Working Paper

Better Vision for the Poor

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Abstract

About 500 million to 1 billion poor people in the world need eyeglasses but do not get them. Visual impairment is more than just a health problem; it has economic, educational, and public safety implications. In 2005, the French multinational Essilor launched a 'bottom of the pyramid' initiative to market eyeglasses to the Indian rural poor. VisionSpring was founded in 2001 as a social enterprise with the mission to provide affordable eyeglasses to the poor. Another approach to solving the vision problem emphasizes technological innovation to provide low-cost self-adjustable spectacles. None of these approaches has succeeded on a large enough scale so far. We propose an alternative solution that emphasizes dramatic cost reduction by utilizing ready-made eyeglasses, basic screening without a trained optometrist, economies of scale, piggyback distribution, and low overheads.

Keywords: Reducing Poverty; Public Health; Vision Correction

About 2.3 billion people in the world suffer from poor vision due to refractive error, a common disorder in the eye that blurs vision.[1] Of these people, approximately 517 million people in developing countries are considered visually impaired because they do not have access to corrective treatment.[2,3] The Centre for Vision in the Developing World at the Oxford University has a higher estimate: over one billion people need but do not get vision correction.[4] There is a simple, old, and cost-effective technology to solve this problem: eyeglasses. Yet, the problem persists on a massive scale. For the poor, eyeglasses often are either inaccessible or unaffordable, forcing hundreds of millions people to live below their full potential.

Visual impairment, however, is more than just a health problem; it has economic, educational, and public safety implications. For example, in Tanzania, 71% of people who are farsighted are dissatisfied with their ability to do near work, such as winnowing grain, sewing, reading, and cooking food.[5] However, only 6% of people who are farsighted in Tanzania have eyeglasses.[6] In the mid-2000, only 7% of the Indian population actually wore spectacles, whereas about 65% of the population needed spectacles.[7]

Those of us who are affluent and wear eyeglasses would find it difficult to imagine life without spectacles. A simple pair of eyeglasses could dramatically improve the lives of the poor: increase earning power, improve educational opportunities, increase occupational and public safety, and foster the ability to perform everyday tasks. Even the straightforward economic return from eyeglasses for the poor far exceeds the cost of

eyeglasses. A variety of approaches have been tried to solve this problem: for-profit business model, social entrepreneurship, and innovative technology. Yet, to date, none have succeeded on a large enough scale.

The 'bottom of the pyramid' (BOP) proposition, popularized by CK Prahalad, argues that selling to the poor can simultaneously be profitable and eradicate poverty.[8] Given the high economic value and low cost of eyeglasses, it would seem that private companies could profitably supply eyeglasses to the poor -- an ideal situation for applying the BOP approach. Essilor International, a French company, dominates the ophthalmic lens industry with annual revenues of $4.2 billion and a global market share of about 30%. In 2005, Essilor launched a BOP initiative targeting the Indian rural poor. However, the project was not sufficiently profitable and Essilor decided in 2010 to limit future investments and slow down the growth of this project.

Social entrepreneurship emphasizes using entrepreneurial principles to create social change. VisionSpring, founded in 2001 by Dr. Jordan Kassalow and Scott Berrie as a non-profit organization with the mission "to reduce poverty and generate opportunity in the developing world through the sale of affordable eyeglasses," has received several awards for social entrepreneurship. In 2009, VisionSpring sold 201,000 pairs of ready-made reading glasses. However, VisionSpring is trying to scale up its efforts and hopes to sell 1 million pairs of eyeglasses per year by 2012. Even if VisionSpring achieves this goal, the impact is arguably too little given that estimates of people needing eyeglasses

range from 517 million to 1 billion, and that number too is growing. While VisionSpring is an admirable effort, it is clearly not the only solution to the problem.

Another approach to solving the vision problem emphasizes technological innovation to provide low-cost self-adjustable spectacles, and has been attracting much media attention recently. At least three organizations are now offering their own versions of adjustable spectacles, but none of these has achieved significant scale yet, probably because they are not cost effective, and have not gained customer acceptance from a style perspective.

This article addresses the question why it has been so difficult to solve a social problem that apparently should be easy to solve. We first describe the nature of the problem. We then examine in-depth the three case studies Essilor, VisionSpring and technological innovation. Finally, we present our analysis of why these efforts have not been more successful so far, and propose an alternative solution for providing eyeglasses to the poor.

Blurry Vision

Refractive errors are disorders, not diseases, that are the result of the eye not focusing light precisely on the retina, leading to blurry vision. The common refractive disorders are:

- Nearsightedness, or myopia, which is hereditary, and is often discovered in childhood and often progresses throughout the teenage years.

- Farsightedness, which can be hereditary (hyperopia) or due to the lens in the eye becoming more rigid because of aging (presbyopia), usually after age 40 years.
- Astigmatism, usually occurs when the cornea has an irregular curvature resulting in blurred vision at all distances.

Presbyopia is age-related and is prevalent in adults older than 35-40 years; in 2005, it was estimated that over a billion people in the world had the disorder. Of the 517 million poor people in developing countries who need eyeglasses, it was estimated that 386 million (about 75%) suffer from presbyopia.[9] Unfortunately, the problem of blurred vision is set to get worse, as epidemiological studies have determined that refractive error is on the rise as the populations of developing nations become more urban. Increasing life expectancy will also cause an increase in the number of people who will suffer from presbyopia.

The vast majority of refractive disorders can be treated using eyeglasses. Historians believe that the first pair of reading eyeglasses was used in the late 13th century in Italy.[10] Eyeglasses for nearsightedness are believed to have developed in the 15th or 16th century. Pope Leo X was reported to have worn eyeglasses for hunting that allowed him to see his targets clearer than his companions could.[11] The Historian David Landes describes eyeglasses as one of the crucial inventions that allowed for other inventions and, indeed, the development of Europe.[12] Spectacles doubled the working life of skilled craftsmen, especially those who did fine jobs. Though eyeglass technology, of course, has become

more sophisticated, the basic concept of using a lens to improve vision has remained the same.

Economic Value

A World Health Organization study using conservative definitions estimates that 157 million people suffered from visual impairment due to uncorrected refractive errors other than presbyopia. The study estimates the global economic productivity loss associated with visual impairment to be $269 billion. This staggering number doesn't even include the economic drain associated with presbyopia that afflicts skilled workers, who use their hands and eyes, often at the height of their skill set. Even under the most conservative assumptions, "if each affected individual were to be provided with appropriate eyeglasses for less than $1000, a net economic gain may be attainable."[13] It is likely that the cost of providing eyeglasses is about $5 per person, including the cost of glasses and the necessary infrastructure, as we will discuss further in this article.

At an individual level, it is easy to understand the impact of eyeglasses on productivity. Without glasses, weavers cannot set their looms, farmers cannot sort seeds before planting, and artisans cannot see enough detail to create intricate designs. In India, research has shown that factory workers with near-vision impairment are less productive than their co-workers without blurry vision, and those with eyeglasses are able to better perform near-vision tasks.[14] Another study found that 44% of Indian cotton mill workers that required vision correction improved their productivity by more than 10% on previous levels.[15] VisionSpring's research suggests that investment in one pair of glasses can

generate a return greater than 27 times the cost, creating a ripple effect of economic improvement in the world's poorest communities. Furthermore, the reading glass project of BRAC/VisionSpring demonstrated that the use of eyeglasses increased mean working hours by at least 1.5 hours/day/person and that over 75% of subjects reported increased income after the purchase of their eyeglasses.

Educational Opportunities

Blurry vision due to uncorrected refractive errors has a strong negative impact on children by limiting educational opportunities. Inability to see well has a dramatic impact on a child's learning capability, educational potential and career prospects. It is easy to imagine how hard school would be without being able to see the chalkboard. Studies have demonstrated the prevalence of visual impairment amongst children. Cultural biases sometimes compound the problem. In China, a commonly held (but mistaken) view is that wearing eyeglasses causes children's vision to deteriorate faster. [16]

About 10% of primary school students in developing countries have poor vision, yet very few children wear glasses. A study performed in China found that by the age of 15 years, 46% of children were myopic and that the prevalence of uncorrected vision was 13%.[17] In one of the few empirical studies on the impact of poor vision on academic performance, it was found that provision of eyeglasses significantly increased the students' test scores.[18]

Visual impairment limits educational opportunities even in adults. A study performed in an adult literacy class in Ghana showed that among the adult learners who had dropped out of their class, 93% were found to need vision correction.[19]

Occupational/Public Safety

In addition to the strong relationship between vision and work, and vision and learning, a third link exists between vision and occupational/public safety. A study on the link between vision and driving showed that vision degradation decreased a person's road sign recognition and road hazard avoidance.[20] Research in South Africa has shown that drivers involved in accidents have statistically significant worse vision than those who are accident-free.[21] Vision also impacts personal, everyday safety. Among the elderly, research has shown that people with visual impairment are approximately twice as likely to fall or have multiple falls compared to their fully sighted counterparts.[22] There is also anecdotal evidence that other household injuries, such as burns, poisoning, electrical injuries, and workplace injuries, such as factory accidents, are often caused by visual impairment.

Challenges

Many challenges confront the provision of eyeglasses to the poor in developing countries; see Table 1 for the results from a study in Andhra Pradesh in India.[23]

Table 1. Principal Barriers to Eye Care Expressed by Those with Presbyopia

Barriers	%
Did not have a serious problem	23.8
Able to see adequately	23.4
Other obligations prevent eye checkup	20.4
Do not have money	17.5
Natural process with old age and hence need not treated	3.5
No escort	2.5
Eye checkup not a priority	2.2
Have to travel far for a checkup	1.8

Awareness

Many poor people are even unaware that their vision is deficient. Another reason why the poor do not seek corrective eye care is because they do not realize the need for it -- a form of psychological denial.[24] In developing countries, the rural poor often assume that poor vision is inevitable and treatable only in ways they cannot afford. Most people are unaware that a simple, affordable product exists to restore their clear vision, and many assume that only expensive eyeglasses will solve their vision problem. Some poor people do not fully appreciate the benefits of good vision. For instance, an illiterate farmer may not believe that he/she needs eyeglasses; however, eyeglasses could improve the farmer's productivity, and hence earned income. VisionSpring relates a case where a farmer's crop failed because he planted the wrong seeds due to his poor near point vision. Lack of awareness is part of the reason why the poor are unwilling to pay a price that reflects the value they would derive from the eyeglasses, or even a price that would cover the full cost of eyeglasses.

Cultural biases related to comfort and attractiveness also pose hurdles to the usage of eyeglasses.[25] A study in East Timor found that the main reasons for unwillingness to use eyeglasses were appearance (41.1%) and embarrassment (37.5%).[26] As mentioned earlier, some people in China (mistakenly) believe that wearing eyeglasses causes children's vision to deteriorate faster. Some poor people settle for traditional medicine, which is at best inefficient to correct refractive error.

In addition to the overall lack of education about the importance of vision correction there is also a lack of knowledge about where to go for eye care. A study in Tanzania found that though the subjects perceived eyeglasses to be useful and affordable, most did not know where to get them.[27]

Access

In the developing world, eyeglasses are primarily available in high-priced urban optical shops. For the rural poor, a trip to buy glasses requires travel to an urban center to visit an eye doctor, which is often a day-long trip each way. On top of the cost of custom glasses, they must pay for transportation and doctor's fees and take time off from work.

Eye screening centers are sparse especially in rural areas because of lack of funding. A study in Andhra Pradesh, India, found significantly greater availability of eye care treatment in urban areas than in rural settings.[28] As a result, primary eye care has experienced difficulty in achieving financial sustainability in countries where

governments lack the willingness to pay for such services or where there is not a community base with the ability to pay for such services.[29] Without addressing the financial sustainability of eye care facilities and screening centers, access to eye care will continue to be constrained.

Affordability

In the Tanzania study, 31% of the people surveyed were unable to afford eyeglasses at "a price that covered the cost and shipping of the spectacles."[30] A study in East Timor found that 49% of rural subjects were unwilling to pay even $1 for eyeglasses, and only 16% were willing to pay $3.[31] Willingness to pay was higher for the urban poor than the rural poor, and higher for men than women. VisionSpring's experience is that most people are willing to pay around 10% of their monthly income once they experience proper vision through a pair of eyeglasses. This implies eyeglasses have to be priced at about $2.50 or less to gain wide acceptance among the poor. A recent study in India provided eyeglasses free to the subjects. One month after using the eyeglasses, the subjects were asked how much they would be willing to pay for the eyeglasses; the median answer was about $4.[32] This is an overestimate of the true willingness to pay because in real markets spectacle purchase is required upfront, prior to use. In addition, this was a hypothetical question because the spectacles had already been provided free of charge. In developing countries, eyeglasses are sold at significant margins by eye doctors and optical shops. A pair of custom eyeglasses often costs about $50, a price truly out of reach for poor people living below the poverty line of about $3 per day.

The indirect cost of obtaining eyeglasses due to inconvenient access is often the prohibitive factor. The total indirect cost of acquiring eyeglasses (including reduced livelihood, cost of transportation, and doctor fees), particularly in developing countries, can be significantly more than the cost of the eyeglasses themselves.[33] This makes the eyeglasses even more unaffordable.

Trained Personnel

A major barrier to delivering vision correction is the lack of trained optometrists. Many developing countries have as few as one optometrist for every million people -- the figure for the United Kingdom is one per 8000 people. In Mali the ratio is one per 8 million.[34]

Many developing countries lack sufficiently trained ophthalmic support personnel, such as assistants and technicians, and rely too much on highly skilled ophthalmologists for simple eye screenings. A study in Andhra Pradesh, India, found that 93% of those who wore eyeglasses for farsightedness got a prescription from an ophthalmologist.[35] The researchers write: "This is wasteful use of human resources, especially when one considers the high eye disease burden including age-related cataract in India that required medical and surgical interventions by an ophthalmologist."[36] Assessing refractive errors requires only modest technical expertise. There is an opportunity to train more optometrists and other midlevel ophthalmic personnel, such as refractionists, to perform eye screenings.

BOP Approach

The 'bottom of the pyramid' (BOP) proposition, popularized by CK Prahalad, argues that selling to the poor can simultaneously be profitable and eradicate poverty.[37] Given the high economic value and low cost of eyeglasses, it would seem that private companies could profitably supply eyeglasses to the poor -- an ideal situation for applying the BOP approach. We now examine in-depth the case study of a BOP initiative launched by Essilor targeting the rural poor in India.

With revenues of $4.2 billion and a global market share of about 30%, Essilor International dominates the global ophthalmic lens industry. Essilor designs, manufactures and sells plastic optical lenses in over 100 countries all over the world. The company does not sell any glass lenses. Plastic lenses are superior to glass lenses because they are about 35% lighter and are more shatter-resistant.[38] However, plastic is more malleable than glass, and therefore scratches more easily. Plastic lenses are generally more expensive in India, and require more sophisticated handling than glass lenses.

Essilor owns 15 lens manufacturing plants including one in India, and 270 prescription laboratories including 31 in India. The plants manufacture semi-finished lenses for prescription laboratories, which grind and polish the lenses to meet specific prescriptions. Finished lenses are then sold to opticians, optometrists, cooperatives, and optic chain stores.

Operations in India

In 1998, Essilor entered the Indian market after internal market research showed much growth potential for plastic lenses. At that time, most people in India with eyeglasses used glass lenses; however, the growth of plastic lenses was estimated at 20% a year.[39] Sales climbed and Essilor in fact achieved annual growth rate of 35%.[40]

Essilor sold all its lenses through optical shops. Indian opticians generally realized a gross margin of 60% on the sale of each pair of eyeglasses; in developed countries, gross margins were typically 100% or more.

Since most Indian optical shops were located in urban centers, 70% of India's population that lived in rural communities did not have access to Essilor's lenses or services. In the early 2000s, Essilor's management began to view the rural population as a large, untapped consumer market that could not only contribute to Essilor's growth, but also allow Essilor to address a major health need in India: visual impairment. This seemed to be an ideal application of the BOP proposition. Because poor infrastructure (e.g. roads, communication) made access to the rural market very difficult, Essilor needed to develop an innovative distribution strategy.

Eyeglasses on Wheels

In 2005, Essilor teamed up with two highly respected, Indian not-for-profit eye hospitals, Aravind and Sankara Nethralaya, to launch a BOP initiative targeting the Indian rural poor. The pilot project started by operating four refraction and tele-ophthalmology vans

which visited villages to prescribe and sell corrective spectacles to poor people suffering from visual disorders. This innovative approach solved the problem of the rural poor not having feasible access to eye care facilities. The goal of the project was to provide rural patients access to high-quality eyeglasses in a timely manner and at an affordable price. The model was not meant to be a corporate social responsibility venture nor be charity-based. The expectation was that serving the rural poor would provide a profitable and significant growth avenue for Essilor India. The hope was that Essilor in the future would scale up the operation; the company estimated that 1000 vans would be needed to reach the 600,000 villages of India.

During the pilot project, refraction and tele-ophthalmology vans were used to host eye camps in villages across India. The camps went on for two days and had capacity to serve up to 150 patients a day. The tele-ophthalmology vans had state-of-the-art equipment to provide screening for various eye disorders (e.g. cataract) through a satellite connection to a hospital. The optometrists at the camp screened patients for both nearsighted and farsighted vision. After a screening, a patient who had a vision disorder was provided a prescription and given the opportunity to purchase custom-made eyeglasses from the refraction van. The refraction vans carried frames, lenses, a grinding machine, and refraction equipment; in other words, the van was an optical shop on wheels. Each van carried 200 to 500 frames and approximately 1,000 lenses, and had the capacity to produce roughly 60 custom-made eyeglasses a day.

Under the terms of the agreement, Essilor paid for the refraction vans, grinding equipment, and lens material. Each fully stocked van cost Essilor approximately $50,000. In addition to funding the vans, Essilor supported the training of the optometrists. To share in the cost of the project, the hospitals agreed to fund the tele-ophthalmology vans and all related operating expenses, such as wages and fuel costs. Revenues were generated from the sale of the eyeglasses and sponsorships. Each pair of eyeglasses was priced around $4. Sponsors provided support for the eye camps and, in return, they got their organization's name placed on a banner.

Performance

During the pilot project phase, approximately 50% of clients screened were provided prescriptions; of these, roughly 40% purchased eyeglasses from the van. On average, the project sold 35 pairs of eyeglasses a day. The revenues earned from the sale of eyeglasses and the sponsorships, however, were not sufficient to cover operating expenses, let alone make a profit.

To improve financial performance, Essilor recently decided to allow the refraction vans to also distribute ready-made glasses without prescription. These low-range products are outsourced from external low cost providers. In parallel, Essilor has increased the price of its prescription spectacles from $4 to $5, which resulted in a 40% decrease in volume. Thanks to these changes in pricing and product mix, in addition to cost reduction initiatives, Essilor claims its BOP operation has turned profitable. However, Essilor does not charge this initiative with overead and capital costs; only operational and depreciation

costs at the van level are taken into account. Consequently, Essilor is unwilling to commit new capital to the project. After trying to franchise the vans to local opticians, the company has decided to operate them on its own, and to limit future investments to the amount of cash generated by the existing vans. Even with donations/sponsorships, the project hardly earns its cost of capital. In 2010, Essilor operated only 8 refraction vans.

Social Entrepreneurship

Social entrepreneurship, the concept of applying entrepreneurial principles to creating social change, has been gaining increasing attention in recent years. VisionSpring is a good example of this movement, and has won several social entrepreneurship awards. VisionSpring was founded in 2001 by Dr. Jordan Kassalow and Scott Berrie as a non-profit organization with the mission "to reduce poverty and generate opportunity in the developing world through the sale of affordable eyeglasses." VisionSpring started by providing only ready-made reading glasses to correct farsightedness. This strategy was adopted because of the strong link between poor near vision and economic productivity and the fact that presbyopia represented about 75% of the visual impairment problem; this was the simplest 'low lying fruit' portion of the overall problem. Its objective was to take reading glasses out of the exclusive hands of eye care professionals and make reading glasses a consumer product. In the developed countries, this shift had already happened decades ago and reading glasses are widely available as an over-the-counter product.

To accomplish its mission, VisionSpring developed an innovative business model to provide basic screening services and ready-made reading eyeglasses to people living in rural villages. After assessing multiple suppliers around the world, management decided that China is the most cost-effective source for ready-made reading eyeglasses. To reach people living in rural communities, VisionSpring trains local women, as independent commissioned sales representatives who they call Vision Entrepreneurs, to go into villages and sell its reading glasses for under $4 a pair. Vision Entrepreneurs provide basic screenings using distance and near eye charts to determine the appropriate strength of the lenses. VisionSpring provides them with a 'business in a bag', a sales kit containing inventory of reading glasses, screening tools, marketing materials, and a uniform. Vision Entrepreneurs undergo a three-day training program in basic eye care and business management.

To increase its global reach and scale, VisionSpring has also developed a franchise model on a fee-for-service basis. This involves disseminating its sales kits to other nonprofit and for-profit organizations, such as BRAC, a microcredit organization in Bangladesh. Through this franchise model, VisionSpring presently has over 5,000 Vision Entrepreneurs in 11 countries.

Finally, using a wholesale approach, VisionSpring distributes its reading glasses through pharmacies in urban and peri-urban centers. These retail outlets are expected to help VisionSpring reach a greater breadth of people. They are presently testing this approach with Apollo, one of the largest pharmacy chains in India.

Performance

VisionSpring has operations in eleven countries in Asia, Latin America and Africa, with its biggest presence in India. In 2008, VisionSpring sold 98,000 pairs of glasses, and 201,000 in 2009, doubling their sales for the fifth straight year. They have the objective of selling one million eyeglasses in 2012. Much of the growth is expected to come from franchising and wholesaling their business model to leverage large distribution networks that already exist in target countries, especially the partnership with BRAC.

In 2009, VisionSpring earned revenues of $0.26 million while its total costs were $1.36 million; the difference was covered by philanthropic donations and grants. Cost of eyeglasses procured was 13% of total costs, while field and overhead expenses (e.g. training, marketing, staff salaries, travel, etc.) accounted for the remainder. This implied that the total cost to deliver a pair of glasses was $7.7.

VisionSpring's budget for the year 2012 anticipates 1 million eyeglasses sold, earned revenues of $1.3 million and total costs of $2.8 million, requiring philanthropic subsidy of $1.5 million. Overhead expenses would account for 71% of total costs. Presently, 18% of total costs are covered by earned revenue; VisionSpring expects this ratio to reach 38% in 2012, and has a long-tem goal of 100% earned revenue coverage. Though VisionSpring seeks to be self-financing in the long run, at least for the medium term its business model is highly dependent upon 'repeatable philanthropy,' which is defined as 'dollars that are raised using processes that can be reliably repeated from one year to the

next, in a sustainable manner."[41] Looking into the future, management believes that VisionSpring will require at least a decade-long period of subsidizations before reaching sufficient economies of scale to be self-sustainable. Enterprise break-even point is estimated at 5 million eyeglasses per year.

Technological Innovation

Another approach to solving the vision problem emphasizes technological innovation to provide low-cost self-adjustable spectacles, which let untrained wearers set the right focus for the lenses themselves in less than a minute, greatly reducing the need for trained optometrists. These adjustable glasses cannot yet help with astigmatism, though about 80% of people needing vision correction have such mild astigmatism that the glasses can still be very effective. There are two different technologies that are trying to solve the vision correction problem.

Joshua Silver, a physics professor at Oxford University who directs the research institute the Centre for Vision in the Developing World at his university, developed in 1996 a technology, called AdSpecs, which has been attracting widespread media attention for a decade now.[42] The glasses are round plastic frames with lenses made of clear sacs of silicon oil sandwiched between two clear plastic discs. The two sacs are each connected to a tube and a small syringe that can be adjusted by turning a dial. As a wearer adjusts the dials, she controls how much liquid is loaded into each sac thereby changing its curvature; this fine tunes the glasses to an individual's prescription. Once the lenses are adjusted, the sacs are sealed off permanently with a small valve and the adjusting

mechanisms are removed. The glasses do look rather klutzy: thick lenses in a dark tortoiseshell frame.

Prof. Silver has set up a company (which he calls "an ordinary company that's never made a profit") to sell the AdSpecs at $19 per pair. The company has in the last 13 years sold 30,000 eyeglasses to organizations such as the Ghana Education Ministry and the US Government (which alone purchased 20,000 glasses to distribute as humanitarian aid). Clearly the high price is a major drawback. Prof. Silver has set an ambitious goal of distributing a billion pairs of glasses at the price of $1 per pair by the year 2020. He does not reveal how he plans to lower the cost to $1, but says the key will be making the technology cheaper and cranking up the volume. Prof. Silver also does not discount the importance of aesthetics and continues to work on new more appealing designs.

Two Dutch organizations, Focus on Vision Foundation and VU University Medical Center, are also trying to produce low-cost adjustable eyeglasses, though they have received less media attention.[43] Both the Dutch models are based on a design pioneered in the 1960s by Luis Alvarez, an American who won a Nobel Prize in physics; the design uses two lenses that slide across each other to alter their focus. Neither of the Dutch organizations has yet produced the glasses on a mass scale. Focus on Vision, which is probably further along the development process, plans to distribute 30,000 eyeglasses in 2010, and says its production costs are $4 per pair. Its president anticipates "as soon as we make a million per year, the price will drop to one euro."

Better Vision for the Poor

We next analyze why each of the three approaches described above have not been able to achieve scale to make a significant dent in the problem, and present our proposal for providing better vision to the poor. The major problem is that the poor are not willing to pay a price even remotely equal to the value they would derive from the eyeglasses, and that the price they are willing to pay does not cover the full cost of the glasses. There are only three solutions here: 1) through education and awareness increase their appreciation of the benefits of eyeglasses and thus increase the demand and willingness to pay, 2) reduce the total cost of eyeglasses through some technological or business innovation, and 3) subsidize the glasses. It is, of course, possible to pursue a combination of these three strategies.

The first solution, education and awareness to increase willingness to pay, is probably not feasible for a private organization, and none of the organizations described above emphasize this. Libertarian economics mistakenly assumes that the poor always act rationally. The poor are no less rational than more affluent people, but because of the narrow margins for error, the consequences can be worse for the poor. The poor make decisions that seem irrational from our perspective because they are vulnerable by virtue of lack of education (often they are illiterate), lack of information, and economic, cultural and social deprivation.[44] "The deprived people tend to come to terms with their deprivation because of the sheer necessity of survival, and they may, as a result, lack the courage to demand any radical change, and may even adjust their desires and expectations to what they unambitiously see as feasible."[45] The fact that the poor are

unwilling to pay much for eyeglasses is not that surprising; the poor tend to under invest in their nutrition and health.[46] Trying to change the poor to realize the rational value of eyeglasses and be willing to pay more is probably too ambitious and an infeasible solution by itself; but it might work in conjunction with the other two solutions (reducing costs and subsidies).

Essilor found out that charging $4 resulted in only 40% of people needing glasses actually buying glasses. A study in East Timor found that 49% of rural subjects were unwilling to pay even $1 for eyeglasses, and only 16% were willing to pay $3.[47] Even if this study is exceptional, it is clear that any solution to the blurry vision problem must emphasize dramatic cost reduction.

The quality of the products and services provided by Essilor are very high, but the problem is its costs are also very high. Essilor sold only plastic lenses, which are more expensive than glass lenses; it provided bi-focals which are also more expensive. A large part of the cost of eyeglasses is due to the professional optometrists involved and due to customizing the eyeglasses to the prescription of each client. Essilor did not reduce these costs. Essilor needed to change the price-quality trade-off to make the eyeglasses more affordable to the poor.

VisionSpring significantly reduces costs by substituting a low-skilled Vision Entrepreneur instead of a professional optometrist. It also reduces the production costs by centralizing purchasing, sourcing from China, and providing glasses in a few

standardized strengths. In spite of that, its revenues are not high enough to cover its costs, and VisionSpring needs philanthropic subsidies, which limits its ability to achieve scale commensurate with the size of the vision problem. Scaling up their model is also constrained by limited distribution channels that serve the poor, especially in rural areas. At the same time, creating a distribution network dedicated to one product is a very expensive solution. Piggybacking onto an existing distribution network is more cost effective, as VisionSpring is doing in its partnership with BRAC, Women's Development Business, and others. An initial drawback of VisionSpring's approach is that it provided only reading glasses. This left out the significant number of people suffering from myopia, especially children who are much more likely to be myopic. VisionSpring has now started a school based initiative to provide myopic children with glasses; it has also begun pilot projects to provide eyeglasses for myopia to adults.

The technology innovation approach is very appealing because by making the glasses *self-adjustable* it eliminates two large cost elements: optometrists and customized manufacturing. Its biggest drawbacks, of course, are the high cost of producing the eyeglasses and the poor aesthetic appeal. If the costs can be brought down to $1-2 per pair, and eyeglasses made more cosmetically pleasing, then the technology approach might solve the blurry vision problem. But, that is a big 'if' – there is little evidence so far of such dramatic cost reduction or design changes. Even if the cost of producing the adjustable eyeglasses comes down dramatically, distribution costs can still be a hurdle. VisionSpring sources the reading glasses at about $1 per pair from China, and sells them at $4 per pair to the consumer, and still needs significant philanthropic subsidies.

Limited Attention

The impact of blurry vision is real and extremely costly to the poor, especially skilled middle-aged workers who rely on clear near vision and children who need to see the blackboard to learn. The economic and social benefits of solving this problem far exceed the costs of providing eyeglasses to all poor visually impaired people. Yet the problem persists. Despite the evidence, blurry vision has attracted little attention as a global public health issue. In the developed countries, because eyeglasses are widely available and affordable, there is the perception that blurry vision does not create a socio-medical disorder.[48] Eyeglasses are taken for granted in the rich world -- there is no sense of urgency being drummed up to influence policy makers. Unlike for other public health causes, such as AIDS, there are no activists shouting that eyeglasses are a human right. Or, some may hold the view that blurry vision is not a critical issue in poor communities where people are illiterate. It is distressing that such a simple, inexpensive and politically neutral health intervention has been so under funded and underutilized in poor countries.

Proposed Solution

But the situation is not hopeless. The challenge is to move the entire spectacles business from low volume, high margin approach to high volume, low margin emphasis to gain much greater penetration among the poor. The starting point of our proposal is to reduce costs as much as possible by reducing overall quality, while still providing 'acceptable' quality. The standards to judge what is acceptable have to be from the perspective of a poor person who does not get any vision correction now, and not from the perspective of

an affluent person who receives modern eye care. The proposed solution must utilize a basic screening process that does not require a trained professional. This sacrifices precision, but that is acceptable because medical evidence suggests that under-correction of vision does not have significant negative side effects.[49] [50] Over-correction of vision does have side effects such as headaches and nausea. The screening process needs to avoid over-correction, but that is easy to achieve using simple techniques. Self-adjustable glasses rather than becoming the final product could be utilized for determining a patients prescription needs without a high cost technically trained professional.

Our proposal reduces the production costs of eyeglasses by manufacturing eyeglasses in a large factory, emphasizing scale economies, centralized sourcing, and standardization.[51] Lenses would be manufactured from the least expensive material, which is probably acrylic; this is the type of plastic that is used in readymade reading glasses sold in the U.S. Lenses would be offered in steps of 0.50 dioptres for reading glasses and in steps of 0.25 diopters up to -2.00D and in steps of 0.50 dioptres above this for distance glasses; there would be no correction for astigmatism (which requires customized prescription). We estimate that using this approach about 80% of the people who require a distance prescription would be corrected to 20/40 or better.[52] This is a level of vision that is required to drive legally in the United States. A study in India conducted a randomized clinical trial with poor adults to compare ready-made eyeglasses with customized spectacles. The results showed that while vision is slightly better with customized spectacles, after one month of use, 90% of the subjects were satisfied with ready-made

eyeglasses and planned to continue wearing the eyeglasses.[53] Another similar study with Chinese school-age children confirms the high level of satisfaction and acceptance of ready-made spectacles.[54]

There would be very limited variety of frames styles that were carefully selected based on local preferences. The factory cost of producing standardized prescription eyeglasses using simple frames in a country such as China is well below $2 per pair. Distribution costs would be reduced by piggybacking onto an existing network such as microcredit organization or a packaged consumer goods company. Overheads would be minimized by locating all possible costs in a developing country and restricting the scope to one or a few neighboring countries.

Even after following all these suggestions, it is not clear whether the total costs will be below what the poor are willing to pay for glasses – and this is likely to differ from country to country, and even from region to region. If willingness to pay is high enough to cover the total costs, then this could be a profitable business, and consistent with the current vogue of market-based solutions for poverty alleviation. But, if the costs are still too high compared to the willingness to pay, then the only way to cover the gap is a subsidy. Given the scale of the problem -- at least 500 million people need eyeglasses -- the only source for such large subsidies is the government. Governments bear responsibility, and accept responsibility for public health. Since the economic and social benefits of solving the blurry vision problem far exceed the costs, this is an area where the governments can intervene effectively. Governments can play a key role in building

the market for eyeglasses by funding education/awareness campaigns or subsidizing eye care centers. They can also implement targeted policies such as requiring children to get basic eye screening in schools. In any case, governments must a play a significant role in solving the problem of blurry vision.

Modern financial markets can provide virtually unlimited quantities of capital provided the venture is expected to be profitable, making it easy for for-profit organizations to scale up. Governments enjoy the privilege of access to the treasury for resources needed to scale up. Not-for-profit organizations find it difficult to attract the capital needed to scale up and satisfy the social need directly to a significant extent. Ultimately it will have to be business and/or government that provide eyeglasses to the poor on a large enough scale. The appropriate role for not-for-profit organizations is that of advocate and catalyst to prod governments and companies to solve the social problem. If it is profitable to sell eyeglasses to the poor (using the approach proposed above or some other business model), then a not-for-profit such as VisionSpring can demonstrate and publicize the economic viability of this approach. The hope is that this profit potential will attract private companies, multinational or domestic, into the market to satisfy the need for eyeglasses. The not-for-profit organization could even morph into a for-profit company in that case. However, if it is not profitable to sell eyeglasses to the poor, then the not-for-profit has to act as an advocate and catalyst to get the government to step in on a large scale. There are only two possible approaches to providing eyeglasses to the poor on a significant scale: market based solution or government subsidies. The role of NGOs is to act as catalysts and advocates by demonstrating the appropriate approach.

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