Invited Review

The effect of economic development on population health: a review of the empirical evidence

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Abstract

Background: Economic growth is considered an important determinant of population health.

Sources of data: Relevant studies investigating the effect of economic growth on health outcomes were identified from Google Scholar and PubMed searches in economics and medical journals.

Areas of agreement: Additional resources generated through economic growth are potentially useful for improving population health.

Areas of controversy: The empirical evidence on the aggregate effect of economic growth on population health is rather mixed and inconclusive.

Growing points: The causal pathways from economic growth to population health are crucial and failure or success in completing the pathways explains differences in empirical findings.

Areas timely for developing research: Future research should investigate how additional resources can more effectively reach those in need and how additional resources can be used more efficiently. It is particularly relevant to understand why preventive health care in developing countries is very price elastic whereas curative health care is very health inelastic and how this understanding can inform public health policy.

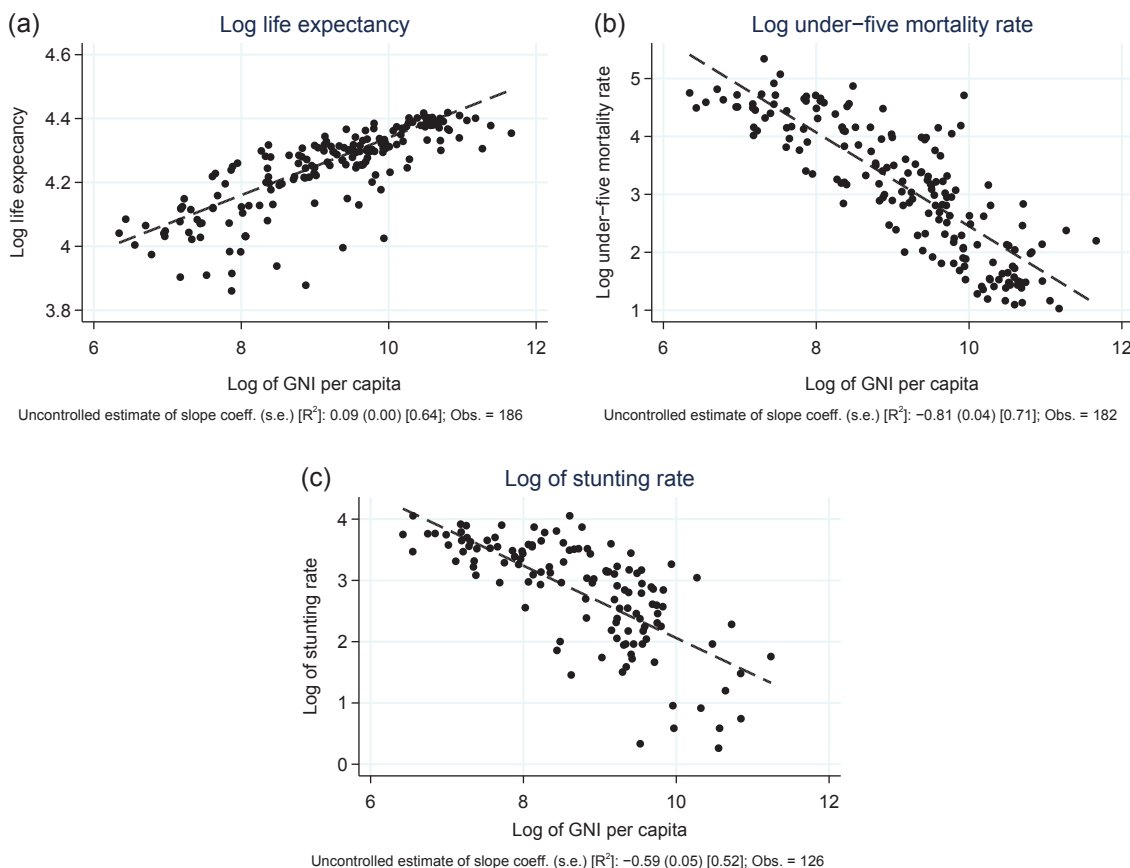**Key words:** economic development, population health

Background

There exists a strong positive association between average income (or wealth) and indicators of population health status, which is evident both across countries and within countries.[1,2] Illustration 1 depicts indicators of population health (life expectancy at birth, under-five mortality rates, and the prevalence of stunting), all in logs, against log Gross National Income (GNI) per capita. Data from 2010 was used for life expectancy and under-five mortality and the latest available observations for each country for stunting. Concomitant regressions reported at the bottom of each panel indicate that these relationships are always statistically significant.

The explanations for this association can be manifold. One is that increasing incomes cause improved population health. But the relationship might also be a result of confounding variables that affect both incomes and health. Potential confounding factors are, *inter alia*, the availability and use of advanced technologies, the population's level of education, governance and institutional quality, and individuals' rate of time preference, a taste parameter that determines the extent to which individuals make provisions for the future. It is also plausible that population health causes economic growth rather than only the other way around. In fact, there is a large and growing literature that investigates this reverse channel.[4,5]

In this review, we focus on the causal effect of economic development on population health. That such a causal effect exists is plausible: firstly, growth

(a) Log life expectancy

Uncontrolled estimate of slope coeff. (s.e.) [R²]: 0.09 (0.00) [0.64]; Obs. = 186

(b) Log under−five mortality rate

Uncontrolled estimate of slope coeff. (s.e.) [R²]: −0.81 (0.04) [0.71]; Obs. = 182

(c) Log of stunting rate

Uncontrolled estimate of slope coeff. (s.e.) [R²]: −0.59 (0.05) [0.52]; Obs. = 126

Illustration 1 Indicators of population health against GNI per capita. We use the most recent year for each country for which both variables in each scatter plot are available. Source: Data accessed through wbopendata-Stata module in December 2015.[3]

may affect the consumption of health-relevant commodities. Importantly, growth may improve nutrition through an increase in the consumption of nutritious foods. Well-nourished individuals are in turn in a better position to resist bacterial diseases and have better prospects to recover from illnesses. Increasing incomes can lead to an increase in consumption of calories and micronutrients, which is particularly beneficial for better health outcomes in developing countries. People may invest in curative as well as preventative health goods as well as other health-relevant goods as a result of higher incomes. Secondly, economic growth may affect the supply side of health if it allows governments to increase spending on effective public health services and complements in the production of health (such as improved transportation infrastructure).

Although increasing incomes are generally associated with improvements in health, they can also lead to unexpected increases in the number of illnesses and diseases linked with prosperity, so-called 'diseases of affluence'. On the demand-side, there may be an increase in the demand for goods associated with health risks, including alcohol and smoking consumption. Economic development can also be linked to concomitant shifts in dietary structure and lifestyle habits. It can promote a sedentary lifestyle and adverse eating habits, which may, in turn, result in an increase in noncommunicable diseases such as obesity and diabetes.

The remainder of this study comes in two parts: in the first part, results from a systematic literature search on the effect of economic development on health outcomes are presented. In the second part, the potential causal pathways from economic growth to population health are discussed.

Literature review

Search strategy

Google Scholar and Pubmed we searched for articles published in economics, public health and medical journals between 1990 and 2015 that included combinations of 'mortality', 'life expectancy' or 'malnutrition' with either 'GDP', 'unemployment', 'recessions', 'downturns' or 'crises'. We then included only empirical studies that considered indicators of health outcomes, including mortality, malnutrition, and life expectancy, as the dependent variable and Gross Domestic Product (GDP), GDP per capita, growth in GDP (or GDP per capita) or the unemployment rate as the main explanatory variable. We further did backward and forward citation searches with the remaining studies. Studies which focus primarily on the reverse causal link from health to economic growth were excluded from the review. Also excluded were studies that use individual-level indicators (e.g. family or personal income) as the explanatory variable as these exclude, by construction, public health interventions as an important pathway from economic development to health. We also did not consider studies which exclusively looked at business cycle variations in developing countries.

Results

Summary

Table 1 provides summaries of the studies that resulted from the literature search. The search suggests the existence of distinct strands of the literature that we summarize briefly in what follows. They deal, respectively, with (1) the effect of economic growth on child survival, (2) the effect of growth on child undernutrition, and (3) the effect of economic downturns on mortality from various causes. While the first two strands focus on developing countries, the third looks at downturns in developed countries.

Economic growth and mortality in early childhood

An early study that aims to identify the causal effect of economic growth on infant mortality[15] based on fixed effects-panel data models finds that the elasticity of the mortality rate with respect to GDP per capita is negative and statistically significant: infant and child mortality rates decrease by about −0.2 percent in the short-run and −0.4 percent in the long-run for every one-percent increase in GDP per capita. These results are robust to a large number of alternative specifications and samples as well as to using instrumental variables to extract exogenous variation in GDP per capita. They are somewhat lower (in absolute terms) than elasticities obtained from cross-country regression.[10]

Table 1 Summary of studies

Study	Setting	Outcome variable	Main explanatory variable	Main findings
Ariizumi and Schirle[6]	Canada 1977–2009	Mortality rate	Unemployment rate	A one percentage point increase in the unemployment rate lowers the predicted mortality rate of individuals in their 30s by nearly 2 percent.
Baird et al.[7]	Developing countries Late 1980s to early 2000s	Infant mortality	Lagged GDP, Current GDP, Lead GDP	Evidence of large, negative association between per capita GDP and infant mortality.
Coope et al.[8]	England and Wales 2001–2011	Suicide rate	Unemployment rate	For men aged 35–44 years old job loss and long-term unemployment is a key risk factor.
Dehejia and Lleras-Muney[9]	United States 1975–2000	Mothers' characteristics, babies' health, or use of prenatal care	Unemployment rate	Evidence of improvement of infant's health status during economic downturns.
Filmer and Pritchett[10]	Developing countries 1990s	Infant and under-five mortality	GDP per capita	Ninety five percent of cross-national variation in mortality can be explained by income per capita, income inequality, female education, ethnic fragmentation, and predominant religion.
Gerdtham and Ruhm[11]	OECD countries 1960–97	Mortality rate	Unemployment rate	A 1 percentage point decrease in the national unemployment rate is associated with growth of 0.4 percentage in total mortality.
Harttgen et al.[12]	Sub-Saharan African countries 1991–2009	Child undernutrition – stunting, underweight, wasting	GDP per capita	Evidence of modest association between increases in per capita GDP and reduction in undernutrition.
Headey[13]	Developing countries 2010	Child malnutrition – stunting and underweight	GDP per capita	Economic growth is a strong predictor of nutritional performance.
Miller et al.[14]	United States 2004	Mortality rate	Unemployment rate	Mortality rates increase in own unemployment.
Pritchett and Summers[15]	Developing countries 1960s–85	Infant mortaliy, child mortality or life expectancy	Per capita income	Long-run income elasticity of infant and child mortality in developing countries varies from −0.2 to −0.4.
Ruhm[16]	United States 1972–91	Mortality	Unemployment rate	A one-percentage point increase in the unemployment rate leads to a 0.43 decrease in the mortality rate.
Ruhm[17]	United States 1972–81	Medical condition and chronic condition	Unemployment rate	Evidence of persistence or accumulation of negative health effects of economic expansions over time.
Ruhm[18]	United States 1979–98	Coronary heart disease mortality	Unemployment rate	A one-percentage-point reduction in unemployment is predicted to raise coronary heart disease mortality by 0.75 percent.

Study	Economic variable	Outcome	Location and period	Findings
Ruhm[19]	Unemployment rate	Mortality rate	United States 1976–2013	The effects of severe national recessions in the United States seem to have a beneficial effect on mortality.
Ruhm[20]	Unemployment rate	Mortality rate	United States 1976–2010	Deaths from cardiovascular disease and transport accidents continue to be pro-cyclical; however, counter-cyclical patterns have emerged for fatalities from cancer mortality and external causes.
Smith and Haddad[21]	GDP per capita	Prevalence of child malnutrition	Developing countries 1970–96	National income growth will be a major factor in achieving future reductions in child undernutrition in developing countries.
Subramanyam et al.[22]	GDP per capita	Child undernutrition – stunting, underweight, wasting	India 1992–93, 1998–99, 2005–06	No consistent evidence that economic growth leads to reduction in childhood undernutrition.
Vollmer et al.[23]	GDP per capita	Child undernutrition – stunting, underweight, wasting	Developing countries 1990–2011	Evidence of very small to null association between increases in per-capita GDP and reduction in early childhood undernutrition.

One disadvantage of the study above is that the mortality series relies to a large extent on interpolation and may be thus inappropriate when identification flows solely from variation across time. The authors acknowledge this and present various robustness checks that leave their main conclusions intact. Nevertheless, more convincing evidence on the effect of growth on premature mortality stems from a recent study that relies on data on 1.7 million births recorded through the Demographic and Health Surveys (DHS) in which only non-random sampling error should play a role.[7] The empirical strategy is based on removing country-specific trends in GDP per capita and infant mortality. The authors then show that fluctuations in GDP per capita have a large negative effect on infant mortality: a one percent increase in GDP per capita is associated with a decrease in infant mortality by between 0.3 and 0.8 percent.

The elasticity varies by gender of the child (with a greater elasticity in absolute terms for females), by location (greater for births in rural areas), and by birth order (greater for higher order births). The authors also show (by including mother fixed-effects) that their result cannot be explained by a change in the composition of women that give birth and remains significant even once the authors control for weather shocks (droughts and floods) and episodes of conflict.

As a whole, the studies from Table 1 point to the conclusion that increases in GDP per capita are associated with reductions in mortality in low- and middle-income countries.

Economic growth and undernutrition

A number of studies of the effect of economic growth on anthropometric indicators of child nutrition (such as underweight[21] and stunting[13]) relied on country-level data. They usually reported a negative and statistically significant relationship, although the parameter estimates often suggested only a modest effect.

A recent study based on data from the DHS on more than 450 000 children in 36 countries investigates the relationship between growth and anthropometric indicators of early childhood undernutrition.[23] The study controls for country- and survey-year-fixed

effects and a large subset of socio-demographic variables. Contrary to the theory that economic growth will lead to better health, findings indicate that the effect of growth on childhood undernutrition in the medium- to short-run is close to zero. This finding is robust to a wide variety of empirical specifications, the inclusion of different sets of covariates, and across sub-samples. Two studies that rely on similar methods to investigate this relationship for India and Sub-Saharan Africa respectively arrive at broadly similar conclusions.[12,22]

Overall, the summary of studies in Table 1 indicates that there is no conclusive evidence that growth of GDP per capita plays a major role for reducing childhood undernutrition.

Mortality during economic downturns

In a series of papers Christopher Ruhm[16–20,24] shows that state-level mortality rates in the US are pro-cyclical, i.e. that mortality increases during recessions. The result is economically significant: a one-percentage point decrease in the state unemployment rate in the US is associated with a 0.5–0.6 percent increase in total mortality. The author finds that about one fourth of the increase is due to an increase in externally caused deaths, particularly traffic fatalities. To a lesser extent, deaths from cardiovascular disease, liver ailments, or flu/pneumonia decrease during downturns due to deaths from these sources responding to short-term changes in medical care or lifestyles to a certain degree. Deaths from cancer, on the other hand, are not found to be sensitive to changes in unemployment rates and deaths from suicides increase during downturns.

Turning to infant health specifically, a study based on state-level data from the USA finds that infants' health status improves during economic downturns.[9] The finding is attributed to mothers having more pre-natal care visits and a significant alteration in the pool of mothers that give birth during recessions toward more educated mothers. The first finding is consistent with mothers having more time available, that is, with decreasing opportunity costs of time spent not working. The second finding is consistent with credit constraints: uneducated mothers may be less likely to be in a position to afford a pregnancy financially during

downturns. In addition, there is evidence that a recession's effect on air pollution may play a role for child health outcomes.[25]

The above studies investigate the effect of short-run fluctuations in growth or unemployment rates on mortality. It seems very likely that shocks to permanent income, that is, events that permanently alter an individual's income path over time, would have very different effects. And while the above studies rely mostly on repeated cross-sections, analyzing the effect of permanent income changes would require panel data with many observations over time. Sullivan and von Wachter[26] show that earnings of US workers averaged over long time periods are a significant predictor of future mortality risk. A follow-up study based on the same data investigates the effect on the long-run mortality risks of US workers of job displacement.[27] The authors find that the effect is very large initially: mortality risk increases between 50 and 100 percent. And while this effect decays over time, the temporal pattern indicated that the total loss in life expectancy of a worker laid off at age 40 may be around 1.0–1.5 years.

In summary, there exists evidence from high-income countries that temporary economic downturns can lead to improved health outcomes; however, this is not necessarily true for long-term economic decline.

Conclusions

Taken together, three main conclusions emerge from this discussion. Firstly, the effects of short-run fluctuations in growth typically vary with a country's stage of development. Health, particularly when operationalized as mortality rates, tends to be counter-cyclical in developed and pro-cyclical in developing countries. While changes in health behaviors are the main driver of counter-cyclicality in developed countries, these findings are also consistent with findings from the literature on the cyclicality of public health expenditures that typically indicate that expenditure is counter-cyclical in developed and pro-cyclical in developing countries.[28] Secondly, the effect of shocks to permanent (lifetime) income is likely very different. The little evidence that exists suggests positive effects of an increase in permanent income on health outcomes.

Third, how health outcomes are measured tends to matter. There is convincing empirical evidence for a positive effect of downturns on mortality rates in developing countries while the case for an effect on changes in nutritional outcomes, is much weaker.

Pathways from economic growth to population health

In this section, we investigate the channels through which economic growth impacts population health. We include studies that we found by targeted keyword searches, screening the references and citing articles of the original search in order to establish the pathways from economic growth to population health. Several factors could potentially account for the failure of the above-mentioned studies to establish a robust positive causal effect of higher incomes on health. First, if economic growth improves health but also increases survival chances, the net effect on health is ambiguous as those that survive due to higher incomes might have lower levels of health. Second, whether rising incomes will increase population health might depend on the distribution of gains in the population. If only those in good health benefit, the effect on overall population health will be small. This is potentially an issue both within and between households as we will discuss below. Third, the effect of additional income on health will depend on how this additional income is spent. Additional income might be spent on goods and services that have no or even a negative effect on health. Finally, it could be that public health services and infrastructure play a decisive role such that without improvements in this area, the effect of economic growth on health status is negligible.

Selective mortality

The effect of growth on childhood mortality is significant and sizable yet insignificant and small in studies that use undernutrition as a measure of health. As an empirical matter, one explanation for this could be positive sample selection: if improvements in nutritional status also lower the probability of premature death, the composition of the sample is altered in that it will also include individuals that would otherwise

have died. If, at the same time, undernutrition is an important cause of death, the relationship between childhood mortality and anthropometric outcomes may be non-monotonic.

There are, to the best of our knowledge, only two studies that investigate the issue directly. The first is a recent cross-country study on the relationship between adult height, an important marker for chronic under-nutrition during childhood, and mortality rates of children.[29] The study concludes that people tend to be taller in high mortality-countries as compared to people in countries with moderate mortality. On the other hand, this relationship is negative and monotonic at lower levels of mortality. The second is a study based on DHS data from India.[30] Based on simulations, the authors argue that any selection effect is likely to be very small. In other words, in order for the selection effect to be large, differences in anthropometrics between children who died and those who survived would have to be very large.

The distributional impact of economic growth

The demand-side argument above will fail and economic growth will not translate into improvements in health outcomes if the gains to growth accrue to those in good health only. But the poor typically suffer from the largest disease burden. An important link in the causal chain from economic growth to population health is thus the link between growth of average incomes and growth of the incomes of the poor. A widely cited study finds that growth in average incomes translates into about equi-proportionate growth in the incomes at the lower end of the income distribution[31] and this finding has been confirmed in an updated dataset recently.[32] The finding is robust to both growth promoting policies as well as poverty reducing policies.

There is, however, considerable variation in how episodes of growth translated into poverty reductions across space and time.[32–35] For instance, countries in Latin America achieved growth that was pro-poor during the 1990s, while Asia experienced a significant increase in inequality in the 1990s and 2000s.[32] The sectoral composition of

growth matters: as one would assume, growth in agriculture and other sectors that use unskilled labor intensively has been found to be important for making growth pro-poor.[36],[37] These considerations substantially weaken the link from growth *per se* to changes in the incomes of the poor.

Behavioral responses to income growth, prices, and quality

The demand-side channel discussed above works through changes in expenditure on health-relevant goods and services, where goods are broadly defined and also include time spent in different activities (e.g. physical exercise). Health problems including increased susceptibility to infectious diseases and physiological disorders are often a direct result of under- or malnutrition, particularly in developing countries. We first review studies that analyze the effect of higher incomes on the intake of calories and other nutrients. We then turn to the effect of income on the demand for medical care, where we will distinguish between preventive and curative care.

It is important to clarify that not all of the additional goods and services that can be consumed as a result of higher income have to have a positive effect on health. There may also be an increase in the demand for goods associated with health risks such as smoking or alcohol consumption.

Income elasticities of the demand for nutrients

If growth were to affect health status through an improvement in nutritional outcomes, we would expect to find that increases in incomes are associated with a significant increase in the consumption of calories or nutrients. The question is of obvious interest to policy-makers: a positive elasticity would suggest that cash transfers are effective in reducing hunger and malnutrition and, thus, improving health status. It would also imply that standard policy recommendations for equitable and sustained economic development would be effective in eradicating malnutrition.

Note first that the canonical finding that expenditure on food items increases with income – referred to as Engel's Law – does not imply that an increase in incomes will also result in higher calorie consumption. In fact, the income elasticity of calories will typically be lower than the elasticity of food as households substitute more expensive foods with lower caloric content for foods that are cheap yet contain more calories.

It is also important to note that such investigations face serious empirical challenges and put a high demand on data: First, they require fine-grained data on food expenditure that can be readily matched to caloric and micronutrient content of food items. In particular, one should be able to rule out that prices of specific food items change with income conditional on location as this certainly suggests heterogeneity in quality and potentially heterogeneity in the caloric content. Second, one has to assign caloric content to food items that households reportedly consumed and there may be both variability in the caloric and nutritional content of a given food item and differences between items consumed and purchased through wastage. Third, the composition of food consumed outside the household is usually not reported yet its share is often not negligible. Fourth, current income is a noisy proxy for households' economic means. Naive estimates of the income elasticity are thus likely to be biased towards zero. Researchers usually use expenditure as the explanatory variable but this, in turn, may bias estimates upward as there may be common measurement error in total expenditure and calorie consumption.[38] Finally, the relationship that is uncovered may actually reflect reverse causality from better nourishment to higher incomes.

An early literature on this topic,[38],[39] argued that the income elasticity of the demand for nutrients in developing countries is close to zero such that 'increases in income will not result in substantial improvements in nutrient intakes'.[39] A subsequent study based on detailed expenditure data from rural India finds that calorie intake increases by 0.3–0.5 percent for every one-percent increase in total expenditure.[46] This elasticity declined only slowly with total expenditure and was non-zero over the entire range. While these estimates are on the high side of what is usually reported, it seems clear that income growth will improve nutritional status at least for the poor. The study also found that sufficient in-take is affordable even in settings with high

poverty rates. In rural India, all the calories required for a full day worth of farming activity could be purchased for less than five percent of a typical daily wage. It thus seems unlikely that insufficient calorie intake is the cause for low incomes.

External validity is a concern in this literature. For instance, it is theoretically plausible that income elasticities depend on the price of food relative to other goods. A recent study that exploits variation in relative prices due to an economic crisis suggests that elasticities may be higher when food items are relatively more expensive.[41] There is also some evidence that higher relative food prices in the late 20th century in today's industrialized countries were associated with higher income elasticities.[42]

While our knowledge about the relationship between changes in income and changes in calorie-intake may be quite advanced, malnutrition may also result from insufficient intake of other nutrients. Estimates of the extent of 'hidden hunger', the number of individuals that suffer from micronutrient deficiencies, are difficult to come by yet in some cases exceed two billion.[43,44] And what little we know suggests that elasticities for important nutrients such as iron and vitamins may be close to zero.[41] One reason for this may be that consumers lack information about nutrient contents.[45]

Curative and preventive health expenditures

A vast literature in economics is devoted to understanding health expenditure in developing country-settings and two key observations emerge from this literature[46]: First, households in low-income countries often spend a significant fraction of total household expenditure on remedial health care. This type of spending is typically out-of-pocket as health insurance is almost universally lacking.[47] Second, preventive health care spending in developing countries is often found to account only for a negligible share of total expenditure. This traditionally resulted in low coverage rates of preventive measures such as insecticide-treated bednets (ITNs) and point-of-use chlorination of drinking water despite their proven effectiveness.[46] For instance, the cost of an ITN is much lower than the costs in

terms of future earnings foregone that result from bouts of malaria.[48]

What causes this imbalance between expenditure on remedial and preventive health goods in developing countries? Households frequently cite financial constraints as the main reason for not investing in preventive health goods and randomized control trials (RCTs) show that demand is highly price elastic – even a small increase in price results in a large decrease in demand for de-worming drugs,[49] ITNs,[50] and water purification products.[51] Demand for curative health goods, on the other hand, is price-inelastic. One study finds that increasing the price of an antimalarial treatment course for children from $0.30 to $1.50 did not reduce the share of households buying the treatment.[52] An observational study of health care demand in Tanzania found that substitution between private and public services is high yet a price increase across all offers will result in few people opting for self-treatment.[53]

So will removing financial constraints, for instance, by providing cash, increase demand for preventive health goods? This could be the case if households are credit constrained,[54,55] if they lack a secure place to save money,[56] or if they fail to build up sufficient savings for behavioral reasons.[57,58]

To be sure, there are alternative explanations: It could be that households lack information about health risks they face or the effectiveness of preventive measures. There is some evidence that information campaigns affect health behavior when the information itself is very specific and targeted. For instance, two RCTs in which treated households were informed about contamination levels of their own water source resulted in significant behavioral change.[59,60] Parallel RCTs in Kenya and Bangladesh on point-of-use water chlorination and filters also resulted in higher uptake.[61] But the effects of other more general campaigns are usually small or even zero for the uptake of preventive health care.[49,62]

The evidence for credit constraints or savings failures, on the other hand, is somewhat stronger. Two recent studies based on RCTs in India[55] and Morocco[54] show that giving households access to credit to purchase subsidized, preventive health goods (ITNs and a tap water connection, respectively) are effective in increasing take-up. If presented with the

options of either making the purchase on credit or in cash, most households that did purchase tended to opt for a loan. One caveat is that in both experiments credit was offered to treated households only for one particular good. Hence, it seems unlikely that removing credit constraints globally would have a similar effect. Studies that investigate the effect of unconditional credit access[63,64] typically find no impact on the uptake of curative health goods yet do not investigate impacts on preventive health goods.[46] However, a recent RCT conducted in Burkina Faso in which treated households were provided unconditional cash transfers found that this did not increase the number of preventative health care visits.[65]

Intra-household bargaining

Another important literature with links to both the distributional impact of growth and households' behavioral responses and discussed above investigates the effect of female empowerment.[66] While a more detailed discussion of this literature is beyond the scope of this review, it is important to note that the empirical evidence suggests that 'money in the hands of mothers (as opposed to fathers) increases expenditures on children'. In fact, there are several studies that find that positive shocks to the mother's income are associated with improvements in their children's health.[67]

Growth, health spending, and outcomes

Economic growth in theory enables governments to raise additional resources for public investments and expenditure, including public health. Higher individual incomes could also increase demand for the quantity and quality of public and private health services. However, outcomes will also depend on whether the government is responsive to popular demands and whether increased public health spending will improve health.

Growth and aggregate health expenditure

We first ask whether aggregate growth will typically increase aggregate health spending and we will highlight some of the key considerations in this debate. There are, however, some caveats: First, identifying the direction of causality in this relationship is, once

again, challenging. In fact, a large number of studies look at the reverse link, from public spending on health to economic growth.[68] Second, good quality data on total health spending from developing countries only became available recently and its reliability with respect to implied trends over time is questionable. Finally, the whole point of health insurance systems is to disconnect personal budget constraints and personal consumption of health goods commodities.[69] As a consequence, one typically observes that the income elasticity varies with the level of analysis: it is close to zero at the individual-level where extensive health insurance systems are in place but significantly different from zero in settings in which health insurance is not available. It is closer to one and, in some cases, exceeds one if the relevant variables are defined at the level of countries.[70,71]

While an elasticity in excess of one would suggest that income growth should have a large effect on health spending and, thus, potentially also on health outcomes, recent studies find that it depends on the level of income.[72,73] For instance, one study finds that spending on health care in OECD countries is elastic at low levels of income and more inelastic at higher levels of income. Health care tends to be a luxury good at low levels of income but a normal good at higher levels.[72] Consistent with this, a recent study that also considers data from developing countries finds that health care spending 'is less responsive to changes in income in low-income countries and most responsive in middle-income countries with high-income countries falling in the middle'.[73]

Effectiveness of public health care spending

Early cross-country studies typically found that the average effect of public health spending on health outcomes across countries is close to zero once national income is accounted for.[10,74] This came as a surprise as typical estimates of the cost-effectiveness of public health interventions suggested much larger effects. Attenuation bias may explain this result at least to some extent as the quality of administrative data, particularly in developing countries, is often questionable. In addition, reverse causality is a concern as countries with poor

population health may try to address the problem by spending more on health. But there may also be substantive causes for a lack of association.

One possibility is that public health spending crowds out private health spending, that is, private spending declines as a consequence of increasing public spending.[75] Another possibility relates to government capacity and the institutional environment in which public health programs are implemented. Effectiveness requires the ability to gather information about binding constraints and administrative capacity to roll-out and manage programs. It also requires institutional oversight and an incentive system that prevents fraud and promotes cost efficiency. In line with this reasoning, recent empirical investigations found evidence for significant interaction effects between public spending and variables that aim to capture the institutional environment.[76,77] Findings suggest that public spending has no effect in poorly governed countries yet a substantial effect well governed countries.[77] This would be consistent on the one hand with several recent country-level studies that suggest that higher public health spending in administrative units in more advanced (and, likely, better governed) countries did improve health outcomes.[78–80]

Overall, the evidence for the relevance of good governance for the effect of public expenditure on outcomes is very strong. At the same time, the *quality* of public health care in developing countries is often dismal.[81–83]

Conclusion

There exists somewhat mixed evidence on the aggregate effect of economic growth on population health. Economic growth in theory can give poor households the economic means to spend more on health and nutrition of their family members. However, for this pathway to work, economic growth has to reach the poor and they also have to make the decision to spend their additional resources in a way that benefits their health. Economic growth in theory also can give governments the means to provide a better public health system and to invest in infrastructure that directly or indirectly affects health. However, for this pathway to work, governments have to be able to effectively raise tax revenue, make the decision to spend the additional resources in domains that are beneficial for health, and to actually spend the resources in a way that improves health outcomes. There are many things that can go wrong along these pathways and failure or success in completing the causal chain may explain why in some settings economic growth is found to be beneficial for health whereas in others it is not.

Aggregate growth may or may not benefit the poor depending on where it originates, how relative incomes at the household-level are altered, and what kind of institutions are in place. Individual increases in permanent income are associated with an increase in the consumption of calories and, with exceptions, micronutrients. The effect of increases in income on health care uptake is less clear. Price changes are very consequential for the uptake of preventive health care and the quality of health services seems to matter for the effect of income on health care utilization.

The relationship between economic growth and health spending varies by level of economic development. Public health spending is particularly sensitive to changes in per capita GDP at intermediate levels of economic development, i.e. expenditure on direct health goods becomes a priority at this point. There is often no association between health outcomes and public health spending in cross-country studies. Crowding-out of private expenditure may explain this finding to some extent. However, the effect of public health expenditure on outcomes depends on the institutional environment.

Overall, the evidence suggests that economic growth will not automatically lead to improved population health. Additional resources are potentially useful, but it largely matters how they are distributed and how they are utilized. There is thus an important role for public health to ensure that additional resources generated through economic growth are used in a way that is most beneficial for population health.

Conflict of interest statement

The authors have no potential conflicts of interest.

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