends in Nutrition and Mortality: Some Implications for Population Theory*. In M. Rosenzweig and O. Stark, eds., *Handbook of Population and Family Economics*, vol. 1A. New York: Elsevier.
- FOGEL, R. W. (2004). *The escape from hunger and premature death, 1700-2100: Europe, America, and the Third World*. Vol. 38, Cambridge University Press.
- FRENK, J., J. L. BOBADILLA, J. SEPULVEDA, Malaquias Loópez CERVANTES (1989). « Health Transition in Middle-income Countries: New Challenges for Health Care ». *Health Policy and Planning* 4, 1: 29-39.
- GACHUHI, D. (1999). « The Impact of HIV/AIDS on Education Systems in Eastern and Southern Africa Region ». draft, New York: UNICEF.
- GALLUP, J. L., J. D. SACHS (2001). "The Economic Burden of Malaria." *The American Journal of Tropical Medicine and Hygiene* 64, no. 1 suppl (January 1): 85–96.
- GAUTHIER, B., WANE, W. (2008). Leakage of Public Resources in the Health Sector: An Empirical Investigation of Chad?. *Journal of African Economies* 18: 52-83.
- GEOFFARD, P-Y., T. PHILIPSON (1996). « Rational epidemics and their public control ». *International Economic Review*: 603–624.
- GLEWWE, P., MIGUEL, E.A. (2007). Chapter 56. *The Impact of Child Health and Nutrition on Education in Less Developed Countries*. In T. Paul Schultz and John A. Strauss (Ed.), *Handbook of Development Economics*. Elsevier, 3561–3606.
- GROSSMAN, M. (1972a). On the concept of health capital and the demand for health. *The Journal of Political Economy* 80, 2: 223–255.
- GROSSMAN, M. (1972b). Front matter, the demand for health: a theoretical and empirical investigation. In *The demand for health: a theoretical and empirical investigation*, 20–0.

- HECKMAN, J. J. (2005). The scientific model of causality. *Sociological methodology* 35 (1): 1–97.
- JOHANSSON, S.R., MOSK, C. (1987). Exposure, resistance and life expectancy: disease and death during the economic development of Japan, 1900–1960. *Population Studies* 41, 207–235.
- KAKWANI, N., WAGSTAFF, A., Van DOORSLAER, E. (1997). Socioeconomic inequalities in health: measurement, computation, and statistical inference. *Journal of econometrics* 77, 87–103.
- KREMER, M., GLENNERSTER, R. (2011). Chapter 4 - *Improving Health in Developing Countries: Evidence from Randomized Evaluations*. In Mark V. Pauly, T.G.M. and P.P.B. (Ed.), *Handbook of Health Economics*. Elsevier, 201–315.
- KUDAMATSU, M., T. PERSSON, et D. STRÖMBERG. (2012). *Weather and infant mortality in Africa*. Centre for Economic Policy Research.
- LAMIRAUD, K., P-Y. GEOFFARD (2007). « Therapeutic non-adherence: a rational behavior revealing patient preferences? ». *Health economics* 16 (11): 1185–1204.
- LAVY, V, J. STRAUSS, D. THOMAS, Ph. De VREYER (1996). « Quality of health care, survival and health outcomes in Ghana ». *Journal of Health Economics* 15, 3: 333-357.
- LEIBOWITZ, A. (1974). Home investments in children. *The Journal of Political Economy*, 82(2), 111-131.
- LEVINSOHN, J., MCLAREN, Z.M., SHISANA, O., ZUMA, K. (2013). HIV Status and Labor Market Participation in South Africa. *The Review of Economics and Statistics* 95:98-108.
- LUCAS, A. M. (2010). “Malaria Eradication and Educational Attainment: Evidence from Paraguay and Sri Lanka.” *American Economic Journal: Applied Economics* 2, no. 2: 46–71.
- MACINKO, J., M. F. LIMA-COSTA (2012). “Horizontal Equity in Health Care Utilization in Brazil, 1998–2008.” *Int J Equity Health* 11: 33.
- MAITRA, P. (2004). “Parental Bargaining, Health Inputs and Child Mortality in India.” *Journal of Health Economics* 23, no. 2: 259–291.
- MARSHALL. A. (1898). Distribution and exchange. *Economic Journal* 8, 29.
- MARMOT, M. (2002). The Influence Of Income On Health: Views Of An Epidemiologist. *Health Affairs* 21, 2: 31–46.
- MCCARTHY, F., WOLF, H., WU, Y. (2000). *Malaria and growth*. World Bank Policy Research Working Paper.
- MCCLELLAN, M., B. J. MCNEIL, J. P. NEWHOUSE (1994). « Does more intensive treatment of acute myocardial infarction in the elderly reduce mortality ». *Analysis using instrumental variables. JAMA* 272 (11): 859–866.
- MANE, P. Y. B. (2013). “Décomposition des inégalités dans l’utilisation des soins de santé au Sénégal.” *Revue d’économie du développement* 27, no. 1: 61–89.
- MIGUEL, E., M. KREMER (2004). “Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities.” *Econometrica* 72, no. 1: 159–217.

- MOATTI, J-P., N. BELTZER, W. DAB (1993). Les modèles d'analyse des comportements à risque face à l'infection à VIH: Une conception trop étroite de la rationalité. *Population*: 1505–1534.
- MOATTI, J-P., B. VENTELOU (2009). Économie de la santé dans les pays en développement : des paradigmes en mutation. *Revue économique* 60 (2): 241–256.
- MONTEIRO, C. A., W. L. CONDE, B. M. POPKIN (2001). « Independent Effects of Income and Education on the Risk of Obesity in the Brazilian Adult Population ». *The Journal of Nutrition* 131, 3 (janvier 3): 881S-886S.
- ODIWUOR, W. H. (2000). « The impact of HIV/Aids on primary education: a case study on selected districts of Kenya ». Doctoral thesis, Stockholm.
- PACKARD, R. M. (2009). « “Roll Back Malaria, Roll in Development”? Reassessing the Economic Burden of Malaria ». *Population and Development Review* 35 (1): 53–87.
- PRESTON, S.H. (1975). The changing relation between mortality and level of economic development. *Population studies* 29, 231–248
- PRESTON, S. (1980). Causes and consequences of mortality change in less developed countries in the twentieth century. In R. Easterlin (Ed.), *Population and economic change in developing countries* (pp. 289–360). University of Chicago Press.
- PUSHKAR, M. “Parental Bargaining, Health Inputs and Child Mortality in India.” *Journal of Health Economics* 23, 2: 259–291.
- RAM, R., SCHULTZ, T.W. (1979). Life span, health, savings, and productivity. *Economic Development and Cultural Change* 27, 399–421.
- RASSEN, J.A., BROOKHART, M.A., GLYNN, R.J, MITTLEMAN M.A, SCHNEEWEISS, S. (2009a). « Instrumental variables I: instrumental variables exploit natural variation in nonexperimental data to estimate causal relationships ». *Journal of clinical epidemiology* 62 (12): 1226–1232.
- RASSEN, J.A., BROOKHART, M.A., GLYNN, R.J, MITTLEMAN M.A, SCHNEEWEISS, S. (2009b). « Instrumental variables II: instrumental variable application—in 25 variations, the physician prescribing preference generally was strong and reduced covariate imbalance ». *Journal of clinical epidemiology* 62 (12): 1233.
- REITER, P., S. LATHROP, M. BUNNING, B. BIGGERSTAFF, D. SINGER, T. TIWARI, L. BABER, M. AMADOR, J. THIRION, J. HAYES (2003). Texas lifestyle limits transmission of dengue virus. *Emerging infectious diseases* 9 (1): 86.
- ROCHAIX L., TUBEUF S. (2009). Mesure de l'équité en santé: fondements éthiques et implications. *Revue Economique* 2(60).
- SACHS, J. (2006). *The end of poverty: economic possibilities for our time*. Penguin.
- SACHS, J., MALANEY, P. (2002). The economic and social burden of malaria. *Nature* 415, 680–685.
- SCHULTZ, T. P. (2002). Wage gains associated with height as a form of health human capital. *American Economic Review* 92(2), 349-353.
- SCHULTZ, T. W. (1961). Investment in human capital. *The American Economic Review* 51 (1): 1–17.
- SEBAN, J., J. THUILLIEZ, V. HERBRETEAU (2013). “Possession of Bed Nets in Haut-Katanga (DRC): Prevalence-elastic Behaviour or Performance of Health Care System Delivery?” *Health & Place* 24 (November): 275–285.

- SEN, A. (1980). « Equality of what? ». *The Tanner lectures on human values* 1: 353–369.
- SEN, A. (1988). « The concept of development ». *Handbook of development economics* 1: 9–26.
- SEN, A., M. NUSSBAUM (1993). « Capability and well-being ». *The quality of life* 1 (9): 30–54.
- STRAUSS, J. (1986). Does better nutrition raise farm productivity?. *The Journal of Political Economy* 94(2), 297-320.
- STRAUSS, J., THOMAS, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature* 36(2), 766-817.
- STRAUSS, J., THOMAS, D. (2008). Health over the life course. In T. P. Schultz and J. Strauss (ed.) (Ed.), *Handbook of development economics* (Elsevier B.V ed., 3375-3474).
- THOMAS, D., E. FRANKENBERG (2002). « Health, nutrition and prosperity: a microeconomic perspective ». *Bulletin of the World Health Organization* 80, 2 : 106–113.
- THUILLIEZ, J. (2009). « L’impact du paludisme sur l’éducation primaire: une analyse en coupe transversale des taux de redoublement et d’achèvement ». *Revue d’Economie du Développement* 1 : 167–201.
- THUILLIEZ, J. (2010). « Fever, malaria and primary repetition rates amongst school children in Mali: Combining demographic and health surveys (DHS) with spatial malariological measures ». *Social Science & Medicine* 71, 2: 314–323.
- THUILLIEZ, J., M. S. SISSOKO, O. B. TOURE, P. KAMATE, J.-C. BERTHÉLEMY, O. K. DOUMBO (2010). « Malaria and primary education in Mali: A longitudinal study in the village of Donéguebougou ». *Social Science & Medicine* 71, 2: 324–334.
- TRAVIS, P., S. BENNETT, A. HAINES, T. PANG, Zulfiqar BHUTTA, A. A. HYDER, N. R. PIELEMEIER, A. MILLS, T. EVANS (2004). “Overcoming Health-systems Constraints to Achieve the Millennium Development Goals.” *The Lancet* 364, no. 9437: 900–906.
- VENKATARAMANI, A. S. (2012). “Early Life Exposure to Malaria and Cognition in Adulthood: Evidence from Mexico.” *Journal of Health Economics* 31, no. 5 (September): 767–780. doi:10.1016/j.jhealeco.2012.06.003.
- WAGSTAFF, A., PACI, P., VAN DOORSLAER, E. (1991). On the measurement of inequalities in health. *Social science & medicine* 33, 545–557.
- WAGSTAFF, A. (2002a). Inequality aversion, health inequalities and health achievement. *Journal of health economics* 21, 627–641.
- WAGSTAFF, A. (2002b). Poverty and health sector inequalities. *Bulletin of the world health organization* 80, 97–105.
- WAGSTAFF, A., F. BUSTREO, J. BRYCE, M. CLAESON (2004a). « Child health: reaching the poor ». *Journal Information* 94 (5).
- WAGSTAFF, A., M. CLAESON (2004b). *The Millenium Development Goals for Health : Rising to the Challenges*. World Bank Publications.
- WANG, H, ZHANG, L, YIP, W, HSIAO, W (2011). An experiment in payment reform for doctors in rural China reduced some unnecessary care but did not lower total costs. *Health Aff* (Millwood), 30(12):2427-36.

- WELL, D.N. (2007). Accounting for the Effect of Health on Economic Growth. *The Quarterly Journal of Economics* 122, 3: 1265-1306.
- YIP, W.C, HSIAO, W, MENG, Q, CHEN, W, SUN, X (2010). Realignment of incentives for health-care providers in China. *Lancet*, 375(9720):1120-30.
- YIP, W.C.-M., HSIAO, W.C., CHEN, W, HU, S., MA, J., MAYNARD, A. (2012). Early appraisal of China's huge and complex health-care reforms. *Lancet* 379, 833–842.
- YOUNG, A. (2005). The gift of the dying: the tragedy of AIDS and the welfare of future African generations. *Quarterly Journal of Economics* 120:423–66.
- ZHOU, Z., J. GAO, A. FOX, K. RAO, K. XU, L. XU, Y. ZHANG (2011). “Measuring the Equity of Inpatient Utilization in Chinese Rural Areas.” *BMC Health Services Research* 11, no. 1: 201.
- ZHANG, J., ZHANG, J. (2005). The Effect of Life Expectancy on Fertility, Saving, Schooling and Economic Growth: Theory and Evidence. *The Scandinavian Journal of Economics*. 107, 45–66.