Should Global Health be Tailored Toward the Rich? Altruism and Efficient R&D for Neglected Diseases

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Abstract: We analyze the problem of incentivizing research and development (R&D) into developing world disease from an economic efficiency perspective. We view the problem as how to best promote R&D into goods with positive external effects in the sense that medicines that directly affect the health of the poor also indirectly affect the utility of the altruistic “rich.” We demonstrate why existing policy proposals – such as price concessions by manufacturers – adversely impact the poor by placing the burden of R&D only on innovators rather than all altruists in the rich world. We offer policy solutions that are based on economic efficiency and therefore rely on a broad sense of how the world values the treatment of developing world disease. We estimate that global altruism toward those with malaria is, at a minimum, valued between $835 million and $2.4 billion annually and for HIV/AIDS, between $9.1 billion and $26.6 billion annually. We argue that future policies toward neglected diseases need to better incorporate how efficient R&D meets the need of this global altruism.

Keywords: AIDS; HIV

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1 Introduction

Despite great strides in medical knowledge and in the delivery of medical care in both developed and developing countries, disparities in global health remain a source of distress. Current market incentives induce research and development (R&D) into developing world diseases that is strikingly low compared to R&D into diseases affecting developed countries. For example, although malaria accounts for an estimated 3% of the total global burden of diseases – as measured by life-years lost from diseases – malaria R&D comprises only 0.15% of worldwide R&D
spending (Anderson et al. 1996). Reducing these worldwide disparities in health through R&D or distribution of existing medicines is one of the central concerns of global health initiatives.

Although the challenge of improving mortality from developing world disease is a well-recognized problem, it has not been explicitly analyzed from the perspective of economic efficiency. In particular, efficiency criteria necessary to assess existing policy proposals to stimulate R&D into these diseases have not been precisely analyzed. In this paper, building on our previous work (Jena et al. 2010), we attempt to fill those gaps by exploring how to provide correct R&D and distribution incentives for developing world disease when people are altruistic and therefore care about the health of others. More precisely, when developed countries care about the provision of medicines to the developing world, the incentives for companies to innovate may be substantially different than if developed countries were not altruistic at all. Medicines to treat developing world disease are “consumed” by two parties – the poor who derive direct health benefits (but cannot afford to pay for them) and the wealthy that derive altruistic benefit from helping those in need.

The challenge of improving global health is, in fact, a unique joint economic problem the components of which have previously been addressed in isolation.¹ The first prong of the joint problem is how to encourage innovation into products with only private consumption effects, products that are valued only by those who consume them. This may involve developing strategies to stimulate cancer R&D when only those with or prone to cancer value new cancer treatments. The second prong is how best to provide health care to those in need, when improvements in their health have positive external effects on the well-being of others. For example, new treatments for malaria may have little direct health benefit to citizens of richer developed countries, yet may nonetheless be valued if those countries are altruistic and care about the health needs of the world’s poor. The joint problem of efficient R&D for altruistic goods is poorly understood but at the heart of neglected diseases.

 Viewing the challenge of improving mortality from developing world disease in this way, we argue that efficiency implies that to promote R&D into developing world diseases is to reward innovators by the amount the developed world is willing to pay for improved health from these diseases. Because the poor may have a low willingness to pay (WTP) for treatments simply because they cannot afford them, R&D is efficiently increased by allowing innovators to tap into the value that developed countries place on improving health in the developing world.

¹ As discussed in Section 4, existing research discusses the general issue of global public goods but does not address the joint allocation problem of efficiently incentivizing R&D and efficiently providing goods with positive external consumption externalities.
This joint problem calls for new solutions for stimulating R&D and measurement techniques to evaluate those solutions. Patents are not useful for socially efficient R&D when there are no monopoly profits; exclusivity bears little value when the WTP of consumers is below production costs. Likewise, prizes are inadequate because competitive pricing after discovery leads to under-provision. Rather, what needs to be reflected in efficient rewards to R&D is the value placed on new treatments by those not consuming them, i.e., the rich; new measurement techniques to quantify those values are needed.

In addition, we critically evaluate recent proposals to stimulate R&D into developing world disease and demonstrate how their prescriptions depart from efficiency criteria. For instance, many proposals call for innovators to distribute medicines at low prices in developing countries. An unrecognized implication of these proposals is that they may adversely impact poor nations by yielding levels of R&D that are too low, as they inefficiently place all the altruistic burden on the shareholders of innovating companies rather than others in richer countries who value better global health as well.

Given the importance of rich countries’ WTP for R&D into neglected diseases, the issue arises of how to estimate the magnitude of altruism of rich countries toward improving global public health. To that effect, we calibrate a model that allows us to use data on foreign assistance for malaria and HIV/AIDS to estimate an implicit lower bound on the dollar value of global altruism toward those inflicted with these diseases. The intuition is simple: For any disease, the larger international aid is and the more highly valued charitable giving is generally, the larger global altruism is. We estimate that global altruism toward those with malaria is valued, at a minimum, between $835 million and $2.4 billion annually. This is a surplus above the $701 million in annual foreign aid for malaria. For HIV/AIDS, global altruism is $9.1 billion to $26.6 billion annually, again substantially greater than the $7.6 billion in annual foreign aid for HIV/AIDS. We argue that future policies toward neglected diseases need to better incorporate how efficient R&D meets the need of global altruism.

2 R&D into Neglected Diseases of Poor Nations

Consider a single new drug targeted toward a disease such as malaria or HIV/AIDS that primarily affects the developing world. We assume that the drug, if developed, not only improves the health of poor people in developing countries but also increases welfare among citizens of developed countries who value the treatment of disease in poor nations. We term this latter component an altruistic
externality, although it could arise from either altruism directly or from selfish motives if the improvement of health in poor countries benefits the richer world (e.g., through enhanced economic productivity, elimination of infectious diseases that also affect the developed world, etc.).

The economically efficient level of treatment is determined by two factors: the marginal cost (MC) and marginal benefit (MB) to the world of treating an additional person. The MC of treatment is straightforward – it is simply the cost of drug production once the drug has been developed. The MB of treatment is comprised by the direct health benefit to the additional poor who consume the drug plus the indirect benefit to all altruists of seeing an additional person treated. The treatment of developing world diseases is therefore a “public good” in that the altruistic benefits of treatment cannot be limited to one person. The economically efficient level of treatment occurs where the *private* MC equals the *social* MB of treatment. This is often termed by economists as the “Pigouvian” level of treatment and the subsidy that reduces prices for the poor so that this level of treatment is achieved is termed the “Pigouvian subsidy.” Not subsidizing treatment would result in too few people being treated from an economic efficiency perspective.

The drug’s social value is defined as society’s total WTP for the drug net of the costs of production. The total WTP is the WTP of the poor, whose ability to pay may be limited by income, plus the WTP by the rest of the world for treating disease in the developing world. Drugs that are more valued by society, either because of direct health benefits to the poor or because of indirect altruistic benefits to the developed world, warrant greater R&D. Moreover, greater R&D occurs when more of this total WTP is available as a reward to innovators. In the simplest economic models, rewarding innovators with the full social value of a new drug would be expected to promote optimal levels of R&D.

Consider now a “Pigouvian” policy in which treatment of a disease (say malaria) is subsidized by foreign assistance to the point where the lower price paid by poor individuals results in a level of treatment that equates MC of treatment to the MB to society. Although economically optimal once a drug is developed, this policy will often lead to inefficiently low levels of R&D (see the Appendix for mathematical discussion). Although subsidizing treatment will increase the number of individuals treated and therefore increases profits to innovators, these profits will always fall short of the total dollar value society places on treating and subsidizing disease in developing countries. As such, R&D will fall short of its optimal level because the full value the world places on treating diseases like malaria will not be available to innovators with simple subsidies alone.

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2 The textbook example of a Pigouvian instrument is the Pigouvian tax applied to a polluter so that its marginal cost lines up with the marginal cost to society.
3 Economically Efficient Policies to Stimulate R&D into Developing World Diseases

How do we construct economically efficient global health policies? Optimal policies must perform two tasks. The first is to ensure the efficient production and distribution of treatments once they are developed. The second is to ensure that innovators have enough incentive to innovate. There are two sources of inefficiencies that must be tackled, implying that one instrument or policy is not enough to solve the problem of providing incentives for R&D into developing world disease; two instruments are needed to deal with the two problems.

3.1 Two Instruments through Separate Supply and Demand Prices

Separating the prices that developing world consumers pay for treatments from the prices that producers receive is one solution. In this approach, poor consumers face subsidized treatment prices that result in treatment demand that equates MC to social MB. This subsidized price may fall below the MC of treatment if the poor’s ability to pay for treatment is low and/or the value of altruism is high. On the producer side, prices paid to innovators would be independent of the price paid by consumers and would instead reflect the average WTP for the efficient level of treatment (again where MC=MB). Producers receive a price for each person treated that equals the average per-person social value of treating developing world disease. This price would generate profits to the innovator that equal the full social value of treating disease.

3.2 Two Instruments through Prizes and Distribution Incentives

Patents are not useful for socially efficient R&D when there are no monopoly profits; exclusivity bears little value when the WTP of consumers is below production costs. An alternative method to separate supply/demand prices may then be a properly designed prize with correct distribution incentives. Innovative companies would be rewarded for their R&D after which generic manufacturers may produce and deliver innovations. Prizes have for decades been discussed as alternatives to patents for stimulating innovation. For instance, in the context of global health, they have been advocated in terms of so-called advance purchase contracts (Kremer 2002; Kremer and Glennester 2004).
In the absence of externalities, the optimal prize is typically the dollar present value of the social value a treatment generates. In this case, optimally chosen prizes always dominate patents because the latter limit utilization due to higher prices. When externalities exist, prizes tend to be more favored over patents the greater is the altruism. Further, if we have reason to believe that the costs of achieving the desired innovation are substantially less than the total social value, a prize may work even if it does not approach the magnitude of social value.

A previously unrecognized but important point, however, is that the superiority of prizes under altruism depends critically on how production and distribution occur after the prize has been awarded. For example, because standard prizes assume free and unrestricted licensing after discovery, treatments whose MC exceeds the poor’s WTP would be discovered but never distributed by generic manufacturers.

One solution would be a nonstandard prize that contractually guarantees production after discovery. For example, after awarding a prize, third-party donors would be expected to make up the difference between the MC of production and the price charged to poor consumers by generic manufacturers. Another solution would be a committed public demand contract, e.g., 100 million doses of a vaccine at the price of $10 per shot. For such a prize to be efficient the specified treatment level would have to be efficient, and the specified price would have to reflect the average WTP for that level of treatment.

4 Analyzing Existing Policy Proposals

At the root of many proposals to incentivize R&D into developing world disease is the restriction of intellectual property (IP) rights of the pharmaceutical industry in developing countries. The difference between most of these proposals and ours is that these proposals drive incentives away from, rather than toward, efficient levels of R&D. They tax altruism when it should be subsidized.

For example, Lanjouw (2002) argues that cutbacks in IP rights may provide greater access to drugs while preserving R&D incentives for specific diseases that have large markets in wealthy countries already (Grossman and Lai 2002; Lanjouw 2002). This is similar in spirit to a World Health Organization proposal (Sachs 2001) that advocated cost-based pricing in poor countries, although here

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3 Arguably though, the initial use for a new drug may not be its more important or valuable use. Hence, there needs to be a mechanism to incentivize continuing R&D after initial approval for marketing.

4 In a more general context, Grossman and Lai (2002) discuss the optimality of streamlining IP protection across countries.
through competition rather than regulation and only when those countries make up a small share of world demand. Even in that scenario, the problem is that R&D should be affected by poor markets, through the WTP of richer countries. The Lanjouw proposal therefore implicitly supports “free riding” by donor countries: The benefits to innovators are reduced when those benefits should actually be increased to reflect altruism among donors.

In a series of proposals, Grabowski et al. (2005) argue for “priority review, accelerated approval, and fast track status” marketable rights. The basic idea is to reward innovators for treatments developed for world diseases through transferable vouchers for faster U.S. Food and Drug Administration (FDA) review on any subsequent drug application (Ridley et al. 2006). The voucher can be sold through auctions to another company – typically one that is contemplating a blockbuster drug not applicable to developing countries. The economic efficiency of such transferable priority reviews is not obvious. First, when the value the developed world places on the discovery of neglected-disease drugs is less than the value of the priority voucher, there may be inefficiently high levels of R&D into neglected diseases. Second, economic efficiency dictates that those who benefit from the development of neglected-disease drugs should be the ones to pay for them; in these proposals, however, they are not.

5 Estimating Global Altruism toward Those with Malaria and HIV/AIDS

We are left with the quantitative question of whether the developed world’s WTP to combat developing world diseases is economically significant and could reasonably further stimulate innovation into these diseases. Estimating or calibrating this altruistic surplus is not an obvious task.

We utilize a simple model, the details of which are in the Appendix, which allows us to calculate the world’s WTP for the eradication of diseases predominantly affecting the third world. The calibration is based on the amount of foreign health aid devoted to treating developing world diseases. Using data on global

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5 The threat of compulsory licensing after a drug is developed is such that nations would pay less with compulsory licensing than what their citizens would actually be willing to pay without it. Perversely, direct willingness to pay in poor nations is effectively suppressed.

6 Rather, it is those companies (and the patients who consume their therapies) who do not bid enough to win the priority voucher who ultimately pay, mainly through slower expected review times from mobilization of FDA towards the winner.
funding for malaria and HIV/AIDS specifically, we provide a first estimate, imprecise as it may be, of the dollar value of global altruism.

Although we use the term “altruism” to reflect the motives behind this aid, altruism may reflect “pure” or “selfish” behavior, and our framework cannot and need not distinguish between the two. For example, wealthy countries may subsidize treatment of HIV/AIDS in poorer nations out of “selfish motives” of preventing the transmission of disease abroad.

5.1 A Model to Calibrate Global Altruism

Regardless of whether financing occurs through nongovernmental organizations (NGOs), direct foreign transfers, or government-to-government transfers, the sum of these components should reflect a lower bound of global altruism toward those with these diseases. The difficult computation is that of surplus, i.e., the amount people are willing to pay above and beyond what they do pay. Note that total surplus here should in principle take into consideration the “public good” nature of donations. Even those individuals and governments who “free ride” and do not directly contribute to foreign assistance for malaria and HIV/AIDS altruistically benefit from this care.

The Appendix derives a multiplicative factor, on the basis of economic theory, which allows us to scale up observed levels of global assistance into the world’s WTP for those with malaria and HIV/AIDS. The multiplicative factor depends only and inversely on the demand elasticity of altruism, i.e., how sensitive altruistic giving is to the price (or tax treatment) of altruistic giving.

We draw on published estimates of the elasticity of charitable giving (Peloza and Steel 2005) to calculate that factor. The distribution of reported elasticities of charitable giving imply that global assistance for malaria and HIV/AIDS should be multiplied by a range of 1.2 to 3.5, with a median of 1.5 (details in the Appendix).

5.2 Calibration of Global Altruism toward Treating Malaria

Malaria is the fifth leading cause of death worldwide and the second in Africa, after HIV/AIDS. In 2000, there were an estimated 350 to 500 million cases of

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7 Although the analysis of Peloza and Steel (2005) is mainly US-focused and does not distinguish between types of giving (e.g., domestic vs. foreign giving, health vs. religious giving), we interpret the reported elasticity as broadly reflecting how responsive altruistic giving is to the price of donation.
malaria worldwide with more than 1 million associated deaths (Rowe et al. 2006). Total global spending on malaria grew considerably in the past decade, reaching nearly $1.5 billion in 2007 alone. Of this spending, 19% was spent by private households, 34% by governments in endemic countries, and 47% by international donors. The $701 million breakdown among international donors was as follows: the Global Fund, 50.2%; the US President’s Malaria Initiative, 18.0%; USAID, 12.6%; World Bank, 7.3%; UN agencies, 6.7%; and bilateral arrangements, 5.0% (World Health Organization 2008).

On the basis of these foreign assistance levels for malaria, our model predicts a global WTP for those afflicted with the disease of between $835 million and $2.4 billion annually, with a median estimate of $951 million (nearly 65% of total global malaria spending in 2007).

5.3 Calibration of Global Altruism toward Treating HIV/AIDS

In 2009, approximately 31 million people worldwide were alive with HIV/AIDS, 23 million of which were in Sub-Saharan Africa, North Africa, or the Middle East and 4.1 million of which were in Southeast Asia. An estimated 1.8 million died from complications due to AIDS in 2009 with 1.3 million of those deaths occurring in Africa and Southeast Asia (UNAIDS 2012). Similar to malaria, international assistance toward AIDS increased dramatically in the past decade from approximately $1.2 billion in disbursements in 2002 to $7.6 billion in disbursements in 2009. Unlike malaria, nearly 77% of foreign aid was distributed through bilateral assistance from donor countries, whereas approximately 20% ($1.6 billion) was distributed through The Global Fund and UNITAIDS.

Applying our model to these estimates of international assistance for HIV/AIDS, the predicted global WTP for those afflicted in the third world with HIV/AIDS is large, ranging from $9.1 billion to $26.6 billion annually, with a median estimate of $10.3 billion.

5.4 Limitations

Calculating the dollar value of eradicating diseases mainly prevalent in the developing world is the first step to designing optimal R&D policies that encourage efficient amounts of R&D into these diseases. The challenge with identifying this value is that no market-based mechanism can transparently disclose the full value of an innovation that displays externalities; e.g., we do not fund R&D into orphan diseases on the basis of the total WTP of only those unfortunate few
afflicted with these diseases. Our approach of instead using estimates of foreign, disease-specific assistance embedded in an economic model has several potential limitations.

First, one may argue that global WTP based on measurements of foreign aid is lacking in credibility. Foreign aid estimates grounded in government decisions that are closely related to political processes rather than market measures should be treated, the argument goes, with even more skepticism. This objection can be countered by viewing the political process determining foreign aid toward a disease as somehow guided by altruists’ concerns. Governments have a stable preference for listening to their constituency, and it could certainly be explored whether governments’ foreign aid decisions are insulated from political majority changes. Also, our estimates of foreign aid encompass the assistance of NGOs whose funding, arguably, more directly reflects altruism.

More generally, using foreign aid toward a developing world disease to help measure the value of curing that disease is analogous to computing the value to society of clean air based on public sector expenditures on pollution-reducing activities. Our model does not use foreign assistance directly as the measure of WTP, but rather uses it to reveal a lower bound on the underlying WTP. However imperfect, this is a second best in absence of alternative direct measures of altruism.

A second limitation of our estimates is that governments may not accurately assess how much their own citizens value curing developing world diseases like malaria and HIV/AIDS. Our calculations must necessarily embed that uncertainty.

Another potential limitation is the fact that countries (and even individuals within countries) free ride by not giving foreign aid yet benefitting altruistically. This would affect our estimates in a predictable way, however. Because foreign assistance is even lower when countries or individuals within countries free ride on each other’s donations, our estimates may underestimate the global value placed on treating developing world disease.

Our results may alternatively overestimate global altruism if foreign aid is endogenous in the sense that recipient countries reduce their own spending in expectation of greater foreign aid. Although possible, we know of no evidence to support, however, that larger domestic health spending in the poorest countries is met with substantial reductions in foreign assistance.

A fifth limitation of our model is that it ignores the fungibility of aid and how this may impact the value of R&D into developing world disease. For example, by spending more on R&D for developing world disease, other health aid may be reduced, the reductions in welfare of which we do not account for. To the extent that HIV and malaria are the most pressing issues, the net benefit of reallocating foreign aid toward R&D would arguably be positive but it is impossible for us to determine.
A final limitation of our estimates is that they are based on foreign aid aggregated from different nations, each with a potentially different WTP for the treatment of developing world disease. Yet, our economic model of computing the world’s WTP is based on elasticities of donation with respect to taxes primarily estimated from US data. Whereas varying elasticities of donation in other countries could bias our results in unpredictable directions, the impact is likely to be small given that over 60% of world foreign aid for malaria and HIV/AIDS is based on expenditure by the US Government and US-based NGOs.

The overall point we make, and that we believe deserves attention in the future, is that policy proposals to stimulate neglected-disease R&D need to better address how to increase economic efficiency. Explicit analyses are necessary to make any quantitative assessments of the gains to the poor and the rich from implementing such policies.

6 Conclusion

Worldwide mortality from diseases largely prevalent in developing continues to be a pressing global policy issue. Despite the multitude of innovative policy proposals put forth to stimulate R&D into prevalent third-world diseases, general criteria do not exist by which existing proposals can be evaluated in terms of their economic efficiency. We attempted to analyze the problem of incentivizing R&D into developing world disease from an economic efficiency perspective. In our view, the key economic problem is how to promote R&D into medicines that both directly affect the lives of the poor and indirectly affect the lives of those in wealthier countries who value cures for diseases primarily affecting the developing world.

Our analysis suggests that the economically efficient way to stimulate R&D into these diseases is to reward innovators by some amount of the world’s altruistic WTP for improvements in mortality from these diseases. Optimal R&D policies should not be driven simply by the ability to pay of the world’s poor, but rather by the WTP of the world’s rich. In our view, most existing proposals lead to inefficiently low levels of disease R&D because they tax, rather than subsidize, innovators for the altruistic value their drugs generate. In essence, to varying extents, these proposals place the burden of R&D on the shareholders of innovating companies as opposed to those in the developed world who benefit from seeing more lives saved in poorer countries.

Given our results, an important component of any R&D policy that attempts to efficiently incentivize R&D into a developing world disease is assessing the
empirical magnitude of worldwide altruism toward those with that disease. Despite their limitations, our illustrative estimates suggest that the dollar value of worldwide altruism may be large and that better aligning the world’s WTP for curing diseases like malaria and HIV/AIDS with the rewards to innovators may successfully promote R&D. To the extent that encouraging cures for developing world disease by rewarding innovators with large prizes is politically infeasible, a second-best option would be to allocate our estimates to public research budgets (e.g., NIH) or joint public-private partnerships (Granville and Trushin 2010).

7 Appendix 1

This theoretical appendix demonstrates why standard subsidies to lower the price of drugs developed for third-world disease are economically inefficient. The Appendix formally demonstrates that such subsidies do not provide the correct incentives for R&D when drugs are valued not only by those who directly consume them but by altruists in the developed world as well.

Let $y$ denote the output or number of people in the developing world treated by drug specifically designed for a third-world disease such as malaria, $p(y)$ the private inverse demand curve in developing countries, $e(y)$ the global monetary value to altruists when $y$ individuals consume the drug, and $c(y)$ the total cost function. The function $e(y)$ is increasing in the number of people treated with the drug. Let the producer surplus $\pi(y)$ (profits) and consumer surplus $s(y)$ be denoted by:

$$\pi(y)=p(y)y-c(y) \quad (1)$$

$$s(y)=\int_0^y p(s)ds-p(y)y \quad (2)$$

and let $y_\pi$ represent the assumed unique output that maximizes profits $\pi$.

Static (or ex post) social welfare $W(y)$, i.e., society’s total welfare after a drug has been commercialized, is then defined by consumer and producer surplus $s(y)+\pi(y)$ together with the altruistic surplus $e(y)$ of those affected externally by the provision of the new drug:

$$W(y)=s(y)+\pi(y)+e(y) \quad (3)$$

Let $y_w$ denote the (assumed unique) output or number of people consuming the drug that maximizes $W$. 
An allocation \((r, y)\) is defined as an R&D level \(r\) and an output level \(y\) after the drug has been discovered. The expected (or ex ante) social welfare given R&D \(r\) and output \(y\) is:

\[
D(r, y) = x(r)W(y) - r. \tag{4}
\]

It represents ex post welfare weighted by the probability the drug is discovered \(x(r)\) minus the cost of innovation, which needs to be incurred in any event. The first-best R&D and output pair \((r^*, y^*)\) maximizes this social welfare. Conditional on discovery of the drug, the optimal output choice is given by:

\[
D_y = xW_y = 0. \tag{5}
\]

Clearly, the first-best and ex post optimal output coincide: \(y^* = y_w\). Given an optimal welfare \(W^*\), the optimal R&D is then one that solves the first-order condition:

\[
D_r = xW^* - 1 = 0. \tag{6}
\]

More generally the optimal level of R&D that maximizes expected payoffs for any hypothetical ex post award \(z\) is denoted \(r(.)\) and is defined by:

\[
r(z) = \arg\max_r x(r)z - r. \tag{7}
\]

In this notation, the corresponding first-best R&D takes into account the highest level of ex post welfare \(r^* = r(W(y_w))\).

The first-best allocation differs from the allocation that results when the externality of altruism toward third-world disease is corrected by Pigouvian subsidies. If \(r(\pi(y))\) is the R&D induced by the patented profits, the Pigouvian output will generally not induce the first-best dynamic allocation because the R&D induced by the Pigouvian output coincides with the first-best R&D level only when:

\[
r(\pi(y_w)) = r(W(y_w)) = r^* \tag{8}
\]

which implies \(s(y_w) + e(y_w) = 0\). As consumer and producer surpluses are never zero under a positive externality, this condition fails to hold and Pigouvian corrections will lead to inefficient R&D levels.

## 8 Appendix 2

This empirical appendix develops an economic model that allows us to calculate the dollar value of global altruism toward third-world diseases such as malaria and HIV/AIDS on the basis of two pieces of information: 1) estimated foreign assistance for these diseases and 2) general estimates of the value of charitable giving.

Consider a poor nation for which the social surplus arising from the utilization of a new drug to treat third-world disease is defined by the WTP of those who
directly consume treatment plus the WTP of those in the developed world who value utilization of this drug by the poor, all net of production costs:

\[ W(y) = \int_0^y p(q) dq - c(y) + Na(y) \]  

(9)

Production is assumed to take on constant returns to scale so that \( c(y) = cy \). The value the developed world places on utilization of this drug by the poor, i.e., the altruistic surplus, is given by \( e(y) = Na(y) \). There are \( N \) foreign altruists who provide treatment assistance to those in the poor country afflicted by the disease targeted by the drug. In this welfare function, treating those in the third world with a new drug is viewed as a public good in the sense that individuals in all wealthy, donor countries can benefit from the donor behavior of a single country. Each altruist therefore has a total WTP for providing the drug to the poor given by \( a(y) \), where \( a(y) \) is assumed to be increasing and either linear or concave in \( y \). If \( p_a(y) \) is the downward sloping demand curve for altruism, then \( a(y) \equiv \int_0^y p_a(q) dq \).

The level of drug provision that maximizes \( W(y) \), \( y_w \), can be attained by an appropriately chosen Pigouvian subsidy, \( \delta \), which we interpret to reflect foreign treatment assistance. Under the assumption that observed levels of foreign treatment assistance, e.g., toward malaria or HIV/AIDS, reflect a Pigouvian correction to the altruism externality toward these diseases, we can use this simple model to calibrate the relationship between treatment assistance and the dollar value of global altruism toward these diseases. We therefore assume that observed foreign assistance for a disease such as malaria reflects a correctly chosen Pigouvian subsidy that subsidizes spending by affected countries to the point where the MC of subsidization in poor countries equals the MB to the world of having additional people treated by these lower, subsidized prices. We assume that manufacturers practice cost-based pricing in poorer nations.

### 8.1 Measuring Altruism

The first-order maximizing condition that determines the optimal level of drug provision is given by:

\[ p(y) + Na'(y) = c \]  

(10)

where the left-hand side is the social MB of an expansion in treatment and the right-hand side is the social MC. Under competitive pricing, the optimal subsidy \( \delta \) that induces this quantity of treatment is simply \( \delta = Na'(y) \). This expression can be rewritten to highlight the relationship between foreign treatment assistance, given by \( \delta y \), and global altruism toward those with the given disease \( Na(y) \):

\[ \delta y = Na(y)e_{a_y} \]  

(11)
where $\varepsilon_{a,y} = a'(y)(y/a)$ is the elasticity with respect to the level of treatment of a single altruist’s total WTP for treatment of those with disease. The elasticity is defined as the percent change in the total WTP for treatment of those with disease given a 1% change in the number of people treated. When $a(y)$ is concave, this elasticity is less than unity.

The implication of this expression is that data on international assistance toward a disease can be used to identify the dollar value of global altruism toward treating those with that disease. In particular, global altruism $Na(y)$ is measured by scaling up foreign assistance $\delta y$ by a multiplicative factor $(1/\varepsilon_{a,y})$, which, when $a(y)$ is concave, will be greater than one. In fact, when the demand for altruism is perfectly elastic, e.g., if $p_a(y)$ equals the constant $\beta$, the altruist’s total WTP for a given number of people treated will be linear $a(y)=\beta y$. In this case, the level of global altruism toward those with a given disease will be identical to observed international assistance toward those affected; that is, $\delta y=Na(y)$. In this framework, then, total observed foreign assistance toward those afflicted with malaria or HIV/AIDS in developing countries can be construed as a lower bound of what the world is willing to pay for to treat those with these diseases.

When the demand for altruism is inelastic, measured altruism will be greater than foreign assistance by a multiple of $(1/\varepsilon_{a,y})$. Being able to measure global altruism toward those with a given disease will therefore rely on being able to measure $\varepsilon_{a,y}$ for that disease. When the demand curve for altruism is linear, it is straightforward to show that the elasticity of the total WTP with respect to output, $\varepsilon_{a,y}$, satisfies:

$$\varepsilon_{a,y}^{\text{linear demand}} = \frac{\varepsilon}{\varepsilon + 0.5}$$

where $\varepsilon = -\frac{dy}{dp_a} \frac{p_a}{y}$ can be interpreted as the absolute value of the elasticity of foreign assistance or charity care with respect to the “price of altruism.” In the context of charity donations, for example, this elasticity would be the percentage increase in donation dollars for a 1% decline in the price of donation, as perhaps generated by a given tax benefit to donating. To further illustrate, suppose that charitable donations are initially non-tax-deductible and individuals donate $100. This generates a particular level of utility at a price of altruism equal to $100. If donations now become tax deductible and the tax rate is 20%, the price of generating that same level of utility is $80 per year. If donations then increase to $120, the price elasticity of charity care would be one.

Combining Equations (11) and (12), one arrives at a simple equation that gives the dollar value of global altruism toward a given disease as a function of two parameters: 1) foreign assistance for the disease and 2) the price elasticity of altruistic or charitable giving.
Altruism for disease $i \equiv \frac{\text{Foreign assistance toward disease } i}{\frac{\epsilon + 0.5}{\epsilon}}$ \hfill (13)

The intuition behind Equation (13) is straightforward. First, higher levels of foreign health assistance toward a disease imply a greater global WTP for improvements in that disease. Second, as individuals care more about altruism generally, such that the demand for altruistic behavior becomes more inelastic with respect to the price of donating, a given level of foreign assistance will reflect a greater WTP for treatment of those with the disease.

The multiplicative factor in Equation (13) that scales up foreign assistance toward a disease requires data on the price-elasticity of donation, which we obtain from a recent meta-analysis of the elasticity of charitable contributions (Peloza and Steel 2005). These authors find an average price elasticity of charitable contributions of roughly 1.44 (in absolute value terms, with a standard deviation of 1.21) across all studies considered. Although their analysis is mainly U.S.-focused and does not distinguish between different types of giving (e.g., domestic vs. foreign giving, health vs. religious giving), we interpret the reported elasticity as broadly reflecting how responsive altruistic spending is to the price of donation. Using an average price elasticity of charitable contributions of 1.44 plus or minus one standard deviation (0.2 vs. 2.6) gives a range of the foreign assistance scaling factor between 1.2 and 3.5 with an average of 1.5. For a given disease like malaria or HIV/AIDS, our model suggests a dollar value of global altruism toward each of these diseases equal to 1.2–3.5 times foreign assistance toward each of these diseases.

References


