W. E. Johnson and Some Historical Notes on the Early Contributions to The Study of Consumer Behaviour

Santanu Ghosh
Professor (West Bengal Senior Education Service), Department of Economics
Maulana Azad College

Abstract

The theory of value and choice occupies a prime position in economic theory. Its modern beginning is traced to the works of Slutsky, Hicks and Allen and these authors have, accordingly, have been hailed as the pioneers of the ordinal utility based indifference curve approach. While Slutsky's paper was published in 1915, it, however, remained unnoticed or unattended till the appearance of the collaborative work of Hicks and Allen in 1934.

The present paper argues that the beginning of the indifference curve analysis actually goes back to an article published by William Ernest Johnson, a Cambridge logician and philosopher, in the year 1913 (in the December issues of the Economic Journal). A close look at his work reveals that Johnson envisaged the relevant concepts and ideas earlier than Slutsky and, hence, was much ahead of Hicks and Allen in formalizing the modern consumer behaviour theory. While some authors have cast doubt over Johnson's originality and have accused him of borrwoing ideas from Pareto without any mention of or acknowledgment to the Italian economist, the present paper, however, contends that the calendar year 2013 marked the centenary of the indifference curve analysis and strongly advocates for rehabilitation and recognition of Johnson, an unsung hero, in the pages of the history of economic thought. The paper also highlights some early and fundamental contributions of a set of individuals in the area of consumer behaviour during the mid-1930s – when the field was in its nascent stage of research and development – and laments that their works have also virtually been forgotten by the academic community amidst the euphoria of applauding Slutsky, Hicks and Allen.

JEL Classification Keys: B 31 (History of Economic Thought – Individuals); D11 (Consumer Economics – Theory)

1. Introduction

One of the fundamental and acceptable laws (hypotheses) of economic science is the 'law of demand'. This is the law with which introduction to economic theory is usually made (to the starters). The law of demand is actually derived from the theory of consumer choice. The choice theory is, indeed, one of the cornerstones of economic analysis. A number of economists in the 19th century itself contributed to its early development – prominent among them being Jevons,

Walras, Pareto, Marshall, Edgeworth and Menger. In the 20th century, Slutsky, Hicks, Allen and Samuelson took the development of the choice theory to a new height while persons like Arrow and Debreau – through rigorous application of mathematical tools – enriched the field further. Slutsky is credited to have been the initiator of the modern utility analysis though his contribution remained unnoticed for nearly two decades after its publication. Hicks, Allen and Samuelson have possibly cornered the major glory as far the early development of the modern choice theory is concerned.

The purpose of the present paper – which is more of a sort of historical note – is to explore into the early contributions to the study of consumer behavior in the 20th century; in doing so it not only highlights some other important works, but also argues that the origin of the modern utility analysis goes back to a point even before the paper by Slutsky (1915) – with the publication of a paper by the Cambridge logician and philosopher Willian Ernest Johnson in 1913 while admitting that it was the Italian economist Vilfredo Pareto who first laid the foundation of the modern choice theory, and closely followed by Francis Ysidro Edgeworth. In fact, the paper contends that both Pareto and Johnson had independently developed the theory of consumer choice, though Pareto did it earlier than Johnson. In a sense, the calendar year 2013 may be taken as the centenary of the indifference curve analysis. This brief exercise is, therefore, taken as a tribute to the unsung hero (W.E.Johnson) and all those who had played a vital role in facilitating our understanding of the theory of consumer behavior.

2.   Slutsky-Hicks-Allen – the Hailed Trio

Hicks and Allen (1934.a, 1934.b) in a set of two papers emphatically outlined the ordinal utility analysis. Their work actually triggered off systematic interest of the scholars in this area and that ultimately led to proliferation of a rich literature on theory of consumer behavior. Hicks and Allen were not initially aware of the work of Slutsky (1915) till Henry Schultz drew their attention to it; they considered their approach to be a new one. While the first of the two Hicks-Allen articles was actually authored by Hicks, its mathematical counterpart was developed by Allen in the second part (though both articles carry names of Hicks and Allen). The inspiration to the work of Hicks-Allen was the work of Pareto (1909). According to Hicks (1934.a), Pareto's "*Manuel d'économie politique*" (and particularly its mathematical appendix) contains the most complete static theory of value which economic science has hitherto been able to produce". Allen's paper (1934.b), in contrast, acknowledges the contribution of Edgeworth too, apart from Pareto. At this juncture, one needs to acknowledge academic community's debt to Fisher (1892); in his *Mathematical Investigations into the Theory of Prices,* Fisher challenged the old Marshallian conception of utility. Hicks' work was basically concerned with establishing Pareto's contention that

"even if it is possible to deduce a utility function from the directions of indifference, that utility function is to a very large extent indeterminate". The question of integrability was the major concern. The argument was that while it is possible to proceed from a utility function to a scale of preferences, it is not possible to take the opposite route. While analyzing this issue, Hicks and Allen distinguished between complementary and competitive (substitute) goods. It was shown that magnitudes of elasticity of substitution (in consumption) and income elasticity of demand play a key role in determining complementarity and/or competitiveness between (among) commodities and as well as in integrability property of the system. While Hicks primarily laid the theoretical basis of the ordinal indifference curve analysis, Allen's effort was in providing its mathematical counterpart. They started with a 2-good framework and examined the implications of adding a third good and subsequently more goods to the system. Since Hicks' approach was primarily a geometric and intuitive one, he could explicitly discuss up to 3-good case. Allen, in contrast, was able to provide a general picture in terms of an n-good framework since his was a mathematical treatment of Hicks' approach. Allen demonstrated that in an n-good framework, (a) there are "*eight independent indices of the individual's complex of preferences*" which may be captured in terms of "*six elasticities of complmentarity and two of the coefficients of income variation*", (b) in the presence of integrability, there would be only "*five indices of the individual's' complex of preferences*", including three elasticities of complementarity (instead of six) plus two coefficients of income variation, and, hence, there is a reduction "*in the number of degrees of freedom in the system*". And in case of three independent goods, (c) there are "*only three independent indices of the individual's complex of preferences*" where two independent coefficients of income variation would be captured in terms of the three elasticities of complementarity.

Slutsky, as mentioned earlier, remained in oblivion for nearly two decades even though later on he was accorded the status of being the first to explore the ordinal utility approach. Slutsky's now famous and acclaimed piece of work actually appeared in the midst of the First World War. Interestingly and surprisingly, Slutsky – a Russian – published his paper in Italian – in the leading Italian journal of the subject, viz. Giornali degli Economisti e Rivista di Statistica. It may be recalled that Slutsky was primarily a statistician by profession and that is why he possibly chose to send his article to the Italian journal which catered to contributions in both Economics and Statistics. It is also interesting to observe that both Slutsky and Hicks(-Allen) refer to the Page 159 of Pareto's *Manuel* where Pareto argues that "*even it is possible to deduce a utility function from the directions of indifference, that utility function is to a very large extent*

indeterminate". In other words, Slutsky and Hicks(-Allen) attempted to provide a concrete formulation of Pareto's contention, which the latter left unattended. An analysis of Slutsky's paper reveals that he reached the Hicks-Allen conclusions earlier; in fact, Slutsky's approach was purely mathematical (there is not a single diagram in the whole paper) as in case of Allen's work (the second part of Hicks-Allen); it is possible to argue that while Hicks' and Slutsky's papers are complementary in nature – the former emphasizing the theoretical and intuitive parts of the study of consumer behavior and the latter addressing the precise quantitative results of the theoretical contentions – Slutsky's and Allen's approaches were basically two sides of the same coin. However, though Allen started with the 2-good model and then gradually extended into 3-good and then into n-good cases, Slutsky from the very beginning primarily relied on a generalized n-good model.

3.   Johnson – the Neglected Forerunner

As far as early developments of the indifference curve analysis are concerned, one fellow has virtually remained in perpetual neglect and oblivion till date. Two years before Slutsky, i.e. in the year 1913, W. E. Johnson published a highly significant article, "*The Pure Theory of Utility Curves*". Johnson's starting point was the work of Edgeworth, and not Pareto (as in cases of Slutsky and Hicks-Allen). He introduces modifications in Edgeworth's "*indifference curves*". In Edgeworthian analysis, on one axis we measure the quantity of a good acquired (giving positive or addition to utility) and on the other axis we measure quantity of another good sacrificed (giving negative or loss of utility); in other words, while the acquisition yields utility, sacrifice results in disutility and, accordingly, in a simple two dimensional plane, one can think of drawing a positively sloped indifference curve (*a là* Tobin's mean variance analysis where we draw positively sloped indifference curves involving return and risk). Johnson, in contrast, "*instead of considering* the '*net utility*' of an *exchange",* considered the "*resultant utility obtained from the acquisition of two commodities which both contribute positively to utility*". In other words, Johnson was possibly the first to talk of utility function of the modern type that we usually postulate in the theory of consumer behavior. He was able to identify explicitly probable or alternative shapes of indifference curves, apart from the normal downward sloping, convex curves (in a 2-good world) – i.e. upward rising and concave, negatively sloped, but linear and L-shaped. In a sense, he was the first person to deal explicitly the standard present day text book treatments of modern indifference curve analysis. He also discussed budget constraint, price consumption curve and income consumption curve, which Hicks-Allen handled little after two decades. Johnson realized the importance of the convexity of the indifference curves for ensuring an interior solution. It is worth quoting from his article: "*What precise conditions are*

involved by our assumption, that the utility curves "descend convexly", which is required if the tangent solution for the price line is to yield a true maximum". It is absolutely wrong to credit Slutsky-Hicks-Allen as the pioneers of the ordinal utility approach; Johnson was clearly the forerunner. An excerpt from a relevant passage of his article bears testimony to this contention: "……. *it is worthwhile to point out that the diagram measures only the quantities x and z. There are no lines in the figure which measure the utility itself. The several utility curves are arranges in a scale of increasing value as we pass to the right and above, and thus the "distance" (measured arbitrarily) from one curve to another indicates (without measuring) the increase in utility. But this impossibility of measurement does not affect any economic problem. Neither does economics need to know the marginal (rate of) utility of a commodity. What is needed is a representation of the ratio of one marginal utility to another. In fact, this ratio is precisely represented by the slope at any point of the utility-curve*" [(p. 490, Johnson (1913)]. The notion of monotonic transformation and ordinality is clearly embedded in this paragraph. Further, at other places he also mentions: "*It follows that any straight line (between the axes) can touch only one utility curve, and only at one point; and at this point the utility will be maximum"* and *"Provided we assume that the utility-curves descend convexly, it is obvious that the resultant utility is maximum where this price line touches a utility-curve*" (p. 496, op. cit.). The statement clearly points to the axiom of transitivity whereby we rule out the possibility of intersecting indifference curves and these excerpts or statements are sufficient to clinch and establish the fact that it was, indeed, Johnson who had first conceptualized and formalized the treatment of the modern indifference curve analysis, ahead of Slutsky and much earlier than Hicks and Allen.

Taking two goods, x and z, Johnson introduced concepts like *mediate section*, *x-urgent section* and *z-urgent section*, and with these analyzed convexity conditions. He also extended his framework to n-good case and derived convexity condition in terms of determinants, minors etc. which, later on, Slutsky and Allen (-Hicks) negotiated. It needs to be pointed out that Johnson, Slutsky and Allen (-Hicks) all explored the condition for utility maximization without resorting to the Lagrange multiplier technique and Johnson explicitly talked of and derived the second order condition for utility maximization. Johnson, in the process, was able to abandon the restrictive Marshallin assumption of '*constant marginal utility of money*' and, instead, allowed for its variability and as well as treated the possibility of Giffen paradox. Using his framework, he was able to highlight that Giffen goods are a subset of inferior goods, apart from providing a mathematical condition for and, accordingly, a definition of complementarity in consumption. Moreover, he took a brief foray – using his analytical structure – into discussion of production function. One comes across a final section in his article with the nomenclature

"*On Some Special Forms of the Production Function*" (where he talks of 'grouped factors'). Indeed, this paper might then be treated as one of the earliest attempts of formalizing production function too.

In spite of introducing seminal ideas and approach, Johnson has, unfortunately, remained an unsung hero; rather, some have doubted his originality. Only some passing references were made by Hicks-Allen and Schultz (but not by Slutsky and possibly because he was then not aware of Johnson's work) and due accolades have eluded him. In fact, there has been some debate concerning Johnson's knowledge of Pareto's *Manuel*, especially its 1909 French edition (the Italian edition appeared in 1906 under the title *Manuale di Economia Politica*) since Johnson was versed in French language and had even published a paper (though not on Economics) in the leading French journal *Bibliothèque du Congrès International de Philosophie*. While some Italian Paretians have virtually accused Johnson of plagiarism because he did not refer to or acknowledge Pareto's contributions, some authors – notably, Amoroso (1916) and Baumol-Goldfeld (1968) – are of the opinion that Johnson was unaware of Pareto's work and he developed his ideas independently; this view was also shared by Hicks-Allen. While raising doubt about Johnson's ignorance of Pareto's contributions, Schumpeter (1954), however, observed "*This* (Johnson's 1913 paper) *important paper contains several results that should secure for its author a place in any history of our science*". Blaug-Stuges (1983), Bruni (2002) and Moscati (2005) have left open the question of Johnson's familiarity with Pareto's *Manuel*. On the other hand, Edgeworth (1916), Zotoff (1923) and Bowley (1924) were aware of the importance of Johnson's article. It needs to be asserted that at the time Johnson published his paper in the *Economic Journal*, the present day custom or format of listing references was not in vogue – i.e. in those days, one would not find at the end of any paper detailed bibliography containing relevant works and articles cited in the article under consideration. It may not then be right to accuse Johnson of suppressing his debt to Pareto. Further, given that Johnson explicitly cited Edgeworth in his paper, would it not be too unfair to infer that he deliberately omitted Pareto and, thus, was guilty of plagiarism ? Accordingly, it is high time that the fraternity of economic science should take cognizance of Johnson's original contributions to the development of ordinal utility theory, especially to the development of indifference curve approach – which he had developed independently after Pareto, but before Slutsky and Hicks-Allen – and rehabilitate him in proper manner. Considering that Johnson's work was the first published journal work in the field of modern indifference curve analysis as far as back in 1913 – and not of Slutsky's (1915), as is usually recognized – the calendar year 2013, therefore, marked the centenary of the development of indifference

43

curve approach and, accordingly, we must repay our debt to Johnson by duly acknowledging his outstanding contributions.

4.   Georgescu-Rogen-Schultz-Hotelling-Ricci – the Forgotten Quartet

Two years after the appearance of Hicks-Allen formulation, Georgescu-Rogen (1936) provided another vital breakthrough in the study of consumer behavior. His paper not only settled the issue of integrability, but also served as a very important milestone towards methodological questions in the context of consumer's choice. While applauding the efforts of Hicks-Allen, Georgescu-Rogen opined: "*The method of economics remains …. That of mental experiment aided by introspection. There are well known attacks directed against this procedure for supporting scientific laws. Nevertheless, we may defend our position by arguing that, so far as we deal with the consumer's position, introspection is justified by the problem itself …. At the same time we seek a safer line of approach. This might be reached, for instance, by formulating our mental experiment in such a way as to suggest, and direct step by step, the pattern of an actual experiment which may be carried out in the future, subject to technical possibilities in the matter*".

In terms of its sheer rigour and significance, Georgescu-Rogen's work must rank as one of the front ranking ones, almost at par with Slutsky and Hicks-Allen. Using some (four) postulates or axioms of choice, he showed that utility varieties of Edgeworth and the theory of choice of Pareto contain consistent choices. He established the necessary and sufficient analytical conditions for the stability of exchange equilibrium (a point not explicitly emphasized by Hicks-Allen) and also demonstrated the importance of the integrability of indifference elements. Georgescu-Rogen was also able to establish the necessity of distinguishing between indifference elements and integral varieties. He contended that "*the integrability of the indifference elements has less to do with the existence of constant ophelemity varieties that the condition of transitivity has*".

Economics being a behavioural science, there is ample scope of experiments with human behaviour and psychology. Experimental economics is now an emerging field of research; also, we are now aware of the seminal investigations and research works by persons like Kahneman and his associates (1979, 1981). When one judges Georgescu-Rogen's work against this background, the significance and relevance of his 1936 paper becomes even more prominent. In this article, unlike Slutsky and Hicks-Allen, he applied probability analysis in order to repeat and conceptualize a choice-experiment and, thereby, demarcate, say, between zones of preference and indifference. Here he talks of obtaining a "*psychological threshold*" – a zone within which an individual would remain indifferent between two alternatives and beyond which there will be a clear-cut superior-inferior

relation. This was, possibly, the first attempt to integrate pure mathematical economics with tools of probability and statistics while dealing with the question of integrability.

From the early 1930s onwards, a few other authors were also drawn into lending meaningful and useful contributions in this field (i.e. theory of consumer behavior). Two notable persons in this list were Harold Hotelling (1932) Henry Schultz (1933, 1935) [the interesting point about the works of these two economists is that their works preceded the work of Hicks-Allen; in other words, in the early 1930s a small number of researchers had already started working in the area of consumer behaviour simultaneously and independently]. Schultz provided a simple, alternative proof of the interrelations of demand, price and income; he also "*developed the implications of these interrelations on the demand for related (completing and competing) goods and on the elasticity of substitution*". In doing this, he also compared between Slutsky condition and Hotelling condition with respect to checking or testing the rationality or consistency of human behavior in the market place. While in Georgescu-Rogen's work one finds simultaneous application of mathematical economics and probability and statistical theory, in Schultz's work one comes across an attempt towards empirical verification of the theory of demand. This empirical verification part, with the aid of US data and covering household expenditure on three related commodities – beef, mutton and pork – was, perhaps, the most praiseworthy and novel idea in that era (at a time when econometric theories did not adequately develop). It was, in all likelihood, the first of its kind. Actually, Schultz was the first economist to give a clear graphical treatment of decomposing total effects (of a price change) into substitution and income effects and he also made an attempt of empirical estimation of the two components with the aid of real life data. Schultz's study, therefore, was a pioneering study – a study that handled not just pure theory of consumer behaviour, but also covered its applied part.

We wrap up our discussion by highlighting an interesting piece of work of the time that was due to Umberto Ricci (1935). The standard price theory usually employs the twin assumptions (a) perfect divisibility in units of purchase and consumption (for all goods) and (b) presence of diminishing marginal utility for all goods. Ricci made an ingenious attempt by relaxing these assumptions. While he considered indivisibility in purchase/consumption of a good, on one hand, he also allowed for, on the other hand, situations where marginal utility from consumption of a good would, at least, be rising over a certain range (consequences of two cases dealt separately, though). By introducing these features, Ricci tried to examine the probable implications of the same (e.g. with respect to applicability of Jevons-Walras equi-marginal principle), apart from

proposing the manner about how to handle these cases. It needs to be remembered that Ricci made an attempt in incorporating indivisibility at a time when mathematical techniques, like integer programming, did not develop. Both the novel idea and the attempt to deal the same at theoretical level must, therefore, be appreciated.

5.   Conclusion

In this short paper we have tried to highlight some of the major theoretical developments that had taken place over the last one hundred years, with special reference to the period around the mid-1930s. Our discussion shows that even though Slutsky, Hicks and Allen have stolen the limelight by being hailed as pioneers of modern utility analysis, the credit of developing the theory first should, instead, go to Johnson along with Pareto. At the same time, one needs to express explicit and due acknowledgement to persons like Georgescu-Rogen, Schultz, Hotelling and Ricci, among others, for they also provided useful insights and extensions during the mid-1930s – the nascent stage in the development of modern consumer behavior theory.

We conclude by pointing out that our contention is based on the survey of works appearing primarily in the English professional journals (except that of Slutsky). Given the importance of the Austro-German region and of Vienna, in particular, till the late 1930s, we should, however, be more careful in our assertion: it may be possible to unearth similar, but neglected, pieces of work in German professional journals of the era (notably, *Weltwirtschaftliches Archiv* and *Zeitschrift für Nationalökönomie*) and also in Swedish and Scandinavian journals. It is, indeed, imperative, to delve deeper into this aspect in order to gain further insight on the history and development of consumer behavior in the late 19th and the early 20th centuries.

Select Bibliography:
Allen, R.G.D. (1932) – "The Foundations of a Mathematical Theory of Exchange", *Economica*, No. 36 (May)

Bowley,A.L.(1924) – The Mathematical Groundwork of Economics, Oxford: Clarendon Press

Bruni, L. (2002) – Vilfredo Pareto and the Birth of Modern Microeconomics, Cheltenham: Edward Elgar

Edgeworth, F.Y. (1916) – "Recent Contributions to Mathematical Economics", *Economic Journal*, Vol. 25, Nos. 97 & 98 (March & June)

Fisher, I. (1892) – Mathematical Investigations in the Theory of Value and Prices, *Transactions of the Connecticut Academy*, July (Rep. Yale University Press, 1925)

Georgescu-Rogen, N. (1936) – "The Pure Theory of Consumer Behaviour", *Quarterly Journal of Economics*, Vol. 50, No. 4 (April)

Hicks, J. R. – Allen, R. G. D. (1934.a) – "A Reconsideration of the Theory of Value. Part I. *Economica*, *(New Series)*, Vol. 1, No. 1 (February)

,, (1934.b) – "A Reconsideration of the Theory of Value. Part II. A Mathematical Theory of Individual Demand Functions", *Economica (New Series)*, Vol. 1, No. 2 (May)

Hotelling, H. (1932) – "Edgeworth's Taxation Paradox and the Nature of Demand and Supply Functions", *Journal of Political Economy*, Vol. 40, No. 5 (October)

Johnson, W.E. (1913) – "The Pure Theory of Utility Curves", *Economic Journal*, Vol. 23, No. 92 (December)

Kahneman, D. – Tversky, A. (1979) – "Prospect Theory: An Analysis of Decisions Under Risk", *Econometrica*, No. 47 (313 – 327)

Moscati, I. (2005) – "W.E.Johnson's 1913 Paper and the Question of His Knowledge of Pareto", Journal of the History of Economic Thought, Vol. 27, No. 3 (September)

Pareto, V. (1896) – Cours d'èconomie politique: Tome Premier, Losanne: Rouge

Pareto, V. (1906) – Manuale di Economia Politica, Milano: Società Editrice Libraria

Pareto, V. (1909) – Manuel d'économie politique, Paris: Giard et Brière

Ricci, U. (1935) – "The Modification of the Utility Curve for Money in the Cases of Indivisible Goods and Goods of Increasing Utility", *Economica (New Series)*, Vol. 2, No. 6 (May)

Schultz, H. (1933) – "Interrelations of Demand", *Journal of Political Economy*, Vol. 41, No. 4 (August)

,, (1935) – "Interrelations of Demand, Price, and Income", *Journal of Political Economy*, Vol. 43, No. 4 (August)

Slutsky, E. (1915) – "Sulla teoria del bilancio del consumatore", *Giornali degli Economisti e Rivista di Statistica*, Vol 51, No. 1 (July)

Tversky, A. – Kahneman, D. (1981) – "The Framing of Decisions and the Psychology of Choice" – Science, Vol. 211, No. 4481 (Januay 30)

Zotoff, A.W. (1923) – "Notes on the Mathematical Theory of Production", *Economic Journal*, Vol. 33, No.129 (January