The Logic of Value and the Value of Logic

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Abstract

Jevons composed his value theory of nonenties. These creatures are elusive. Subsequent formal refinements did not eliminate the fundamental flaw but made it only harder to detect. A vacuous formal structure is one that cannot be interpreted in some domain. For want of any correspondence in the monetary economy, Jevons's approach could not produce viable results. Roughly speaking, Jevons made value dependent on subjective factors. This paper gives a rigorous formal proof that value is determined by objective conditions. Within the structural-axiomatic framework there is no formal spare room for the major behavioral nonentities utility, optimization, rational expectations, and equilibrium.

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1 Entities and nonentities

> Repeated reflection and inquiry have led me to the somewhat novel opinion, that *value depends entirely on utility*. (Jevons, 1911, p. 1), original emphasis

When a person sparks a surprising amount of assent, sympathy, or enthusiasm the need for a characterization is felt and we say that the person has charisma. The word functions like the X in an equation. Up to this point not much has happened. We use one word as a shorthand for a complex and ill-understood social phenomenon. The trouble begins with inversion, that is, when the placeholder word is used in an explanation. Then it signifies an identifiable active entity, for example in the statement: Y won the election *because* he/she has charisma. Unwittingly one has slithered into a logical circle. In his methodological writings J. S. Mill criticized this habitual reification:

> Mankind in all ages have had a strong propensity to conclude that wherever there is a name, there must be a distinguishable separate entity corresponding to the name; ... (Mill, 2006b, p. 756)

As long as we cannot identify charisma directly or indirectly in some objective form any explanation that employs the word is vacuous and not acceptable, at least for the present, according to scientific standards. Day-to-day communication is mainly made up of socially accepted reifications. A nonentity's reality content consists exclusively in the degree of popular consent. As a matter of fact, most people are talking most of the time about nonentities and all sounds sensible.

When economists are criticized for employing unrealistic, weird, or empty concepts the answer is usually (a) physicists do the same, (b) it is an elegant abstraction, (c) it is only to be understood 'as if', (d) it is not decisive for the argument, (e) there is no alternative. All this sounds good and right but it begs the question. The point of the criticism is usually that a *specific* unrealism, the auctioneer for instance, cannot be justified by (a) to (e) or, for that matter, by any stretch of the imagination.

In general, it is indeed perfectly legitimate to introduce unrealistic or weird concepts in a conjecture. Newton's occult force of gravity is the paradigmatic case.

> It does not matter that moos and goos cannot appear in the guess. You can have as much junk in the guess as you like, provided that the consequences can be compared with experiment. (Feynman, 1992, p. 164)

From this follows, as a matter of course, that *not all* unrealistic or weird concepts are acceptable. Those that have no testable implication are not. Hence, they have to go

out of the window as fast as possible. To recall, physicists have an impressive track record for both creating *and* eliminating scores of nonentities. Paradigmatic cases are epicycles, phlogiston, ether, absolute space and the perpetual motion machine. It is important, though, to be aware that there is no convenient criterion available for a hard and fast distinction between an entity and a nonentity. This occasionally long lasting indecision provides the ecological niche for nonentities.

There are two kinds of unrealism or weirdness: justified and unjustified. Newton underpinned his occult force with a neat formula. The calculations that were carried out with it proved to be quite accurately in correspondence with facts. Nothing roughly comparable ever happened with, for example, utility. Jevons offered his fellow economists this nonentity as an explanation of economic phenomena and the great majority eventually adopted it, not realizing that, on closer inspection, it cannot, as a matter of principle, explain anything.

Newton called assumptions that lack an objective referent hypotheses. And he was quite explicit that employing nonentities has more to do with fiction than science.

> Those who take the foundations of their speculations from hypotheses, even if they then proceed most rigorously according to mechanical laws, are merely putting together a romance, elegant perhaps and charming, but nevertheless a romance. (Roger Cotes, Preface to the second edition of Newton's *Principia*, Newton, 1999, p. 386)

The romance of standard economics, rigorous and elegant as it is, has been based on four behavioral nonentities: utility, optimization, rational expectation, and equilibrium. The present paper is concerned in greater detail with the role of utility in the explanation of value.

2 Words don't matter – do they?

> One must be able to say at all times – instead of points, straight lines, and planes – tables, chairs, and beer mugs. (Hilbert, 1935, p. 403)

Formally, a theory consists of premises and conclusions or axioms and theorems; and, hopefully, it tells us something important about reality that we hitherto did not know. In mathematics, we have solely axioms and theorems. Here, the key point of axiomatization is that basic concepts are not defined with reference to real world objects and relations, but implicitly and *uno actu* by laying down the set of axioms. Thus, the axioms can have an arbitrary number of real world interpretations. Or, vice versa, entirely different and seemingly unrelated real world phenomena may be expressible by the same axiomatic structure. For the mathematicians the formal properties of an axiom set and its logical implications are of primary

interest; they can deal with them without ever taking notice of the possible real world interpretations. Hence the question of the realism or unrealism of basic concepts does not arise at all. The axioms create a self-contained formal world that surprisingly often, but by no means always, finds a correspondence in the real world.

> From the axiomatic point of view, mathematics appears thus as a storehouse of abstract forms – the mathematical structures; and it so happens – without our knowing why – that certain aspects of empirical reality fit themselves into these forms, as if through a kind of preadaptation. (Bourbaki, 2005, p. 1276)

Debreu took advantage of this dichotomy. His proof of the existence of a price vector that satisfies the conditions of market clearing, budget balancing and Pareto optimality does, in the strict sense, in no way deal with the economy but exclusively with a clearly defined mathematical object that has no meaning beyond itself. Strictly speaking, it would make no difference if price, market, and budget were replaced by table, chair and beer mug. Realism or unrealism is not an issue at the formal base line.

> Allegiance to rigor dictates the axiomatic form of the analysis where the theory, in the strict sense, is logically entirely disconnected from its interpretations. (Debreu, 1959, p. x)

This is fine as long as the discussion is kept within the mathematical sphere. Problems arise when it comes to a real world interpretation. Without interpretation, Debreu's mathematical object has nothing at all to do with economics or anything else outside mathematics.

> Formal axiomatic systems must be interpreted in some domain ... to become an empirical science. (Boylan and O'Gorman, 1995, p. 198)

Lacking an interpretation that establishes some convincing correspondences with real world phenomena general equilibrium is a nonentity. This, clearly, is not an argument against axiomatization.

> My opinion continues to be that axiomatics, like every other tool of science, is no better than its user, and not all users are skilled. (Clower, 1995, p. 308)

The standard axiomatic approach has to be rejected because it does not afford a valid interpretation in terms of the monetary economy we happen to live in; its formalism belongs to the 'whole crop of monster-structures, entirely without application' (cf. Bourbaki, 2005, p. 1275, fn. 9). The accustomed approach is beyond repair, yet:

> There is another alternative: to formulate a completely new research program and conceptual approach. As we have seen, this is often spoken of, but there is still no indication of what it might mean. (Ingrao and Israel, 1990, p. 362)

The conceptual consequence of the present paper is to discard the familiar subjective-behavioral axioms and to take objective-structural axioms as the formal point of departure.

In the following, Section 3 first provides the new formal foundations with the set of four structural axioms. These represent the evolving consumption economy as the most elementary economic configuration. The structural axiom set excludes nonentities. In Section 4 the properties of the market clearing price for a reproducible monetary economy are determined. In Section 5 the economy is differentiated. This raises the question of how the labor input is allocated. It is shown that the zero profit condition determines the exchange value and that the breakup of the expenditure ratios determines the allocation. With the help of the obtained results it is then possible to exactly localize, in Section 6, the logical black holes in Jevons's approach. Section 7 concludes.

3 Principles

> When the premises are certain, true, and primary, and the conclusion formally follows from them, this is demonstration, and produces scientific knowledge of a thing. (Resume of Aristotle's Analytica Priora, from Wikipedia Posterior Analytics, 2014 Feb)

The formal foundations of theoretical economics must be nonbehavioral and epitomize the interdependence of the real and nominal variables that constitutes the monetary economy.

3.1 Axioms

The first three structural axioms relate to income, production, and expenditure in a period of arbitrary length. The period length is conveniently assumed to be the calendar year. Simplicity demands that we have for the beginning one world economy, one firm, and one product. Axiomatization is about ascertaining the *minimum* number of premises.

Total income of the household sector Y in period t is the sum of wage income, i.e. the product of wage rate W and working hours L, and distributed profit, i.e. the product of dividend D and the number of shares N. Nothing is implied at this stage about who owns the shares.

$$Y = WL + DN \quad |t \tag{1}$$

Output of the business sector O is the product of productivity R and working hours.

$$O = RL \quad |t \tag{2}$$

The productivity R depends on the underlying production process. The 2nd axiom should therefore not be misinterpreted as a linear production function.

Consumption expenditures C of the household sector is the product of price P and quantity bought X.

$$C = PX \quad |t \tag{3}$$

The axioms represent the pure consumption economy, that is, no investment, no foreign trade, and no government.

The period values of the axiomatic variables are formally connected by the familiar growth equation, which is added as the 4th axiom.

$$\begin{gathered} Z_t = Z_{t-1}\left(1 + \dddot{Z}_t\right) \\ \text{with} \quad Z \leftarrow W, L, D, N, R, P, X, \ldots \end{gathered} \tag{4}$$

The path of the representative variable Z_t is then determined by the initial value Z_0 and the rates of change $\dddot{Z}_t$ for each period.

For a start it is assumed that the elementary axiomatic variables vary at random. This produces an evolving economy. The respective probability distributions of the change rates are given in general form by:

$$\begin{array}{cc} Pr\left(l_W \leq \dddot{W} \leq u_W\right) & Pr\left(l_R \leq \dddot{R} \leq u_R\right) \\ Pr\left(l_L \leq \ddot{L} \leq u_L\right) & Pr\left(l_P \leq \ddot{P} \leq u_P\right) \\ Pr\left(l_D \leq \dddot{D} \leq u_D\right) & Pr\left(l_X \leq \dddot{X} \leq u_X\right) \\ Pr\left(l_N \leq \dddot{N} \leq u_N\right) & |t. \end{array} \tag{5}$$

The four axioms, including (5), constitute a simulation. The simulation replaces the inoperative set of equations as analytical tool. There is no need at this early stage to discus the merits and demerits of different probability distributions, which, by the way, need not be fix over time. It is, of course, also possible to switch to a completely deterministic rate of change for any variable and any period. The structural formalism does not require a preliminary decision between determinism and indeterminism. If, for instance, the upper (u) and lower (l) bounds of the respective intervals are symmetrical around zero this produces a drifting or stationary economy as a limiting case of the growing economy.

The economic content of the four axioms is plain. One point to mention is that total income in (1) is the sum of wage income and *distributed profit* and not of wage income and profit. This distinction makes all the difference between good or bad economics (see 2013a).

3.2 Definitions

Income categories

Definitions are supplemented by connecting variables on the right-hand side of the identity sign that have already been introduced by the axioms. With (6) wage income Y_W and distributed profit Y_D is defined:

$$Y_W \equiv WL \qquad Y_D \equiv DN \quad |t. \tag{6}$$

Definitions add no new content to the set of axioms but determine the logical context of concepts. New variables are introduced with new axioms.

Given the paths of the elementary variables, the development of the composed variables is also determined. From the random paths of employment L and wage rate W follows the path of wage income Y_W. Likewise follows from the paths of dividend D and number of shares N the path of distributed profit Y_D. From the 1st axiom then follows the random path of total income Y.

Ratios

We define the sales ratio as:

$$\rho_X \equiv \frac{X}{O} \quad |t. \tag{7}$$

A sales ratio $\rho_X = 1$ indicates that the quantity bought/sold X and the quantity produced O are equal or, in other words, that the product market is cleared.

We define the expenditure ratio as:

$$\rho_E \equiv \frac{C}{Y} \quad |t. \tag{8}$$

An expenditure ratio $\rho_E = 1$ indicates that consumption expenditures C are equal to total income Y, in other words, that the household sector's budget is balanced.

Monetary profit

Total profit consists of monetary and nonmonetary profit. Here we are at first concerned with monetary profit. Nonmonetary profit is treated at length in (2011).

The business sector's monetary profit/loss in period t is defined with (9) as the difference between the sales revenues – for the economy as a whole identical with consumption expenditure C – and costs – here identical with wage income Y_W:

$$Q_m \equiv C - Y_W \quad |t. \tag{9}$$

Because of (3) and (6) this is identical with:

$$Q_m \equiv PX - WL \quad |t. \tag{10}$$

This form is well-known from the theory of the firm.

The Profit Law

From (9) and (1) follows:

$$Q_m \equiv C - Y + Y_D \quad |t \tag{11}$$

or, using the definitions (7) and (8),

$$\begin{aligned} Q_m &\equiv \left(\rho_E - \frac{1}{1+\rho_D}\right) Y \\ \text{with} \quad \rho_D &\equiv \frac{Y_D}{Y_W} \quad |t. \end{aligned} \tag{12}$$

The four equations (9) to (12) are formally equivalent and show profit under different perspectives. The Profit Law (12) tells us that total monetary profit is zero if $\rho_E = 1$ and $\rho_D = 0$. Profit or loss for the business sector as a whole depends on the expenditure and distributed profit ratio and nothing else (for details see 2013a).

It is important to notice that neither Jevons nor the other founding fathers of marginalism developed a correct profit theory.

> Nor do the modern variants add anything whatever on this score. For Debreu profits are simply a nonissue, while Arrow and Hahn make only passing reference to profits – and that only as a historical introduction. Whatever may be the usefulness of these idealized theoretical constructs, they cannot be said to throw any light on the profit issue; surely, therefore, they fail to capture the essence of a capitalist market economy. (Obrinsky, 1981, p. 495)

The lack of a correct profit theory alone suffices to make the standard approach unfit for any real world application whatsoever.

Individual monetary profit

For firm 1 individually eq. (10) reads in the case of market clearing:

$$Q_{m1} \equiv P_1 X_1 - W_1 L_1$$

$$Q_{m1} \equiv P_1 R_1 L_1 \left(1 - \frac{W_1}{P_1 R_1}\right) \tag{13}$$

$$\text{if} \quad \rho_{X1} = 1 \quad |t.$$

Monetary profit of firm 1 is zero under the condition that the quotient of wage rate, price, and productivity is unity. This holds independently of the level of employment or the size of the firm. From the zero profit condition follows:

$$P_1 = \frac{W_1}{R_1}$$

$$\text{if} \quad \rho_{X1} = 1, Q_{m1} = 0 \quad |t. \tag{14}$$

The price of product 1 is, in the simplest case, equal to unit wage costs.

Relative prices

In the same way one gets the individual profits and the zero profit market clearing prices for all other firms. With this, the structure of relative prices is determined for the most elementary case.

$$\frac{P_1}{P_2} = \frac{\frac{W_1}{R_1}}{\frac{W_2}{R_2}} = \frac{R_2}{R_1} \tag{15}$$

$$\text{if} \quad W_1 = W_2, \rho_{X1} = 1, \rho_{X2} = 1, Q_{m1} = 0, Q_{m2} = 0 \quad |t.$$

Under the zero profit condition, relative prices stand in the same relation as unit wage costs. With equal wage rates, relative prices stand in inverse relation to productivities.

This limiting case is the structural-axiomatic counterpart to Walras's zero profit general equilibrium. In the case of a non-zero profit economy the derivation of the market clearing price vector is a bit more involved.

From relative prices in (15) we advance to the classical term value:

> The word Value, when used without adjunct, always means, in political economy, value in exchange; or as it has been called by Adam Smith and his successors, exchangeable value, ... (Mill, 2006a, p. 457)

If P_1 is double P_2 then half a unit of X_1 exchanges for one unit of X_2. Eq. (15) states that the exchange value is, under the condition of zero profit and equal wage rates in the two lines of production, equal to the inverse of the productivities. Value is objectively determined by the production conditions. There is no formal room left for subjective-behavioral notions like utility. The zero profit condition is sufficient to exclude utility as an explanation of value.

Retained profit

Once profit has come into existence for the first time (that is: logically – a historical account is an entirely different matter) the business sector has the option to distribute or to retain it. This in turn has an effect on profit. This effect is captured by (11) but it is invisible in (9). Both equations, though, are formally equivalent.

Retained profit Q_{re} is defined for the business sector as a whole as the difference between profit and distributed profit in period t:

$$Q_{re} \equiv Q_m - Y_D \quad \Rightarrow \quad Q_{re} \equiv C - Y \quad |t. \tag{16}$$

Retained profit is, due to (11), equal to the difference of consumption expenditures and total income.

Monetary saving

The household sector's monetary saving is given as the difference of income and consumption expenditures (for nonmonetary saving see 2011):

$$S_m \equiv Y - C \quad |t. \tag{17}$$

In combination with (16) follows:

$$Q_{re} \equiv -S_m \quad |t. \tag{18}$$

Monetary saving and retained profit always move in opposite directions. This is the Special Complementarity. It says that the complementary notion to saving is negative retained profit; positive retained profit is the complementary of dissaving.

There is no such thing as an equality of saving and investment in the consumption economy, nor, for that matter, in the investment economy (for details see 2013b).

If distributed profit is zero then follows as a corollary of (18):

$$\begin{aligned} & Q_m = -S_m \\ & \qquad\qquad |t. \\ & \text{if} \quad Y_D = 0 \end{aligned} \tag{19}$$

Profit is zero in the limiting case of zero distributed profit and zero saving. Otherwise profit is equal to dissaving, loss is equal to saving in a given period. To focus the analysis, distributed profit and saving is set to zero in the following.

3.3 Nonentities excluded

Equilibrium in whatever definition is not taken into the premises. Methodologically, this would amount to a *petitio principii* (cf. Mill, 2006b, pp. 819-827). Not admitted are, in addition, utility, optimization, and rational expectation. The first rule of theory building says: never put a behavioral assumption into the premises, or, as Newton famously said: hypotheses non fingo.

4 The market clearing price

> But in political economy the greatest errors arise from overlooking the most obvious truths. (Mill, 2006a, p. 458)

From (3), (7), and (8) follows the price as dependent variable:

$$P = \frac{\rho_E}{\rho_X} \frac{W}{R} \left(1 + \frac{Y_D}{Y_W} \right) \qquad |t. \tag{20}$$

This is the general structural axiomatic law of supply and demand for the pure consumption economy with one firm (for the generalization see 2014a). In brief, the price equation states that the market clearing price, i.e. $\rho_X = 1$, is ultimately determined by the expenditure ratio, unit wage costs, and the income distribution. Note that the quantity of money is *not* among the determinants. This rules the commonplace quantity theory out. The structural axiomatic price formula is testable in principle.

Under the condition of market clearing and zero distributed profit follows:

$$P = \rho_E \frac{W}{R}$$
$$\text{if} \quad \rho_X = 1, Y_D = 0 \quad |t. \tag{21}$$

The market clearing price depends now alone on the expenditure ratio and unit wage costs. All changes of the wage rate, of the productivity, and of the average expenditure ratio affect the market clearing price in the period under consideration. We refer to this formal property as *conditional* price flexibility because (21) involves no assumption about human behavior, only the purely formal condition $\rho_X = 1$.

Under the additional conditions of budget balancing follows:

$$P = \frac{W}{R}$$
$$\text{if} \quad \rho_E = 1, \rho_X = 1, Y_D = 0 \quad |t. \tag{22}$$

The market clearing price is equal to unit wage costs if the expenditure ratio is unity and distributed profit is zero. In this elementary case, profit per unit is zero and by consequence total profit is zero. All changes of the wage rate and the productivity affect the market clearing price in the period under consideration.

With (22) the real wage $\frac{W}{P}$ is *uno actu* given; it is under the enumerated conditions invariably equal to the productivity R. The agents gets the whole product. The real wage is determined by the production conditions and *not* in the labor market.

With regard to standard economics, the structural axiom set has two important implications: (a) the market clearing price is *not* determined by the quantity of money, (b) the real wage is *not* determined by supply-demand-equilibrium in the labor market. In other words, seen from the structural-axiomatic standpoint the commonplace quantity theory and the standard labor market theory are false.

It has to be emphasized that market clearing, budget balancing, and zero profit are conditions that apply also to Walras's original model. On this score, there is absolutely no difference.

5 Allocation in the two-markets consumption economy

> The theory thus represents the fact, that a person distributes his income in such a way as to equalize the utility of the final increments of all commodities consumed. (Jevons, 1911, p. 140)

We now introduce a second market and determine the allocation of total labor input L between the two lines of production.

Total income (1) remains unchanged:

$$Y = WL + \underbrace{DN}_{0} \quad |t. \tag{23}$$

The partitioning of labor input is given by:

$$L \equiv L_1 + L_2 \quad |t. \tag{24}$$

With given productivities the respective outputs in the two lines of production follow from (2) as:

$$\begin{array}{l} O_1 = R_1 L_1 \\ O_2 = R_2 L_2 \end{array} \quad |t. \tag{25}$$

From (3) follows for the respective consumption expenditures:

$$\begin{array}{l} C_1 = P_1 X_1 \\ C_2 = P_2 X_2 \end{array} \quad |t. \tag{26}$$

From (8) follow as corollaries:

$$\begin{array}{l} C_1 = \rho_{E1} Y \\ C_2 = \rho_{E2} Y \end{array} \tag{27}$$

$$\text{if} \quad \rho_{E1}, \rho_{E1} \quad \text{are taken as independent} \quad |t.$$

Under the condition of market clearing eqs. (27), (26) and (25) boil down to:

$$\frac{P_1}{P_2}\frac{R_1}{R_2}\frac{L_1}{L_2} = \frac{\rho_{E1}}{\rho_{E2}} \tag{28}$$

$$\text{if} \quad \rho_{X1} = 1, \rho_{X2} = 1 \quad |t.$$

Relative prices are determined by the zero profit condition (15) and this gives:

$$\frac{L_1}{L_2} = \frac{\rho_{E1}}{\rho_{E2}} \tag{29}$$

$$\text{if} \quad Q_{m1} = 0, Q_{m2} = 0, W_1 = W_2, \rho_{X1} = 1, \rho_{X2} = 1 \quad |t.$$

Under the enumerated conditions, the labor input is allocated in direct proportion to the expenditure ratios. The partitioning of demand determines the allocation of labor. This presupposes, of course, that labor can move freely between the two

firms. The absolute amount of labor input in firm 1, and analogous in firm 2, is finally given by:

$$L_1 = \rho_{E1} L$$

$$\text{if} \quad Q_{m1} = 0, Q_{m2} = 0, W_1 = W_2, \rho_{X1} = 1, \rho_{X2} = 1 \tag{30}$$

$$L \equiv L_1 + L_2, \rho_{E1} + \rho_{E2} = 1 \quad |t.$$

What remains to be done is to determine the partitioning of final demand between the two goods. Here we arrive at the open interface to utility theory.

Eq. (28) is first rewritten as:

$$\frac{P_1}{P_2}\frac{X_1}{X_2} = \frac{\rho_{E1}}{\rho_{E2}} \tag{31}$$

$$\text{if} \quad \rho_{X1} = 1, \rho_{X2} = 1 \quad |t.$$

The familiar optimum condition says that the marginal rate of substitution MRS is equal to the price ratio. This condition is met at the tangential point of the budget line with an indifference curve (for details see 2014a, Sec. 3.3). The tangential point provides the respective quantities X_1, X_2. Together with the given price relation eq. (31) then delivers the optimal partitioning of the consumption expenditures C_1, C_2 or, what amounts to the same, the optimal breakup of the expenditure ratios ρ_{E1}, ρ_{E2}. All is fine therefore, except for the fact that the indifference curve is a nonentity.

The marginal principle asserts, in Jevons's language, that the ratio of marginal utilities is equal to relative prices but it cannot tell us where the tangential point is located. Hence there is no way to determine the quantities X_1, X_2 and by consequence the distribution of expenditures between the goods. In plain words Jevons asserts, I cannot give you the coordinates where the agents stand but it is an optimum. This optimum, though, he has put himself into the hat.

It would be possible at any time to integrate marginal utility into the structural-axiomatic framework in order to determine the expenditure ratios for different products but this amounts to nothing because the marginal principle cannot tell us what we want to know. To ask: where does an indifference curve touch the budget line is, apart from the wording, not different from asking how many angels can dance on the head of a pin.

> Economists think of themselves as scientists, but ... they are more like theologians. (Nelson, 2006, p. xv)

In any case they are primarily concerned with nonentities.

6 Winding up the Vacuous Jevonian Interlude

> Reification (also known as concretism, or the fallacy of misplaced concreteness) is a fallacy of ambiguity, when an abstraction (abstract belief or hypothetical construct) is treated as if it were a concrete, real event, or physical entity. In other words, it is the error of treating as a concrete thing something which is not concrete, but merely an idea. (Wikipedia Reification, 2014 Feb)

6.1 Value and allocation

We have seen above, eq. (15), that the exchange value is objectively determined by the zero profit condition and therefore has nothing at all to do with a final degree of utility. From the systemic standpoint it is irrelevant whether the agents realize some kind of optimum or not. It is not irrelevant, though, whether the firms break even or not. An economy with loss making firms is not reproducible over a longer time span. Zero profit is a minimum condition, positive overall profit is the normal case in the real world. Jevons's profit formula, (1911, p. 270), is demonstrably false and this, as a matter of principle, invalidates his value theory already before the speculation about the final degree of utility sets in. Independently of this, the subjective value theory has to be refuted on its own terms.

Let us start with an economy where the respective productivities in period t=1 are given by the actual production conditions and where the households have partitioned their total consumption expenditures which in turn are equal to total income. The conditions of market clearing, budget balancing and zero profit apply. For the sake of illustration, let the two products be bread and water (wine would be better, of course, but not straightforwardly lead us to the water-diamond paradox). In this case, the exchange value of water is objectively determined by the production conditions in both firms according to (15) (see also Arrow and Hahn, p. 14).

The quantity of water that is produced and sold depends on the partitioning of consumption expenditures according to (29). If the expenditure ratio for water is high relative to that for bread, the greater part of labour input is allocated to water production. The breakup of expenditure ratios can be observed and exactly measured for all households and all periods. There is no problem with the data. Yet, why the expenditure ratios are what they are is unknown to any observer. To say that the partitioning depends on preferences is neither true nor false but a pointless reification. To assert that the partitioning is optimal is pure verbiage. An utility function or an indifference map is a nonentity and that is that.

Now let the productivity of water production increase in period t=2. The first round effect is this: the price goes down and the quantity goes up such that total expenditures for water remain constant. This hyperbolic adaptation leaves the rest of the economy undisturbed. The only thing that changes is the real consumption

pattern. The households' diet is now composed of more water and an unchanged quantity of bread. Hyperbolic adaptation, to be sure, is a convenient idealization.

The households may be happy with the new composition of consumption goods. In this case, the adaptation process ends. If the households want to restore the previous relation of water and bread they have to reduce the expenditures for water and to increase the expenditures for bread. The business sector then reallocates labor input at the going wage rate. There is no price signaling of any sort. Total income, total consumption expenditures, and the price of water and bread are not affected by the reallocation. The price mechanism is fully replaced by the quantity mechanism.

At the end of the adaptation process, which consists of two *logical* steps, the exchange value of water is lower according to the new productivities as determined by (15). The claim that the marginal utilities of water and bread have been equal before the adaptation and are equal after the adaptation can neither be proved nor disproved, it is therefore empty.

There is no need and no place for the nonentity utility and its derivatives and variants in theoretical economics. Theoretical economics is about the systemic properties of the economy and not about reading the thoughts of agents. There is nothing ever to be expected from second-guessing homo oeconomicus.

6.2 Primary and secondary markets

Up to this point we have only considered perishable consumption goods. Conditions change when we take durable goods into the picture. A car or a house is bought in period t but consumed over a longer time span; consumption expenditures C and valued consumption K are therefore different (for details see 2011, Sec. 4.2).

Conditions are again different when, in the limiting case, no consumption takes place at all. Ricardo clearly recognized this and excluded "rare statues and pictures, scarce books and coins, ..." from the classical value theory (1981, p. 12). Jevons took up this remark and used it as a refutation of the labour theory of value (1911, p. 163). He did not realize that goods which are not consumed like bread and water are not subject to his own Law of the Variation of Utility which refers explicitly to varying quantities of food (1911, pp. 45-49). Adam Smith's narrow-stomach argument does not apply beyond a very small realm.

Let the two goods in the example of Section 6.1 now be diamonds and water (yes, this combination lacks vitamins). This requires an update of the productivity R_1 and of the price P_1 in (28) but nothing more. While the productivity in the water production remains unchanged, compared to diamonds the exchange value of one unit of water will be 'lower' in quantitative terms than compared to bread. The quantities, however, have different dimensions (liter, kilogram, carat). The respective prices of diamonds and water are definitely determined by the conditions of market clearing, budget balancing, and zero profit.

Since diamonds are not consumed and do not vanish from the commodity space the story does not end in the period of production. Beginning with the next period, the diamonds assume the role of a store of value. At first, those agents who have bought the diamonds in period t cannot sell them in period t+1. There is simply no market. Since income has always been fully spent in the pure consumption economy nobody is in the possession of the requisite stock of money. What is logically needed first, then, is that some agents accumulate money.

Let us assume that one half of the households saves and the other half dissaves such that saving and dissaving are equal and the household sector as a whole neither saves nor dissaves. Thus, the overall expenditure ratio is still unity (for details see 2014b, Sec. 3). Total income is fully spent, just as in the bread-water economy. The significant difference is that the deposits and overdrafts of the household sector at the central bank, which stands for the banking industry as a whole, grow in lockstep. The owners of deposits eventually become the potential buyers of diamonds.

What emerges in the process is that we have now two entirely different kinds of markets: the primary market where the goods out of current production are sold and the secondary market where all kinds of durables are sold.

The primary and secondary markets function according to different rules. For the primary market the income out of current production and saving/dissaving is relevant, for the secondary market the accumulated stock of deposits and the possibility of credit leverage is relevant. Of course, there are interdependencies between the two kinds of markets. They are ignored for the moment.

The crucial point is that it is positively misleading to speak of "the" market. There are – at least – *two* different types of markets and to treat them equally is a gross technical blunder. There is no such thing as "the" market. A value theory that does not account for this elementary economic fact is vacuous. The marginalistic approach squarely falls into this category.

What is important with regard to Jevons's value theory is this: even if we grant, for the sake of argument, that there is something like marginal utility it would be only applicable to the primary market but not to the secondary market. Water as a consumption good is not comparable to diamonds as a pure store of value. The assertion that the low price of water corresponds to a low marginal utility and that the high price of diamonds corresponds to a high marginal utility is unacceptable even in Jevons's own frame of reference. To apply the Law of the Variation of Utility to the secondary market is simply a category mistake.

What is really paradoxical about the diamond-water paradox is that its apparent resolution by superficially distinguishing between total and marginal utility was accepted so long by so many economists. Fortunately, that is over now. Utility has been definitely identified as nonentity. As Keynes aptly put it (Moggridge, 1976, p. 39): 'a little clear thinking' can solve 'almost any problem.'

7 Conclusion

> Our science has become far too much a stagnant one, in which opinions rather than experience and reason are appealed to. (Jevons, 1911, p. 277)

The secular stagnation of the standard approach can be traced back to Jevons himself. His approach, which has been greatly refined but never thoroughly rectified, is based on indefensible premises.

The standard subjective-behavioral axioms are in the present paper replaced by objective-structural axioms. The set of four structural axioms constitutes the most elementary case of an evolving consumption economy. The formalism is absolutely transparent, the logical implications are testable in principle.

The main results of the structural axiomatic analysis of value are:

- Neither Jevons nor the other founding fathers of marginalism developed a correct profit theory. The lack of a correct profit theory alone suffices to make the standard approach unfit for any real world application whatsoever.
- Exchange value is objectively determined by the production conditions and therefore has nothing at all to do with a final degree of utility. There is no formal room left for subjective-behavioral notions like utility. The zero profit condition is sufficient to exclude utility as an explanation of value.
- The structural-axiomatic conditions of market clearing, budget balancing, and zero profit apply also to Walras's original model. On this score, there is absolutely no difference. The difference is in the axioms.
- It would be possible at any time to integrate marginal utility into the structural-axiomatic framework in order to determine the expenditure ratios for different products but this amounts to nothing because the marginal principle cannot tell us what we want to know.
- There are – at least – *two* different types of markets and to treat them equally is a gross technical blunder. There is no such thing as "the" market. A value theory that does not account for this elementary economic fact is vacuous. The marginalistic approach squarely falls into this category.

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