Cost-Benefit Analysis:
The What, the Why, the Where, the When, the Who and the Why Not?

The CBA Guru

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WHAT is Cost-Benefit Analysis (CBA)?

ANSWER: It is just what the name implies – an approach suggested by Ben Franklin (yes, Ben Franklin) two and a half centuries ago of tallying up the pros and cons and then comparing them. A number of innovations have developed over the centuries for converting the pros and the cons into a common unit of account, metric, or "numeraire" so that they can be added and subtracted one from the other, but even the sophisticated versions and applications that have developed over time retain Franklin's original intent.

WHY do we do CBA of international development projects?

ANSWER 1: Because we generally don't have access to a fully-specified general equilibrium[1] model of the economy into which we can put more detail than we can put into an *Ad Hoc* CBA model.

ANSWER 2: Because we want to make sure the proposed 'intervention' (aka project) improves society's overall economic welfare – or at least, leaves it unchanged – instead of reducing economic welfare.

WHERE did today's formal version of Cost-Benefit Analysis come from? WHEN did its various pieces arrive?

ANSWER:

- It started, of course, with **Ben Franklin's 1772 letter** to a friend (per *The Economist* 11September 2009): "…my way is to divide half a sheet of paper by a line into two columns; writing over the one "Pro", and the other "Con". Then … I put down under the different heads short hints of the different motives … for and against the measure … I endeavour to estimate their respective weights; where I find one on each side that seem equal, I strike them both out. If I find a reason pro equal to two reasons con, I strike out three … and thus proceeding I find at length where the balance lies … And, though the weight of reasons

[1] Defined as an economic situation in which the supply and demand requirements of all producers and consumers are fully satisfied, without having any surpluses or deficits in any of the individual markets. Fully-specified means that all or the relevant markets are explicitly represented, as are all of the conditions affecting them.

cannot be taken with the precision of algebraic quantities, yet when each is thus considered, separately and comparatively, and the whole lies before me, I think I can judge better, and am less liable to take a rash step."

- Then in **1848 the French engineer Jules Dupuit** suggested valuing the benefits of transportation projects using what Alfred Marshall later would call "consumers' surplus" [2] (i.e., the diminishing unit value as one moves down a demand schedule – which some would say Dupuit also "invented") rather than market price multiplied by quantity. This was the origin of the distinction that would come later between "financial analysis" (market price times quantity) and "economic analysis" (consumers' surplus, later to be joined by producers' surplus).
- After World War II – during the **"High Theory of Development" period – planning models** were hypothesized (but never developed) out of which development interventions could be identified and planned, in theory. Imagining general equilibrium models that actually could be solved[3], High Theorists envisioned judging societal welfare with and without the proposed intervention (project). They likely took much inspiration from George Danzig's presentation in 1947 of the Simplex Method for solving a linear programming problem, the dual solution of which would give the "shadow prices" [4] on all the constrained inputs and outputs – i.e., the ones that were not freely available from outside the production system. With such a set of shadow prices, the planners – in theory –would have an alternative to solving the whole model twice – once with and once without the project. Using the shadow prices from solving the LP for the 'dual', they would have been able to judge the contributions of several small, individual, incremental changes to the production system. But both solutions were part of a dream world, as Bixby[5] points out: "… Laderman's solution of

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[2] Technically, the consumers' surplus is the geometric area underneath a demand curve but above the price actually paid by consumers. In other words, it is the 'surplus' that some consumers receive in a single-price, competitive market by paying the market price rather than the higher value (the 'willingness-to-pay') that some of those consumers would pay, if required to. Obviously, there will be one consumer – the 'marginal' purchaser – whose price-paid will be exactly what the good is worth to him/her. Producers' surplus is analogous. It is the summation of differences between the marginal cost of production for each unit and the actual selling price for that unit.

[3] Practical models carrying the name computable general equilibrium (CGE) did not start arriving until the mid-1970s – for example, Lance Taylor and S.L. Black (1974), "Practical General Equilibrium Estimation of Resources Pulls under Trade Liberalization", *Journal of International Economics* 4(1): 37-58. True CGE models "… are completely-specified models of an economy or a region, including all production activities, factors and institutions, including the modeling of all markets and macroeconomic components, such as investment and savings, balance of payments, and government budget. These models incorporate many economic linkages and can be used to try to explain medium- to long-term trends and structural responses to changes in development policy." Defined at http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPSIA/0,,contentMDK:20481443~menuPK:1108016~pagePK:148956~piPK:216618~theSitePK:490130~isCURL:Y,00.html

[4] In LP, the shadow price measures the increase in the objective function that would result from relaxing a particular constraint by one unit. For example, imagine LP modeling to maximize income from maize production (maize price = px/MT) on a farmer's 15 ha plot of land where seeds and fertilizer are 'slack' (unconstrained) inputs available without limit at prices p1 and p2, respectively, while the farmer's (unpriced) labor is constrained at 10 hours/week. The shadow price of the farmer's labor would be derived from re-computing the optimal combination of inputs and estimating the new maximized maize output value with one more (or one less) hour per week of the farmer's time. A shadow price for the (constrained) land could be calculated the same way – i.e., by holding labor at 10 hours and relaxing the land constraint by one unit.

[5] Robert Bixby, "A Brief History of Linear and Mixed-Integer Programming Computation", *Documenta Mathematica* · Extra Volume ISMP (2012) 107–121, p. 107.

a 21 constraint, 77 variable instance of the classical Stigler Diet Problem … total computation time was 120 man-days!" It clearly would be a while before the computational capacity – both in terms of an efficient algorithm and in terms of the computers – would exist to solve a model from which meaningful shadow prices could be derived.

- **In the 1960s, practical methods of shadow pricing** emerged almost simultaneously from two sources – one focused on CBA of international development projects specifically, and the other focused on the then-new trend in public finance of showing as much interest in public expenditure analysis as in the discipline's traditional focus on raising public revenue. Ian Little and Jim Mirrlees (1968)[6] solved the problem of getting shadow prices without a fully specified and computable whole-economy model by taking international (aka 'border') prices as the shadow prices – for everything, including not only tradable goods and services but also non-tradable goods and services. Al Harberger (1971, 1972)[7], on the other hand, solved the problem by showing that one could use the "little triangles" (i.e., changes in consumers and producers surpluses) to derive shadow prices and to measure welfare changes – a technique so simple that it is included in intermediate microeconomics textbooks. The Little and Mirrlees approach is now called the "Trade Policy Approach" (TPA) to CBA, since that is what it was primarily focused upon. The Harberger method came to be called the "Public Finance Approach" (PFA) to CBA, since it focuses on tallying the costs and benefits of public expenditures. The TPA of Little and Mirrlees was applied almost exclusively to international development projects from 1975[8] until 1997. From the outset, the Harberger method was used for domestic applications of CBA in the USA and in other developed countries.
- **Around 1998[9], The Public Finance Approach of Harberger** replaced the Trade Policy Approach of Little and Mirrlees in international development project applications, as the focus of international development finance shifted from getting trade policy right to financing projects in the social sectors and dealing with organizational and institutional change. The TPA was better suited for the industrial and agricultural projects for which it was developed, while the PFA has advantages in CBA applied to the sectors where markets are incomplete or 'missing' – such as environment, institutional development, public health, education. The Public Finance Approach is the method now taught in the E3/EP training programs.

WHO does CBA?

ANSWER: Generally, economic development projects are prepared by sector technicians (engineers, agronomists, etc.) and/or sector-specialized economists (agricultural economists,

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[6] *Manual of Industrial Project Evaluation in Developing Countries*, Volume 2. Paris: The Organization for Economic Cooperation and Development, 1968.

[7] Harberger, Arnold C. 1971. "Three Basic Postulates for Applied Welfare Economics," *Journal of Economic Literature*, IX, No. 3 (September 1971): 785-97; and Harberger, Arnold C. 1972/1973. *Project Evaluation*. London: The Macmillan Co., 1972; and Chicago: Markham Publishers, Rand McNally, and University of Chicago Press.

[8] Squire, Lyn and Herman van der Tak. 1975. *Economic Analysis of Projects*. Baltimore and Washington: The Johns Hopkins University Press for the World Bank.

[9] World Bank. 1998. *Economic Analysis of Investment Operations*. Washington: World Bank. Prepared by Pedro Belli, Jock Anderson, Howard Barnum, John Dixon and Jee-Ping Tan. [Revised 2001]

transportation economists, etc.) rather than general economists. Ideally, these same professionals also apply the CBA – hopefully, from the earliest through the latest stages in the project cycle. Thus, a well-organized investment planning system needs sector-specialized CBA manuals for each sector.

WHY is CBA **NOT** conducted on a greater number and percentage of international development projects?

ANSWER: Numbers and percentages went down from the late 1980s because the TPA – while well-suited to analyzing policy failures in industry and agriculture – had not been designed for the traditional 'market failure' applications in the social sectors, environment, organizational and institutional change – projects which took over dominance from agriculture and industry in the late-1980s. The numbers and percentages of CBA applications did not vault back up after the 1998 switch to the PFA, partly due to the need for new manuals across all the sectors as regards international development applications of CBA. With the change from the TPA to the PFA in 1998, even the agriculture and industry sector CBA manuals were obsoleted.[10] Not only have we not re-written those yet, we also must be careful in taking manuals from the other sectors in developed countries and applying them to the developing world even for those 'market failure sectors' where the PFA to CBA made tremendous progress while CBA of international development projects was practically hibernating. We have work left to do.

[10] Including the World Bank's all-time best selling title by J. Price Gittinger (1972, 1982), *Economic Analysis of Agricultural Projects*. Baltimore and Washington: Johns Hopkins University Press.