Economics of the one laptop per child in India

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Much controversy has surrounded the adoption of the one laptop per child (OLPC) programme in India. In the debate, however, an economics perspective has rarely been adopted. In what follows, accordingly, I use some basic economic principles to analyse the full-scale adoption of OLPC laptops in all primary schools in India. Two specific questions are posed. One of them is how much of the country's total education budget will be spent on the endeavour? Then I ask whether such a large expenditure on laptops can be justified in the Indian context?

The one laptop per child (OLPC) project has mostly been used on a small-scale, pilot basis in the developing world (note 1). At this level of analysis, evaluation of individual projects is at best anecdotal. In fact, the aim of the project is to provide *all* primary school students with a specially designed laptop (known as XO). In its extended form, the OLPC programme has been adopted in two Latin American countries, Peru and Uruguay, and a third country, Rwanda, is planning full adoption in the future (note 2). For these countries and any others that are contemplating a full-scale transition to XO laptops, the economics of the programme needs to be studied at the national or macro level (note 3). So far no such evaluation has been undertaken in the Indian context and the purpose of the succeeding text is to begin filling this gap in an oversimplified yet insightful way. Two specific questions are asked:

(1) What percentage of the national education budget would the full implementation of the OLPC programme entail?
(2) Can this amount of spending be justified?

The macro dimension

This dimension is captured by the following ratio:

$$\frac{\text{Number of primary school pupils} \times \text{Price of laptop}}{\text{Total education budget}}.$$

That is, the number of children in primary education multiplied by the price of an XO laptop (assumed to be USD 200), divided by the total education budget (including all levels of the education system). The higher the numerator and lower the denominator, the higher will be the value of the ratio and vice versa. The outcome is important because it denotes the ease/difficulty with which the OLPC project can be accommodated in the national education budget.

In very poor countries, the value of the ratio may approach, or even exceed unity or 100%. Nepal is a case in point. There, the government drastically raised the education budget with a planned expenditure of USD 688 million for the 2009/2010 school year. Assuming a price of USD 150 for each LCCD (low-cost computing device), and with 4.4 million primary students, the cost of providing each with a LCCD would be USD 663 million – practically the entire education budget[1].

In rich countries, by contrast, where the total education budget is already relatively high, the ratio in question will be correspondingly low.

The data contained in Table 1 enable me to calculate the hypothetical effect of providing each child in India's primary schools with a laptop in 2011 (note 4). Note that for the enrollment Figure 1 also consulted the 8th All-India Education Survey[2]. But the data in that publication relate to the year 2009, unlike the other numbers in the table. I therefore used instead the later, 2011 estimate, from UNESCO.

Table 1. Elements of the ratio, India 2011

Variable	Source	Value
Price of XO laptop	OLPC.org	USD 200
Enrolment in primary schools	UNESCO	USD 138.4 million
GDP (PPP)	IMF	USD 4425 billion
Percentage of GDP spent on education	World Bank	3.2%

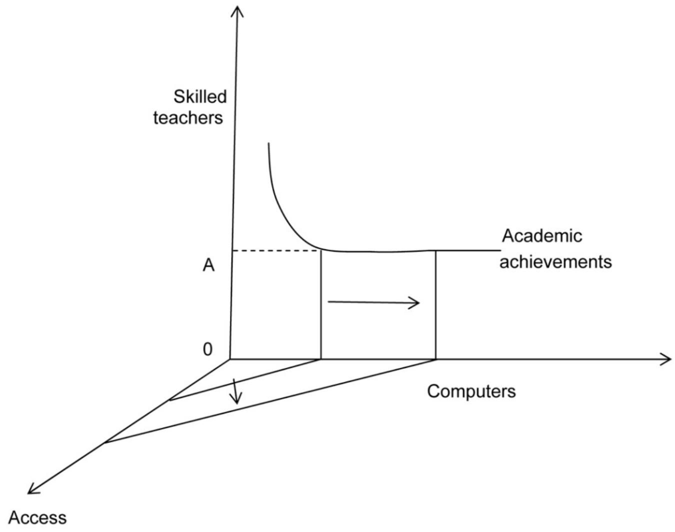

Figure 1. The outcome of OLPC in Peru.

Thus, the ratio defined above in India's case is equal to

$$\frac{138.4 \text{ million} \times \text{USD } 200}{\frac{3.2}{100} \times \text{USD } 4425 \text{ billion}}$$

or

$$\frac{\text{USD } 27.6 \text{ billion}}{\text{USD } 141.6 \text{ billion}} = 19.5\% .$$

To this amount, almost 20% of the education budget, should be added the formidable cost of providing electricity to primary schools without it. For, there are many such schools in India, especially in rural areas (where most schools are based). According to one study, 44% of all schools in the country are without electricity. Then again, there are costs associated with providing teachers who are suitably equipped with the skills needed to impart knowledge about computer science (note 5).

On the other hand, there are several ways in which private–public initiatives help to reduce the costs of providing XO computers. One of them is a 'give one get one' campaign that allows private buyers in certain developed countries to donate a computer to a primary school in the developing world. Then again, 'One source of funding in some countries has been the contribution that telecommunications operators make to finance infrastructure development in underserved areas. The funds have been used in several countries to finance the acquisition of computers for schools'[1].

Is it worth it?

For the sake of discussion let us leave aside these additional costs of the OLPC programme and focus instead on the percentage of the education budget specified above (i.e. on the direct costs). Let us further note that the degree of imbalance in the Indian education budget created by the full implementation of this project is not without precedent. Indeed, the corresponding figure for Peru is even higher, at 25% (recall that this is one of only two countries to have made a complete transition to XO laptops) (note 6). And as noted above, for the poorest countries the ratio may be close to 100%.

Nevertheless, however, one still needs to ask the question of whether the full implementation of OLPC is worth it or not. It will tend to be worth it the more revolutionary is the (favourabe) learning experience created by the programme (note 7) and the less is the value of the educational expenditure it displaces. On neither point, unfortunately, does the limited evidence available favour the full adoption of the OLPC in a country such as India.

For one thing, there are important lessons to be learnt from the case of Peru, where the first large-scale randomized evaluation of the OLPC has been carried out. What the study found was that: 'The intervention generated a substantial increase in computer use both at school and at home. Results indicate limited effects on academic achievement, but positive impacts on cognitive skills and competences related to computer use. Cognitive abilities may arise through using the programs included in the laptops, given that they are aimed at improving thinking processes. However, to improve learning in math and languages, *there is a need for high-quality instruction*... this does not seem the norm in public schools in Peru, where much rote learning takes place. ...Our results suggest that computers by themselves, at least as initially delivered by the OLPC program, do not increase achievement in curricular areas'[3] (emphasis mine).

The essence of what occurred in Peru is illustrated in Figure 1. The figure shows that an increase of XO computers leads to increased access among primary school children. But access does not automatically translate into improved achievements. In fact, the translation is constrained by the number of skilled teachers (as shown in the top panel of the figure). Indeed, below a certain number of teachers (OA), achievements will not increase no matter how many computers are provided.

Matters are only made worse for the OLPC paradigm when one considers that teachers are likely to be among the most severely affected factors in the education budget as a result of the expenditure on XO laptops. This is because teacher salaries are arguably the most important item in that budget in many developing countries (comprising typically 80–90% of recurrent spending on education). Thus, at the time that more teachers are going to be required to teach primary school children to use laptops effectively, the OLPC programme itself reduces the supply of these resources. Note that there is already a severe shortage of teachers in India. According to a UNESCO study[4], for example, two million teachers would be needed to meet the Millenium Development Goal of providing elementary education to all children in India by 2015. Given the additional finding that teachers are usually the most significant determinants of educational achievements in a developing country[5], one is entitled to wonder whether the items that would be supplanted by the application of the OLPC project in India are not worth much more than the costs of supplying all children with an XO laptop. In this regard, a potentially useful direction for future research would be to include access to computers as an independent variable in regression equations designed to explain variations in educational achievements among primary school students. One could then compare the influence of access to that of the role of teachers.

Conclusion

This note has brought an economic dimension to the task of assessing a full-scale rollout of the OLPC programme in India. Two questions were posed in this regard. One dealt with the burden of the programme on the national education budget and the other was concerned to ask whether such a burden could be justified. With regard to the former question, I calculate that the full OLPC programme would take up almost 20% of the education budget. This would tend to be worth it, I suggested, if the programme really brought about revolutionary changes in primary education and displaced resources of relatively low value. In neither case, unfortunately, does evidence support the widespread adoption of the OLPC programme. As an alternative, policy-makers should consider the idea of sharing low-cost computers in laboratory-like settings. Individual ownership is a rich-country feature that is inappropriate to most developing country situations (note 8).

Notes

1. For a general, critical survey, see Warschauer and Ames[6].
2. See OLPC.org for a discussion of these cases.

3. In fact, economics in general is notably absent from the debates over the OLPC programme in developing countries.
4. Although those responsible for the OLPC project repeatedly claim that the goal is to reach *all* primary school children (this is what happened in Peru and Uruguay for example), the aim of the Indian version is much more limited, namely, to reach the 25 million students who are not privileged enough to benefit from the traditional computing and education (OLPC, India). This would of course substantially reduce the burden of the programme on the education budget, but it is entirely unclear how the figure (of 25 million) was actually reached. The same report notes, more generally, that the private sector has been active in some countries in supporting low-cost computing initiatives (known as one-to-one computing).
5. The OLPC model is based on a constructionist theory of learning which assumes that pupils tend to be able to learn on their own[6]. The Peru case discussed suggests that this is little more than wishful thinking.
6. See James[7] for the calculation.
7. Certainly Warschauer and Ames[6] feel that the expenditure on laptops under the OLPC project could be better spent on more basic (and proven) items such as books and teachers.
8. For a full discussion, see James[8].

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5. Michaelowa, K., *World Dev.*, 2001, **29**(10), 1699–1716.
6. Warschauer, M. and Ames, M., *J. Int. Affairs*, 2010, **64**(1), 33–52.
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Legally binding Minamata Convention on Mercury: politics and science behind

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Mercury is a naturally occurring element having widespread uses globally. It is highly toxic, persists in the environment and has global ramifications on humans, wildlife and environment. Post the dreadful Minamata incident caused due to mercury contamination, there had been international endeavours to address this issue on a global level. The Minamata Convention on Mercury is a gallant global effort towards a legally binding instrument to protect human health and the environment from mercury contamination. Political and scientific factors played a major role in shaping the provisions of the Minamata Convention. This article addresses such factors including the rationale of adopting a legally binding approach instead of much-pushed voluntary measures and why did India, despite its active participation in the meetings, which shaped the Convention, refuse to sign it?

10 October 2013 was a historic day, not only for Japan, but also for the rest of the world. More than 1,000 participants from over 140 countries, intergovernmental and non-governmental organizations (IGOs and NGOs) gathered in Kumamoto, Japan to adopt the first ever international legally binding Convention on Mercury, following decades of increased awareness regarding the toxicity of mercury and mercury-related compounds. Named the Minamata Convention on Mercury, the agreement was a response to the realization that mercury pollution is a global problem and no single country can solve it alone. Naming and venue the Convention could not be more appropriate, as it was a memorial to local history where the first case of Minamata disease was identified in 1956.

Minamata incident

Minamata, a part of Kumamoto Prefecture, is located approximately 1,000 km from Tokyo, the capital of Japan. During 1950s, in Minamata, the outbreak of an unknown neurological illness was first reported among the fishing families of the area. They were diagnosed with a mysterious ailment, which was attributed to contaminated seafood due to discharge of untreated chemical waste from a local chemical factory owned by Chisso Corporation. Chisso Corporation started as a hydroelectric power company in 1908. It eventually began producing chemical fertilizers, and became Japan's major chemical company. The company used mercury as a catalyst to produce acetaldehyde, which was then used to produce acetic acid and vinyl chloride. The people living in the vicinity of the Minamata Bay experienced severe neurological damages such as visual, auditory, and sensory disturbances, numbness, and difficulty in walking. In 1956, scientists gave the ailment a name: Minamata disease. Mercury was understood to be the primary reason behind the disease.

The responsible contaminant was then eventually identified as mono methyl mercury (CH_3Hg), formed from mercury by action of anaerobic sulphate-reducing bacteria. Mono methyl mercury is a potent neurotoxin. It affects people and wildlife through bioaccumulation at multiple levels in the food chain. People were exposed primarily through consumption of seafood contaminated with methyl mercury, particularly those