BEHAVIOURAL INDIFFERENCE CURVES*

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ABSTRACT

According to the endowment effect there is some discomfort associated with giving up a good, that is to say, we are willing to give up something only if the price is greater than the price we are willing to pay for it. This implies that the indifference curves should designate a reference point at the current level of consumption. Such indifference maps are kinked at the current level of consumption. The kinks in the curves imply that the utility function is not differentiable everywhere and the budget constraint does not always have a unique tangent with an indifference curve. Thus, price changes may not bring about changes in consumption which may be one of the reasons for the frequent stickiness of prices, wages, taxes, and interest rates. A multiple-period example is also discussed in which the indifference map shifts as the reference point shifts implying that the curves cross over time even though tastes do not change.

Keywords: Behavioural economics, indifference curves, endowment effect, reference state, gain and loss equivalence, price and wage stickiness.

JEL classifications: A2, B50, D03, D11, D81, E03.

1. INTRODUCTION

The standard description of indifference curves is still being taught to millions of students annually, although a crucial inconsistency with its conceptualization was reported more than three decades ago, namely that it fails to indicate the reference point or the current level of consumption (Knetsch & Sinden 1984; Kahneman, Knetsch, & Thaler

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According to the conventional indifference curve diagrams when deciding between two goods it is as though we’ve never consumed them before. Thus, we are assumed to come to the problem in a pristine state, without indicating the amount of the goods in question we consumed in the prior period or are adapted to. However, this is incongruous, because if we have not consumed those goods before how are we to know how much utility we should expect from them.

Moreover, the customary indifference curve depends on the implicit assumption that choice along the indifference curves is reversible. That is, if an individual owns $x$ and is indifferent between keeping it and trading it for $y$, then when owning $y$ the individual should be indifferent about trading it for $x$. If loss aversion is present, however, this reversibility no longer holds (Knetsch 1989; Kahneman, Knetsch & Thaler 1991; Ortona & Scacciati 1992). Knetsch & Sinden (1984) were the first to point out that the standard assumption pertaining to the equivalence of losses and gains is outright contradicted by experimental evidence: “the compensation measure of value seems to exceed significantly the willingness to pay measure, which would appear to call into some question . . . interpretations of indifference curves”. In the meanwhile, the finding has been repeated in many settings. For instance, Carmon & Ariely (2000) report that people were willing to sell their tickets to an NCAA tournament at a price that was an amazing 14 times higher than the amount they were willing to pay for it.

Thus, the mainstream representation of indifference curves is anachronistic insofar as it overlooks the solid empirical evidence that current consumption (or current endowment) matters to subsequent consumption decisions as it becomes a reference point to which other states of the world are compared (Rabin 2008). The endowment effect implies that there is an extra discomfort associated with giving up something, i.e., in excess of the pleasure associated with acquiring it. Let us suppose that the current level of consumption of goods $x$ and $y$ is at $(Q_{x1}, Q_{y1})$ in Figure 1. Then point $a$ becomes the origin of the coordinate system and the relevant reference point for the current period 1. Figure 1 superimposes the conventional indifference curve upon the indifference curves with a reference point.
2. INDIFFERENCE CURVES WITH A REFERENCE POINT

For the behavioural indifference curves we divide the plane into four quadrants (numbered counter-clockwise) with the axis going through the origin at point $a$, the current level of consumption (Figure 2). In quadrant 1 the reference point is irrelevant as both $x$ and $y$ are increasing. In this quadrant the standard convex-to-the-origin indifference curves are unchanged. However, in quadrant 2, good $x$ decreases while good $y$ increases, in quadrant 3 both $x$ and $y$ decrease, while $x$ increases in quadrant 4 and $y$ decreases. (All changes are relative to the axes that go through the initial reference point at $a$ in Figure 2.

Thus, lowering consumption of $x$ by one unit below the initial level, $Q_{x1}$ (in quadrant 2) requires a larger amount of a compensating good $y$ [$\Delta y(2)$] in order to maintain the same level of utility than the amount of $y$ required [$\Delta y(4)$] to be given up (in quadrant 4) if there were a one unit increase in $x$ beyond $Q_{x1}$ (Figure 3). In other words, at point $a$ the loss in marginal utility of giving up a unit of $x$ is larger (in absolute value) than the gain in marginal utility of obtaining a unit of $x$; i.e., decreasing one’s consumption from the current level is more painful than increasing consumption from the current level is beneficial.
This is critical, because it implies that the indifference curves are kinked at the axis that go through point $a$, with slopes steeper in quadrant 2 than in quadrant 4, a pattern overlooked in conventional treatments of indifference curves.

Properties of behavioural indifference maps have been worked on with straight lines, i.e., with constant marginal rate of substitution (Ortona & Scacciati 1992; and Just 2014, p.81), while Knetsch, Riyanto & Zong (2012) demonstrate with such indifference curves the discrepancy of evaluating welfare in the domains of gains and losses.

To demonstrate the impact of the endowment effect on the indifference map with declining marginal rate of substitution ($m$) let us suppose that the standard ($m$) along an indifference map were $m_i = -(\Delta Y_i)/(\Delta X_i)$, that the endowment effect of $x$ at a point $i$ is given by $\varepsilon_{xi}$ and that of $y$ is given by $\varepsilon_{yi}$ where $\varepsilon_i > 0$ is the extra price (in terms of the other good) required to give up an object above the price for which it would be acquired. Then the marginal rate of substitution of the behavioural indifference curve ($bm$) in quadrant 2 relative to the reference point $a$ is $bm_i = -(\Delta Y_i + \varepsilon_{yi})/(\Delta X_i)$, in quadrant 3 it is $bm_i = -((\Delta Y_i + \varepsilon_{yi})/(\Delta X_i + \varepsilon_{xi})$, while in quadrant 4 it is given by $bm_i = -(\Delta Y_i)/(\Delta X_i + \varepsilon_{xi})$. 

![Figure 2: Behavioural Indifference Curves in Period 1 Showing Initial Endowment](image)
Figure 3: The Behavioural Indifference Curve is Kinked at the Reference Point

Hence, in quadrant 2 the slope of the indifference curve is steeper than the standard indifference curve (Figure 1) because in order to give up 1 unit of $x$ one would need a greater amount of $y$ as compensation on account of the pain of giving up $x$ relative to the level to which one is accustomed (Figure 3). Similarly, in quadrant 4 except in this case the indifference curve is flatter than the standard indifference curve because in this case it is more difficult to give up $y$ (Figure 1). In quadrant 3 the slope of the behavioural indifference curve relative to the standard one is ambiguous depending on the sizes of $\varepsilon_{xi}$ and $\varepsilon_{yi}$; the curve is drawn in this quadrant in such a way that the endowment effects cancel each other and the standard indifference curves obtain.

The implication is that there is a kink in the behavioural indifference curves as they cross the axis from one quadrant to another. This implies that the utility function is not differentiable everywhere and that preferences are not homothetic. Moreover, budget lines cannot be tangent to the indifference curve along the axes that divide the plane into four quadrants. For instance, budget lines 1 and 2 in Figure 4 show that changes in price will not bring about any change in the consumption bundle at point $a$, contrary to conventional analysis. This effect may well be the cause for the oft found stickiness
Figure 4: Behavioural Indifference Curves in Period 1 with Two Budget Constraints

Figure 5: Demand Curve for a Good is Kinked at the Current Level of Consumption
in adjustment to changes in wages, prices, taxes, and interest rates (Anderson 1998; Carlton 1986; and Ausubel 1991). This implies that straight line demand curves are not plausible. Rather the demand curve is most likely kinked at the current level of consumption (Figure 5).

3. NEW BUDGET CONSTRAINT

Let us suppose that in period 2 line 3 becomes the budget constraint (Figure 6). It is tangent to the indifference curve at $b$ in quadrant 4. Thus, with budget constraint 3 the new consumption bundle becomes ($Q_{x2}$, $Q_{y2}$) at point $b$ (Figure 7). Once choosing to consume at point $b$ in period 2, however, the origin of the new axis of the behavioural indifference map shifts to $b$ and, in turn, that becomes the new reference point in period 2. This implies that the two sets of indifference maps cross over time even if the taste of the consumer does not change at all over time.

**Figure 6: Behavioural Indifference Curves in Period 1 with Several Budget Constraints**
Moreover, the new indifference map of period 2 is superimposed on the previous one of period 1 (Figure 7). However, the budget constraint, which was tangent to the old indifference curve at $b$ is no longer tangent to the new indifference curve at $b$ (Figure 7). The tangency with the new set of indifference curves is at $c$ implying that consumption will change in period 3 from $b$ to $c$ even if prices, income, or taste remain unchanged (Figure 8). Thus, the consumption bundle can change even if there is no fundamental change in either the economy or in the consumer’s preferences. In other words, the adjustment to the new budget constraint occurs in two steps: the first step uses the initial reference point in order to choose the optimal bundle and having made that choice the reference point also shifts implying that the whole set of indifference curves shift. This, in turn, displaces the optimal consumption bundle once again to a tangent between line 3 and the new set of indifference curves at $c$ even if there are no other changes in the relevant parameters.

Figure 7: In Period 2, Behavioural Indifference Curves Shift the Origin from $a$ to New Reference Point at $b$
3. CONCLUSION

Behavioural indifference curves are relative to a reference point. The endowment effect implies that people are willing to give up an object only at a higher price than the price at which they are willing to buy it, i.e., it is psychologically more difficult to give up an object than to acquire it. This changes the shape and properties of the indifference map that has far-reaching implications and not only in the classrooms but also in applied areas such as the evaluation of welfare states and stickiness of such variables as wages, prices, taxes, hours worked, and interest rates (Knetsch, Riyanto & Zong 2012; Scacciati 2004).

Furthermore, kinks in the indifference curves may explain why consumers do not respond to taxes in the way predicted by traditional theory (Wansink et al. 2013; The Economist 2012; Ortona et al. 2008). In addition, the theory of demand has to be reformulated insofar as the theory of aggregation or the estimation of lifetime utility will differ with reference points in the focus. In fact, probably most of the usual theorems associated with demand theory such as the Slutsky equation, need to be reformulated. This salient issue ought not be ignored any
longer and needs a much wider research agenda than hitherto allotted to it at the margins of the discipline.

Even at this stage it is important to incorporate the behavioural indifference curves into the curriculum. If the straight-talking Nobel-prize winning physicist Richard Feynman (1918-88) were still with us he would concur with this view; in his famous 1974 commencement address at the California Institute of Technology, he beseeched the graduating class to practice “scientific integrity,” “utter honesty”, and “leaning over backwards” so as “not to fool ourselves” [and of course others] (Feynman 1985). I believe that teachers of economics should also lean over backwards by teaching behavioural indifference curves.

REFERENCES


